Thrombin

Experimental study on effective application of fibrin glue.

Authors: Kin H., Nakajima T., Okabayashi H.

Publication Date: 2012

Abstract:

Purpose. Fibrin glue is effective for maintaining hemostasis after anastomosis and for filling needle holes after cardiothoracic and vascular surgery, but few experimental studies concerning methods of application to obtain more effective hemostasis have been reported. Methods. Bolheal was used as the fibrin glue. Fibrinogen solution (A, 0.3 ml) and thrombin solution (B, 0.3 ml), components of fibrin glue, were applied to the needle holes by the following four methods: group 1 (n = 8), drip method; group 2 (n = 8), spray method; group 3 (n = 8), rub-and-spray method; group 4 (n = 8), rub-andrub method. Additional studies were done in groups 3 and 4 to evaluate the hemostatic effect with different curing times and temperatures. Results. The pressure at which the fibrin sealant ruptured were significantly higher in group 3 (109 +/- 16 mmHg) and group 4 (113 +/- 7) (for both groups: $P < 0.05$ vs. group 1 (22 +/- 8) and group 2 (64 +/- 10)). The pressure increased with prolongation of the curing time, and significant differences were noted between the pressures at = 2 min and that at 30 s (both groups: $P < 0.05$ vs. 30 s). The curing temperature had no significant influence in the two groups. Microscopically, the glue effectively plugged the needle holes in groups 3 and 4 Conclusion. Compared with the current drip and spray methods, more effective hemostasis was obtained by rubbing on the fibrin glue.

Autologous fibrin sealant CryoSeal FS system: Performance and efficacy evaluation for use in surgical procedures.

Authors: Kumar V., Ragimov A.A., Chapman J.R.

Publication Date: 2009

Abstract:

The CryoSeal FS System consists of a medical device (the CS-1 instrument) and a proprietary plasma processing disposable that work in concert to rapidly (approximately 60 minutes) prepare both components of a Fibrin Sealant (FS), (cryoprecipitate and thrombin), from a single unit of autologous plasma. When the cryoprecipitate and the thrombin produced by the CryoSeal FS System are mixed together, a Fibrin Sealant is obtained from a single unit of plasma. Furthermore, the CryoSealSystem's ability to also produce human Thrombin eliminates the need to use bovine thrombin present in other fibrin sealants and other adjuncts to hemostasis. The primary objective of this study was to investigate the efficacy and performance of the Fibrin Sealant prepared by the CryoSeal FS System as an adjunct, in terminating bleeding of liver resection, heart valve replacement, aortocoronary shunts and thoraco-abdominal aorta replacement procedures. Materials and methods: The study was designed to use the Fibrin Sealant produced by the CryoSeal System as an adjunct to hemostasis. The product evaluation trial reported here was a clinical study involving total 11 patients for 4 different surgical procedures: liver resections (2), heart valve replacements (3), aortocoronary shunts (4) and thoraco-abdominal aorta (2) replacement procedures. Results: The CryoSeal FS system produced an average 11 mL of fibrin sealant with an average fibrinogen concentration (31 mg/mL) and thrombin activity (50 U/mL). The primary efficacy endpoint for this study was complete hemostasis. In all procedures the CryoSeal FS System derived fibrin Sealant provided complete hemostasis in the peri-operative region. Conclusions: The results of this trial show that the Fibrin Sealant produced by the CryoSeal FS System conforms to its stated

characteristics, provides good hemostatic properties and is comparable to the pharmaceutical fibrin adhesive in terms of biocompatibility and adhesiveness.

Closure of guide wire-induced coronary artery perforation with a two-component fibrin glue.

Authors: Storger H., Ruef J.

Publication Date: 2007

Abstract:

Perforation or rupture of a coronary artery with subsequent pericardial effusion and cardiac tamponade is a potentially life-threatening complication of percutaneous coronary intervention (PCI). Several emergency treatment strategies exist to close the perforation including reversal of anticoagulation, prolonged balloon inflation, implantation of stent grafts, local injection of thrombogenic molecules, placement of microcoils, or open heart surgery. Here we report on a 66-year-old patient who underwent urgent PCI for acute stent thrombosis in the proximal LAD. The artery was reopened, a new stent implanted successfully, and a GPIIb/IIIa-antagonist was given. Shortly thereafter the patient suffered from cardiac tamponade requiring pericardiocentesis and pericardial drainage. The coronary angiogram indicated a severe guide wire-induced perforation and pericardial effusion originating from a distal diagonal branch segment. Prolonged balloon inflation did not stop the leakage. Therefore the monorail balloon was exchanged for an over-the-wire balloon. A two-component commercial fibrin glue consisting of fibrinogen and thrombin was rapidly but separately injected through the wire channel of the balloon into the distal segment of the diagonal branch. The coronary leak was successfully closed and the patient recovered quickly. In comparison with the previously reported cases of thrombin injection important differences should be noticed: (1) a two-component hemostatic seal was used without reversal of anticoagulation, (2) rapid injection instead of prolonged infusion of the hemostatic drugs was performed, and (3) the rescue technique was applied in a cath lab that routinely uses monorail catheter systems. Therefore we consider this a novel and effective approach for closure of coronary ruptures.

Inc.

Patient-derived fibrin sealant: Clinical, preclinical, and biophysical aspects.

Authors: Kjoergard H.K.

Publication Date: 2003

Abstract:

Today, there is an enormous interest in surgical sealant, not only for hemostasis, but also for binding of tissues together during surgery, and to improve wound healing. Man has imitated nature in developing fibrin sealant that is biodegradable. However, the risk of transmission of both known and unknown infectious agents can generally not be ruled out completely for plasma products from donors. In addition there is a considerable immunologic risk of using biological products of animal origin. Preclinical and clinical data has demonstrated that a safe and useable surgical fibrin sealant can be prepared from the patient's own blood using the enzyme batroxobin. Experimental data showed that patient-derived fibrin sealant provided enhanced instant adhesion strength and elasticity compared with conventional fibrin sealant due to its faster polymerisation rate. Test methods for fibrin sealant were found to be inaccurate, and we constructed and validated a new computer assisted test method to get information about elasticity and other dynamic properties of biological sealant. The method is highly reproducible and is the first validated using vital human tissue as the adhesion substrate. It takes about one half hour to prepared patient-derived fibrin sealant, which may turn a good operation into a perfect operation without any known risk.

Pharmacological strategies to decrease transfusion requirements in patients undergoing surgery.

Authors: Porte R.J., Leebeek F.W.G.

Publication Date: 2002

Abstract:

Surgical procedures are inevitably associated with bleeding. The amount of blood loss may vary widely between different surgical procedures and depends on surgical as well as non-surgical factors. Whereas adequate surgical haemostasis may suffice in most patients, pro-haemostatic pharmacological agents may be of additional benefit in patients with (diffuse) surgical bleeding or in patients with a specific underlying haemostatic defect. In general, surgical haemostasis and pharmacological therapies can be complementary in controlling blood loss. The use of pharmacological therapies to reduce blood loss and blood transfusions in surgery has historically been restricted to a few drugs. Antifibrinolytic agents (aprotinin, tranexamic acid and aminocaproic acid) have the best evidence supporting their use, especially in cardiac surgery, liver transplantation and some orthopaedic surgical procedures. Meta-analyses of randomised, controlled trials in cardiac patients have suggested a slight benefit of aprotinin, compared with the other antifibrinolytics. Desmopressin is the treatment of choice in patients with mild haemophilia A and von Willebrand disease. It has also been shown to be effective in patients undergoing cardiac surgery who received aspirin up to the time of operation. However, overall evidence does not support a beneficial effect of desmopressin in patients without pre-existing coagulopathy undergoing elective surgical procedures. Topical agents, such as fibrin sealants have been successfully used in a variety of surgical procedures. However, only very few controlled clinical trials have been performed and scientific evidence supporting their use is still limited. Novel drugs, like recombinant factor VIIa (eptacog alfa), are currently under clinical investigation. Recombinant factor VIIa has been introduced for the

treatment of haemophilia patients with inhibitors, either in surgical or non-surgical situations. Preliminary data indicate that it may also be effective in surgical patients without pre-existing coagulation abnormalities. More clinical trials are warranted before definitive conclusions can be drawn about the safety and the exact role of this new drug in surgical patients. Only adequately powered and properly designed randomised, clinical trials will allow us to define the most effective and the safest pharmacological therapies for reducing blood loss and transfusion requirements in surgical patients. Future trials should also consider cost-effectiveness because of considerable differences in the costs of the available pro-haemostatic pharmacological agents.

The role of fibrin sealants in hemostasis.

Authors: Mankad P.S., Codispoti M.

Publication Date: 2001

Abstract:

Hemostasis is a prerequisite for wound healing, and under normal physiologic conditions, it is achieved by means of the coagulation cascade. However, there are a number of surgical procedures where there may be considerable benefits to the patient, surgeon, or health-care costs if hemostasis can be achieved more efficiently. The rapid and effective control of bleeding during and after surgery reduces blood loss and can help reduce postoperative complications. These improved outcomes can reduce the need for transfusion, with the associated risk of viral transmission, and have a positive impact on operative and hospital stay times. Fibrin sealants are surgical hemostatic agents derived from human plasma that reproduce the final steps in the coagulation pathway and form a stable fibrin clot. Fibrin sealants are used in a broad range of surgical procedures to assist hemostasis, including cardiovascular, hepatic, and splenic surgery, gastrointestinal hemorrhage, skin grafting, and dental extractions in anticoagulated patients. Patients with coagulopathies are at high risk of prolonged or excessive bleeding during or after invasive surgery, and these patients may also benefit from the use of fibrin sealants. This article reviews the role of fibrin sealants in hemostasis, citing a number of key clinical studies that report a significant reduction in blood loss or chest drain output after surgery with fibrin sealant compared with controls.

Fate of fibrin sealant in pericardial space.

Authors: Hattori R., Otani H., Omiya H., Tabata S., Nakao Y., Yamamura T., Osako M., Saito Y., Imamura H.

Publication Date: 2000

Abstract:

Background. Although fibrin sealant (Beriplast, Aventis Behring, Marburg, Germany) has been widely used as a supplementary measure for hemostasis during cardiac surgery in Europe and is becoming popular in the United States, the pharmocokinetics of fibrin sealant applied in pericardial space has not been elucidated. Methods. A small incision was made on the epicardial surface of the left ventricle of a rat, and the incision was sutured. Total 0.2 ml of fibrin sealant containing iodine 125 (¹²⁵I)-labeled fibrinogen, aprotinin, blood coagulation factor XIII and thrombin was applied to the area around the suture line. Results. Distributions of ¹²⁵I-labeled fibrinogen in the heart on postoperative days 1, 3, 7, and 14 were 48.2% +/- 1.8%, 20.7% +/- 2.2%, 0.15% +/- 0.02%, and 0.01% +/- 0.02%, respectively. The radioactivity was negligible in the blood, liver, spleen, and kidney except for the thyroid in which the radioactivity increased to 7.9% +/- 0.7% and 4.3% +/- 0.4%, respectively, on postoperative days 7 and 14. Iodine 125-labeled fibrinogen concentrations of the heart and other organs showed a similar change in the time course of distribution. Dense and thick fibrin network, observed on postoperative day 1, had dissipated and was thinner with collagen formation by postoperative day 7. Conclusions. Fibrin sealant applied to the pericardial cavity regresses rapidly and plays an important role in wound healing.

Severe bleeding due to factor V inhibitor after repeated operations using fibrin sealant containing bovine thrombin.

Authors: Muntean W., Zenz W., Edlinger G., Beitzke A.

Publication Date: 1997

Abstract:

Not Available

Immunization against bovine antigens after cardiac surgery.

Authors: Bastien O., Berruyer M., Fffrench P., Paulus S., Belleville J., Amiral J., Estanove S.

Publication Date: 1994

Abstract:

Not Available

Fibrin glue in cardiothoracic surgery.

Authors: McCarthy P.M.

Publication Date: 1993

Abstract:

Not Available

Autologous whole plasma fibrin gel: Intraoperative procurement.

Authors: Hartman A.R., Galanakis D.K., Honig M.P., Seifert F.C., Anagnostopoulos C.E.

Publication Date: 1992

Abstract:

Fibrin glue is a relatively recent addition to the armamentarium of hemostatic agents for surgical use. Its efficacy has been repeatedly demonstrated in almost all surgical disciplines and subspecialties. Its use in the United States has been limited because of the risk of viral transmission associated with the use of human plasma. Previous authors have described techniques that limit this risk, but they are frequently impractical, expensive, or cumbersome. We describe the use of patients' own fresh plasma to make fibrin gel at the operative field. It provided hemostasis at least as good as that from heterologous plasma glue in 40 cardiac surgical patients. Autologous whole plasma fibrin gel is inexpensive and safe and eliminates the risk of viral transmission associated with glue derived from heterologous donor plasma.

Acquired thrombin inhibitor in a 9-year-old child after total correction of univentricular heart with pulmonary atresia and administration of fibrin glue. [German]

Authors: Muntean W., Zenz W., Finding K.

Publication Date: 1992

Abstract:

Not Available

A technique for spray application of fibrin glue during cardiac operations.

Authors: Baker J.W., Spotnitz W.D., Nolan S.P.

Publication Date: 1987

Abstract:

Fibrin glue can be a useful adjunct to hemostasis in surgical patients. An effective technique for spray application of fibrin glue during cardiac operations is described.

Cryoprecipitate-topical thrombin glue. Initial experience in patients undergoing cardiac operations.

Authors: Lupinetti F.M., Stoney W.S., Alford Jr. W.C.

Publication Date: 1985

Abstract:

The use of fibrin glues as topical hemostatic agents is reported in the European literature. We have composed an analogous compound in our operating rooms using cryoprecipitate and topical thrombin (1000 units/ml) in equal volumes applied directly to the bleeding site. We have used cryoprecipitate-topical thrombin glue in 26 patients undergoing cardiac operations. Severe bleeding not responding to usual methods of control was encountered during or after coronary artery bypass (n = 17), valve replacement (n = 3), bypass plus valve replacement (n = 5), or repair of postinfarction ventricular septal defect (n = 1). Five patients were operated on emergently and four were undergoing their second cardiac operation. The glue was used in four patients while on bypass and fully heparinized and in 17 patients who continued to bleed after separation from bypass and administration of protamine. Hemostasis was achieved in all patients and none required reexploration for bleeding. In five patients undergoing reexploration for postoperative hemorrhage (none having received cryoprecipitate-topical thrombin glue during the initial operation), the glue provided hemostasis when other measures failed, and no additional reexplorations were needed. No patient exhibited hypersensitivity, fibrinolysis, or coagulopathy following the use of this glue. In 16 patients followed for 9 to 12 months postoperatively, no hepatitis has occurred. The highly concentrated fibrinogen in cryoprecipitate is activated by thrombin to form fibrin and bring about rapid hemostasis. Cryoprecipitate-topical thrombin glue is a readily available, reliable, and inexpensive topical hemostatic agent in the patient undergoing a cardiac operation.

Fibrin glue for the management of kinks in the long vein graft.

Authors: Comer T.P.

Publication Date: 1985

Abstract:

Not Available

Hemostatic effectiveness of fibrin glue derived from single-donor fresh frozen plasma.

Authors: Dresdale A., Bowman Jr. F.O., Malm J.R.

Publication Date: 1985

Abstract:

Fibrin glue derived from pooled human blood is an effective sealant for high-porosity vascular grafts and a valuable topical hemostatic agent in heparinized patients. Use of this agent in the United States is prohibited because of potential transmission of hepatitis B, acquired immunodeficiency syndrome, and other serologically transmitted illnesses. We have developed a cryoprecipitation technique that allows preparation of fibrin glue from single-donor fresh frozen plasma. Use of this agent presumably entails no greater risk of disease transmission than intravenous administration of single-unit fresh frozen plasma. This report describes our early clinical experience with this material. Fibrin glue was used as a sealant for porous woven Dacron tubular prostheses and cardiovascular patches in 19 patients. The fibrin glue sealant has also been employed to control bleeding from needle holes and small anastomotic tears in 22 patients. No patient in this series had a bleeding complication from a suture line or graft treated with fibrin glue. This experience indicates that like fibrin glue from pooled blood, fibrin glue from single-donor plasma is effective as a graft sealant and topical hemostatic agent. Preparation of fibrin glue from single-donor plasma is simple and economical, and may provide cardiothoracic surgeons in the United States with a widely available, valuable hemostatic adjunct.

Clinical experience with fibrin glue in cardiac surgery.

Authors: Koeveker G., De Vivie E.R., Hellberg K.D.

Publication Date: 1981

Abstract:

Cardiac surgery is often associated with hemostatic abnormalities leading to severe bleeding. Special problems are to be expected, if prosthetic material has to be implanted. Preclotting of Dacron prostheses with blood is well established but failures are sometimes encountered. Several years ago a new hemostatic sealing system (fibrin glue) was introduced into therapy. Since 1978 fibrin glue has been applied in 176 patients. The indications were: 1. sealing of woven-Dacron prosthesis, 2. bleeding from suture-holes (Gore-Tex), 3. diffuse myocardial bleeding and 4. prevention of kinking of coronary artery grafts. In 32 patients with an aortoventriculoplasty operation using Dacron the 'blood preclotting' and 'fibrin sealing' methods were compared. In the fibrin glue group there was a significant reduction in postoperative blood loss as well as shortening of the operation time (period of protamin administration to skin closure). No fibrinolytic dissolution of the fibrin layer on the prostheses was observed.

Fibrin glue in coronary artery bypass grafting operations: casting out the Devil with Beelzebub?.

Authors: Lamm P, Adelhard K, Juchem G, Weitkunat R, Milz S, Kilger E, Gotz A, Reichart B

Publication Date: 2007

Abstract:

OBJECTIVE: Fibrin sealants are frequently used in aortocoronary bypass operations. Although they are considered to be clinically safe, we performed a retrospective analysis of our data to examine the possible side effects of Tissucol fibrin sealant, namely the acute thrombosis of grafts and native coronary arteries resulting in severe myocardial damage and patient deaths.

METHODS: The data of 2716 patients (2001 male, 715 female) who received an aortocoronary bypass operation from November 1995 to December 1999 were studied retrospectively. Two groups (group 1: received Tissucol, group 2: no sealant used) were compared with respect to an a priori selected set of demographic and clinical variables and with respect to their effect on the outcome using bivariate tabulation. Multiple exploratory assessments of factors possibly related to fatal outcome were done by multiple logistic regression.

RESULTS: Nine hundred ninety patients (group 1) received Tissucol, 1726 patients (group 2) did not receive it. Mean patient age was 64+/-9.1 years. Group 1 had a higher risk of death (7.8% vs 2.8%, $p<0.001$). The peak values of creatine kinase >500 and creatine kinase-myocardial band >50 were higher in group 1 than in group 2, $p<0.001$. Adjusted odds ratios for the risk of fatal outcome were: 2.01 for the use of Tissucol, 2.71 for patient age >70 years, 2.02 for aortic cross clamp time >90 min, 3.95 for postoperative ventricular fibrillation, 6.35 for postoperative cardiopulmonary resuscitation, 4.55 for postoperative aortocoronary reoperation.

CONCLUSION: In our analysis an increased risk of myocardial injury or even death was found in coronary artery bypass grafting patients when Tissucol fibrin sealant was used intraoperatively.

Acquired inhibitors to factors V and X after exposure to topical thrombin: interference with monitoring of low molecular weight heparin and warfarin.

Authors: Israels SJ, Leaker MT

Publication Date: 1997

Abstract:

Repeated surgical exposure to topical bovine thrombin is known to be associated with the development of antibodies to bovine and human thrombin and factor V. This is demonstrated by abnormalities of in vitro coagulation assays and, rarely, postoperative bleeding. We describe a 4-year-old child in whom an antibody to bovine factor X developed after cardiac surgery; this antibody interfered with the heparin anti-Xa assay, thereby complicating the monitoring of heparin therapy.

Immunization by bovine thrombin used with fibrin glue during cardiovascular operations. Development of thrombin and factor V inhibitors.

Authors: Berruyer M, Amiral J, Ffrench P, Belleville J, Bastien O, Clerc J, Kassir A, Estanove S, Dechavanne M

Publication Date: 1993

Abstract:

Brief case histories of three patients aged 58, 38, and 44 years are reported. All underwent cardiovascular operations. Subsequently hemostasis test abnormalities developed between the seventh and eighth postoperative days after exposure to bovine thrombin used with fibrin glue. These were characterized by an increased activated partial thromboplastin time (64 to 147 seconds), prothrombin time (19 to 24 seconds), bovine thrombin time (> 120 seconds) and a markedly reduced factor V level (< 10% in two patients and 16% in the third patient). A patient plasma dilution of 1 in 200 with a normal plasma pool was necessary to correct bovine thrombin time. No fast-acting or progressive inhibitor against factor V could be detected by coagulation tests, and fresh frozen plasma perfusion had no effect. Plasmapheresis was performed preventatively to avoid bleeding, and factor V levels stabilized at around 50% after two to four exchanges. Immunologic studies showed that the inhibitors were directed not only against bovine factors but also against human ones. Therefore factor V decrease could have been the result of rapid clearance from the circulation of complexes formed with a nonneutralizing inhibitor that is not detected by clotting tests. These antibodies were purified by standard methods and immunoaffinity. Fast immunization could be explained by a prior sensitization to bovine thrombin exposure during previous operations. It is suggested that bovine thrombin used with fibrin glue contains small amounts of factor V and may be responsible for these abnormalities. This is in agreement with

previous literature reports. However, these described neutralizing factor V inhibitors, which were easily detected.

Fibrin glue in surgery: frequent development of inhibitors of bovine thrombin and human factor V.

Authors: Banninger H, Hardegger T, Tobler A, Barth A, Schupbach P, Reinhart W, Lammle B, Furlan M

Publication Date: 1993

Abstract:

We report on a 34-year-old woman whose plasma showed a marked prolongation of thrombin time (TT) (> 200 s) using bovine thrombin. The patient had previously been exposed twice to topical bovine thrombin contained in fibrin glue during cardiac surgery. TT was normal when human thrombin was used as reagent. The patient's purified IgG reacted with bovine prothrombin and bovine thrombin in immunoblotting studies but showed virtually no cross-reaction with human thrombin. In addition, following surgery, factor V clotting activity (FV:C) was reduced to 9% of normal. The inhibitor of bovine thrombin persisted over a period of more than a year, while the level of FV:C progressively returned to normal within this time period. Development of thrombin and FV:C inhibitors was also investigated in plasma of 34 consecutive patients who had undergone either cardiac surgery or neurosurgery with use of fibrin glue containing bovine thrombin. Eleven of 24 patients after cardiac surgery and two of 10 patients after neurosurgery presented with TT > or = 25 s (normal plasma 15 s). Two patients had been re-exposed to fibrin glue during cardiac re-operation and showed markedly prolonged TT (> 60 s). All 13 patients who had acquired a thrombin inhibitor also had low FV:C activity (10-60% of normal plasma), whereas FV:C activity remained in the normal range in the 21 patients with normal TT. Our findings indicate that development of inhibitors of bovine thrombin as well as co-immunization to factor V occurs frequently and is associated with the amount of applied fibrin glue and with the type of operation. Re-exposure to fibrin glue seems to enhance formation of inhibitors of bovine thrombin and human factor V.

The use of TachoSil associated to fibrin glue as dural sealant in spinal intradural tumors surgery.

Authors: Montano N., Papacci F., Fernandez E.

Publication Date: 2017

Abstract:

Not Available

Safety and Efficacy of TachoSil (Absorbable Fibrin Sealant Patch) Compared With Current Practice for the Prevention of Cerebrospinal Fluid Leaks in Patients Undergoing Skull Base Surgery: A Randomized Controlled Trial.

Authors: George B., Matula C., Kihlstrom L., Ferrer E., Tetens V.

Publication Date: 2017

Abstract:

Background:Cerebrospinal fluid (CSF) leakage associated with incomplete sealing of the dura mater is a major complication of intradural procedures. Objective:To compare the efficacy and safety of adjunctive TachoSil (Takeda Pharma A/S, Roskilde, Denmark) with current practice for the prevention of postoperative CSF leaks in patients undergoing elective skull base surgery involving dura mater closure. Methods:Patients were intraoperatively randomized to TachoSil or current practice immediately before primary dura closure by suturing ± duraplasty. Choice of adjunctive treatment in the current practice group was at the surgeon's discretion. Primary efficacy endpoint was occurrence of clinically evident verified postoperative CSF leak or clinically evident pseudomeningocele within 7 weeks after surgery or treatment failure (third application of trial treatment or use of other treatment). Results:A total of 726 patients were randomized to TachoSil (n = 361) or current practice (n = 365). More current practice patients had sutures plus duraplasty for primary dura closure compared with TachoSil (49.6% vs 35.7%) and fewer had sutures only (45.5% vs 63.2%). The primary endpoint of estimated leak rate favored TachoSil with events in 25 (6.9%) patients vs 30 (8.2%) current practice patients; however, this was not statistically significant (odds ratio: 0.82; 95% confidence interval: 0.47, 1.43; P = .485). Both treatments were well tolerated with similar frequency of adverse events. Conclusion:Very low rates of postoperative CSF leaks can be achieved in patients undergoing skull base surgery of various indications. Although the study did not

meet its primary endpoint, TachoSil appears to be safe and effective for the prevention of CSF leaks and associated complications.

The FINISH-3 trial: A phase 3, international, randomized, single-blind, controlled trial of topical fibrocaps in intraoperative surgical hemostasis.

Authors: Bochicchio G.V., Gupta N., Porte R.J., Renkens K.L., Pattyn P., Topal B., Troisi R.I., Muir W., Chetter I., Gillen D.L., Zuckerman L.A., Frohna P.A.

Publication Date: 2015

Abstract:

Background This Phase 3, international, randomized, single-blind, controlled trial (FINISH-3) compared the efficacy and safety of Fibrocaps, a ready-to-use, dry-powder fibrin sealant containing human plasma-derived thrombin and fibrinogen, vs gelatin sponge alone for use as a hemostat for surgical bleeding in 4 indications (ie, spinal, hepatic, vascular, soft tissue dissection).

Study Design Adults with mild to moderate surgical bleeding (randomized 2:1; Fibrocaps vs gelatin sponge) were treated at a single bleeding site (day 1). Time to hemostasis (TTH) during 5 minutes was compared (log-rank statistic) within each indication. Safety follow-up continued to day 29.

Results Patients were treated (Fibrocaps, n = 480; gelatin sponge, n = 239) when undergoing spinal (n = 183), vascular (n = 175), hepatic (n = 180), or soft-tissue (n = 181) procedures. Fibrocaps was applied by spray device in 53% of all procedures (94% of hepatic and soft-tissue procedures). Fibrocaps significantly reduced TTH compared with gelatin sponge; estimated hazard ratios were 3.3, 2.1, 2.3, and 3.4 for the 4 surgical indications, respectively (each $p < 0.001$; primary end point). Fibrocaps significantly reduced median TTH for each indication ($p < 0.001$) and was superior for secondary efficacy end points of restricted mean TTH ($p < 0.001$) and probability of hemostasis at 3 ($p < 0.001$) and 5 ($p <= 0.002$) minutes. Adverse event incidences were generally similar between treatment arms. Non-neutralizing, anti-thrombin antibodies developed in 2% of Fibrocaps-treated and 3% of gelatin sponge-treated patients.

Conclusions Fibrocaps was well tolerated and significantly reduced TTH relative to gelatin sponge alone in all 4 surgical indications. These findings demonstrate the broad utility of Fibrocaps as a hemostatic agent for mild to moderate surgical bleeding.

Novel surgical technique to solidify cyst-type metastatic brain tumors using autologous fibrin glue for complete resection.

Authors: Okuda T., Fujita M., Yoshioka H., Tasaki T., Kato A.

Publication Date: 2014

Abstract:

Background: An outstanding issue regarding the surgical treatment of cyst-type metastatic brain tumors is the incomplete resection of cyst walls. Herein we propose a novel surgical technique that can overcome this issue. During a surgical procedure for cystic tumors, autologous fibrin glue is to be injected into the tumor cysts, which solidifies the cyst lumens and cyst walls en bloc with reducing the tumor size. As a result, tumor masses and cyst walls can be removed completely in an en bloc fashion in all cases. Copyright:

Methods: The illustrative case presented in this report is a patient with metastatic brain tumors in the frontal lobe. When we reached the tumor wall surgically, we first suctioned out the cyst content and subsequently injected autologous fibrin glue into the cyst lumen. The autologous fibrin glue solidified the tumor en bloc, and we resected the tumor mass and the cyst walls in an en bloc fashion.

Results: We have applied this technique to four cases with cyst-type metastatic brain tumors. This approach made it possible to perform ideal en bloc resection in all cases. There were no adverse events due to the autologous fibrin glue.

Conclusion: We developed a novel surgical technique to solidify cyst-type metastatic brain tumors using autologous fibrin glue, which allows en bloc resection of tumor masses and cyst walls quite safely using inexpensive materials. Given these advantages, it appears a promising surgical strategy for cyst-type metastatic brain tumors.

Complex reconstructive surgery following removal of extra-intracranial meningiomas, including the use of autologous fibrin glue and a pedicled muscle flap.

Authors: Giugno A., Maugeri R., D'Arpa S., Visocchi M., Iacopino D.G.

Publication Date: 2014

Abstract:

Background: Skull reconstructive surgery is critical to prevent cerebrospinal fluid (CSF) fistulas and infections, and to ensure good aesthetic results in meningiomas surgery.

Methods: A 65-year-old woman was surgically treated for a bilateral parasagittal meningioma with complete superior sagittal sinus (SSS) involvement, and an intra-extracranial extension, determining a significant cranial defect at the vertex. A Simpson I resection was achieved. Postoperatively a considerable and not conservatively repairable CSF leak was detected. Surgical revision of the wound with repair of the fistula and complex reconstructive operation was performed including a combination of techniques and devices such as autologous fibrin glue and reparation of the extracranial planes by an autologous vascularized vastus lateralis pedicled muscle flap.

Results: No postoperative complications, infections or new neurological deficits were detected, and the CSF leak definitively ceased after surgery; the aesthetic results were satisfactory.

Conclusions: Reparation of CSF fistulas that arise after meningioma surgery can require a complex reconstructive surgery of the superficial layers; when cranioplasty is not feasible or indicated, a meticulous reconstruction of the extracranial soft tissues is possible also by using vascularized autologous distal muscular tissue, with close interdisciplinary cooperation.

An international, multicenter, randomized, single-blind, controlled trial of a dry-powder, fibrin sealant for mild to moderate perioperative surgical bleeding.

Authors: Bochicchio G., Singla N., Gupta N.Y., Porter R., Renkens K.L., Pattyn P., Topal B., Chetter I., Frohna P.

Publication Date: 2014

Abstract:

INTRODUCTION: Topical hemostatic agents are important adjuncts for controlling surgical bleeding. The objective of this study was to evaluate the safety and efficacy of a dry-powder, fibrin sealant containing human plasma-derived thrombin and fibrinogen in reducing time to hemostasis (TTH). METHODS: Multicenter, randomised control trial (RCT) (clinicaltrials. gov: NCT01527357) comparing fibrin sealant plus gelatin sponge vs. gelatin sponge alone in 4 surgical indications (spinal, hepatic, vascular, soft tissue), run in parallel as independently-powered trials for efficacy and pooled across indications for safety. Adult patients with mild/moderate surgical bleeding were randomized 2:1 to fibrin sealant or gelatin sponge during surgery. The primary efficacy endpoint was a comparison of the time to hemostasis (TTH) survival curves over 5 minutes. Subjects were followed for 28 days for safety. RESULTS: 719 patients provided informed consent, were randomized, and treated (fibrin sealant: 480; gelatin sponge: 239) while undergoing spinal (n=183), vascular (n=175), hepatic (n=180), or soft tissue (n=181) procedures. Fibrin sealant was applied by proprietary spray device in 53% of procedures and significantly reduced TTH compared to gelatin sponge, with hazard ratios of 3.3, 2.1, 2.3, and 3.4 for the 4 surgical indications, respectively (each $p<0.0001$). Adverse event incidences were generally similar between treatment groups and none were related to the spray device. Non-neutralizing, anti thrombin antibodies developed in 2% of fibrin sealant and 3% of gelatin sponge-treated patients. CONCLUSIONS: A ready to use, dry-powder,

fibrin sealant was well tolerated and significantly reduced TTH across a wide variety of surgical procedures, strongly supporting its safety and broad utility as a hemostatic agent.

Cerebrospinal fluid leak after microsurgical surgery in vestibular schwannomas via retrosigmoidal craniotomy.

Authors: Arlt F., Trantakis C., Krupp W., Renner C., Winkler D., Strauss G., Meixensberger J.

Publication Date: 2011

Abstract:

Objective: Cerebrospinal fluid (CSF) leak is still a common complication in surgery of vestibular schwannoma, increasing morbidity and prolonging hospital stay. Our single center study was performed to determine the incidences of CSF leaks after microsurgical removal of vestibular schwannoma via a retrosigmoidal approach with two different surgical closure techniques. Methods: Between January 2003 and December 2009 in 81 patients, microsurgical tumor resection using a suboccipital, retrosigmoidal approach was performed with an interdisciplinary ENT and neurosurgical management was performed. In 41 cases, the dural closure was done using a sandwich technique: subdural closure with TissuFleece respectively Spongostan, and after that dural suture and epidural Tachosil were fixed on. In 40 cases, the dura was sealed epidurally with Tachosil after suture. In 65 cases, the posterior wall of the petrous bone was drilled. The closure was performed using muscle and FibrinGlue. All patients had a minimal follow-up of 1 year. Results: Seven patients (8.6%) developed a CSF fistula. Three patients (3.7%) underwent surgical procedure because of persisting CSF fistula while in four cases (4.9%) spontaneous closure under lumbar drain was observed. Comparing the different techniques of dural sealing, we found in 41 patients with sandwich technique three CSF leaks (7.3%) while there were four CSF leaks (10%) in 40 patients with a single epidurally sealed dural closure (P50.69). No rhinorrhea or otorhinorrhea was observed. No intracranial infection or meningitis in case of CSF leak occurred. Conclusion: Suture and occlusion of the dura is an important step to prevent CSF leak and postoperative infection. By comparing sandwich technique and single-layer dural sealing, no significant difference could be

shown.

Use of single-donor platelet glue and fibrin glue in human cranioplasty.

Authors: Burnouf T., Chen T.M., Tsai J.-C.

Publication Date: 2010

Abstract:

Background: Reconstruction of post-traumatic, full-thickness calvarial bone defects is needed to provide brain protection, to restore aesthetic contours, and to correct intracranial ventricular collapse. The two most widely used materials, autogenous bone graft and methyl methacrylate, are not ideal. Much effort has been directed to the development of osteoconductive materials composed of various calcium phosphate compounds. However, as an osteoinductive agent is needed to favor bone regeneration, there is interest in the use of growth factors (GF) - rich platelet materials in this indication. Aim: Evaluate a bone graft substitute obtained by combining hydroxy-apatite/s-tricalcium phosphate (HA/s-TCP) with human platelet glue rich in growth factors. Methods: The safety and efficacy of (HA/s-TCP)-platelet glue to reconstruct post-traumatic, full-thickness, calvarial bone defects was evaluated in 6 consecutive patients (5 males and 1 female; 26-66 years). Interval between injury and reconstruction ranged from 6 months to 4 years. Equal volumes of single-donor platelet-rich-plasma and cryoprecipitate were mixed with HA/s-TCP. Twice the volume of human single-donor thrombin was then added and the mixture was gently stirred for a few seconds, quickly consolidating into a firm moldable paste. The paste was applied to the bone defect and shaped using simple finger pressure. The HA/s-TCP granules were carefully compacted to prevent the formation of dead spaces. Once the desired bone contour had been achieved, a closed suction drain was placed through a separate stab incision well behind the reconstructed site. Single-donor fibrin glue was sprayed to facilitate hemostasis, the wound was closed and a pressure dressing applied. Patients were followed for 28-48 months subsequent to surgery (mean period: 30 months).

Post-operative evaluation included serial photography, repeated physical examinations, and three-dimensional computed tomography (CT) scan performed 2 years subsequent to surgery. Results: High fibrin concentration of the platelet glue allowed easy molding and sculpting of the scaffold, providing mechanical stability and avoiding spillage of the granules into the operating field. The HA/s-TCP-human platelet glue paste demonstrated good tissue biocompatibility in all 6 patients. No infection of the surgical site or extrusion of HA/s-TCP was observed. The contour of the reconstructed calvarium was esthetically acceptable during the follow-up period. No secondary depression resulting from resorption of the HA/s-TCP was noted. There was no visible thinning of the overlying skin or sharp edges at the HA/s-TCP host bone interface. Three dimensional CT scans taken 2 years subsequent to reconstruction revealed good reconstruction of the bone defect in all six patients. Visual inspection of the reconstructed calvarium 2 years after surgery in one patient evidenced conversion of the scaffold into solid new bone. Section of the biopsy demonstrated new bone formation at the expense of the scaffold. Conclusion: Combining an osteoconductive scaffold with single-donor growth factor-rich platelet glue offers an interesting alternative to autogenous bone graft or methyl methacrylate for post-traumatic calvarium bone defect reconstruction.

Local application of fibrin glue in peripheral nerve regeneration. [Chinese]

Authors: Gao Y.-M., Li J.-N.

Publication Date: 2007

Abstract:

Aim: To observe the effect of fibrin glue at local use on the regeneration of peripheral nerve based on the suture. Methods: The experiment was conducted in the Central Laboratory of Dalian Medical University between March and July in 2005. Experimental materials: fibrin glue (Guangzhou Bioseal Biotech Co. Ltd. main component includes 50-70 mg/injection fibrinogen and 400 U/injection thrombin, purified from mammal blood, sterilized and freeze dried, without pyrogen). A total of 48 SD rats were randomly assigned into suture group and combination of suture and fibrin glue group, with 24 rats in each. All the rats were anesthetized to expose sciatic nerve by a 2-cm incision posterior to lateral left thigh, and sciatic nerve was cut off from 1.5 cm distally pidformis muscle and epineurial neurorrhaphy was performed with 10-0 non-trauma thread, with the interval of 1-2 mm. Combination group: Fibrin glue was injected into peripheral muscle of 2 symmetric sutures to produce the gel ring, the mixture curing lead to regeneration division. Suture group: Epineurial neurorrhaphy was performed only. Animal ethology was observed continuously postoperation: movement of lateral hind limb and toes, ulceration, ulcer healing of toes and toe nail, reflection of unfold claws. Four rats from each group were selected for electrophysiologic study and detect the nerve conduction velocity and latency at 8 weeks postoperation. At 2, 4, 6, 8 weeks postoperation, two rats of each group stained with hematoxylin-eosin were observed under light microscope for nerve regeneration. Eight weeks postoperation, four rats of each group was adopted to analyze the number and diameter of axon in toluidine blue-stained nerve tissue slices by means of LUZEX-F color image analyzer, determine the axonal regeneration in slices that were stained with both lead citrate and uranyl

acetate using Philip-10 transmission electron microscope, and assay the motor neuron in anterior cornu of medullar spinalis, which was labeled with horseradish peroxidase (HRP), respectively. Results: All the 48 rats were involved in the result analysis. 1 Animal ethology: Except a little toe ptosis and flexion 8 weeks postoperation, the gait, reflection of unfold claws and activity of hind limb were found in the combination group, while those of suture group were fair. 2 Electrophysiologic analysis: At 8 weeks postoperation, the nerve conduction velocity of combination group was significantly higher and latency was shorter than that of the suture group [(11.13+/- 0.37), (9.26+/-0.44) m/s, (1.83+/-0.18), (2.17+/-0.19) ms, F=27.78, 5.53, P < 0.05]. 3 Neural regeneration under light microscope: Myelinated nerve fiber presented thick myelin sheath, long diameter, tight arrangement and good regeneration in the combination group, whereas unsatisfactory effect was found in the suture group. 4 Axonal number and diameter was more in the combination group than in the suture group [(2 187+/-107), (1 847+/-96) axons/400 field of vision; (2.79+/-0.15), (2.05+/-0.17) mum], with the significant difference (F=80.70, 42.92, P < 0.05). 5 Axonal regeneration was observed under transmission electron microscope: At 8 weeks postoperation, the regenerative axon grow well and arranged orderly in the combination group, additionally both the axonal diameter and myelin sheath thickness were identical, axons were evenly staining, Schwann cellular nucleus in oval shape was also presented. While in the suture group, axonal growth was different, their arrangement was in disorder, and the myelin sheath was thin, accompanying the vascular dilation and partly area of bleeding and edema. 6 HRP-labeled motor neuron in anterior cornu of medullar spinalis: HRP-labeled motor neurons were found in anterior cornu at a greater quantity in the combination group, whereas few in the suture group. Conclusion: Fibrin glue can obviously improve the repair and regeneration of injured peripheral nerve, and the effect is superior to that of simple suture.

Assessment of cryoprecipitate-thrombin solution for dural repair.

Authors: Wiegand D.A., Hartel M.I., Quander T., Latz B., Dankle J.A.

Publication Date: 1994

Abstract:

Background. After resection of cranial and skull base tumors, fibrin- thrombin solutions can provide a temporary biologic seal of dural closures until final healing occurs. We investigated several variables affecting the strength of these 'tissue glues' for repair of dural defects using in vitro methods to model clinical repairs. Methods. The competence of human cryoprecipitate-thrombin (CPT) 'tissue glues' in providing a watertight seal for patched rat fascia and human cadaveric dural defects was assessed. A saline column was fabricated to allow for controlled pressure (up to 700 mm) to be applied over an open aperature containing the repaired defect. Variables of repair included time after repair, defect size, and mixing temperature. Results. Wide variations in the strength of different cryoprecipitate glues were found. Time allowed after repair did not significantly affect the repair strength. Cooling the components of the glue solution prior to mixing significantly increased repair strength. Similar results were found for different defect sizes. Conclusions. Under controlled in vitro conditions, integrity of fibrin glue repairs varied widely. This was not attributable to differences in solution fibrinogen concentration. Cooling the 'tissue glue' components prior to mixing significantly increased repair strength of patched tissue defects.

Sutures or fibrin glue for divided rat nerves: Schwann cell and muscle metabolism.

Authors: Becker C.M., Gueuning C.O., Graff G.L.

Publication Date: 1985

Abstract:

Peripheral nerve anastomoses using either epiperineurial sutures or a fibrinogen adhesive technique have been compared in the rat sciatic nerve model. Evaluation of results was made using radiolabelling of the metabolically active acid-soluble phosphate fractions of both nerve and muscle. In none of the situations tested - traumatic degeneration and regeneration in the sciatic nerve proximal segment, Wallerian degeneration and regeneration in its distal segment, atrophy and regeneration of the fast gastrocnemius muscle, and atrophy and regeneration of the slow soleus muscle - was one repair method significantly superior to the other. A significant degree of cross-reinnervation was shown to take place after anastomosis, altering the characteristics of the regenerating muscles. Both repair methods were equally inferior to the spontaneous repair occurring after a simple nerve crush.

Fields of application and experiences with tissue adhesion with fibrinogen and thrombin. [German]

Authors: Schafer M., Klein H.J., Richter H.-P.

Publication Date: 1985

Abstract:

The definitive stoppage of bleeding in large cerebral resection zones is often difficult due to possible petechial seeping haemorrhage. Evacuo-rebleeding can be reduced by the application of tissue adhesion with fibrinogen and thrombin together with oxycellulose or very thin strips of collagen viles. A further indication exists in the additional adhesion of dural seams or duraplasties not only supra-, but especially infratentorially and spinally. In extra-intracranial anastomosis operations, even the smallest bleeding from the side branches of the arteria temporalis superficialis can be avoided by applying tissue adhesion with fibrinogen and thrombin to the stem of the vascular muscles of the donor artery. This minimises the danger of a subdural haematoma in the anastomotic region. An electrical coagulation of these small side branches, directly next to the donor artery, should not be forced due to a possible thrombosis of the trunk. The seams can be limited to six to eight by thin application of tissue adhesions with fibrinogen and thrombin onto the actual vascular anastomosis, so that not only the danger of vascular obliteration caused by additional seams, but also the period of time of the intermitting clamping of the cerebral recipient vessel can be reduced. Further indications are mentioned.

Fibrin glue for otorhinolaryngology. [German]

Authors: Wolf G.

Publication Date: 1981

Abstract:

A tissue glue easy to produce and made of the patient's own blood plasma could be synthesized. By the addition of different mixtures its characteristics and its applicability were tested. The most qualified glue combination for otorhinolaryngology was determined. Excellent results were obtained upon application on dura plastics and in microsurgery. The advantages of the glue are: no danger of infection by virus hepatitis, flexible intervals of adhesion, no storage problems, easy to synthesize, few expenses.

Pilot-study for the production and the application of self-made human-fibrin-glue. [German]

Authors: Beleites E., Tietz U., Forberger Ch., Gudziol H.

Publication Date: 1983

Abstract:

Not Available

Fibrocaps for surgical hemostasis: two randomized, controlled phase II trials.

Authors: Verhoef C, Singla N, Moneta G, Muir W, Rijken A, Lockstadt H, de Wilt JH, O-Yurvati A, Zuckerman LA, Frohna P, Porte RJ

Publication Date: 2015

Abstract:

BACKGROUND: Fibrocaps, a ready-to-use, dry-powder fibrin sealant containing human plasma-derived thrombin and fibrinogen, is being developed as an adjunct for surgical hemostasis.

MATERIALS AND METHODS: Safety and efficacy of Fibrocaps applied directly or by spray device, in combination with gelatin sponge, was compared with that of gelatin sponge-alone in two randomized, single-blind controlled trials: FC-002 US (United States) and FC-002 NL (the Netherlands). A total of 126 adult patients were randomized (Fibrocaps: n = 47 [FC-002 US], n = 39 [FC-002 NL]; gelatin sponge alone: n = 23 [FC-002 US], n = 17 [FC-002 NL). One bleeding site was treated during a surgical procedure (n = 125). Time to hemostasis (primary end point) was measured, with a 28-d safety follow-up. Four surgical indications included hepatic resection (n = 58), spinal procedures (n = 37), peripheral vascular procedures (n = 30), and soft tissue dissection (n = 1).

RESULTS: Mean (standard deviation) time to hemostasis was significantly shorter after Fibrocaps treatment than after gelatin sponge alone (FC-002 US: 1.9 [1.3] versus 4.8 min [3.1], P < 0.001; FC-002 NL: 2.2 [1.3] versus 4.4 min [3.1], P = 0.004). The incidence of hemostasis was greater after Fibrocaps compared with that of gelatin sponge alone within 3 min (FC-002 US: 83% versus 35%, P < 0.001; FC-002 NL: 77% versus 53%, P = 0.11), 5 min (94% versus 61%, P = 0.001; 95% versus

71%, P = 0.022), and 10 min (100% versus 78%, P = 0.003; 100% versus 82%, P = 0.025). Adverse events were consistent with surgical procedures performed and patients' underlying diseases and generally similar between treatment arms; most were mild or moderate in severity. Non-neutralizing antithrombin antibodies were detected in 5% of Fibrocaps-treated patients on day 29.

CONCLUSIONS: Fibrocaps had good safety and efficacy profiles, supporting continuing clinical development as a novel fibrin sealant.

Effects of Tisseel fibrin glue on the central nervous system of nonhuman primates.

Authors: Kassam A, Nemoto E, Balzer J, Rao G, Welch WC, Kuwabara H, Boada F, Horowitz M

Publication Date: 2004

Abstract:

For many years, neurosurgeons and otolaryngologic surgeons have used the fibrin glue product Tisseel to repair skull-base spinal fluid leaks and to help secure repairs following anterior cranial-base surgery. Despite the widespread use, the potential focal cerebral toxicity of this fibrin glue has never been investigated. We studied the safety of Tisseel applied directly to neural tissue (brain parenchyma, cervical cord, and C3-C6 spinal roots) of 6 monkeys (Macaca nemestrina) to determine if any underlying biochemical injury would occur. Another 3 animals that served as controls received saline rather than Tisseel. We found that median nerve electroencephalographic tracings and somatosensory evoked potentials in the experimental and control animals were identical. Likewise, cerebrospinal fluid indicators of neuronal or brain injury, inflammatory responses, and infection were negative in both groups. Finally, there were no significant differences between the two groups with respect to edema volumes and apparent diffusion coefficient values. We conclude that Tisseel does not induce an apparent inflammatory response or abnormal neurophysiologic or histologic response within 5 days of its application when it is applied directly to the brain parenchyma or onto the cervical spinal cord.

Fibrin glue in surgery: frequent development of inhibitors of bovine thrombin and human factor V.

Authors: Banninger H, Hardegger T, Tobler A, Barth A, Schupbach P, Reinhart W, Lammle B, Furlan M

Publication Date: 1993

Abstract:

We report on a 34-year-old woman whose plasma showed a marked prolongation of thrombin time (TT) (> 200 s) using bovine thrombin. The patient had previously been exposed twice to topical bovine thrombin contained in fibrin glue during cardiac surgery. TT was normal when human thrombin was used as reagent. The patient's purified IgG reacted with bovine prothrombin and bovine thrombin in immunoblotting studies but showed virtually no cross-reaction with human thrombin. In addition, following surgery, factor V clotting activity (FV:C) was reduced to 9% of normal. The inhibitor of bovine thrombin persisted over a period of more than a year, while the level of FV:C progressively returned to normal within this time period. Development of thrombin and FV:C inhibitors was also investigated in plasma of 34 consecutive patients who had undergone either cardiac surgery or neurosurgery with use of fibrin glue containing bovine thrombin. Eleven of 24 patients after cardiac surgery and two of 10 patients after neurosurgery presented with TT > or = 25 s (normal plasma 15 s). Two patients had been re-exposed to fibrin glue during cardiac re-operation and showed markedly prolonged TT (> 60 s). All 13 patients who had acquired a thrombin inhibitor also had low FV:C activity (10-60% of normal plasma), whereas FV:C activity remained in the normal range in the 21 patients with normal TT. Our findings indicate that development of inhibitors of bovine thrombin as well as co-immunization to factor V occurs frequently and is associated with the amount of applied fibrin glue and with the type of operation. Re-exposure to fibrin glue seems to enhance formation of inhibitors of bovine thrombin and human factor V.

The Use of a Fibrin Glue with a Low Concentration of Thrombin Decreases Seroma Formation in Postbariatric Patients Undergoing Circular Abdominoplasty.

Authors: Pilone V., Vitiello A., Borriello C., Gargiulo S., Forestieri P.

Publication Date: 2014

Abstract:

Background: The serum collection under the abdominal flap is the most common complication after a lipo-abdominoplasty. The frequency of seroma increases further among obese patients, who have achieved massive weight loss after bariatric surgery. The purpose of this study is to demonstrate the effectiveness of fibrin glues with a low concentration of thrombin in reducing seroma formation after a lipo-abdominoplasty.Methods: Thirty patients, that had achieved a significant weight loss after an intervention of laparoscopic adjustable gastric banding (LAGB), underwent a circular lipo-abdominoplasty at our bariatric surgery department. Patients were divided into two groups of 15 subjects each: group A underwent traditional surgery; in group B, we applied a slow-clotting variant of fibrin glue (ARTISS, Baxter) under the abdominal flap. All subjects were evaluated clinically using an ultrasound device on postoperative day 15. We considered positive for seroma, those cases with a liquid collection greater than 20 cc.Results: The groups were homogeneous for age, BMI, male/female ratio, and diabetic or smoker patients. The mean hospital stay was significantly longer in group A than in group B. We found eight cases of serum collection >20 cc in group A and only one case in group B. Hematoma, umbilicus necrosis, and surgical site infection occurred in both groups, but overall complication rate was lower in group B.Conclusions: The use of a fibrin glue with a low concentration of thrombin could be useful during wound closure and may decrease seroma formation in postbariatric patients undergoing lipo-abdominoplasty.

Life-threatening pleural hemorrhage following intrapleural enzyme therapy and successful treatment with fibrin-thrombin sealant pleurodesis: A case report.

Authors: Vun S.V., Lance D.G.

Publication Date: 2015

Abstract:

Introduction: Intrapleural fibrinolytic enzyme therapy is a potentially surgery-sparing treatment for poorly resolving parapneumonic effusion and empyema. It is safe in the majority of patients, however the most significant risk associated with this treatment is severe bleeding secondary to pleural hemorrhage. Contraindications for intrapleural enzyme therapy are not widely agreed upon and little is known about how to treat this difficult and potentially lethal hemorrhagic complication. Case presentation: An independent 82-year-old Caucasian man presented to hospital with an empyema complicating community-acquired pneumonia and coincidental pulmonary embolus. He was initially commenced on intravenous antibiotics, pleural drainage and anticoagulation, however failed to improve significantly and was commenced on intrapleural fibrinolytic enzyme therapy. Shortly after, he suffered severe pleural hemorrhage that was uncontrollable despite emergency thoracotomy and washout. Subsequent hemostasis was achieved after re-exploration and application of topical fibrin-thrombin sealant spray. The patient survived and was discharged home. Conclusions: Intrapleural enzyme therapy can be effective in loculated parapneumonic effusion and empyema, but massive pleural hemorrhage can complicate its use. Pleural hemorrhage appears to be associated with anticoagulation or coagulopathy, and can be difficult to manage. This case adds to the body of data on bleeding complications following intrapleural enzyme therapy, and to the best of our knowledge is the first report of fibrin-thrombin sealant use in this setting.

Proteases in human pancreatic juice degrade both liquid and carrier-bound fibrin sealants in vitro.

Authors: Adelmeijer J., Porte R.J., Lisman T.

Publication Date: 2013

Abstract:

Background: Fibrin sealants are used in a variety of surgical procedures mainly to control bleeding and to reinforce suture lines. Furthermore, these products are frequently applied to enhance tissue sealing for purposes other than induction of hemostasis in procedures including liver, lung, and pancreatic surgery. We have previously shown that fibrin sealants are unstable in the presence of human bile, and this observation may explain the lack of efficacy of fibrin sealants to avoid bile leak-related complications following liver surgery. Fibrin sealants have been used in pancreatic surgery for almost 35 years with the main aim of preventing fistula formation as a consequence of leakage of pancreatic juice. However, the clinical efficacy of this approach is still unclear. Aims: Here we investigated the stability of commercially available liquid and carrier-bound fibrin sealants in the presence of pancreatic fluid using in vitro experimentation. Methods: Fibrin clots were generated in vitro from two commercially available liquid fibrin sealants and exposed to saline or human pancreatic fluid. Degradation of clots was assessed by weighing clots or by examination of release of fibrin degradation products. Also, pancreatic fluid was exposed to the carrier-bound fibrin sealant Tachosil, and stability of the sealant was assessed qualitatively and quantitatively by measuring fibrin- and collagen degradation products. Results: Clots generated from liquid fibrin sealants degrade rapidly in pancreatic fluid, but not in normal saline, as evidenced by a rapid reduction in clot weight and release of fibrin degradation products. Exposure of Tachosil to pancreatic fluid results in rapid degradation of both the fibrin and collagen part of the sealant, as evidenced by release of fibrin- and collagen degradation products and a visual inspection of sealant integrity. Protease

inhibitor cocktails or individual serine protease inhibitors reduce breakdown of both liquid sealants and Tachosil, and a collagenase inhibitor reduces breakdown of Tachosil. Conclusions: Proteases present in pancreatic juice effectively degrade both liquid and carrier-bound fibrin sealants in vitro. These results may imply that the use of these products in pancreatic surgery with the aim to prevent fistula formation as a result of leakage of pancreatic fluid may serve limited purpose.

Cost analysis of haemostatic treatment with a fibrin-based sponge versus fibrin sealant in lung surgery and liver resection in a Spanish setting.

Authors: Darba J., Kaskens L., Perez-Alvarez N.

Publication Date: 2011

Abstract:

OBJECTIVES: To assess the health care resources used and estimate the costs associated with the use of a collagen sponge coated with human fibrinogen and thrombin compared with fibrin sealant to improve haemostasis in lung surgery and liver resection. METHODS: A cost-analysis of the healthcare resources used with the administration of a fibrin-based sponge and fibrin sealant was performed. Health care resource utilisation and unit costs associated with both treatments in lung surgery and liver resection was obtained from literature research. Costs included for lung surgery were drug costs, preparation and administration time and additional hospitalisation due to post-surgery pulmonary air leakage. Costs for liver resection included drug costs, preparation and administration time, drainage and hospitalisation days at ward or an intensive care unit. Drug costs were obtained from Spanish medication databases. All costs were referred to EUR 2010. Based on the healthcare resource use the mean cost per patient for each treatment was estimated. A two-way sensitivity analysis was performed determining minimum and maximum mean costs per patient. RESULTS: Mean drug costs for the fibrin-based sponge and fibrin sealant in lung surgery resulted in 275 and 345, respectively. Total treatment costs per patient were estimated at 376 and at 509 for the fibrin-based sponge and fibrin sealant. In liver resection mean drug costs resulted in 550 for the fibrin-based sponge and in 690 for fibrin sealant, respectively. The associated total treatment costs per patient added up to approximately 5725 for the fibrin-based sponge and 6148 for fibrin sealant. CONCLUSIONS: The use of a fibrin-based sponge showed benefits over the use of fibrin sealant in

lung surgery and liver resection. Less use of health care resources with the application of fibrin-based sponges versus fibrin sealant resulted in lower associated treatment costs per patient.

The effects of sheet-type absorbable topical collagen hemostat used to prevent pulmonary fistula after lung surgery.

Authors: Miyamoto H., Sakao Y., Sakuraba M., Oh S., Takahashi N., Miyasaka Y., Akaboshi T., Inagaki T.

Publication Date: 2010

Abstract:

Background: Numerous reports have been published on the application of fibrin glues, biological adhesives used as sealants for air leaks after pulmonary resection; however, the use of blood products has been questioned from both safety and economic perspectives. Therefore we were prompted to attempt the use of Integran (method C), a sheet-type absorbable topical collagen hemostat that is neither expensive nor derived from blood. Objective: To compare the efficacy of method C with that of method G, a combined approach in which TachoComb or a polyglycolic acid (PGA) sheet was fixed with a fibrin glue in a randomized controlled trial to prevent pulmonary fistula formation after lung surgery. Materials and Methods: Of the patients who were scheduled to undergo pulmonary resection in 2006 at the Department of General Thoracic Surgery, Juntendo University, and who provided informed consent for the study before surgery, those who developed visible air leaks during lobectomy, segmentectomy, partial resection for lung tumor or pulmonary cyst, or intractable pneumothorax were included as the subjects of this study. The subjects were randomized for treatment with either of 2 procedures, namely, method C or method G. Pulmonary fistula was defined as an obvious air leak persisting until day 3 after surgery. Results: A total of 38 patients were assigned to method C and 34 to method G. Three patients (7.9%) assigned to method C (including 1 who underwent lobectomy and 2 who underwent partial resection), and 6 (17.6%) patients assigned to method G, including 3 who each underwent a lobectomy and partial resection, developed postoperative pulmonary fistula. The incidence of pulmonary fistula was significantly

lower in the group assigned to method C, with a statistically significant difference of p = 0.044. Conclusions: In a Randomized Controlled Trial of Sealing with a Sheet-type Collagen vs. a Combined Approach of Fixing a Collagen Sponge, Using Fibrin Glue for Closure of Air Leaks, the use of Integran, a sheet-type absorbable topical collagen hemostat, is feasible to prevent pulmonary fistula after lung surgery. It is also affordable and safe because it is not a blood product.

The efficacy of fibrin tissue adhesives in pleurodesis in rats.

Authors: Cetin B., Atalay C., Kockaya E.A., Akay M.T.

Publication Date: 2005

Abstract:

In search for a new sclerosing agent for pleurodesis, fibrin tissue adhesive is compared to tetracycline for its efficacy in rats. Twenty-four albino Wistar rats were divided into 3 groups. Groups 1, 2, and 3 were given intrapleural isotonic saline, 35 mg/kg tetracycline, and fibrin tissue adhesive with fibrinogen and thrombin concentrations of 30 mg/mL and 10 U/mL, respectively. Rats were evaluated for macroscopic pleural adhesions and mean values of macroscopic scoring were compared among the groups. Fibrin tissue adhesive- and tetracycline-treated rats had significantly more adhesions compared to the control group, whereas fibrin tissue adhesive was more effective for pleurodesis than tetracycline and no deaths or major side effects were observed in any rat. Thus, fibrin tissue adhesive was found as a more effective sclerosing agent than tetracycline for pleurodesis in rats.

The sealing effect of fibrin glue against alveolar air leakage evaluated up to 48 h; Comparison between different methods of application.

Authors: Kawamura M., Gika M., Izumi Y., Horinouchi H., Shinya N., Mukai M., Kobayashi K.

Publication Date: 2005

Abstract:

Objective: There is little experimental evidence to show how much positive airway pressure fibrin sealants can actually withstand, and in particular, how this effect changes over time. In the present study, we experimentally evaluated the sealing effect of fibrin glue against alveolar air leakage up to 48 h after application. Methods: Beagles were used (n=48). Under thoracotomy, approximately 5x10 mm defects (2 mm depth) were made on the lung surface. Fibrin glue sealants were applied to this defect in three ways. In rubbing and spray method, fibrinogen was rubbed, followed by spraying of both fibrinogen and thrombin solutions. In double layer method, fibrinogen was dripped, followed by thrombin. Collagen fleece, coated with fibrinogen and thrombin (TachoComb) was also tested. The minimum positive airway pressure which produced air leakage was measured for each sealed defect (seal breaking pressure, cmH<inf>2</inf>O) at 0, 3, 6, 12, 24, and 48 h after application (n=6 at each time point). Results: The seal-breaking pressure increased over time in all of the application methods. At 6 h, differences between methods were not significant but three defects in RS reached 70 cmH<inf>2</inf>O, the maximum pressure tested, compared with none in other two methods. At 12 h, the seal-breaking pressure was significantly higher in RS compared with the other two methods (rubbing and spray method vs TachoComb; 66+/-3 vs 47+/-17, P=0.047, rubbing and spray method vs double layer method; 66+/-3 vs 42+/-18, P=0.024). Beyond 24 h, sealing pressure reached close to 70 cmH<inf>2</inf>O in all the methods. Conclusions: The results show that the sealing effect of fibrin glue is relatively unstable up to 12 h after its application. Rubbing and spray method may help the fibrin seal to reach its full strength faster compared with the other two

methods.

Modern glue compositions in thoracic surgery. [Russian]

Authors: Perel'man M.I., Zykov A.S., Kononenko S.N., Pavlenko I.A., Limonchikov S.V.

Publication Date: 2002

Abstract:

Not Available

Fibrin glue pleurodesis for persistent pneumothorax in an extremely premature neonate.

Authors: Orces J., Jeffries I., Fistel H.

Publication Date: 2002

Abstract:

A premature infant developed persistent pneumothorax during mechanical ventilation. Despite multiple thoracostomies and high-frequency ventilation at minimal settings, the pneumothorax persisted. Fibrin glue pleurodesis achieved successful resolution of the persistent pneumothorax.

Intrathoracic fibrin sealant application using computed tomography fluoroscopy.

Authors: O'Neill P.J., Flanagan H.L., Mauney M.C., Spotnitz W.D., Daniel T.M.

Publication Date: 2000

Abstract:

Persistent intrathoracic airspace and bronchopleural fistula remain a problem following lung resection or in patients with severe bullous disease experiencing a spontaneous pneumothorax. Although fibrin sealant has been used successfully to manage such air-leaks, precise non-operative intrathoracic application is difficult. This report describes a novel technique using computed tomography fluoroscopy for catheter-directed FS application through a previously placed thoracostomy tube. Continuous computed tomography-fluoroscopy images allowed real-time catheter manipulation for precise placement of fibrin sealant. (C) 2000 by The Society of Thoracic Surgeons.

Closure of leaks by fibrin gluing - Effects of various application techniques and temperatures.

Authors: Shimada J., Mikami K., Nishiyama K., Satoh S., Wada Y., Kimura T., Oka T.

Publication Date: 1995

Abstract:

This study was performed to determine the differences in covering power obtained with fibrin gluing using three different methods, layered, mixing, and spraying. The experimental system consisted of a 2 x 2 cm plastic plate with a hole 1 mm in diameter, a plastic syringe, and a digital manometer. The internal pressure of the syringe barrel was measured with the digital manometer. Five minutes after fibrin glue membranes (1 mm in thickness) had been prepared on the plastic plate with the layered, mixing, or spray method, the plunger of the syringe was pushed slowly, and the maximum internal pressure in the syringe barrel was measured, just before the breakage of the membrane. Experiments were performed five times at each four temperatures, 12degreeC, 17degreeC, 22degreeC and 37degreeC. Covering power of fibrin glue membranes (units: mmHg; atmospheric pressure 760 mmHg) were as follows: 1) Layered method (12degreeC: 810.0 +/- 68.6, 17degreeC: 769.0 +/- 10.2, 22degreeC: 812.0 +/- 112.4, 37degreeC: 773.6 +/- 24.4). 2) Mixing method (12degreeC: 956.6 +/- 219.3, 17degreeC: 372.4 +/- 243.5, 22degreeC: 1045.2 +/- 233.0, 37degreeC: 1059.0 +/- 220.2). 3) Spray method (12degreeC: 1010.0 +/- 231.1, 170degree: 1144.4 +/- 170.6, 22degreeC: 1148.0 +/- 234.7, 37degreeC: 1250.0 +/- 111.8). The covering power of fibrin glue membrane obtained with layered method was significantly less than that with the two other methods at all temperatures tested. The mean covering power obtained with spray method was higher than that with the mixing method at all temperatures, significantly so at 17degreeC and 37degreeC ($p < 0.05$: two-way ANOVA). Assuming an activity of 100% at 37degreeC, the thrombin required for producing fibrin clot was 52% at 12degreeC and 81% at 25degreeC. The spray method

yields greater covering power than the other methods because it gives the best uniformity to fibrin glue membranes. Since thrombin activity is less at low temperature, less fibrin product can be made. This suggests that fibrin glue membranes yield Little covering power at low temperatures.

A vanished giant bulla after repeated pleurodesis for pneumothorax - A case report. [Japanese]

Authors: Sugimura S., Ohba H., Yoshida K.

Publication Date: 1994

Abstract:

A 78-year-old man was admitted because of left pneumothorax. He had a giant bulla in the left lung which had enlarged slowly since three years previously. The refractory pneumothorax was treated by repeated pleurodesis using minocycline hydrochloride 200 x 4, factor XIII with fibrinogen (Beriplast P) 3 mlx1, autologous blood 50 ml with thrombin 10,000 u.x1, only thrombin 10,000 u.x1. On the 38th hospital day, left giant bulla disappeared on the plain chest roentgenogram, and at the same time the air leakage ceased. To our knowledge, there has been no case report that giant bulla accompanying pneumothorax disappeared by pleurodesis only.

Use of a fibrin glue in partial pulmonary excision surgery. Results of a controlled trial in 50 patients. [French]

Authors: Wurtz A., Chambon J.P., Sobecki L., Batrouni R., Huart J.J., Burnouf T.

Publication Date: 1991

Abstract:

A controlled study concerning the surgical use of a fibrin glue was conducted in 50 patients undergoing partial pulmonary excision. In 25 of these patients, chosen at random, hemostasis and aerostasis of the fissural, and/or intersegmentary dissection planes were achieved by electrocoagulation, in the other 25 by the application of fibrin glue. The statistical study did not show any significant difference between the two groups in terms of the surgical indication, the type of excision and the associated surgical procedures (pleurectomy and parietectomy). No significant statistical difference was observed concerning the quality of aerostasis, the post-operative drainage, the persistance of residual collection or faulty reexpansion after removal of the latter, and the necessity for repeated drainage. The same applied to the length of post-operative hospital stay. This study seems to demonstrate that the surgical application of fibrin glue on the fissural and/or intersegmentary dissection planes is feasible but, as compared to electrocoagulation, does not significantly improve the quality of the surgical results for partial pulmonary excision; however its use could reduce the duration of post-operative drainage.

Management of experimental pneumothorax in weanling rabbits with the use of fibrin glue sclerosant.

Authors: Goldman C.D., Blocker S.H., Ternberg J.L., Crouch E.C.

Publication Date: 1986

Abstract:

Fibrin glue pleurodesis successfully sealed surgically created pneumothoraxes in 12 (92.3%) of 13 New Zealand white rabbits, an animal model chosen for its similarity to the thoracic configuration of the human neonate. All chest tubes were removed at 24 hours; there were no recurrences. Two rabbits, in whom human cryoprecipitate was used, died of an immunologically mediated pneumonitis. This reaction would not be expected in the human setting. Four mothers' follow-up revealed nearly total fibrin glue resorption. This 'biodegradability' is well suited to the neonate, since alveolar barotrauma, not congenital emphysematous blebs, is the usual initiator of pneumothorax. Time-limited adhesions created by fibrin glue pleurodesis should be adequate for treatment of the acute event, while avoiding persistent pleural adhesions that could interfere with subsequent thoracic surgery or cause long-term deleterious effects on pulmonary function.

Closure of lung lacerations by fibrin adhesive. Experimental investigations. [German]

Authors: Turk R., Weidringer J.W., Wried-Lubbe I., Blumel G.

Publication Date: 1982

Abstract:

The effect of the fibrin adhesive on the gas density of pleura-lung-sutures was investigated in 28 male Wistar rats. Standardized pleura-lung-lacerations were closed by additional fibrin adhesive application in combination with fibrinolytic inhibitors. 30 minutes and 5 days after operation the animals were sacrificed and manometric and micromorphological examinations performed. In good histo-compatibility the additional application of the fibrin adhesive proved to be a proper technique in elevating the pressure tolerance of pleura-lung-sutures significantly.

Closure of lung leaks by fibrin gluing. Experimental investigations and clinical experience.

Authors: Turk R., Weidringer J.W., Hartel W., Blumel G.

Publication Date: 1983

Abstract:

In 28 male Wistar rats a standardized lung incision was closed by running suture and in half of the animals by additional application of fibrin adhesive. The animals were sacrificed 30 minutes and 5 days postoperatively. A significantly higher tolerance to increased inflation pressure was found in the fibrin-treated group. Ten patients undergoing pulmonary resection had conventional closure of parenchymatous lesions with additional fibrin gluing. Under positive airway pressure ventilation the sealing effect proved to be better after application of fibrin adhesive to the sutured area.

Culture and characterization of oral mucosal epithelial cells on a fibrin gel for ocular surface reconstruction.

Authors: Sheth R., Neale M.H., Shortt A.J., Massie I., Vernon A.J., Daniels J.T.

Publication Date: 2015

Abstract:

Aim of the study: To develop a clinical grade fibrin gel for the culture of oral mucosal epithelial cells (OMEC) intended for ocular surface reconstruction in the treatment of limbal stem cell deficiency (LSCD).Materials and methods: Transparent fibrin gels composed of fibrinogen and thrombin were developed for the culture of epithelial cells. Oral mucosa was harvested from the buccal region of healthy volunteers and cultured as explants on fibrin gels. Tranexamic acid (TA), a clinically approved anti-fibrinolytic agent was added to prevent the fibrin gel from digesting due to cellular activity. The gels were stained for p63alpha (as a marker of poorly differentiated epithelial cells), CK19, CK13 and CK3 (expressed by OMEC). Epithelial cell stratification was observed using hematoxylin-eosin staining.Results: Addition of TA prevented gels from dissolving during the culture period. OMEC proliferated on the fibrin gel and attained confluence over a 2-week period (+/-2 d) and exhibited a typical epithelial, cobblestone morphology. Basal OMEC exhibited positive staining for p63alpha while the superficial cells exhibited positive staining for CK3. The cells expressed a strong immunoreactivity for CK19 and CK13 suggesting that they retained a normal oral epithelial phenotype.Conclusion: Fibrin gels, maintained in the presence of TA, to control the rate of substrate degradation, provide a more robust yet transparent substrate for the culture and transplantation of cultured OMEC. The fibrin gels are easily standardized, the components commercially available, and produced from clinically approved materials. The resulting stratified OMEC-derived epithelium displays characteristics similar to that of a human cornea, e.g. CK3 expression. The conventional dependence on a murine feeder layer for support of epithelial cells is unnecessary with this

technique and hence, provides for an attractive alternative for treatment of LSCD.

Additional benefit of fibrin sealant patch in preservation of ovarian reserve during laparoscopic ovarian cystectomy.

Authors: Aiello N., Leone Roberti Maggiore U., Laraud F., Bondi C., Tafi E., Racca A., Venturini P.L., Ferrero S.

Publication Date: 2016

Abstract:

Study question: Is additional hemostasis by hemostatic fibrin sealant patch (FSP) superior to that achieved by bipolar coagulation (BC) only in preserving ovarian reserve in patients undergoing laparoscopic ovarian cystectomy? Summary answer: In women with bilateral endometriomas, post-operative anti-Mullerian hormone (AMH) levels, was less diminished when ovarian hemostasis was obtained combining FSP and BC versus BC only. What is known already: There is a consensus that surgical excision of ovarian endometriomas may damage ovarian reserve. The methods used to obtain the hemostasis after stripping of endometriomas might influence ovarian reserve. Study design, size, duration: This study was based on a retrospective analysis of a prospectively collected database of patients who underwent laparoscopic stripping of unilateral (UE; n = 30) or bilateral endometriomas (BE; n = 20). After surgical excision of endometriomas, hemostasis was obtained either by BC or by minimal BC plus the application of FSP (Tachosil, Takeda, Rome, Italy) according to surgeons' preference. Participants/materials, setting, methods: This study included women undergoing laparoscopic stripping of unilateral or bilateral endometriomas with largest diameter >=4 cm. Exclusion criteria were: age >=40 years, previous surgery on the ovaries or for endometriosis, previous oophorectomy. Ovarian reserve was assessed before surgery and at 6 months from surgery by measuring antral follicle count (AFC) and serum AMH. The prevalence of ovarian adhesions was assessed by ultrasonography at 6 months from surgery. Main results and the role of chance: The mean age of the study population was 32.5 (+/-3.6) years. Both in patients with UE and

in those with BE, the baseline AFC ($p = 0.773$ and $p = 0.764$, respectively) and the AMH levels ($p = 0.941$ and $p = 0.824$, respectively) were similar the two treatment groups. In patients with UE, the AFC of the operated ovary did not change after surgery both in patients treated by BC ($p = 0.419$) and in those treated by FSP ($p = 0.659$); at 3-month follow-up, the AFC of the operated ovary was similar between the two treatment groups ($p = 0.814$) and also AMH levels did not differ (0.548). In patients with BE, the total AFC did not change after surgery both in patients treated by BC ($p = 0.398$) and in those treated by FSP ($p = 0.840$), while a significant reduction in AMH levels was observed in both in patients treated by BC ($p = 0.002$) and in those treated by FSP ($p < 0.001$); at 3-month follow-up, the total AFC was similar between the two treatment groups ($p = 0.444$), while AMH levels were significantly higher in patients treated by FSP versus BE (0.031). In addition, the use of FSP did not increase the prevalence of postoperative adhesions both in patients with UE ($p = 0.337$) than in those with BE ($p = 0.110$). Limitations, reasons for caution: The main limitation of the current study is the retrospective design. Another important limitation of this research is the small sample size. Wider implications of the findings: In women undergoing surgical excision of bilateral endometriomas, the use of FSP provides a potential additional benefit in the preservation of ovarian reserve. Future studies in larger population of patients should confirm these preliminary results.

Pancreatic fistula after laparoscopic splenectomy in patients with hypersplenism due to liver cirrhosis: effect of fibrin glue and polyglycolic acid felt on prophylaxis of postoperative complications.

Authors: Tsutsumi N., Tomikawa M., Akahoshi T., Kawanaka H., Ota M., Sakaguchi Y., Kusumoto T., Ikejiri K., Hashizume M., Maehara Y.

Publication Date: 2016

Abstract:

Background This study aimed to determine the effect of fibrin glue and polyglycolic acid (PGA) felt on prevention of pancreatic fistula (PF) after laparoscopic splenectomy in patients with hypersplenism due to liver cirrhosis. Methods Fifty consecutive patients were enrolled in this prospective study. Twenty-three patients underwent laparoscopic splenectomy with a fibrin sheet (fibrin sheet group). The sealing ability of each treatment was evaluated by an ex vivo pressure test model. Based on the results from ex vivo experiments, 27 patients received prophylaxis using fibrin glue and PGA felt (PGA with fibrin group). The primary endpoint was the incidence of PF. Results Significantly more (5, 22%) patients developed PF in the fibrin sheet group than in the PGA with fibrin group (0%, P =.037). Conclusions Our new application of fibrin glue and PGA felt is an effective prophylactic procedure for preventing development of PF after laparoscopic splenectomy.

Successful treatment of persistent post-dural puncture headache from implantation of spinal cord stimulator using epidural fibrin glue patch after continued failure of epidural blood patches.

Authors: Wong K., Monroe B.

Publication Date: 2016

Abstract:

Introduction Post-dural puncture headache (PDPH) is a well-recognized, iatrogenic complication associated with interventional neuraxial procedures. It is postulated to be caused by caudal displacement of pain-sensitive intracranial structures secondary to cerebrospinal fluid (CSF) leakage through dural defects. 1The incidence of accidental dural puncture varies from 0.4% to 6% with 60% rate of PDPH. 2Risk factors include large-bore cutting needle, young female, multiple needle punctures, previous history of PDPH, and low body mass index. Conservative management includes rest, hydration, caffeine, and analgesics. Epidural blood patch (EBP) is the gold-standard for PDPH treatment with a success rate of 77% to 96%. When EBP is contraindicated or has persistently failed, alternative therapies like epidural fibrin glue patch should be sought. Results/Case report A 58-year-old female was referred for evaluation of PDPH. She had a history of lumbar fusion for spondylolisthesis in 2005 and implantation of intrathecal hydromorphone pump for failed back surgery syndrome (FBSS) in 2008. Recently, she underwent a trial of spinal cord stimulator (SCS) that resulted in dural puncture. Since then, she developed severe positional headache radiating to bilateral frontal and occipital regions. She described the pain as constant, throbbing, cramping, and stabbing. The headache was associated with hearing loss and spells of confusion. It was worsened by sitting and standing, and relieved by lying flat. Despite several trials of EBP at an outside hospital, her headache failed to resolve. The patient had a known history of difficult venous access and her last EBP required central venous access. Physical examination revealed a welldeveloped

woman with several well-healed scars on her back. Magnetic resonance imaging of her thoracolumbar spine demonstrated postoperative changes from previous lumbar fusion and superimposed degenerative changes of the lumbar spine (Fig. 1). The patient agreed to proceed with epidural fibrin glue patch. The patient was positioned in prone position. An 18-gauge Tuohy needle was introduced into the epidural space at the L1-2 level using loss of resistance technique. Contrast dye was injected to confirm proper placement using epidurography (Fig. 2). A total of 5 ml fibrin glue was injected followed by 1 ml of normal saline and 5 ml of thrombin into the epidural space. The needle was removed and patient was discharged home in stable condition. A one-week follow-up phone call was made and she reported complete resolution of her PDPH. Discussion This case illustrates that epidural fibrin glue patch is a therapeutic option. Our patient suffered from PDPH after inadvertent dural puncture during implantation of SCS. The EBP only provided temporary relief and her quality of life was adversely affected. We decided to perform the epidural fibrin glue patch based on two reasons. Firstly, treatment failure after multiple EBP reflected continuous transdural leak. Secondly, the patient was known to have difficult venous access. Repeating EBP implied the need for central venous access. Epidural fibrin glue patch demonstrated promising outcomes for both immediate and long-term resolution of PDPH in our patient. Further studies are needed to investigate the safety and efficacy of fibrin glue for PDPH treatment. (Figure Presented).

Effectiveness of fibrin coating in the management of web formation after laryngomicrosurgery.

Authors: Adachi K., Umezaki T.

Publication Date: 2017

Abstract:

Purpose To explore the effectiveness of fibrin coating in reducing web formation after endoscopic management of the anterior commissure of the larynx. Materials and methods Using a spray device that is generally used for laparoscopic operations, we covered the wound with fibrin glue (Bolheal) to avoid web formation. This technique was employed in cases wherein the anterior commissure was mainly managed by laser operation; the glue was sprayed after vaporization. Fibrinogen was first sprayed and the wound was properly soaked with a swab, which was followed by application of thrombin. We used this method in 17 cases and evaluated voice function by acoustic analysis - pitch perturbation quotient (PPQ) and amplitude perturbation quotient (APQ) - and maximum phonation time (MPT) before and after the operation. Results No severe web formation was observed at three months after the operation. PPQ values improved from 3.048 +/- 2.801% to 0.653 +/- 0.463% ($p < 0.05$, paired t-test). APQ values improved from 7.996 +/- 5.003% to 3.042 +/- 1.872% ($p < 0.05$, paired t-test). Voice quality did not worsen in any of the cases. MPT values improved from 17.2 +/- 10.8 s to 26.7 +/- 14.2 s ($p < 0.05$, paired t-test) Voice function improved 3 months after the operation in all cases. Conclusion The fibrin coating method is an easy and effective approach to avoid web formation without creating cervical wounds in cases that require handling of the anterior commissure under laryngomicrosurgery.

Hemostatic glues in tonsillectomy: A systematic review.

Authors: Sproat R., Radford P., Hunt A.

Publication Date: 2016

Abstract:

Objectives/Hypothesis The aim of this study was to compare use of hemostatic glues to conventional techniques of intraoperative hemostasis for tonsillectomy. Study Design A systematic review of the literature and meta-analysis. Methods All published prospective controlled trials that compared hemostatic glues to conventional techniques of hemostasis were identified. We performed a meta-analysis of articles comparing fibrin sealant to electrocautery, and of those comparing electrocautery to electrocautery plus fibrin hemostasis. Results Seven studies were identified that made qualifications for review, with a total of 748 patients. Outcome measures were postoperative hemorrhage recorded by investigators, and visual analogue scores of pain for day 1, day 3, and day 10 postoperatively. Use of fibrin sealant was not associated with a reduction in hemorrhage rates following tonsillectomy when compared to electrocautery (pooled relative risk [RR] 0.315; 95% confidence intervals [CI]: 0.047-2.093, 224 patients). No statistical difference in bleeding rate was seen between electrocautery hemostasis alone, compared to electrocautery with fibrin sealant (pooled RR 1.742; 95% CI: 0.433-7.005, 108 patients). No statistically significant difference in pain was identified. Conclusions Pain and bleeding are significant causes of morbidity post-tonsillectomy. We conclude that there is no significant evidence to support hemostatic glues over current techniques for reducing severity of these outcomes. Consequently, we do not recommended hemostatic glues for routine use in current clinical practice. Studies were generally of low quality and inadequately powered to detect a statistical difference, even when pooled. We advocate further research to facilitate future meta-analysis.

Fibrin Sealants, Platelet Gels, and Spinal Fusion.

Authors: Elder B.D., Witham T.F.

Publication Date: 2016

Abstract:

Not Available

Use of absorbable fibrin sealant patch (TachoSil) for hemostasis in split liver transplantation.

Authors: Vicentine F., Perdigao F., Goumard C., Brustia R., Sepulveda A., Soubrane O., Scatton O.

Publication Date: 2016

Abstract:

Introduction: Split liver transplantation (SLT) now reaches similar results as whole liver transplantation (WLT), but is not free of complications, such as hemorrhage and bile leak from cut surface area. An absorbable fibrin sealant patch (TachoSil) may be used by liver surgeons to improve hemostasis control from the cut surface. The objective was to assess the efficacy of TachoSil to improve hemostasis control from cut surface area in patients undergoing to split liver transplantation (SLT). Material and methods: From May 2000 to January 2014, all adult patients undergoing a SLT with right/right extended grafts were retrospectively included and divided into two groups according to the use of TachoSil on the cut surface. Donor and recipient characteristics, blood transfusion rate, aspirin use, postoperative complications and biology were recorded. Results: Among 57 patients who underwent SLT, 23 (40.3%) had TachoSil and 34 (59.6%) didn't. The two groups characteristics were comparable (age, gender, BMI, Child, Meld, indication of liver transplantation). A mean of 2 patch per patient were used in TachoSil group. The blood transfusion rate during SLT was not different between the two groups (11 with TachoSilO versus 18 without TachoSil (p = 0.79)), but the mean number of packed red blood cells per patient was significantly lower in the TachoSil group (2.6 versus 8.3 units, p = 0.04). Conclusion: TachoSil use during SLT can be helpful in hemostasis control from cut surface, since when blood transfusion is needed, the number of packed red blood cells used is significantly lower.

Hemostatic plug: Novel technique for closure of percutaneous nephrostomy tract.

Authors: Abbott J.E., Cicic A., Jump R.W., Davalos J.G.

Publication Date: 2015

Abstract:

Percutaneous nephrolithotomy (PCNL) is a standard treatment for patients with large or complex kidney stones. The procedure has traditionally included postoperative placement of a nephrostomy tube to allow for drainage and possible reentry. This practice was first implemented after complications incurred after tubeless PCNL in a small patient population. Recently, tubeless PCNL has reemerged as a viable option for selected patients, resulting in decreased pain and analgesic use, shorter hospitalization, quicker return to normal activity, and decreased urine extravasation. Gelatin matrix sealants are occasionally used in nephrostomy tract closure. Techniques for delivery of these agents have been ill described, and placement may be performed with varying results. We present a literature review comparing tubeless PCNL to its traditional variant with indications for use of each, as well as a comparison of agents used in closure. Finally, we outline a novel, reproducible technique for closure of the dilated percutaneous renal access tract.

Use of absorbable fibrin sealant patch (tachosil) for hemostasis in the split liver transplantation.

Authors: Vicentine F., Perdigao F., Brustia R., Goumard C., Sepulveda A., Schielke A., Soubrane O., Scatton O.

Publication Date: 2015

Abstract:

INTRODUCTION: Split liver transplantation (SLT) has nowadays similar results of whole liver transplantation (WLT), but is not free of complications, like bleeding and bile leak from cut surface area. The absorbable fibrin sealant patch (TachoSil) is a tool known in liver surgery domain to improve hemostasis control from cut surface. OBJECTIVE : To evaluate the efficacy of TachoSil to improve hemostasis control from cut surface area in patients undergoing to split liver transplantation (SLT). MATERIAL AND METHODS: From May 2000 to January 2014 all adult patients undergoing to SLT with right or right extended grafts were retrospectively included and divided into two groups according to the use of TachoSil on the cut surface. Donor and Receiver characteristics, blood transfusion, aspirin use, postoperative complications and biology were recorded. RESULTS: 57 patients underwent to SLT, 23 (40.3%) with TachoSil and 34 (59.6%) without. The two groups were comparable in terms of donor and recipients characteristics (age, gender, BMI, Child, Meld, indication of liver transplantation and presence of Hepatocellular carcinoma). A mean of 2 patch per patient were used in TachoSil group. No difference among the two groups was found concerning the patient needing blood transfusion during SLT: 11 with TachoSil versus 18 without TachoSil (p=0.79). Despite, but the number of packed red blood cells used per patient was lower in the group with TachoSil than in the group without TachoSil (2.63 versus 8.33 units, p=0.04). CONCLUSION : TachoSil use during SLT can be helpful in hemostasis control from cut surface: when blood transfusion is needed, the number of packed red blood cells used is significantly lower.

Evicel and bloodless protocol in orthopaedics surgery clinical evidence and cost-analysis : Italian experience humanitas research hospital.

Authors: Scardino M., Martorelli F., Grappiolo G.

Publication Date: 2015

Abstract:

Objectives: Blood transfusion and hemostasis are becoming an important aspect of preoperative planning and intraoperative decision making in orthopaedic surgery. Total hip arthroplasty (THA), place patients at risk of significant blood loss, which can result in the need for transfusion, risk of postoperative anemia and infection, and increase hospital stay. Humanitas Hospital (ICH) use a new protocol "without blood" perioperative strategies include the use of autologous blood donation and administration of erythropoietin; intraoperative measures include acute normovolemic hemodilution, anesthesia, use of tranexamic acid, intraoperative and postoperative blood salvage, specialized cautery, and a new topical hemostatic agents (EVICEL). Evicel is a fibrin sealant (fibrinogen and high concentration of thrombin) hemostatic agent, facilitates hemostasis, reduce the volume of blood loss in postoperative. The potential role and cost saving generated from use of EVICEL in the "protocol without blood" to control blood loss, number of avoid blood transfusions and reduction of length of hospital stay in patients undergoing THA revisions. Methods: was evaluated in a retrospective observational controlled study in patients undergoing THA revision: one group was treated with EVICEL and a control group with the same protocol but without EVICEL. The outcomes measured (t test, Wilcoxon test, Chi-square test) were: number of patients exposed to allogeneic red cells, amount of blood transfusions, and the number of length of stay in hospital. An economic model was quantified the cost saving of EVICEL in ICH. Results: preliminary results showed that application of EVICEL reduce number of transfused RBC, postoperative haemoglobin loss, and

days of hospital stay. In the hospital cost. analysis EVICEL predicts resource reduction with average cost-savings of 1.227 per patient. Conclusions: Overall, the results suggest that EVICEL are efficacious in reducing both post-operative blood loss, and hospital stay The protocol with EVICEL produce clinical appropriateness and important cost savings for hospital.

Effect of fibrin glue in liver regeneration after laparoscopic surgery.

Authors: Stanojkovic Z., Antic A., Dencic S., Stojanovic M., Stanojkovic M.

Publication Date: 2015

Abstract:

Background: Fibrin glue (FG) is a natural chemical - adhesive system with an important role in blood coagulation and wound healing. It consists of two basic components - fibrinogen and thrombin, where activation of fibrinogen and its transformation into fibrin under the action of thrombin is the third phase of blood coagulation. It is known that the use of FG in laparoscopic cholecystectomy reduces the complication rate in terms of stopping diffuse bleeding in the liver parenchyma, preventing extravasation of bile and the reduction of abdominal adhesions. The main objective of this study was to determine whether the use of FG in laparoscopic surgery has an effect on the speed of healing and regeneration of liver tissue. Material and methods: The study included a total of 40 experimental pigs in which was performed laparoscopic cholecystectomy and intraoperative standardized artificially damage of gallbladder boxes, which was repaired using FG in animals of experimental group (EG) or using standard means in animals of the control group (CG). FG was homemade (Blood Transfusion Institute Nis), prepared from two components, of which the first one was prepared from the cryoprecipitate with the addition of antifibrinolytic agents (aprotinin). The second component was a commercial bovine thrombin with calcium chloride. Animals were monitored for 30 days, 4 animals were sacrificed on the fifth, seventh, tenth, fourteenth and thirtieth day of follow- up. During autopsy we have taken liver tissue and prepared for pathological research on which basis is calculated the histopathologic regeneration score (HRS: 0-3), which shows the level of liver regeneration. Results: HRS was statistically significantly higher in EG on the fifth and seventh day ($P > 0.05$) and extremely higher on the tenth and fourteenth day ($P > 0.0001$). On the thirtieth postoperative day HSR in EG was 3.75 which is verified as a high level of regeneration and

indicates the completion of liver regeneration after thirty days from the application of FG. In the course of liver regeneration, necrosis and hemorrhage fields were lower in EG compared to CG (P = 0.03, respectively). Verified cytoplasmic vacuolization was significantly higher in CG compared CG. Conclusions: Application of fibrin glue in laparoscopic surgery affects the optimal and rapid flow of the process of healing and regeneration of the liver. Its application is recommended especially in the occurrence of diffuse intraoperative liver bleeding or in the bile duct injury, in patients who are on anticoagulant therapy, with liver cirrhosis and severe coagulation disorders.

Hemostatic efficacy of EVARRESTTM, fibrin sealant patch vs. TachoSil in a heparinized swine spleen incision model.

Authors: Matonick J.P., Hammond J.

Publication Date: 2014

Abstract:

Background: First-generation single-component hemostats such as oxidized regenerated cellulose (ORC), fibrin, collagen, and gelatin have evolved into second and third generations of combination hemostats. Objective: This study compares two FDA approved products, EVARRESTTM, Fibrin Sealant Patch, a hemostat comprised of a matrix of nonwoven polyglactin 910 embedded in ORC coated with human fibrinogen and thrombin to TachoSil medicated sponge, an equine collagen pad coated with human fibrinogen and thrombin.

Materials and Methods: Swine were anticoagulated with heparin to 3X their baseline activated clotting time and a 15 mm long x 3 mm deep incision was made to create a consistent moderate bleeding pattern. Test material was then applied to the wound site and compressed manually for 3 min with just enough pressure to prevent continued bleeding. Hemostatic effectiveness was evaluated at 3 min and 10 min.

Results: At 3 min, the hemostasis success rate was 86% in the EVARRESTTM group and 0% in the TachoSil group, $p < .0001$. The overall success rate at 10 min was 100% with EVARRESTTM and 4% with TachoSil, $p < .0001$. Adhesive failure, in which the test material did not stick to the tissue, occurred in 96% of TachoSil sites. In contrast, 100% of the EVARRESTTM applications adhered to the test site.

Conclusions: EVARRESTTM, Fibrin Sealant Patch demonstrated greater wound adhesion and more effective hemostasis than TachoSil. Adhesive failure was the primary failure mode for TachoSil in this model.

The impact of mesh fixation with a collagen-fibrin sealant in a murine ventral hernia model.

Authors: Chen Y., Eraker-Aasland Hansen K., Spasojevic M., Naesgaard J.-M., Ignjatovic D.

Publication Date: 2014

Abstract:

INTRODUCTION: Pain and adhesions represent the challenge in hernia surgery. AIM: To investigate mesh fixation and adhesion prevention with a collagen-fibrin sealant. MATERIALS AND METHODS: Twenty-seven male Sprague-Dawley rats were operated twice, to create and repair 2 ventral hernias. Mesh fixation was with collagen-fibrin sealant on 1 side (group I), whereas an additional peritoneal suture was added in group II. On day 60 animals were killed and mesh migration, integration and number, grade and location of adhesions noted. RESULTS: Migration occurred in 12 (44.4%) in group 1 and 3 (11.1%) in group 2, P=0.023. Adhesions developed to 18 (33.3%) meshes. There was no difference in adhesion grade or area for mesh center or edge between the groups (P=0.735 and P=0.829, respectively). Median adhesion grade for mesh center was 1 and edge 3 (range, 0 to 4), P=0.005 and P=0.001, respectively. Granuloma formation was noted in 8 (18.6%) animals; only with suture-fixed mesh. CONCLUSIONS: Mesh fixation with fibrin sealant is not satisfactory, however, adhesion prevention seems to be; adhesions to the edge of the mesh are most severe.

Randomized controlled multicenter trial on the effectiveness of the collagen hemostat Sangustop compared with a carrier-bound fibrin sealant during liver resection (ESSCALIVER study, NCT00918619).

Authors: Moench C., Mihaljevic A.L., Hermanutz V., Thasler W.E., Suna K., Diener M.K., Seehofer D., Mischinger H.J., Jansen-Winkeln B., Knaebel H.P., Bechstein W.O.

Publication Date: 2014

Abstract:

Background: Despite improvements in liver surgery over the past decades, hemostasis during hepatic resections remains challenging. This multicenter randomized study compares the hemostatic effect of a collagen hemostat vs. a carrier-bound fibrin sealant after hepatic resection. Methods: Patients scheduled for elective liver resection were randomized intraoperatively to receive either the collagen hemostat (COLL) or the carrier-bound fibrin sealant (CBFS) for secondary hemostasis. The primary endpoint was the proportion of patients with hemostasis after 3 min. Secondary parameters were the proportions of patients with hemostasis after 5 and 10 min, the total time to hemostasis, and the complication rates during a 3 months follow-up period. Results: A total of 128 patients were included. In the COLL group, 53 out of 61 patients (86.9 %) achieved complete hemostasis within 3 min after application of the hemostat compared to 52 out of 65 patients (80.0 %) in the CBFS group. The 95 % confidence interval for this difference [-6.0 %, 19.8 %] does not include the lower noninferiority margin (-10 %). Thus, the COLL treatment can be regarded as noninferior to the comparator. The proportions of patients with hemostasis after 3, 5, and 10 min were not significantly different between the two study arms. Postoperative mortality and morbidity were similar in both treatment groups. Conclusion: The collagen hemostat is as effective as the carrier-bound fibrin sealant in obtaining secondary hemostasis during liver resection with a comparable complication rate.

Endoscopic tissue shielding method with polyglycolic acid sheets and fibrin glue to cover wounds after colorectal endoscopic submucosal dissection (with video).

Authors: Tsuji Y., Ohata K., Gunji T., Shozushima M., Hamanaka J., Ohno A., Ito T., Yamamichi N., Fujishiro M., Matsuhashi N., Koike K.

Publication Date: 2014

Abstract:

Background Colorectal endoscopic submucosal dissection (ESD) has made it possible to resect large specimens in an en bloc fashion. However, this can lead to postoperative adverse events, such as perforation and bleeding. Prevention of adverse events after colorectal ESD is therefore an important goal. Objective To evaluate the utility of a shielding method using polyglycolic acid (PGA) sheets and fibrin glue to manage ulcers after colorectal ESD. Design Prospective, single-arm, pilot study. Setting Single tertiary care center for colorectal ESD in Japan. Patients Ten patients with 10 colorectal tumors scheduled for ESD were enrolled between September and November 2012. Interventions Just after ESD, we placed PGA sheets on the mucosal defect with biopsy forceps. After the whole defect was covered, we sprayed fibrin glue through a special double-lumen spraying tube. We sprayed fibrinogen through 1 lumen and then thrombin through the other lumen. Main Outcome Measurements Success rate, mean procedure time, and adverse events associated with the covering technique and the persistence of PGA sheets at follow-up colonoscopy. Results All 10 tumors were successfully resected. Mean tumor size was 39.7 +/- 15.2 mm. All mucosal defects were successfully covered with PGA sheets. Mean procedure time was 18.7 +/- 15.9 minutes. No procedure-related adverse events occurred. Upon colonoscopy 9 to 12 days after ESD, the PGA sheets were still fixed on the whole defect in 8 patients. Limitations Small sample size. Conclusions Our technique, which uses PGA sheets and fibrin glue, appears to shield mucosal defects, and it

may be effective in reducing postoperative adverse events.

The use of fibrin glue injections to manage post kidney transplant lymphoceles and lymph fistulas.

Authors: Presser N., Paschal S., Begala M., Kerr H., Shoskes D., Flechner S.

Publication Date: 2014

Abstract:

Purpose: Multiple techniques exist to repair post kidney transplant lymphoceles and lymph fistulas including open or laparoscopic surgical fenestration into the peritoneum. More recently we have used fibrin glue injections for definitive treatment. Methods: We retrospectively analyzed 42 recipients with lymphoceles or lymph fistulas that were treated with one of these procedures between 2003 and 2011. Study patients were selected for similar demographics and none were receiving an mTOR inhibitor drug. All treated lymphoceles were symptomatic causing pain, distention, obstruction, voiding symptoms, or leg edema. Group 1: Open Repair (OR)=21; Group 2: Lap Repair (LR)=10; and Group 3: Fibrin Glue (FG)=11. Injection of fibrin glue consisted of thawed ABO compatible cryoprecipitated plasma (4-5 units), mixed with calcium gluconate, thrombin 20,000 units, and antibiotics into a previously placed drain. The procedure was done under local anesthesia as an outpatient using fluoroscopy guidance. Clinical/laboratory parameters were compared between the groups. Results: Demographics and Outcomes appear in the table. Recurrence rates, requiring additional therapy after initial treatment for the three groups were 9.1%, 10%, and 9.5% respectively. No FG treated patient required hospitalization. Conclusions: Fibrin glue injection is an effective treatment for post kidney transplant lymphoceles with similar efficacy to surgical approaches, less morbidity, and the advantage of being an outpatient procedure. (Table Presented).

Fibrin sealant to reduce drainage after axillary dissection.

Authors: Olsha O., Hadar T., Dalo R.A., Verocherinsky N., Ashkenazi I.

Publication Date: 2014

Abstract:

Objective: After axillary dissection, drains are left in place for 5 to 10 days until 24 hour drainage decreases to a predetermined amount, almost always less than 50 ml per day. The harmonic scalpel (Harmonic Focus, Ethicon Endo-Surgery, Cincinnati, OH) and electrothermal bipolar vessel sealing (Ligasure, Covidien, Dublin, Ireland]) have shown promise in reducing axillary drainage when compared with unipolar diathermy, but are expensive. TachoSil (Nycomed, Linz, Austria) is a fibrin sealant that has proven efficacy in the control of surgical hemorrhage in a variety of tissues. There is evidence suggesting that it may also reduce axillary drainage and it is less expensive by 30%-40% than instruments used for vessel sealing. Fibrin sealant was used as standard in axillary dissection and the number of days of axillary drainage were recorded for each patient as well as any adverse effects. Methods: The use of fibrin sealant in patients undergoing axillary dissection was prospectively documented. A patch 9.5 cm x 4.8 cm in size was placed over the axillary vein to cover the vein and the space between pectoralis minor and the chest wall medially, and the area over the exit of the intercostobrachial nerve and axillary vein laterally. Axillary drains were removed when drainage was less than 50 ml/24 hours or if there was leakage around the drain sufficient to stain the patient's clothing. Results: Twenty-three consecutive patients undergoing axillary dissection who had fibrin sealant placed at the end of the procedure were included in this study. Seven had neoadjuvant chemotherapy. One of the patients had sentinel node biopsy before axillary dissection, and the rest had axillary dissection on the basis of known lymph node metastases. One additional patient had axillary dissection without breast surgery for axillary recurrence a year after mastectomy and negative sentinel node biopsy. Twelve patients had a simultaneous mastectomy.

All 12 patients with concurrent mastectomy had an additional drain under the skin flaps and 7 other patients had breast drains as part of their oncoplastic resections. The average number of lymph nodes removed was 25 (median, 23; range, 10 to 59). The average number of metastatic lymph nodes was 6 (median, 3; range, 0 to 59). Axillary drains were removed at a median of 4 days (mean, 5.0; range, 1 to 14). Fifteen (65%) of the axillary drains were removed on or before the fourth day (see table). Complications were axillary seroma that did not require drainage (1), axillary cellulitis that resolved with oral antibiotics (2), fever without an identifiable source (1), breast flap seroma (2) of which 1 was drained, and infection under breast flaps requiring open drainage (2). Conclusion: The use of fibrin sealant in axillary dissection limited the duration of axillary drainage compared with that quoted in the literature and may be an easy, useful and less expensive alternative to vessel-sealing instruments.

Fibrin sealant patch for repair of acute type a aortic dissection.

Authors: Lisy M., Kahlil M., Stock U.A., Wildhirt S.M.

Publication Date: 2013

Abstract:

Introduction The use of glues to repair disrupted tissue during acute type-A aortic dissection (TAD) surgery may be discontinuous, and cause embolization and cell necrosis. We report a method of fibrin sealant patch (FSP) to reinforce dissected aortic tissue with a collagen double layer coated with fibrinogen/thrombin on either side (TachoSil; Takeda, Konstanz, Germany). Methods In 12 patients (seven male, 66.9 +/- 11.7 years) with acute TAD we performed FSP of the intima-media disruption at the proximal and distal anastomosis of the aorta. We analyzed the perioperative course and echocardiographical, radiological, and clinical outcomes up to one year. Additionally, we investigated the adhesive potential of the FSP in vitro. Results In vitro, the adhesive strength of the FSP was 60 N/cm². In-hospital mortality was 8.3% (n = 1), recovery was satisfactory with no major neurologic events, mean ICU stay was 13.6 +/- 6.0 days, mean hospital stay was 20.7 +/- 4.4 days. A total of 7.0 +/- 2.6 RBC, 3.4 +/- 1.5 platelets, and 8.0 +/- 4.3 FFP were transfused. One-year survival was 83.3%. In 6/6 DeBakey II dissections the intimal tear was completely resected, in 2/6 DeBakey I dissections the false lumen in the descending aorta completely collapsed. No redissections and no relevant aortic valve insufficiencies were seen during follow-up. Conclusion This analysis shows that FSP using a collagen matrix double layer coated with fibrinogen/thrombin is feasible, safe, and effective in repairing the dissected aortic tissue. It results in continuous reinforcement of aortic tissue and completely avoids the need for conventional glues.

A multicentre, randomized clinical trial comparing the VerisetTM haemostatic patch with fibrin sealant for the management of bleeding during hepatic surgery.

Authors: Ollinger R., Mihaljevic A.L., Schuhmacher C., Bektas H., Vondran F., Kleine M., Sainz-Barriga M., Weiss S., Knebel P., Pratschke J., Troisi R.I.

Publication Date: 2013

Abstract:

Background: Bleeding during hepatic surgery is associated with prolonged hospitalization and increased morbidity and mortality. The VerisetTM haemostatic patch is a topical haemostat comprised of an absorbable backing made of oxidized cellulose and self-adhesive hydrogel components. It is designed to achieve haemostasis quickly and adhere to tissues without fixation. Methods: A prospective, randomized, multicentre, single-blinded study (n = 50) was performed to compare the use of a VerisetTM haemostatic patch with a fibrin sealant patch (TachoSil) (control) in the management of diffuse bleeding after hepatic surgery. Patients were randomized following the confirmation of diffuse bleeding requiring the use of a topical haemostat. Time to haemostasis was assessed at preset intervals until haemostasis was achieved. Results: Both groups were similar in comorbidities and procedural techniques. The median time to haemostasis in the group using the VerisetTM haemostatic patch was 1.0 min compared with 3.0 min in the control group (P 0.001; 3-min minimum application time for the control patch). This result was independent of bleeding severity and surface area. Both products had similar safety profiles and no statistical differences were observed in the occurrence of adverse or device-related events. Conclusions: Regardless of bleeding severity or surface area, the VerisetTM haemostatic patch achieved haemostasis in this setting significantly faster than the control device in patients undergoing hepatic resection. It was safe and easy to handle in open hepatic surgery.

Association.

L-PRP/L-PRF in esthetic plastic surgery, regenerative medicine of the skin and chronic wounds.

Authors: Cieslik-Bieleck A., Choukroun J., Odin G., Dohan Ehrenfest D.M.

Publication Date: 2012

Abstract:

The use of platelet concentrates for topical use is of particular interest for the promotion of skin wound healing. Fibrin-based surgical adjuvants are indeed widely used in plastic surgery since many years in order to improve scar healing and wound closure. However, the addition of platelets and their associated growth factors opened a new range of possibilities, particularly for the treatment of chronic skin ulcers and other applications of regenerative medicine on the covering tissues. In the 4 families of platelet concentrates available, 2 families were particularly used and tested in this clinical field: L-PRP (Leukocyte- and Platelet-rich Plasma) and L-PRF (Leukocyte- and Platelet-Rich Fibrin). These 2 families have in common the presence of significant concentrations of leukocytes, and these cells are important in the local cleaning and immune regulation of the wound healing process. The main difference between them is the fibrin architecture, and this parameter considerably influences the healing potential and the therapeutical protocol associated to each platelet concentrate technology. In this article, we describe the historical evolutions of these techniques from the fibrin glues to the current L-PRP and L-PRF, and discuss the important functions of the platelet growth factors, the leukocyte content and the fibrin architecture in order to optimize the numerous potential applications of these products in regenerative medicine of the skin. Many outstanding perspectives are appearing in this field and require further research.

Fibrin-thrombin coated sealant increases strength of esophagogastric anastomoses in a rat model.

Authors: Verhage R.J., Ruiz A., Verheem A., Goldschmeding R., Borel Rinkes I.H., Van Hillegersberg R.

Publication Date: 2012

Abstract:

Background: Anastomotic leakage is a feared complication after esophagectomy. The purpose of this study was to investigate whether the use of a fibrin-thrombin coated collagen patch (TachoSil; Nycomed, Zurich, Switzerland), applied as a sealant, would strengthen the esophagogastric anastomosis and stimulate anastomotic healing in a rat model. Methods: Hand sewn, end-to-side esophagogastric anastomoses were performed in 54 rats. Animals were randomized for an unsealed or sealed anastomosis. Rats were sacrificed on postoperative d 0, 3, 5, and 7. Primary parameter was bursting pressure. Secondary outcomes were complications, weight, and immunohistochemical staining for collagen formation and fibroblast activity. Results: Bursting pressure at d 0 and 3 was significantly increased when a sealant was used (55.1 +/- 4.6 mmHg versus 102.4 +/- 7.3 mmHg, $P < 0.010$; and 19.7 +/- 3.3 mmHg versus 34.6 +/- 4.9 mmHg, $P < 0.050$ respectively). There was no difference in bursting pressure at d 5 and 7 between unsealed and sealed anastomoses (60.9 +/- 18.2 mmHg versus 53.4 +/- 6.6 mmHg, $P = 0.690$; and 118.8 +/- 20.2 mmHg versus 97.2 +/- 8.3 mmHg, $P = 0.374$ respectively). Application of sealant independently influenced bursting pressure ($P < 0.010$). Increased fibroblastic activity was noticed at d 7 in sealed anastomoses ($P < 0.050$). There were no differences in weight gain between groups. Conclusions: Additional sealing of the anastomosis increased anastomotic strength during early postoperative recovery when anastomotic strength is at its weakest. The findings indicate that sealing of the anastomosis has the potential to prevent leakage after esophagectomy in humans.

Prevention of alveolar air leakage after video-assisted thoracic surgery: Comparison of the efficacy of methods involving the use of fibrin glue.

Authors: Kawai H., Harada K., Ohta H., Tokushima T., Oka S.

Publication Date: 2012

Abstract:

Background The aim of this study was to evaluate the appropriate condition of use of the fibrin glue plus polyglycolic acid (PGA) sheet combination to obtain the optimal sealing effect. Methods 126 consecutive patients underwent video-assisted thoracic surgery (VATS) were divided into groups as follows: fibrin glue sprayed on the PGA sheet placed over the pleural defect (Method I); fibrinogen and thrombin solutions sprayed separately on the PGA sheet soaked in thrombin and placed over the pleural defect after rubbing of fibrinogen solution on the area (Method II); fibrin glue sprayed on the PGA sheet placed over the pleural defect after rubbing of fibrinogen solution on the area (Method III). Method II and Method III were also examined in an animal model. Results Postoperative air leakage was more effectively prevented by Method III than by the other two methods ($p < 0.05$). In the experimental study, a significantly higher seal-breaking pressure was obtained for Method III than for Method II ($p < 0.05$). Conclusion Method III was the most effective for preventing alveolar air leakage.

Effect of intraoperative platelet-rich plasma and fibrin glue application on skin flap survival.

Authors: Findikcioglu F., Findikcioglu K., Yavuzer R., Lortlar N., Atabay K.

Publication Date: 2012

Abstract:

The experiment was designed to compare the effect of intraoperative platelet-rich plasma (PRP) and fibrin glue application on skin flap survival. In this study, bilateral epigastric flaps were elevated in 24 rats. The right-side flaps were used as the control of the left-side flaps. Platelet-rich plasma, fibrin glue, and thrombin had been applied under the flap sites in groups 1, 2, and 3, respectively. Five days later, all flap pedicles were ligated. Necrotic area measurements, microangiography, and histologic and immunohistochemical evaluations were performed to compare the groups. Platelet-rich plasma reduced necrotic area percentages as compared with other groups. Histologically and microangiographically increased number of arterioles were observed in PRP groups. Thrombin when used alone increased flap necrosis. Vascular endothelial growth factor, platelet-derived growth factor, and transforming growth factor A3 primary antibody staining showed increased neovascularization and reepithelialization in all PRP-applied flaps. This study demonstrated that PRP, when applied intraoperatively under the skin flap, may enhance flap survival. Thrombin used alone was found to be unsuitable in flap surgery.

Effects of mesh fixation with collagen-fibrin sealant in a rat ventral hernia model.

Authors: Spasojevic M., Gronvold B. L., Aasland K., Chen Y., Naesgaard J.M., Ignjatovic D.

Publication Date: 2012

Abstract:

Introduction: Chronic pain after hernia surgery has lead to research into new possibilities for MESH fixation. Aim: To determine if a collagen-fibrin sealant (Tachosil) provides adequate mesh fixation and prevents adhesions. Method: Sprague Dawley rats were operated 2 times in isofluran anaesthesia. Act one to create 2 ventralhernia (10 mm). Partial abdominal wall excision was made through both rectus muscles. Act two, 2 weeks after was hernia repair with 2x2 cm prolene MESH (Parietene). Fixation was with Tachosil (group 1) while a peritoneal suture was added to the Tachosil on the other side (group2). Eight weeks after hernia repair the rats were sacrificed and MESH migration, adhesion grades, surface and severity scores were registered, both for MESH surface and edges. Results: 31 rats were operated. Four rats were euthanized due to wound dehiscence. The average weight at operations was 526.9 g and 542.6 g, respectively. Adhesions to the net were noted in 18(33.3%) of 54 operations. MESH migration was 37% (group 1) vs. 11% (group 2), p = 0.023. There was no difference in adhesion grade or surface for MESH center or edge adhesions between groups p = 0.993 and p = 0.935, p = 0.22 respectively. Mean adhesion severity score for both groups was 5.7 (1-16). Total adhesion grade was 2.9 +/- 1.2, for center of MESH 2.8 +/- 1.3 and edge3.1 +/- 1.1 (p = 0.013). Conclusion: MESH fixation with Tachosil does not effectively prevent mesh migration, but serves as a good shield for adhesion formation. Modelling of the MESH produces more severe adhesions on the edge.

Delayed reaction to fibrin sealant after facelift surgery: A case report and literature review.

Authors: Pugao R., Perenack J.

Publication Date: 2012

Abstract:

Fibrin sealants are commonly used in facelift surgery to diminish postoperative ecchymosis and edema, and to support soft tissues during healing.1 Fibrin sealants are two-component systems consisting of fibrinogen and thrombin with aprotinin as a fibrin-clot stabilizer, which potentially could lead to adverse reactions due to its bovine origin.2 This case report is about a patient undergoing facelift surgery in which fibrin sealant was used followed by a type-IV allergic reaction to the sealant. A literature review was also performed using the electronic database, Pubmed, and entering keywords such as fibrin tissue sealant, fibrin glue, allergy, adverse reaction, face-lift, and rhytidectomy. A 55-year-old Caucasian female presented to an affiliatecosmetic surgical center for evaluation and improvement of moderate facial and neck skin laxity. Patient described a history of asthma, rosacea, angioedema, vertigo, migraine headaches, and arthritis. Medications taken by the patient were amitriptyline, Aleve, Epipen, meclizine, promethazine, minocycline, hydroquinone, and cyclobenzaprine. She noted an allergy reaction to penicillin and Neosporin, as well as to certain fabrics. Patient revealed a surgical history of anterior cervical fusion in 1988 and tonsillectomy in 1960. Patient denied any general anesthetic complications during and after both surgeries. The patient underwent a facelift procedure with upper and lower blepharoplasty. The facelift procedure involved extensive pre- and posterior-auricular undermining with submental platysmalplasty. Fibrin sealant was applied at the end of the facelift procedure prior to closure. No complications were encountered before, during, and after surgery. The patient had uneventful follow-ups at post-op day one and five. At 4 weeks, patient presented with mild swelling below the chin not extending past the

hyoid bone. She denied fevers or chills and was maintaining her own airway without any distress. Upon physical examination, there was firm but fluctuant edema with urticaria and erythema along the submental region without tenderness to palpation. Lymphadenopathy was also present. No other signs of urticaria, edema, and erythema noted elsewhere on the face or torso. Submental aspirate collections revealed 1.5mL of pink, clear fluid, which flattened the submental region. Aspirate was sent for cultures, and the patient was prescribed antibiotics and a steroid dose-pack. At 6 weeks, surgical exploration was performed via submental incision and midline platysma-plication sutures were removed. Initial thought was that the patient experienced an allergic reaction to the silk suture. Surgical exploration was uneventful which noted no obvious granulation formations, except for thin, serous fluid. A biopsy was performed and submitted for pathology. Cultures and gram stain were negative, and the patient appeared to respond well to the steroid dose-pack. Pathology reported chronic inflammatory infiltrates. Over the next 6 months, erythema and swelling were evident but gradually subsided while surgical incisions healed well. Patient's symptoms eventually resolved completely without any further events. Type-I reactions to aprotinin are well documented in the literature. It is important to note that reactions related to aprotinin use involved mostly intravascular administration and a previous history of exposure.3 Other case reports describe anaphylactic reactions to fibrin sealants after topical application.4 On this patient, fibrin sealant was applied topically, but the symptoms clinically resembled a delayed hypersensitivity reaction. This is the first recorded incident of a type-IV hypersensitivity to fibrin sealant use in facelift surgery.

FibrocapsTM, a novel fibrin sealant, for bleeding during hepatic resection: Results of a phase 2, randomized, controlled study.

Authors: Porte R.J., Verhoef C., De Wilt J.H.W., Rijken A.M., Klaase J.M., Ayez N., Van Rij M., Frohna P.A.

Publication Date: 2012

Abstract:

Introduction: Fibrin sealants mimic the final stage of the clotting cascade and are used when control of bleeding by surgical technique is difficult. Diffuse bleeding of the hepatic resection surface can be a problem due to the vascularity of the liver, for which fibrin sealants have been used. FibrocapsTM (ProFibrix, Leiden, The Netherlands) is a ready-to-use, premixed powder blend of human plasma-derived fibrinogen and thrombin. We conducted a study of the efficacy and safety of Fibrocaps in liver surgery. Methods: Study FC-002 NL was a Phase 2, randomized, single-blind, controlled, comparative efficacy and safety study of Fibrocaps in subjects with diffuse bleeding during hepatic resection at 5 centers in The Netherlands. 56 subjects were randomized (2 : 1) during surgery to Fibrocaps (n = 39) or gelatin sponge (n = 17). Treatment was followed by a 10-min observation period where hemostasis was evaluated every minute, with failure defined as lack of hemostasis by 10 min. The primary efficacy endpoint was the mean time to hemostasis (TTH), and the secondary was the incidence of hemostasis at 10, 5 and 3 min. Overall safety was determined by treatment-emergent adverse events, clinical labs and antithrombin antibodies monitored for 4 weeks after treatment. Results: Subject demographics were similar across both treatment groups (64% male, mean age of 61 yrs). The mean +/- SD dose of Fibrocaps was 1.4 +/- 0.5 g used for a mean +/- SD bleeding surface area of 58 +/- 29 cm². There was a statistically significant reduction on the intent-to-treat analysis of the mean TTH of Fibrocaps 2.2 +/- 1.2 min vs. gelatin sponge 4.4 +/- 3.1 (p = 0.004). There were no treatment failures in the Fibrocaps arm and 3

in the control arm (p = 0.025). The incidence of hemostasis at 5 min was also statistically significant for Fibrocaps (p = 0.022). The safety was comparable across both treatments, with most AEs gastrointestinal, and classified mild or moderate and unrelated to treatment. No neutralizing anti-thrombin antibodies were detected. Conclusion: These efficacy results with Fibrocaps in liver surgery demonstrate a significant reduction in mean bleeding time across patients and in the incidence of treatment failure. The safety profile of Fibrocaps in this study was very good and consistent with events expected in subjects with multiple diseases undergoing major hepatic resection under general anesthesia. The observed benefit: risk profile strongly supports the conduct of a Phase 3 study in surgical hemostasis.

A prospective, multi-center, randomized, single-blind study to compare the VerisetTM hemostatic patch to fibrin sealant (Tachosil) in subjects undergoing hepatic surgery.

Authors: Troisi R.I., Bektas H., Pratschke J., Topal B., Buchler M., Schuhmacher C.P., Buchler P.

Publication Date: 2012

Abstract:

Introduction: Blood loss during hepatic surgery can be associated with unfavorable outcomes: prolonged hospitalization, increased morbidity and patient mortality. Currently, the available options to treat bleeding do not fully address the medical need. The VerisetTM Hemostatic Patch is a novel topical hemostat comprised of an absorbable backing with hydrogel components. VerisetTM is designed to achieve hemostasis quickly, adhere to tissues without fixation and be absorbed over time by the body. Methods: This study was a prospective randomized, EU multi-center, single-blind study, performed to compare the VerisetTM Hemostatic Patch (Investigational Device) to TachoSil (Control) for the management of diffuse bleeding after hepatic surgery. A total of 50 subjects at 6 centers were included in the study. Subjects underwent hepatic surgery according to the standard practices of each institution and randomized to either VerisetTM (G1) or TachoSil (G2), following confirmation of diffuse bleeding from the hepatic resection surface requiring the use of a topical hemostat. Post application of either device, time to hemostasis was assessed at preset intervals until hemostasis was achieved. Subjects were followed for 30 days post procedure. Results: Both groups were similar in comorbidities, use of the Pringle maneuver, type of resection and cutting techniques. The median time to hemostasis (mTTH) for G1 was 1.0 minute compared to 3.0 minutes for G2 ($p = 0.0001$). This result was independent of both the severity of bleed (minor vs. moderate) and area of the bleeding surface (<100 cm2 vs. >=100 cm2). In patients with moderate blood loss the mTTH for G1 was 1.0 minute compared to 3.0 minutes for G2 ($p = 0.0002$). For subjects with a

large bleeding area (>=100 cm2), the mTTH for G1 was 0.50 minutes compared to 3.75 minutes for G2 ($p = 0.007$). VerisetTM and TachoSil had similar safety profiles and no statistical differences were observed for adverse and device related events. Conclusion: Overall time to hemostasis was shorter with VerisetTM compared to TachoSil. This result was statistically significant and was independent of bleeding severity or bleeding surface area. Safety data generated in this study was similar between the two products. There were no statistical differences in the adverse event profile or other safety assessments at the 30-day follow-up visit. Overall, surgeons perceived VerisetTM to be easy to use, easy to apply and conformed to tissue.

Effects of fibrin pad hemostat on the wound healing process in vivo and in vitro.

Authors: Harmon A.M., Kong W., Buensuceso C.S., Gorman A.J., Muench T.R.

Publication Date: 2011

Abstract:

Fibrin Pad is a hemostatic pad designed to control surgical-related bleeding. It consists of a fully absorbable composite matrix scaffold coated with human-derived active biologics that immediately form a fibrin clot upon contact with targeted bleeding surfaces. Studies were conducted to investigate the effect of Fibrin Pad and its biologics-free composite matrix component (Matrix) on the wound healing process in in vitro and in vivo models. Fibrin Pad was evaluated in solid organ, soft tissue defects, and subcutaneous tissues. Immunocompromised rodents were used to avoid xeno-mediated responses. Extracts created from both materials were evaluated for biological activity using in vitro cell culture assays. Neither Fibrin Pad nor Matrix alone showed any inhibition of the wound healing of treated defect sites. An apparent accelerated healing was noted in the soft tissue and subcutaneous tissue defects with Fibrin Pad as compared to Matrix. Both materials showed desirable properties associated with tissue scaffolds. The in vitro study results show that Fibrin Pad extract can induce dose-dependent increases in fibroblast proliferation and migration. These studies confirm that the biologic components of Fibrin Pad can enhance wound healing processes in in vitro assays and fully support wound healing at the site of in vivo application.

Fibrin glue coating of the surgical surfaces may facilitate formation of a successful bleb in trabeculectomy surgery.

Authors: Sakarya Y., Sakarya R., Kara S., Soylu T.

Publication Date: 2011

Abstract:

Trabeculectomy is commonly conducted when medical therapy fails to control intraocular pressure (IOP). The success of trabeculectomy for the treatment of glaucoma depends on the wound-healing response at the subconjunctival filtering bleb site. Postoperative scar formation is a serious problem in this surgery. Current strategies to counteract scarring include local antimetabolite treatment, which is associated with severe side effects, limiting its application. Therefore, additional means to safely modulate wound healing are desirable. In ophthalmic surgery, fibrin glue is used mainly for sealing and hemostatics purpose. Fibrin glue coating of tenon face of conjunctiva, scleral surface, reverse face of scleral flap and scleral bed with insoluble fibrin glue can halt both ooze bleeding and vascular leakage. By retarding the first step of wound healing, less postoperative inflammation may occur. Additionally aqueous humor flows through a fibrin glue coated interface. Therefore, we hypothesize that fibrin glue coating of the surgical surfaces in trabeculectomy surgery may yield less subconjunctival fibrosis and more successful bleb. To the best of our knowledge, no basic research has yet been performed regarding fibrin glue coating for halting the vascular leakage and easing the aqueous drainage into subconjunctival space in glaucoma surgery.

A comparative biomechanical evaluation of hernia mesh fixation by fibrin sealant.

Authors: Fortelny R.H., Petter-Puchner A.H., Ferguson J., Gruber-Blum S., Brand J., Mika K., Redl H.

Publication Date: 2011

Abstract:

Background: The atraumatic fixation of meshes by fibrin sealant (FS) has been established for both open and laparoscopic techniques of hernia repair. This study was performed to evaluate the use of FS in hernia mesh fixation with different polymerization speed (thrombin concentrations), using commercial hernia meshes, and in two techniques, transabdominal preperitoneal mesh placement (TAPP) and intraperitoneal mesh placement (IPOM). Materials and Methods: A median laparotomy was performed in a pig model and hernia meshes were placed in IPOM and TAPP techniques. After mesh fixation with FS using thrombin concentrations of 4 and 500 IU/mL, maximum shear force before failure was measured at 5, 60, and 120 min. Results: At both thrombin concentrations and in all meshes in which the technique was used, the TAPP method tended to show higher maximum force levels at failure than did the IPOM method. In both TAPP and IPOM techniques and in all meshes, the 4 IU/mL thrombin concentration FS was superior to the 500 IU/mL thrombin concentration sealant. Conclusions: Although both thrombin concentrations are suitable for mesh fixation, lower concentrations allow slower polymerization and better sealant diffusion leading to higher maximum force levels at failure. The TAPP method was biomechanically superior to the IPOM method. There were no major differences between mesh products.

ADverse effects of fibrin sealants in thoracic surgery. The safety of a new fibrin sealant: Multicentre, controlled, prospective, parallel group randomised clinical trial.

Authors: Cardillo G., Lococo A., De Massimi A.R., D'Agostino A., Carleo F., Larocca V., Santini P.F., Gonfiotti A.

Publication Date: 2011

Abstract:

Objectives: The safety of fibrin sealants has been questioned in the light of recent reports of adverse effects, mainly thromboembolic events and fatal anaphylaxis. We evaluated the safety of a new fibrin sealant (FS) in a randomised controlled trial (RCT). Methods: Multicentre, prospective, open-label phase II/III RCT to evaluate the safety of FS. The trial was approved by the Ethic Committee. FS includes two components (component 1: fibrinogen; component 2: thrombin), each of them subjected to two viral inactivation procedures. Out of 200 screened patients, 185 eligible patients (49 females, 136 males), aged between 18 and 75 years, undergoing major thoracic surgery were randomised to receive FS (# 91 patients) as an adjuvant for air leak control or no treatment (#94 patients). Safety variables were: percentage of subjects with adverse events associated with the therapy; formation of antibodies against bovine aprotinin; vital signs (blood pressure, body temperature, heart and respiratory rate); laboratory parameters (haematology and blood chemistry). Results: None of the adverse events was considered as treatment-related. Atrial fibrillation (five patients in the FS group and four in the control group) and hyperpyrexia (five and seven patients, respectively in the two groups) were the most common adverse events. No patient reported thromboembolic events (pulmonary embolism or deep vein thrombosis) during the inhospital stay or within one month from discharge. The formation of bovine aprotinin antibodies was reported in a total of 34 patients (37.4%) in the FS group and was not related to any adverse effect.

Conclusions: The present RCT did not show any increased risk of serious and non-serious adverse events, and of surgical complications, related to the use of FS. The proportion of treated patients that developed bovine aprotinin antibodies was in compliance with literature data.

Readmission rates and costs associated with fibrin sealant use among patients undergoing orthopedic surgery.

Authors: Ye X., Shah M., Rupnow M.F., Hammond J.

Publication Date: 2011

Abstract:

OBJECTIVES: Payers and hospital administrators are increasingly concerned about readmission rates in surgical patients. We sought to examine the readmission rates and hospital costs associated with EVICEL fibrin sealant (all-human formulation), versus VITAGEL fibrin sealant (with bovine thrombin), or no adjunct hemostat use for patients undergoing inpatient joint replacement surgeries. METHODS: A retrospective analysis was conducted using Premier administrative data from over 500 US hospitals. Hospitalized patients (=18 years) who underwent orthopedic surgery and received EVICEL, VITAGEL or no hemostat during surgery between January 1, 2009 and November 30, 2009 were identified. A 1:1 (EVICEL:VITAGEL) and 1:3 (EVICEL: no hemostat) match was conducted using surgery type and propensity scores of receiving EVICEL, based on patient and hospital characteristics via a logistic regression model. The outcomes included 30-day all-cause readmission rates and total index hospital costs. Differences in readmission rates were analyzed using conditional logistic regression. A generalized linear model with loglink/ gamma distribution was used for analyzing differences in total costs. RESULTS: A total of 316 patients were identified (158 per cohort) for the EVICEL versus VITAGEL and 1,808 patients for EVICEL (n=452) versus no hemostat (n=1,356) analysis. Patients in the VITAGEL cohort were 6.8 times more likely to be readmitted to the hospital compared to the EVICEL cohort (12.7% vs 3.8%; OR=6.81, 95%CI 1.62, 28.66). Patients in the no hemostat cohort were 1.6 times more likely to be readmitted compared to the EVICEL cohort. Total index hospital cost was lower for the EVICEL cohort ($16,704) compared to VITAGEL cohort ($18,192 p=0.001) on average. The EVICEL cohort

($17,387) had similar total costs compared to no adjunct hemostat ($17,389) cohort. CONCLUSIONS: Readmission presents significant costs and has been added to hospital quality measures. In this study, EVICEL was associated with lower readmission rates compared to VITAGEL or no adjunct hemostat use in inpatient joint replacement surgeries.

Tension-free primary closure with autologous platelet gel versus vivostatTM for the definitive treatment of chronic sacrococcygeal pilonidal disease.

Authors: Gipponi M., Reboa G., Testa T., Giannini G., Strada P.

Publication Date: 2010

Abstract:

Objective: A randomized clinical trial was performed in patients with chronic or recurrent pilonidal sinus (PS) comparing primary closure coupled with random application of in house autologous platelet gel or produced by means of VivostatTM in order to assess whether a standardized product had an impact on the wound healing process. Patients and Methods: Between June 2006 and June 2009, 100 patients (82 males, 18 females: median age 30 years; range, 16-51 years) underwent wide excision of the pilonidal area with midline tension-free closure and were randomly given either the in house autologous platelet gel (Group 1) or the VivostatTM gel (Group 2). Results: Group 2 patients had shorter wound healing time (8 vs. 10 days; $p<0.0001$), time to return to full activity (11 vs. 16 days: $p<0.0001$), less uncomplicated fluid collections (120 vs. 190 ml: $p<0.0001$), and fewer postoperative wound complications (1/50=2% vs. 5/50=10%, $p<0.001$). After a median follow-up of 21 months (range: 4-40 months), two recurrences were detected in Group 1. Conclusion: The standardized production of platelet gel by means of the VivostatTM system guarantees the reproducibility of the procedure and its use was correlated with an improved outcome, with a high degree of patient satisfaction and better cosmetic results.

A comparison of a bovine albumin/glutaraldehyde glue versus fibrin sealant for hernia mesh fixation in experimental onlay and IPOM repair in rats.

Authors: Gruber-Blum S., Petter-Puchner A.H., Mika K., Brand J., Redl H., Ohlinger W., Benesch T., Fortelny R.H.

Publication Date: 2010

Abstract:

Background: Research in hernia repair has targeted new atraumatic mesh fixation to reduce major complications such as chronic pain and adhesion formation. The efficacy and safety of two surgical adhesives, viz. Artiss (FS, fibrin sealant containing 4 IU thrombin) and Bioglue (AGG, bovine serum albumin/glutaraldehyde glue), were evaluated in this study. Primary study endpoints were tissue integration, dislocation, and adhesion formation. Foreign-body reaction formed the secondary study endpoint. Methods: Twenty-four polypropylene meshes (VM, Vitamesh) were randomized to four groups (n = 6): two groups of onlay hernia repair (two meshes per animal) with mesh fixation by FS (O-FS) or by AGG (O-AGG), and two groups of IPOM repair (one mesh per animal) with mesh fixation by four sutures and FS (I-FS) or AGG (I-AGG). Eighteen rats underwent surgery. Follow-up was 30 days. Tissue integration, dislocation, seroma formation, inflammation, adhesion formation, and foreign-body reaction were assessed. Results: Meshes fixed with FS (O-FS, I-FS) showed good tissue integration. No dislocation, seroma formation, or macroscopic signs of inflammation were detectable. Adhesion formation of I-FS was significantly milder compared with I-AGG (P = 0.024). A moderate foreign-body reaction without active inflammation was seen histologically in O-FS and I-FS groups. Samples fixed with AGG (O-AGG, I-AGG) showed extensive scar formation. No dislocation and no seroma formation were observed. All of these samples showed moderate to severe signs of inflammation with abscess

formation in the six meshes of O-AGG. Histology underlined these findings. Conclusions: The fibrin sealant adhesive showed very good overall results of the primary and secondary outcome parameters. FS is a recommendable atraumatic fixation tool for the surgical onlay technique. AGG provides high adhesive strength, but shows low biocompatibility. Persisting active inflammation was seen in both the O-AGG and I-AGG groups, not favoring its use for these indications.

Sutureless amniotic membrane fixation with fibrin glue in symptomatic bullous keratopathy with poor visual potential.

Authors: Sakarya Y., Sakarya R., Yildirim A.

Publication Date: 2010

Abstract:

Not Available

Local delivery of antibiotics incorporated in fibrin glue; better feasiblity of combination with ABPC/SBT rather than CEZ.

Authors: Motomura N., Saito A., Nawata K., Hisagi M., Ono M.

Publication Date: 2010

Abstract:

Objective: Local delivery of antibiotics has strong potential to reduce the risk of disaster in surgery for prosthetic valve or graft infection. A fibrin glue is a good material to deliver antibiotics in a local setting if used properly. But some antibiotics do not dissolve within the fibrin glue and others would inactivate hemostatic performance. We examined feasibility of antibiotics for a local delivery system with fibrin glue, especially in the target of broad spectrum antibiotics. Methods: Two kinds of antibiotics (ABPC/SBT, CEZ) were incorporated into liquid-A (fibrinogen component) or liquid-B (thrombin component) of a fibrin glue (5 ml, CSL Behring). Solubility, clotting time, tensile strength, thrombin activity were measured. For anti-bacterial performance, size of disk diffusion inhibition zone (the larger, the more effective of antibiotics) using Bacillus subtilis ATCC6633 was compared with control (no glue). Results: While both antibiotics did not dissolve into liquid-A, both antibiotics dissolved into liquid-B within 1 min. Clotting time of liquid-B in ABPC/SBT and CEZ was within 50 s. Tensile strength of ABPC/SBT and CEZ increased by 127% and 160% compared with control, respectively. Thrombin activity in ABPC/SBT and CEZ decreased to 54% and 82%. Size of inhibition zone showed that effectiveness of ABPC/SBT reduced to 76% and that of CEZ disappeared. Conclusions: As a local delivery system using fibrin glue, antibiotics should be dissolved into liquid-B (thrombin component) and not liquid-A (fibrinogen component). To cover broad spectrum antibiotics, ABPC/SBT was preferred to CEZ when locally delivered using the fibrin glue.

The differences in combining fibrin glue with various hemostasis agents for laparoscopic partial nephrectomies.

Authors: Ishii K., Hayama T., Sugimoto T., Kawashima H.

Publication Date: 2010

Abstract:

Introduction: It is being reported now that more doctors are, in laparoscopic partial nephrectomies, doing surgeries to remove larger tumors using a combination of fibrin glue and one of the various hemostasis agents available. Purpose: This experiment was performed to document which combination of fibrin glue and one of three commonly used agents is most effective in hemostasis. Materials and Methods: 14 female rabbits were divided into 4 groups. Group1 (N=6) used only fibrin glue. Collagen material was added in Group 2 (N=8), gelatin material in Group 3 (N=8) and oxidized cellulose in Group 4 (N=6). After transecting the kidney and confirming bleeding, we clamped renal vessels. We put fibrin glue on the area and in Groups 2-4, we also pressed there for (Table presented) 1 minute with agents. After removing clamping, we observed for 3 minutes. If there was bleeding, we repeated procedure. We determined which method was most effective from the number of procedures needed. After fixing removed kidney, we made several thin sections and observed them microscopically. Results: The number of repetitions needed was significantly lower in Group 2 than Groups 1 and 4. Histologically, in Group 2, fibrin glue spread most uniformly into the area between the tissue and agent and also into agent fibers. In Group 4, little fibrin glue remained between tissue and the agent. Conclusions: Collagen materials are significantly more effective than oxidized cellulose. We suggest this is due to mild acid in oxidized cellulose reducing activity of thrombin. In laparoscopic partial nephrectomies, we should avoid using oxidized cellulose with fibrin glue.

A novel technique combining single-donor platelet gel and fibrin glue with skin graft to heal recalcitrant lower extremity ulcers.

Authors: Burnouf T., Chen T.M., Tsai J.-C.

Publication Date: 2010

Abstract:

Background: There is no ideal procedure for the treatment of chronic skin ulcers. Recently, the use of platelet gel (PG) in this indication has generated great interest. Aim: Evaluate the safety and efficacy of a new procedure combining allogeneic single-donor (S-D) PG and S-D fibrin glue (FG) to enhance skin graft take for treating recalcitrant ulcers. Methods: This study was approved by the Institutional Review Board of Tri-Service General Hospital, National Defense Medical Center, Taipei, Taiwan. Protocol 096-05-042. The protocol conformed to ethical guidelines of the 1975 Declaration of Helsinki. 15 patients (17 ulcers) who provided their informed consent and presenting various etiology were enrolled. Skin ulcer was debrided and the wound covered with moist saline dressing. 3-14 days later, the wound bed was sprayed with PG that was obtained by activating S-D platelet concentrate by S-D thrombin (obtained by activation of S-D plasma by calcium chloride). Thin-split-thickness skin graft with multiple slits was then put on the wound bed, and finally S-D FG was sprayed on the skin graft. Short leg P-P splint was used to immobilize the skin graft. Results: Most skin grafts took well. The interval between skin graft and complete wound healing ranged from 3 weeks to 2 months. No recurrence of ulcers was noted during the 3-18 months follow-up period. No adverse reactions were observed. Conclusion: The procedure provides dual advantages in skin grafting for recalcitrant ulcers because PG functions as a delivery system of powerful mitogenic and chemostatic growth factors, and FG as a hemostatic tissue sealant that avoids the use of staple or sutures.

Fibrin sealant combined with fibroblasts and platelet-derived growth factor enhance wound healing in excisional wounds.

Authors: Mogford J.E., Tawil B., Jia S., Mustoe T.A.

Publication Date: 2009

Abstract:

We test the hypothesis that the fibrinogen-thrombin formulation of fibrin sealant combined with fibroblasts and PDGF-BB enhance cutaneous wound healing. Four formulations varying in fibrinogen and thrombin concentration were applied to full-thickness biopsy wounds in the rabbit ear cutaneous wound healing model with or without cultured rabbit dermal fibroblasts (RDFs; 3 x 10 ⁵ cells/wound) embedded in the fibrinogen component. At post-wounding day 7, there was no difference in the diluted vs. non-diluted formulations for either the promotion of granulation tissue coverage of the open wounds or total granulation tissue area when tested without embedded cells. Including the RDFs, the highest degree of wound coverage by granulation tissue was observed in the combined dilution formulation (17.3 mg/mL fibrinogen, 167 U/mL thrombin; n=10 wounds) that was 167% ($p<0.05$) of the nondiluted FS containing cells (50 mg/mL fibrinogen, 250 U/mL thrombin; n=10 wounds). Inclusion of fibroblasts increased granulation tissue area within the wounds vs. FS alone ($p<0.05$) for each diluted formulation although no differences in this parameter were observed within each group (FS alone or with embedded cells). However, addition of the vulnerary growth factor PDGF-BB (3 mg; n=4) with the embedded RDFs in the combined dilution formulation increased granulation tissue area over two-fold ($p<0.01$) over FS alone. Additionally, the presence of the RDFs promoted incorporation of the granulation tissue with and epithelial migration over the FS suggesting an active interaction between cells delivered to the wound by FS and the host repair cells. The findings suggest the progress of cutaneous defect repair can be enhanced by ex vivo cell delivery in fibrin sealant.

The use of fibrin glue in plastic surgery.

Authors: Mooney E., Loh C., Pu L.L.Q.

Publication Date: 2009

Abstract:

Fibrin glue has been used as an adjunct to hemostasis for many years. This article provides an overview of fibrin glue, including its composition, mechanism of action, availability, safety, efficacy, and potential applications in plastic surgery.

Applications of platelet-rich fibrin matrix in facial plastic surgery.

Authors: Sclafani A.P.

Publication Date: 2009

Abstract:

Platelet concentrates enjoyed some clinical popularity in facial plastic surgery several years ago. However, interest waned due to expense, amount of blood required, equipment, space, and staff needed, and lack of clinically significant benefit. A novel, simple method of preparing an autologous platelet derivative (Selphyl; Aesthetic Factors, Princeton, NJ) allows rapid and inexpensive generation of a platelet-rich fibrin matrix (PRFM) that can be used to enhance healing after facial procedures as well as to rejuvenate the face without tissue manipulation. PRFM provides autologous, natural, but concentrated platelet growth factor release and stimulation of surrounding tissue. This article describes its use for cosmetic facial applications.

Fibrin glue-assisted augmented amniotic membrane transplantation for the treatment of large noninfectious corneal perforations.

Authors: Kim H.K., Park H.S.

Publication Date: 2009

Abstract:

PURPOSE: To evaluate and report the efficacy of fibrin glue (FG)-assisted augmented amniotic membrane transplantation (AMT) in patients with large corneal perforations. METHODS: In a retrospective case series, 10 patients with corneal perforations more than 2 mm in diameter were treated with "FG-assisted augmented AMT." A 5- or 7-ply "augmented amniotic membrane" (AM) was constructed by applying FG to each sheet of AM to repair the corneal perforation. The augmented AM was designed 0.5 mm larger than the diameter of the perforation. The augmented AM was transplanted onto the perforation site with 10-0 nylon suture. If needed, additional overlay AM was sutured on top. RESULTS: The mean ulceration diameter was 2.7 +/- 0.95 mm (range, 2-5 mm). All patients retained their own globes after the procedure and had well-formed deep anterior chambers, and 90% of patients showed complete epithelialization over the AM. The mean reepithelialization time was 14.9 +/- 4.9 days (range, 10-24 days). No eyes showed evidence of infection or recurrent corneal melting during the follow-up period. CONCLUSIONS: FG-assisted augmented AMT was easily performed for repairing large corneal perforations. This surgical method was very helpful in stabilizing the wound in the early postoperative period.

Transplantation of muscle-derived stem cell plus fibrin glue restores urethral function in a pudendal nerve-transected rat model.

Authors: Xu Y., Song Y.

Publication Date: 2009

Abstract:

Hypothesis / aims of study: Most muscle-derived cell(MDC) regenerative approaches can restore injured urethral rhabdosphincter. In this study, we investigated if fibrin glue(FG) could improve muscle-derived stem cells(MDSCs) restore urethral function in a pudendal nervetransected rat model. Study design, materials and methods: The pudendal nerve-transected adult female SPF Wistar rats were used to make stress urinary incontinence models. The gastrocnemius muscles of normal three-week-old female SPF Wistar rats were used for the purification of the muscle-derived stem cells. The animals were randomized into five recipient groups: normal (N),denervated (D), denervated+Fibrin Glueinjected rats(F), denervated +MDSCs-injected rats(M),.and denervated +MDSCs+FibrinGlue-injected rats(FM). Each group (n = 10) was also split into two subgroups according to the time; 1 week (n = 5) and 4 weeks (n = 5). In the F, M, FM groups injection of FG and/ or MDSCs was made into the proximal urethra two weeks after pudendal nerve transection. One and four weeks after transplantation , leak point pressure (LPP) and closing pressure(CP) were used to assess urethral rhabdosphincter function. PGC-FU-GFP-Lentivirus was performed to infect MDSCs to track the implantation and immunohistochemical staining was used to detect the neovasculature formation at four week after transplantation. Results: Both LPP and CP were lower in D group at each time compared with those of N, F, M and FM groups ($P<0.05$).Both LPP and CP in the F group were slightly higher than those of D group after one week ($P<0.05$) but no difference between the two groups after four weeks($P>0.05$). Both LPP and CP in FM as well as M groups were slightly higher than those of D group at one week($P<0.05$) and significantly at four

weeks(P<0.001) but no difference compared with those of N group at each time (P>0.05). Both LPP and CP in FM group were slightly higher than M group but no difference between the two groups at each time (P>0.05).After four weeks,pathological examination indicated that transplanted MDSCs in FM group survived better than those in M group and neovasculature density increased significantly in FM group and slightly in F and M group. Interpretation of results: In this study,it was seen that LPP and CP in the F group increased slightly at one week but decreased at 4 weeks. The reduction in volume of Fibrin glue(FG) which actioned as a bulking agent induced the declining tendency of LPP and CP. It was found that both the LPP and CP in FM as well as M groups were shown increasing tendency with the time and even equalled to those of N group. Both the LPP and CP in the D group decreased significantly with time. It was also seen that there were more survival transplanted MDSCs and higher neovasculature density in injected area in FM group as compared to those in M group. To explain the results, FG, a composite of fibrinogen and thrombin, is a potentially suitable biological vehicle for cell transplantation because it has proven biocompatibility, biodegradability and binding capacity to cells. Fibrin-stabilizing factor XIII contained in fibrin glue favors migration of undifferentiated stem cells on the highly cross-linked structure of the glue, and it enhances the proliferation of these cells¹. This keeps the cells in place, increases cell survival, and improves the immediate mechanical properties of the implant. The fibrin extracellular matrix remains in situ while the cells proliferate and differentiate into new tissue, before the scaffold is completely resorbed. Most important of all, the fibrin glue promotes angiogenesis via chemotactic and mitogenic stimuli that promote cell migration, proliferation and matrix synthesis^{2, 3}. Concluding message: Fibrin glue can improve transplanted muscle-derived stem cell survival in the injected area , induce neovasculature formation and improve urethral rhabdosphincter function greatly in SUI rat models.

Fibrin adhesive derived from snake venom in periodontal surgery. Histological analysis.

Authors: Barbosa M.D.S., Stipp A.C., Passanezi E., Greghi S.L.A.

Publication Date: 2008

Abstract:

Background: A new fibrin adhesive made of buffalo plasma-derived fibrinogen and a thrombin-like snake venom enzyme, has been successfully used to immobilize free gingival grafts. This case series histologically compared sutured grafts (control group) with others immobilized by using the fibrin adhesive (experimental group). Case Description: The grafts were placed in the contralateral mandibular bicuspids of 15 patients, so that each subject received one treatment of each type. Five biopsies of each group were collected at 7, 14 and 45 days of healing, which were histologically and morphometrically analyzed as regards the relative volume density of the different connective tissue components. Results: The sites in the control group presented a higher inflammatory cell density at 7 days and a tendency towards a lower collagen density. In the experimental group, the grafts had an appearance of more advanced healing. Tissue maturity characteristics progressed until 14 and 45 days, but no difference between groups could be noted at these times. Conclusions: Within the limits of the present study, it may be suggested that the alternative fibrin adhesive tested could represent an alternative to sutures in gingival grafts procedures.

Clinical application of topical sealants in liver surgery: Does it work?.

Authors: Berrevoet F., De Hemptinne B.

Publication Date: 2007

Abstract:

Hepatic resections are considered as a standard intervention in abdominal surgery. However there is still a remarkable complication rate. Despite all recent developments in surgical techniques during liver surgery, blood loss is still one of the main causes for postoperative morbidity and mortality. In addition to patient-dependent factors, aspects of the surgical technique play a major role, in particular with regard to the occurrence of peri-operative bleeding, fluid accumulation and bile leakage. Nowadays, the use of topical sealants is often recommended as an additional tool to decrease postoperative bleeding and bile fistula. Fibrin sealants are able not only to enhance clot formation and wound healing, but possibly work as a sealing device for the small biliary branches. In this overview we will try to evaluate the efficacy in terms of time to complete haemostasis, the need for blood transfusions and the incidence of bile leakage according to recent trials. Furthermore the clinical benefit for the liver surgery patient will be discussed.

In vitro experiment of aprotinin/tranexamic acid improved injectable fibrin glue. [Chinese]

Authors: Wang J.-X., Zhu L.-X., Jin A.-M., Zhang S.-H., Huang R., Lan X.-Y.

Publication Date: 2008

Abstract:

Background: Injectable fibrin glue brings a new direction for the clinical application of cartilage-defect tissue-engineered complete repair and regeneration, the key issue of which is-regulation of the degradation speed. Objective: To observe the influence of concentration on the degradation rate of the fibrin glue scaffold by adding different concentration of the aprotinin and tranexamic acid into the injectable fibrin glue. Design, time and setting: The in vitro cytology experiment was performed at the Laboratory of Tissue Construction and Detection of Guangdong Province from February to August 2008. Materials: Fibrin glue was prepared with fibrinogen, thrombin and calcium chloride. Methods: The chondrocytes from articular cartilage of 3-weeks-old New Zealand rabbit were isolated and monolayer cultured in vitro, then the cultured chondrocytes were seeded onto the standard fibrin glue scaffold and improved fibrin glue scaffold (adding with aprotinin 7 500, 12 500, 17 500 MIU/L and tranexamic acid 15, 20, 25 g/L compound liquid) and were cultured and amplified in vitro for 6 weeks. Main outcome measures: The degradation of scaffold. Results: At 3 weeks of in vitro culture, the standard group had completely disintegrated, and the volume of each improved group was 1/2 of its original volume. After 6 weeks of culture, the scaffold remained a certain shape with thickness and elasticity. The degrading speed of the fibrin glue was greatly alleviated by adding aprotinin and the tranexamic acid with various concentrations. No significant effect could be found on multiplication of chondrocyte, maintaining of surface type and cytoplasm secretion when the concentration was lower than 12 500 MIU/ L aprotinin and (or) 20 g/L tranexamic acid, however, the higher concentration of aprotinin and (or) tranexamic acid would

greatly inhibit multiplication of cbondrocyte, maintaining of surface type and cytoplasm secretion. Conclusion: The degradation rate of the fibrin glue scaffold can be controlled by regulate the content of aprotinin and tranexamic acid in the fibrin glue.

High-Pressure Fibrin Sealant Foam: An Effective Hemostatic Agent for Treating Severe Parenchymal Hemorrhage.

Authors: Kheirabadi B.S., Sieber J., Bukhari T., Rudnicka K., Murcin L.A., Tuthill D.

Publication Date: 2008

Abstract:

Background: The majority of early trauma deaths are related to uncontrolled, noncompressible, parenchymal hemorrhage from truncal injuries. The purpose of this study was to formulate a fibrin sealant foam (FSF) able to control severe parenchymal bleeding without compression or vascular control. Materials and methods: FSF with high fibrinogen concentration (20 mg/mL) and low thrombin activity (5 U/mL) was prepared and pressurized by addition of liquid gas propellant. The efficacy of this foam was tested against a severe parenchymal hemorrhage, created by partial resection of liver lobes in anticoagulated rabbits (n = 7) and compared to untreated injury (n = 8) and placebo treatment (n = 7). The hemostatic efficacy of pressurized FSF (n = 8) was also compared to a commercially available liquid fibrin sealant (n = 8) and a developing dry powdered fibrin sealant product (n = 8) in the same model. Results: The liver injury resulted in 122 +/- 11.5 mL blood loss and death of 75% of untreated rabbits (3.2-3.4 kg) within 1 h. Treatment with placebo foam had no effect on blood loss or mortality rate. Pressurized FSF significantly reduced bleeding, resulting in 56% ($P < 0.05$) and 66% ($P < 0.01$) reduction in blood loss as compared to untreated or placebo-treated animals, respectively, and 100% survival ($P = 0.008$). When pressurized FSF was compared with liquid and powdered forms of fibrin sealant, only foam significantly reduced blood loss (49%, $P < 0.05$) and mortality rate (54%, $P < 0.05$) of rabbits as compared to untreated control animals (n = 9). Conclusion: Biological nature, rapid preparation, coverage of large wound areas, and effective hemostatic properties make pressurized FSF an ideal candidate for treating nonoperable parenchymal injuries in damage control procedures.

The short-term efficacy of fibrin glue combined with absorptive sheet material in visceral pleural defect repair.

Authors: Gika M., Kawamura M., Izumi Y., Kobayashi K.

Publication Date: 2007

Abstract:

Tissue sealants can prevent the occurrence of pulmonary air leakage, although few studies have evaluated the seal-breaking pressure properties of the various methods. We developed a new method for repairing visceral pleural defects which combines fibrin glue with a sheet material. We used an animal model to compare its efficacy with that of three current techniques up to 24 h after application. Under thoracotomy, 5 x 20 mm visceral pleural defects with a depth of 3 mm were made in beagles. The defects in the normal lungs were repaired using 1 of 4 methods: Method A, fibrin-glue double layer (fibrinogen solution was dripped, followed by thrombin solution); Method B, pack method (fibrin glue combined with polyglycolic acid sheet); Method C, rubbing and spray (fibrinogen was rubbed, followed by spraying of both fibrinogen and thrombin solutions); Method D, fibrin-glue-coated collagen fleece. The defects were repaired also in an emphysematous lung model using Method A, B or C. In the normal lungs, Method B showed significantly higher pressure resistance compared with the other methods at 5 min, 1 and 3 h post-application. Pressure resistance increased with time for all methods. In the emphysematous lungs, Method B showed significantly higher seal-breaking pressure than Methods A and C. Compared with existing tissue sealant methods, the pack method reliably controlled pulmonary air leakage immediately after application.

Effect of fibrin adhesive application in microvascular anastomosis: Reply [12].

Authors: Cho A.B., Mattar Jr. R.

Publication Date: 2007

Abstract:

Not Available

Assessment of the thrombogenic effect of fibrin sealant dressing in a vascular surgery model in rabbits.

Authors: Kheirabadi B.S., Sieber J., Holcomb J.B.

Publication Date: 2006

Abstract:

This study's objective was to investigate the potential thrombogenic effects of thrombin-containing fibrin sealant dressings (FSD) in a vascular repair model. Oval-shaped pieces of the rabbit abdominal aorta and vena cava were excised, the injuries were repaired with FSD, and animals were allowed to recover. Thrombus formation was examined by (1) an infusion of indium-labeled platelets into the rabbits following FSD application and estimation of total number of platelets attached to the wounds at 2, 4, and 6 h later (short-term effect, n = 12); and by (2) morphological and histological examinations of the vessels and dressings on days 1, 3, and 7 after repair operation in another group of rabbits (long-term effect, n = 12). Application of FSD sealed the vascular injures and produced immediate hemostasis that was stable up to 1 week. The highest numbers of platelets (both native and labeled) adhered to the arterial and venous repair sites were 6.5 x 10⁶ and 4.4 x 10⁷, respectively, 6 h after operation. The adhered platelets, however, did not form a visible and clinically significant thrombus. In long-term experiments, no evidence of thrombus was found in the lumens of the repaired vessels or on the dressings, and no microthrombi were detected histologically in other tissues at any time point. Although vena caval injuries showed signs of healing at day 7 postoperatively, the aortic wounds expanded progressively (pseudoaneurysm) and were prone to rupture at later times. Thus, direct exposure of FSD does not cause intravascular thrombosis or thrombotic events in rabbits. The dressing appears to be safe and effective for short-term repair of vascular injuries. It may also allow healing of minor venous defects, but cannot replace conventional surgical techniques (suturing) for permanent repair of arterial

damages.

Using fibrin glue in endonasal surgery (multiple letters) [2].

Authors: Avisar R., Vaiman M., Sarfaty S., Shlamkovich N., Segal S., Eviatar E., Schiff E., Gavish D.

Publication Date: 2005

Abstract:

Not Available

Wound healing and degradation of the fibrin sealant Beriplast P following partial liver resection in rabbits.

Authors: Kroez M., Lang W., Dickneite G.

Publication Date: 2005

Abstract:

The objective of this study was to investigate the degradation kinetics of the fibrin sealant (FS) Beriplast P in an experimental liver surgery model in rabbits. A partial liver resection was performed in 21 rabbits, and the wound area covered with Beriplast P to ensure hemostasis. Wound healing of the resection sites was evaluated morphologically over 11 weeks. Degradation of the FS was evaluated by measuring the thickness of the remaining fibrin layer. Plasma samples were analyzed for antibodies against fibrinogen, albumin, thrombin, fibrin, and factor XIII. No postoperative hemorrhage was observed, indicating successful hemostasis throughout, The FS was degraded with a half-life of about 25 days postapplication and was completely replaced by granulation tissue within 9 weeks. The FS degradation and tissue development followed the general stages of wound healing: inflammation and resorption, proliferation, organization and production of collagen, maturation, and scarring. An immune reaction was elicited against the main four human proteins of the FS. The antibody titers peaked on day 14, with a gradual decrease thereafter. We conclude that the FS accomplished hemostasis, facilitated healing in accordance with natural processes, and was completely degraded over time. In humans, the reduced immunogenicity of the FS would potentially increase its degradation half-life.

The role of fibrin tissue adhesives in flap necrosis in rats.

Authors: Atalay C., Kockaya E.A., Cetin B., Akay M.T.

Publication Date: 2005

Abstract:

Flap necrosis is an important issue in surgery, and fibrin tissue adhesives, due to beneficial properties in preventing flap necrosis, were used in this study. Two groups, each comprising of 10 rats, were formed. Group I served as a control group, and fibrin tissue adhesive was applied to group II. The fibrinogen and thrombin concentrations in fibrin tissue adhesive were 30 mg/ml and 10 U/ml, respectively. The mean area of flap necrosis was 687.5 +/- 72.5 mm² and 78.5 +/- 11.0 mm² in the control and fibrin tissue adhesive groups ($p < .0001$), respectively. The percentage of flap necrosis was significantly lower in the fibrin tissue adhesive group compared to the control group (5.6% vs 49.1%) ($p < .0001$). Fibrin tissue adhesives decreased flap necrosis significantly compared to the control group.

Use of aerosolized fibrin glue fixation after liposuction of the arms [22].

Authors: Prado A., Castillo P.

Publication Date: 2005

Abstract:

Not Available

Possibilities and limitations of fibrin glue usage in nephron-sparing surgery: Experimental study.

Authors: Stojkovic I., Savic V., Djokic M., Balint B., Ljubenovic S., Ignjatovic I.

Publication Date: 2005

Abstract:

Introduction: The possibilities and limitations of fibrin glue (FG) usage in nephron-sparing surgery were studied. Materials and Methods: A prospective experimental study was carried out in 50 pigs: 30 with polar resection, and 20 with mediorenal wedge resection of the kidney. Hemostatic sutures, FG, and FG with a muscle 'cup' in animals with polar resection of the kidney were compared. FG and sutures in animals with the wedge resection of the kidney were studied as well. Bleeding, hot ischemia time, complication rate, and additional scarring were also analyzed. Results: Suture hemostasis is safe but with significant adverse effects in both polar and wedge resection of kidney. FG was not efficient as a sole hemostatic agent for polar resection. It was as efficient as hemostatic suture for wedge resection of the kidney. FG with a muscle 'cup' on a pole of the kidney achieved good results in animals with polar resection of the kidney. Histological analysis confirmed better results with FG because of both the less intense and smaller area of additional scarring. Conclusion: FG is a reliable and efficient hemostatic agent for nephron-sparing surgery whenever both sided gluing is possible.

Use of mesh fibrous dressing covered with fibrin glue (TachoComb) in hemostasis after vascular anastomoses in the groin.

Authors: Pupka A., Rucinski A., Pawlowski S., Barc P., Janczak D., Kaluza G., Szyber P.

Publication Date: 2004

Abstract:

We present in this paper application of haemostatic device TachoComb onto bleeding after vascular anastomosis of dacron vascular prosthesis (branch of aortobifemoral or bypass aortofemoral) with common femoral artery in the groin. Hemorrhagic complications have influence onto clinical status of operated patients. Haemostatic TachoComb dressing was applied at 30 cases and results were compared to control group consist of 25 cases, in which gas compresses were applied. Mean loss blood in group I with the usage of TachoComb was statistical characteristic ($p < 0.003$) smallest than in group II. Also mean time of hemostasis was shortest than in group II ($p < 0.01$). We proved that use of TachoComb limits bleeding from suture line connecting artery with vascular prosthesis.

Intraoperative hemostasis during kidney transplantation and the use collagen mesh dressing covered by fibrin glue (TachoComb).

Authors: Pupka A., Chudoba P., Barc P., Kaluza G., Rucinski A., Janczak D., Pawlowski S., Szyber P.

Publication Date: 2003

Abstract:

In this paper we present influence of use of haemostatic dressing TachoComb, onto bleeding from surface of transplanted kidney. Kidney transplantation (KTX) seems to be main method of treatment of terminal renal failure. Enlarging number of KTX results in growing frequency of intra and postoperative complications. Hemorrhagic complications can impact clinical status of recipient and graft function. Haemostatic dressing was applied at 29 cases. Control group in which only gas compresses were used consisted of 25 patients. It was proved, that use of dressing from collagen mesh covered by fibrin glue TachoComb, after kidney transplantation diminished parenchymal bleeding and time necessary to get complete hemostasis.

Autologous fibrin glue with growth factors in reconstructive maxillofacial surgery.

Authors: Thorn J.J., Sorensen H., Weis-Fogh U., Andersen M.

Publication Date: 2004

Abstract:

The aim of this paper was to describe a method for the preparation of autologous fibrin glue with platelet growth factors and to report its use with particulate cancellous bone in reconstructive maxillofacial surgery. The fibrin glue is a two-component glue, where the one component is a concentrated fibrinogen solution with platelet growth factors and the other component is a thrombin solution. Both components were produced from the patients own blood, thus making the glue entirely autologous. The glue was prepared from platelet rich plasma separated from 200 ml of the patient's blood prior to the operation. The fibrinogen in the glue was precipitated from the platelet rich plasma by ethanol precipitation at low temperature and separated together with the platelets by centrifugation. Raising the temperature to 37degreeC redissolved the precipitate. The thrombin solution in the glue was produced from prothrombin precipitated from 10 ml of the platelet rich plasma by lowering the pH and the ionic strength. The precipitate was separated by centrifugation and dissolved in a calcium ion solution. Increasing the pH to neutral value induced activation to thrombin. Preparation of the fibrin glue was performed in the blood bank within 60 to 90 min with the use of standard equipment. The outcome from 200 ml of blood was approximately 8 ml of fibrin glue: 6 ml fibrinogen to be coagulated with 2 ml of thrombin. The glue had a fibrinogen concentration of approximately 12 times the value in platelet rich plasma and the concentration of growth factors was approximately eight times the value in platelet rich plasma. We have used this glue successfully with particulate bone grafts for reconstructive purposes within the oral and maxillofacial field. It might as well be applied to other surgical areas. Whenever larger amount of the glue will be needed, a whole

unit of blood may be taken from the patient, and the red cells re-transfused to the patient during or after the operation.

Fibrinogen inhibits fibroblast-mediated contraction of collagen.

Authors: Nien Y.-D., Han Y.-P., Tawil B., Chan L.S., Tuan T.-L., Garner W.L.

Publication Date: 2003

Abstract:

Extracellular matrix changes in composition and organization as it transitions from the provisional matrix of the fibrin/ platelet plug to collagen scar in healed wounds. The manner in which individual matrix proteins affect these activities is not well established, In this article we describe the interactions of two important extracellular matrix components, fibrin and collagen, using an in vitro model of wound contraction, the fibroblast-populated collagen lattice. We utilized different fibrinogen sources and measured tissue reorganization in floating and tensioned collagen lattices, Our results showed that both fibrin and fibrinogen decreased the contraction of fibroblast populated collagen lattices in a dose-dependent manner. Polymerization of fibrinogen to fibrin using thrombin had no effect on this inhibition. Further, there was no effect due to changes in protein concentration, alternate components of the fibrin sealant, or the enzymatic action of thrombin. These results suggest that the initial stability of the fibrin provisional matrix is due to the fibrin, because this protein appears to inhibit contraction of the matrix, This may be important in the early phases of wound healing when clot stability is vital for hemostasis. Later, as fibrin is replaced by collagen, wound contraction can occur.

In vivo use of human fibrin glue under the subperiosteal and subcutaneous planes in Holtzman Rats.

Authors: Sasaki G.H., Mirzai T., Potyondy L., Smith M.

Publication Date: 2003

Abstract:

Background: Commercial fibrin sealant has been increasingly used off-label in the United States for aesthetic surgical procedures to minimize postoperative drainage, hematoma and seroma collections, ecchymosis, and edema. Objective: We sought to determine the optimal concentrations of thrombin and fibrinogen to extend the sealant adhesion time and to maintain the maximal glue strength, respectively, in subperiosteal and subcutaneous planes in Holtzman rats. Methods: Three preparations of 2-component fibrin sealant from the Hemaseel APR kit (Haemacure Corp., Sarasota, FL) were formulated: standard fibrin sealant (fibrinogen 75-115 mg/mL, thrombin 500 IU/mL), half fibrinogen concentration (fibrinogen 37.5-57.5 mg/mL, thrombin 500 IU/mL), and 1/100 thrombin concentration (fibrinogen 75-115 mg/mL, thrombin 5 IU/mL). In 6 rats, paired standardized subperiosteal scalp pockets and subcutaneous abdominal pockets were elevated, leaving a retained septum between each pair. In experiment 1, 1 of the 3 fibrin sealant preparations was instilled into 1 side of each paired subperiosteal and subcutaneous pockets in 2 of the 6 rats, leaving the adjacent pocket as a control flap. Changes in force of flap displacement and in setup time for adherence within the treated and matched control flaps were measured at intervals over an hour. In experiment 2, the duration and strength of adherence in flaps treated only with the standard fibrin sealant preparation and their paired control flaps in 34 rats were measured weekly over 6 weeks. One of the 34 rats was sacrificed each week to examine the histologic changes at the tissue-glue interface. Results: In flaps treated with the half-concentration of fibrinogen, the grams of force needed to displace the scalp flaps by 5 mm and the abdominal flaps by 10 mm were significantly reduced

compared with values obtained in similar flaps treated with the standard fibrin preparation over 1 hour of interval measurements ($P < 0.05$). In flaps treated with the 1/100 concentration of thrombin, the setup times before flap adherence were significantly extended to about 1 minute compared with the 15-second setup times observed in flaps treated with the standard fibrin preparation ($P < 0.05$). The use of the standard fibrin preparation in 34 rats resulted in up to 6 weeks of tissue adherence in the subperiosteal scalp flaps and up to 2 weeks of tissue adherence in the subcutaneous abdominal flaps over the paired control flaps, as measured weekly on the basis of force of flap displacement. Histologic examination demonstrated that glue material was absent at about 5 to 6 weeks in the subperiosteal space and 2 to 3 weeks in the subcutaneous space. Conclusions: Any decrease in fibrinogen concentration from that found in the standard fibrin sealant results in suboptimal strength of adherence of flaps. The standard thrombin concentration (500 IU/mL) results in a rapid onset of adherence within 15 seconds that may prevent the surgeon from massaging the glue evenly throughout the pocket and may produce a premature seal on opposing surfaces, leading to a seroma cavity. A reduced thrombin concentration (5 IU/mL), on the other hand, extends the onset time to a minute before adherence occurs, optimizing the sealing of the surgical cavity.

Hemostatic effect of vivostat patient-derived fibrin sealant on split-thickness skin graft donor sites.

Authors: Drake D.B., Wong L.G.

Publication Date: 2003

Abstract:

Topical hemostatic agents are used frequently to control bleeding of skin graft donor sites. In this study, the hemostatic properties of Vivostat (Vivolution A/S, Birkerod, Denmark) patient-derived fibrin sealant were compared with a control group of spray thrombin solution, which is considered an industry standard for topical hemostasis. Treatments were applied simultaneously to two randomly chosen halves of a single split-thickness single donor site in patients in five United States surgical centers. The time to achieve satisfactory hemostasis (<=10 min) was estimated on each half of the wound as the time at which active bleeding had stopped and the wound was suitable for application of a surgical dressing. The time to hemostasis of wounds treated with Vivostat (Vivolution A/S) patient-derived sealant was significantly shorter in comparison with wounds treated with thrombin solution (medians: Vivostat, 31 seconds; thrombin, 58 seconds; p = 0.0012). No abnormalities in wound healing were reported for either treatment site 1 week after the operation. Vivostat (Vivolution A/S) sealant is a more rapidly effective topical hemostatic agent than thrombin on split-thickness skin graft donor sites.

Fibrin sealants in supporting surgical techniques: Strength in factor XIII.

Authors: Phillips M., Dickneite G., Metzner H.

Publication Date: 2003

Abstract:

Factor XIII has a well-established role in natural coagulation and clot stabilization. It is often added back to fibrin sealants that are used in a wide range of surgical settings to achieve successful hemostasis, tissue adhesion and wound healing. Factor XIII is the final enzyme to be activated in the blood coagulation cascade. It plays an important role in maintaining the balance between coagulation and fibrinolysis. Factor XIII facilitates the formation of covalent cross-links within the fibrin network, forming a loose mesh after activation by thrombin. It adds significant resilience to fibrin clots, augmenting strength by as much as 5-fold. Both fibrin cross-linking and the factor XIII-catalyzed ligation of the fibrinolysis inhibitor alpha<inf>2</inf>-antiplasmin to the fibrin clot contribute to the increased proteolytic resistance of factor XIII-stabilized clots. Preclinical studies indicate that the inclusion of factor XIII in fibrin sealants used for vascular grafting significantly reduces suture-hole blood loss. This has important implications for the successful control of bleeding in comparable clinical situations. The advantages of factor XIII stabilized clots (increased strength, resistance to proteolysis, promotion of wound healing) suggest that the presence of factor XIII in fibrin sealants may optimize their performance in the clinical setting. The aim of this paper is to review preclinical data that provide evidence for a potentially positive role for factor XIII in fibrin sealants.

Fibrin sealants in supporting surgical techniques: The importance of individual components.

Authors: Wozniak G.

Publication Date: 2003

Abstract:

Fibrin sealants have many different uses across a broad range of surgeries, where they have proved successful in controlling bleeding, providing suture support and tissue sealing. The action of all fibrin sealants depends on the thrombin-catalyzed formation of a fibrin clot. However, neither the purity nor the concentration of the main components of fibrin sealants (thrombin and fibrinogen) is uniform across all commercial products and this will affect performance. In addition, the optional inclusion of other components such as factor XIII and antiproteolytic inhibitors may also influence the quality of clot formation. Properties that vary among different fibrin sealants, such as the clotting rate, viscosity, adhesiveness, clot strength and resistance to proteolysis, are all-important considerations for the surgeon. The application of fibrin sealants in a very wide spectrum of surgical procedures means that some fibrin sealants may be more suitable for a particular procedure than others. One of the advantages of commercial fibrin sealants is that the high level of quality control ensures that their composition is extremely consistent between batches. On the other hand, blood bank-derived fibrin sealants may vary in their composition from one preparation to the next and hence be less predictable in their performance. This paper discusses how individual components contribute to the overall performance of fibrin sealants, thereby providing to the surgeon the necessary information to select the optimal fibrin sealant for a specific procedure.

Introduction: Does the evidence justify the routine use of fibrin sealants in cardiovascular surgery?.

Authors: Taylor Jr. L.M.

Publication Date: 2003

Abstract:

Not Available

The use of Human Fibrin Glue in the surgical operations.

Authors: Canonico S.

Publication Date: 2003

Abstract:

Human Fibrin Glue (HFG) is made of two components contained in separate vials: a freeze dried concentrate of clotting proteins, mainly fibrinogen, Factor XIII and fibronectin (the sealant) and freeze dried thrombin (the catalyst). The first component is reconstituted with an aprotinin solution that inhibits tissue fibrinolysis. The second component (thrombin), available in 500 I.U. concentration, is dissolved with calcium chloride. It is so a set of substances involved in the hemostatic process and in the wound healing, conferring to the product the following important properties: hemostatic and sealing action, through the strengthening of the last step of the physiological coagulation; biostimulation, which favors the formation of new tissue matrix. The indications for the use of human fibrin sealant are numerous and present in all the surgical branches. A randomized controlled trial of 50 patients undergoing hernia repair according to Lichtenstein's technique under local anesthesia was performed. Patients had concurrent coagulopathies as a consequence of liver disease or long-term treatment with anticoagulants for ischemic heart disease or cardiac rhythm disturbances. Coagulopathies were defined according to the following criteria: prothrombin time <10.5 seconds, activated partial thromboplastin time < 21 seconds, and fibrinogen <230 mg/dL. Patients were randomized in a 1:1 ratio with (group A) or without (control group B) use of human fibrin glue. Postoperative hemorrhagic complications were significantly reduced in group A (4%) compared with group B (24%). This study showed that human fibrin glue is effective in preventing local hemorrhagic complications after inguinal hernia repair in patients with concurrent coagulation disorders.

Fibrin glue for wound repair: Facts and fancy.

Authors: Clark R.A.F.

Publication Date: 2003

Abstract:

In wound repair, fibrin has a multiplicity of activities, some of which are intrinsic to the protein itself and some attributable to other blood constituents associated with the fibrin clot. Fibrin sealants, which have been approved for hemostasis in the US and Europe, are occasionally used wounds to promote healing. However, inconsistency exists in the literature regarding the benefit of these preparations in the healing process. Morecrude fibrinogen preparations, such as cryoprecipitates made from the patient's own blood on location, appear from the literature to have better utility in wounds than more purified fibrinogen preparations available through commercial sources. These divergent outcomes are likely attributable to additional blood-derived products being associated with cryoprecipitates compared to the relatively purified commercial fibrinogen preparations. Clearly standard preparations and methods of application of fibrin sealant need to be defined for each particular surgical setting to resolve the many ostensible discrepancies in the current literature. A corollary is that different fibrin sealant preparations are likely to be preferable for different clinical situations.

Fibrin glue for conjunctival closure in strabismus surgery.

Authors: Mohan K., Kaur Malhi R., Sharma A., Kumar S.

Publication Date: 2003

Abstract:

Not Available

Prospective randomized multicenter trial of fibrin sealant versus thrombin-soaked gelatin sponge for suture- or needle-hole bleeding from polytetrafluoroethylene femoral artery grafts.

Authors: Taylor Jr. L.M., Mueller-Velten G., Koslow A., Hunter G., Naslund T., Kline R.

Publication Date: 2003

Abstract:

Objective: We evaluated the safety and efficacy of the fibrin sealant Beriplast P (FSBP; Aventis-Behring) for hemostasis in anastomosis of polytetrafluoroethylene (PTFE) grafts to the femoral artery. Methods: In a single-blinded randomized prospective multicenter clinical trial, FSBP was compared with thrombin-soaked gelatin sponge (TSG) for efficacy in stopping bleeding from needle or suture holes in PTFE grafts after anastomosis to the femoral artery. Patients were randomized to FSBP application, which requires a 3-minute period of arterial clamping to enable the fibrin clot to adhere, or to TSG application, which requires pressure from gauze sponges, after completion of the femoral artery anastomosis. The primary end point was hemostasis, defined as absence of any detectable bleeding as judged by the operating surgeon, by 4 minutes after randomization. Secondary end points included actual time from randomization to hemostasis, time to beginning of wound closure, measured blood loss (weighed sponges), incidence of recurrent bleeding, stay in the intensive care unit, and hospital length of stay. Data were analyzed with the intention-to-treat method. Results: Two hundred thirty-five subjects were enrolled at 26 medical centers; 34 were subsequently excluded from the study. Of the 201 randomized subjects, 100 received FSBP and 99 received TSG. Hemostasis was achieved by 4 minutes in 64 subjects (63%) in the FSBP group and 40 subjects (40%) in the TSG group (P = .0018). In the FSBP group, compared with the TSG group, time to hemostasis was shorter (median, 4.0 minutes; 95% confidence interval [CI], 3.8-4.18 minutes vs median, 5.6 minutes, 95% CI, 4.5-7.0; P = .008), blood

loss was less (mean, 4.0 +/- 29.7 g vs mean, 15. 6 +/- 28.4 g; P < .0001), and time to wound closure was shorter (median, 15 minutes; 95% CI, 10.47-18.67 minutes vs median, 22.8 minutes; 95% CI, 18.67-30.67; P = .005). There were no differences in recurrent bleeding or any other adverse events. There was no significant difference in ICU stay, but hospital length of stay was shorter in the FSBP group compared with the TSG group, and the difference approached significance (median, 6.5 days; 95% CI, 5.00-7.00 days vs median, 7.0 days; 95% CI, 6.00-8.00 days; P = .0565). Conclusion: FSBP is more effective than TSG for achieving hemostasis of needle or suture hole bleeding from PTFE femoral artery grafts.

Characterizing fibrin glue performance as modulated by heparin, aprotinin, and factor XIII.

Authors: Marx G., Mou X.

Publication Date: 2002

Abstract:

We describe the performance of fibrin glue (FG) as modulated by heparin, aprotinin, or factor XIII levels. In vitro tests and a rat kidney excision model demonstrated that the hemostatic efficacy of fibrin was not modulated by aprotinin. Overlapping rat skin sections demonstrated that adhesion strength (AS) was proportional to the area of overlap as well as to fibrinogen levels. AS was not modulated by exogenous heparin or aprotinin and was independent of the endogenous factor XIII in fibrinogen. SDS-PAGE developed by Coomassie or Western blots with anti-gamma chain antibody confirmed that normal skin sections contain adequate trans-glutaminase to maximally cross-link normal, as well as XIII-depleted, fibrin. Fibrin glue (FG) sprayed onto rat skin incision wounds with a dual channel spray applicator acted in 2 phases: initially (day 1), compared to wounds stapled without or treated with only thrombin, FG significantly increased breaking strength. In the second phase of wound healing (after day 3), all groups achieved increased but equivalent breaking strength. FG containing aprotinin (to 3000 U/m; Immuno, Behringwerke, Germany) exhibited initial tissue bonding strength equivalent to fibrin without aprotinin, but histological examination showed delayed fibrinolysis and a concomitant slower regeneration of granulation tissue. Thus, our data indicated that aprotinin was not particularly beneficial to wound healing and that the endogenous factor XIII level in the fibrinogen did not contribute significantly to skin bonding. Rather, the tissue supplied adequate trans-glutaminase activity required to crosslink fibrin to itself and to the tissue.

Comparative study of the efficacy of the common topical hemostatic agents with fibrin sealant in a rabbit aortic anastomosis model.

Authors: Kheirabadi B.S., Field-Ridley A., Pearson R., MacPhee M., Drohan W., Tuthill D.

Publication Date: 2002

Abstract:

Objective. The purpose of this study was to compare the hemostatic efficacy of the common surgical hemostatic agents with fibrin sealant (FS) and to assess their functional strength to secure hemostasis in lieu of placing additional sutures. Methods. End-to-end anastomosis of transected abdominal aorta was performed in moderately anticoagulated rabbits using 4 or 6 interrupted sutures. The suture line was covered either with gauze alone ("untreated") or with gauze plus Gelfoam, Avitene, Surgicel, FloSeal, or FS, following which blood flow was restored. Blood loss was absorbed by gauze and measured. The surviving rabbits were recovered and the repaired vessel was examined histologically 4 weeks after operation. The investigators were blinded to the treatment groups. Aortic anastomoses using 8 or 12 sutures (untreated) were also performed. Results. Untreated 4-suture anastomosis of aorta resulted in a profuse hemorrhage with an average 108.0 +/- 19.2 (mean +/- SD) ml blood loss and 100% mortality (n = 4). FS application sealed the anastomoses, prevented blood loss ($P < 0.01$ vs untreated) and exsanguination of the rabbits (n = 4). Other hemostatic agents reduced the bleeding to varying degrees compared to the untreated animals (Gelfoam 66.4 +/- 17.6, Avitene 80.6 +/- 34, Surgicel 66.7 +/- 16.7, FloSeal 44.2 +/- 8.5 ml blood loss, n = 4/group), but the changes were not statistically significant. One to three rabbits in each group survived the operation. Six-suture aortic anastomoses, untreated, resulted in 67.7 +/- 21.8 ml blood loss and 100% survival (n = 6). Application of FS produced immediate and sustained hemostasis in all the animals ($P < 0.01$ vs untreated). Other hemostatic agents also reduced the bleeding (Gelfoam 42.5 +/- 10, Avitene 50.9 +/- 12.4, Surgicel 32.1 +/- 14, FloSeal 33.9 +/- 5.4 ml

blood loss, n = 6/group), but the changes were not statistically significant. The 8- and 12-suture aorta repairs resulted in a moderate blood loss (43.9 +/- 19 and 21.3 +/- 14.9 ml, respectively), followed by a stable hemostasis that precluded the need to use any hemostatic agent. The aortic cross-clamping time of the 12-suture and time to hemostasis for both the 8- and the 12-suture techniques were significantly longer than those of the 4-suture plus FS application ($P < 0.01$, $P < 0.01$ and $P < 0.05$, respectively). Conclusion. In a moderate coagulopathy, FS was proven to be the most efficacious hemostatic agent, producing immediate and sustained hemostasis at the arterial anastomotic site. This high efficacy is in part attributed to the strong tissue adhesive property of this agent. FS application may potentially ease the anastomosis and shorten the duration of timely critical vascular procedures.

Can fibrin sealant be used to prevent postoperative drainage? A prospective randomized double blind trial.

Authors: Oliver D.W., Hamilton S.A., Figle A.A., Wood S.H., Lamberty G.B.

Publication Date: 2002

Abstract:

Fibrin sealant imitates the final phase of the blood coagulation process. A stable fibrin network is formed on the wound surface, which is thought to reduce the amount of postoperative bleeding and serous exudate from the wound. Fibrin sealants have proved effective in a wide range of surgical procedures. We undertook a prospective randomized, double blind, controlled trial in the use of a new fibrin sealant, Beriplast P, following axillary dissection (n=10), groin dissection (n=8), latissimus dorsi flaps (n=10) and adbominoplasties (n=16). Fibrin sealant (3 ml) was sprayed onto the wounds following haemostasis, prior to closure. Statistical analysis showed that drainage was reduced in the latissimus dorsi group in the first 24 h (P=0.011). However, there were no other significant differences, and length of hospital stay was similar in all groups. Whilst fibrin sealant may control bleeding and serous exudate in smaller surgical fields, we believe that the use of small volumes of sealant in relatively large wounds, particularly where the lymphatic drainage has been affected, is of limited clinical value. It does little to reduce total wound drainage or length of hospital stay. The cost of fibrin sealant is likely to preclude the use of larger volumes.

Treatment of chylous fistula with fibrin glue and clavicular periosteal flap.

Authors: Yoshimura Y., Kondoh T.

Publication Date: 2002

Abstract:

We describe a new treatment for chylous fistula using fibrin glue and clavicular periosteal flap.

An open pilot study of the effects of a human fibrin glue for endoscopic treatment of patients with acute bleeding from gastric varices.

Authors: Heneghan M.A., Byrne A., Harrison P.M.

Publication Date: 2002

Abstract:

Background: Optimal treatment for gastric variceal bleeding remains to be determined. The use of conventional sclerosing agents is associated with high rates of recurrent bleeding. Other agents, such as cyanoacrylate, have significant complication rates and can damage endoscopic equipment. The risk of prior-associated disease has caused concern regarding the use of bovine thrombin. Methods: Beriplast-P (human thrombin) forms a fibrin clot at the needle tip immediately upon injection through a double lumen needle. In 10 patients with gastric variceal bleeding, a median dose of 6 mL of Beriplast-P was injected into gastric varices. Observations: Immediate hemostasis was achieved in 7 of 10 patients (70%) with a single injection. At a median follow-up of 8 months, there was no recorded episode of recurrent bleeding from gastric varices. Conclusions: These results suggest that Beriplast-P is useful in the treatment of gastric variceal bleeding. Refinements in the design of the injection needle may improve the efficacy of this novel therapy.

Development of an animal model for assessment of the hemostatic efficacy of fibrin sealant in vascular surgery.

Authors: Kheirabadi B.S., Pearson R., Rudnicka K., Somwaru L., MacPhee M., Drohan W., Tuthill D.

Publication Date: 2001

Abstract:

Purpose. Sustained hemostatic function of fibrin sealant (FS) is crucial when it is used in cardiovascular surgery. The purpose of this study was to develop a model that can determine the long-term hemostatic efficacy of tissue sealants in a vascular surgery. Methods. To determine the ability of the model to detect differences in FS performance, various concentrations of FS were prepared and tested. Tensile strength of FS clots was determined in vitro using a tensiometer. Laparotomy was performed on 49 anesthetized rabbits, and a segment of the aorta was occluded, transected, and then sutured in an end-to-end fashion with four or eight interrupted 9-O sutures. The four-suture repair was covered with FS or placebo, and blood flow restored. Spilled blood was absorbed with gauze and weighed to estimate blood loss. Four weeks after surgery the animals were euthanized and the vessels recovered for histology. Results. Average tensile strength of FS clots at 120, 90, and 60 mg/ml topical fibrinogen complex (TFC) concentration was 0.42 +/- 0.07 N, with no significant difference among them. The lowest TFC concentration, 30 mg/ml, produced weaker clots than either 120 or 90 mg/ml ($P < 0.05$). All rabbits with four-suture anastomoses that were treated with placebo bled to death after the vessel was unclamped (n = 6). Treatment of suture line with standard FS concentration (120 mg/ml TFC, n = 8) sealed the anastomosis and prevented blood loss. Hemostasis was sustained for 4 weeks, allowing vascular healing. All rabbits with the eight-suture anastomosis survived the operation but lost 42 +/- 9.2 ml blood (n = 5). Hemostatic efficacy of FS was unchanged when TFC was diluted to 90 mg/ml (n = 6) but further dilution to 60 mg/ml with water (n = 8) produced significantly less effective clots, with an average blood loss of 5.5

+/- 7.6 ml (P < 0.05) and two fatal clot failures postoperatively. When FS was diluted to 60 mg/ml TFC with a buffer, it maintained its hemostatic strength (n = 6). Further TFC dilution to 30 mg/ml led to consistent bleeding with an average blood loss of 35.3 +/- 10.3 ml (P < 0.001, n = 6). Conclusions. The four-suture anastomosis of rabbit aorta offers a consistent and reliable method for evaluating the short- and long-term hemostatic efficacy of FS products. This model is not only able to determine the functional differences in various concentrations of FS, but it is also sensitive to detect the subtle changes in FS preparation (e.g., medium composition) that is not detected by in vitro testing.

Relief of post-tonsillectomy pain by release of lidocaine from fibrin glue.

Authors: Kitajiri S.-I., Tabuchi K., Hiraumi H., Kaetsu H.

Publication Date: 2001

Abstract:

Objectives: Pain inevitably develops after resection of the palatine tonsil (tonsillectomy). Therefore, we applied a mixture of lidocaine and fibrin glue to the tonsillar fossae immediately after tonsillectomy and evaluated its analgesic effects. Study Design: A prospective randomized trial. Methods: Seventy-four consecutive patients who had undergone tonsillectomy by the same surgeon (S.K.) were allocated by the sealed envelope method into three groups. After routine tonsillectomy, the operation was terminated in group A (control group), but the bilateral tonsillar fossae were covered with 1 mL fibrin glue using CaCl<inf>2</inf> as solution to dissolve thrombin in group B and using 4% lidocaine chloride instead of CaCl<inf>2</inf> in group C. No significant difference was observed in age or sex among the three groups. Analgesic effects were evaluated in terms of the postoperative days required until the patient began to eat normally and the postoperative days on which the patient desired analgesic administration. Results: The mean postoperative days until the patient began to eat normally were 4.22 in group A and 3.78 in group B, showing no significant difference, but 2.83 in group C, being significantly shorter (P <.05). The mean postoperative days on which analgesic administration was necessary were 4.56 in group A and 4.91 in group B, showing no significant difference, but 2.88 in group C, being significantly shorter (P <.05). Conclusion: This method can be readily performed, requires no special treatment, and appears to have adequate pain-relieving effects.

Comparison of the thrombogenicity of internationally available fibrin sealants in an established microsurgical model.

Authors: Frost-Arner L., Spotniz W.D., Rodeheaver G.T., Drake D.B.

Publication Date: 2001

Abstract:

Previous studies comparing the thrombotic complications of cryoprecipitated fibrin sealant containing bovine thrombin on microvascular venous anastomoses in a rat epigastric free flap model revealed deleterious outcomes regarding flap survival with higher concentrations of topical bovine thrombin. This study was designed to compare three internationally available fibrin sealants, one experimental fibrin monomer sealant that does not require thrombin, and human thrombin alone as to their effects on the survival of an established rat epigastric free flap model. Ninety, Sprague-Dawley rats (400 to 600 g) were prepared for abdominal surgery, and ah epigastric-based skin flap was raised. The single vein draining the flap was clamped, divided, and reconnected using standard microvascular suturing techniques. Before release of the clamps, the chosen additive was applied precisely to the anastomosis. Additional material was then added to the raw surface of the flap. The animals were divided into seven treatment groups, each receiving 1 ml of commercial or investigational fibrin sealant or human thrombin alone: one control group receiving no additive treatment, four fibrin sealant groups receiving treatment with commercial or investigational fibrin sealant preparations, and two groups receiving different concentrations (500 IU/ml and 1000 IU/ml) of human thrombin applied to the anastomoses and the surrounding tissue. Flap survival was assessed at 7 days postoperatively. This study supports the contention that microvascular free flap survival based on microvascular venous anastomotic patency was adversely effected by high concentrations of thrombin. Lower concentrations (500 IU/ml and less) of thrombin did not seem to affect flap survival. One test product was composed of a fibrin monomer sealant, which obviates the

need for the thrombin additive. This group's survival rate was not statistically different from that of the control group. Thus, for microvascular anastomoses, lower concentrations of thrombin or a sealant devoid of thrombin seem to be best for microvascular anastomotic patency.

Wound healing: Role of commercial fibrin sealants.

Authors: Amrani D.L., Diorio J.P., Delmotte Y.

Publication Date: 2001

Abstract:

This paper focuses on the use of commercial fibrin sealant (FS) in specific wound healing applications. This review is not intended to be all inclusive, but to examine in vitro and in vivo models, as well as select clinical conditions that are representative of specific wound healing applications of FS.

Autologous fibrin sealant reduces pain after tonsillectomy.

Authors: Gross C.W., Gallagher R., Schlosser R.J., Burks S.G., Flanagan H.L., Mintz P.D., Avery N.L., Mayers S.L., Spotnitz W.D.

Publication Date: 2001

Abstract:

Objectives/Hypothesis: Pain is a major cause of morbidity after tonsillectomy. Although various efforts have been made to reduce pain, the use of oral analgesics, which can have adverse side effects, remains the standard of care. It is hypothesized that fibrin sealant, used to achieve hemostasis and enhance healing in many surgical procedures, might help decrease pain after this operation. Study Design: A prospective, randomized, blinded study was performed on 20 children aged 5 to 17 years who were undergoing tonsillectomy, to evaluate the efficacy of FIBRIN SEALANT in reducing postoperative pain. Methods: All patients pre-donated 40 mL of blood from which autologous concentrated fibrinogen was prepared by cryoprecipitation. In the fibrin sealant group, fibrinogen and topical bovine thrombin were sprayed onto the surgical site to form fibrin sealant at the conclusion of tonsillectomy. The 10 patients in the control group (C) received no fibrin sealant. Patients rated their level of pain immediately after surgery and at regular intervals for 3 days after surgery using the Wong-Baker Faces Pain Rating Scale (1-6). Emesis, postoperative bleeding, medications, and adverse events were also evaluated. Results: At 7:00 P.M. on postoperative day (POD) 0, the mean +/- SD fibrin sealant group pain score (2.9 +/- 0.41 units) was significantly lower than for the C group (4.1 +/- 0.43 units; P <= .05). There was also a trend in favor of less pain in the fibrin sealant group at 7:00 P.M. on POD 1, with a mean of 3.5 +/- 0.43 units versus 2.4 +/- 0.48 units for C (P = .15). The odds of a patient in C experiencing emesis were 8.16 times higher, (P <= .05) than for patients in the fibrin sealant group. Conclusions: Fibrin sealant significantly reduced pain the evening after pediatric tonsillectomy and also decreased the chance of experiencing

emesis. Thus fibrin sealant may be clinically useful as an adjunct to tonsillectomy.

A simple technique for fibrin glue application in skin grafting [15].

Authors: Kubo T., Hosokawa K., Haramoto U., Takagi S., Nakai K.

Publication Date: 2000

Abstract:

Not Available

Collagen patch coated with fibrin glue components. Treatment of suture hole bleedings in vascular reconstruction.

Authors: Czerny M., Verrel F., Weber H., Muller N., Kircheis L., Lang W., Steckmeier B., Trubel W.

Publication Date: 2000

Abstract:

Background. Bleeding from suture holes during vascular reconstruction, particularly when polytetrafluoroethylene (PTFE) prostheses are used, is still a problem which can lead to intraoperative delay and increased blood loss. The aim of this prospective, randomised, open, controlled multicentre study was to evaluate whether the use of a new local haemostyptic would reduce intraoperative blood loss and the time to haemostasis. Methods. Thirty patients received a new haemostyptic (TachoComb H, Nycomed Pharma AG), whereas another 30 patients were treated with compresses. The vascular reconstructions were either anastomoses or patch angioplasties and were performed using PTFE vascular prostheses. Results. The mean time to haemostasis of suture hole bleeding in the haemostyptic group (326.0 sec) was significantly shorter compared to the control group (514.3 sec) ($p=0.006$). The median intraoperative blood loss was 24.5 g in the treatment group and 57.3 g in the control group ($p=0.045$). Conclusions. It was shown that collagen patches coated with components of fibrin glue significantly reduce the time to haemostasis as well as blood loss at the operation site in patients undergoing vascular reconstruction with PTFE grafts.

Thrombogenic effects of a nonthrombin-based fibrin sealant compared with thrombin-based fibrin sealant on microvenous anastomoses in a rat model.

Authors: Drake D.B., Faulkner B.C., Amiss L.R. Jr., Spotnitz W.D., Morgan R.F.

Publication Date: 2000

Abstract:

The efficacy and safety of tissue adhesives needs to be clearly defined. A thrombin-based preparation of fibrin sealant has recently been shown to have deleterious effects on microvascular anastomoses in an animal model. The authors found that fibrin sealant constructed with a high concentration of bovine thrombin (1,000 IU per milliliter) was detrimental to microvascular patency when applied to the anastomosis in a rat free flap model. The microvenous anastomosis had the highest rate of thrombosis and failure in this model. A nonthrombin-based fibrin sealant has recently become available for experimental investigation. This study examined the thrombogenic effect of this nonthrombin-based fibrin sealant on microvenous anastomoses in a rat free flap model compared with the effect of traditionally prepared fibrin sealant with varying concentrations of thrombin. The conclusions reveal that flap survival with application of the nonthrombin-based fibrin sealant to the anastomosis was comparable with flap survival of the control animals. Flap survival with application of the traditionally prepared thrombin-based fibrin sealant was also comparable with flap survival of the control animals when a concentration of 500 IU per milliliter of thrombin was used. However, flap survival decreased significantly ($p < 0.005$) when a concentration of 1,000 IU per milliliter of thrombin was used in the construct of the fibrin adhesive. These results support the previous findings of the harmful effects of thrombin when used in high concentrations and applied to the microvenous anastomosis of this free flap model. Moreover, this initial investigation with a nonthrombin-based fibrin sealant did not show any deleterious effects on the microvenous

anastomosis compared with control animals.

Purification of salmon clotting factors and their use as tissue sealants.

Authors: Wang L.Z., Gorlin J., Michaud S.E., Janmey P.A., Goddeau R.P., Kuuse R., Uibo R., Adams D., Sawyer E.S.

Publication Date: 2000

Abstract:

Fibrin sealant prepared from the blood of farmed Atlantic salmon (Salmo salar) represents a potential source of well-controlled natural material with utility in a variety of clinical settings. A potential advantage of this material is a lower probability of viral or bacterial infection that has limited general approval of fibrin glues made from human or bovine proteins. This report describes the purification of fibrinogen from salmon blood, the use of fibrin glues derived from this material to promote wound healing in rats, and the antigenic response to this material. While the low ambient temperature of these cold water fish significantly lessens the probability of infectious transmission to humans, fibrinogen and factor XIII derived from S. salar are activated by human thrombin at 25degreeC and 37degreeC to form clots equivalent to those formed by human fibrin. We compare the reactivity of salmon and human fibrinogen with human and bovine thrombin and the structure and viscoelastic properties of the resulting fibrin gels over a range of pH and salt concentrations. The efficacy of salmon fibrin glues in a wound healing assay and the low antigenic response to salmon fibrinogen suggest that this material may substitute for proteins derived from mammalian sources with lower probability of infections.

Does the absorbable fibrin adhesive bandage facilitate partial nephrectomy?.

Authors: Cornum R.L., Morey A.F., Harris R., Gresham V., Daniels R., Knight R.W., Beall D., Pusateri A., Holcomb J., Macphee M.

Publication Date: 2000

Abstract:

Purpose: To evaluate the ability of the absorbable fibrin adhesive bandage (AFAB), a prototype product comprising lyophilized fibrinogen and thrombin on a Vicryl(TM) mesh backing, to seal the collecting system and control bleeding after partial nephrectomy. Materials and Methods: Growing female pigs (n = 18) underwent left nephrectomy and a 40% (by length) right lower pole partial nephrectomy. One of three treatments was immediately applied: Conventional-closure of the collecting system, ligation of visible segmental vessels, application of Surgicel(TM) with bolstering sutures to the renal capsule; AFAB-application of up to two 4 x 4-inch AFABs held under pressure for 60 seconds; Placebo-application of a hemostatically inert Vicryl(TM) bandage, visually identical to the AFAB. Blood loss and ischemic and total operative times were recorded, and abdominal computerized tomography (CT) was performed on postoperative day 6. Animals were sacrificed at 6 weeks to evaluate the remaining renal mass histologically. Results: Compared with conventional therapy, use of the AFAB resulted in significantly less bleeding (13 versus 68 ml., $p < 0.001$) and lower operative (7.2 versus 16.3 minutes, $p < 0.001$) and ischemic times (3.4 versus 7.8 minutes, $p < 0.001$). Estimated blood loss in the placebo bandage group was dramatically higher (357 ml., $p < 0.001$). Postoperative CT and histological sectioning suggested that the AFAB produces a stable, durable clot and that healing is at least as successful as with conventional treatment. Conclusion: Use of the AFAB facilitated performance of partial nephrectomy by reducing blood loss and ischemic and total operative times. The AFAB appears equivalent to conventional surgery in its ability to seal

the collecting system.

The use of fibrin adhesive in sinus lift procedures.

Authors: Sullivan S.M., Bulard R.A., Meaders R., Patterson M.K.

Publication Date: 1997

Abstract:

Sinus lift bone grafting has expanded the use of dental implants in reconstructions of the atrophic maxilla. Potential problems include sinus membrane tear, which can lead to graft infection and early failure. Attempts at managing sinus membrane perforations are often limited by difficulty of access, as well as by the friability of the soft tissue lining the sinus. Various techniques have been proposed for managing such membrane tears. The use of fibrin adhesive, however, may present a potential solution in such situations. This article reports our experience with the use of fibrin adhesive in sinus lift procedures, as well as on its autologous preparation.

Hemostatic efficacy of fibrin sealant (human) on expanded polytetrafluoroethylene carotid patch angioplasty: A randomized clinical trial.

Authors: Jackson M.R., Gillespie D.L., Longenecker E.G., Golf J.M., Fiala L.A., O'Donnell S.D., Gomperts E.D., Navalta L.A., Hestlow T., Alving B.M., Seeger J.M.

Publication Date: 1999

Abstract:

Purpose: The efficacy of solvent-detergent-treated fibrin sealant (human [FSH]) for controlling anastomotic bleeding from expanded polytetrafluoroethylene (ePTFE) patch angloplasty during carotid endarterectomy was evaluated, and FSH was compared with thrombin-soaked gelatin sponge (Gelfoam; TSG). Methods: The study was of a randomized, open- label, single-site, single-treatment, parallel design that took place in a referral center with hospitalized patients. Forty-seven adult patients (33 men, 14 women) underwent elective carotid endarterectomy. Patients were randomized to receive either FSH (N = 24) or TSG (N = 23). FSH was obtained as an investigational new drug. FSH was applied as a liquid by means of a dual-syringe technique. Heparin anticoagulation, patch thickness, and suture type were standardized. Two different needle sizes were used (CV-6, PT-13: N = 21 [FSH: N = 10, TSG: N = 11]; CV-6, PT-9: N = 26 [FSH: N = 14, TSG: N = 13]). The FSH or TSG was applied to the ePTFE patch, and then blood flow was restored through the carotid artery. Degree of anticoagulation was assessed by anti-factor Xa activity. The time from restoration of carotid blood flow until achieving hemostasis was recorded. The blood loss from patch suture hole bleeding was measured. Completion intraoperative duplex ultrasound scanning was performed in all cases. Heparin was reversed with protamine sulfate. The primary end point was successful hemostasis within 15 minutes of restoration of carotid blood flow. The secondary end points were the amount of blood loss caused by suture line bleeding and the

time to achieve hemostasis. Results: There was no difference in the number of patients with complete hemostasis at 15 minutes (TSG, 13 of 23; FSH, 12 of 24; P = .77). The measured blood loss was 99.0 +/- 119.9 (SD) mL for TSG, and 105.0 +/- 107.9 mL for FSH (P= .86). The time to hemostasis was the same for both groups (TSG, 16.5 +/- 16.5 minutes; FSH, 16.6 +/- 14.2 minutes; P = .97). Within both treatment groups, the use of larger needles (PT-13) was associated with greater blood loss (FSH, 169.7 +/- 124.2 mL; TSG, 172.7 +/- 151.5 mL) than was the use of smaller needles (PT-9; FSH, 58.8 +/- 66.3 mL; TSG, 34.1 +/- 25.6 mL; P = .036, P = .001, respectively). There were no postoperative strokes or bleeding complications in either group. No abnormalities were shown in either group by means of completion carotid duplex ultrasound scanning. Conclusion: FSH was equivalent, but not superior to, TSG in achieving hemostasis during carotid endarterectomy performed with ePTFE patch angioplasty. Adhesion properties of FSH to ePTFE are possibly different than those to native tissue and warrant additional investigation.

Evaluation of fibrin sealants in cutaneous wound closure.

Authors: Scardino M.S., Swaim S.F., Morse B.S., Sartin E.A., Wright J.C., Hoffman C.E.

Publication Date: 1999

Abstract:

Human fibrin sealant (HFS) and bovine fibrin sealant were delivered as preformulated fibrinogen-thrombin mixtures that are light activated. These formulations were evaluated in the healing of incised cutaneous wounds in beagle dogs. Four groups were differentiated by sealant type and study duration with group: BFS for 10 days, HFS for 10 days, BFS for 30 days, and HFS for 30 days. Healing was evaluated by noting incidences of open wounds, laser Doppler perfusion imaging (LDPI), planimetry, breaking strength, and histopathology. In the absence of tension, both sealants tended to hold wound edged together; however, HFS tended to be better than its controls and BFS. Both sealants augmented suture closure, necessitating fewer sutures for wound closure. At 5 and 30 days BFS wounds had larger scar areas than their controls, while scar areas of HFS wounds were smaller than either BFS wounds or controls. Breaking strengths indicated that HFS wounds were stronger than their controls and BFS wounds. Histologically, mild to moderate chronic-active inflammation was observed in wounds receiving either sealants, and this persisted longer in BFS wounds. Overall, HFS had positive qualities, thus showing potential for functional and cosmetic wound closure.

Fibrin sealant in vascular surgery: A review.

Authors: Shireman P.K., Greisler H.P.

Publication Date: 1998

Abstract:

Fibrin sealant (FS) is a mixture of concentrated fibrinogen and thrombin that creates a fibrin matrix that is slowly degraded by the body's fibrinolytic system. FS is currently being used in the clinical arena for many applications. Perhaps the most relevant indication for vascular surgeons concentrates on FS's hemostatic properties. Current research in many centers is investigating FS's capability to incorporate drugs and cytokines into the fibrin matrix for slow release as a drug delivery system for future clinical use. This review will focus on three main uses of FS: as an anastomotic sealant, as an antibiotic coating, and as an agent for endothelialization of grafts.

Fibrin tissue adhesive in otolaryngology-head and neck surgery.

Authors: Toriumi D.M., Lovice D., O'Grady K.M.

Publication Date: 1998

Abstract:

In otolaryngology-head and neck surgery, fibrin tissue adhesive (FTA) is primarily used for fixation of tissues, for attaining hemostasis, or for drug delivery. It can be used for positioning implants or ossicles in the middle ear or as a sealant in closure of cerebrospinal fluid leaks. FTA is an excellent hemostatic agent and can be used for controlling capillary bleeding along the cut surface of muscle or in a previously operated site. As a delivery system, FTA can be used to administer antibiotics, chemotherapeutic agents, or growth factors. New technology is providing safer homologous products, stronger autologous products with higher fibrinogen levels, and better applicators.

Comparative study of different biological glues in an experimental model of surgical bleeding in anesthetized rats: Platelet-rich and -poor plasma- based glue with and without aprotinin versus commercial fibrinogen-based glue.

Authors: Sirieix D., Chemla E., Castier Y., Massonnet-Castel S., Fabiani J.-N., Baron J.-F.

Publication Date: 1998

Abstract:

The use of fibrin glue in cardiovascular surgery has been associated with decreased operative time, effective control of localized bleeding, and reduced postoperative blood loss. All preparations of fibrin glue mimic the final common pathway of the coagulation cascade in which fibrinogen is converted to fibrin in the presence of thrombin and calcium. The goal of the study was to compare five different types of fibrin glue, with or without aprotinin, on a surgical bleeding model in the rat. In 70 anesthetized Wistar rats, after laparotomy, a 3 cm liver incision was performed. After randomization, seven groups were studied. In the first group, Biocol was used as a pinpoint application to the bleeding site. Four groups received a fibrin glue obtained from a single human donor plasma using Cell Saver V (Haemonetics). The sealant was applied as a two-component system. The first component of the glue was either platelet-rich-plasma (PRP) or platelet-poor-plasma (PPP). The second component consisted of a mixture of 0.5 ml CaCl 10% with 1000 U of human thrombin, with or without 400KUI of aprotinin (AP). The last two groups, control and aprotinin were treated using saline solution or topical aprotinin respectively. Hemoglobin and hematocrit were measured before surgery and 30 min after application of the glue. The decrease in hemoglobin (Hb) and hematocrit (Hct) was the primary efficacy variable. Before surgery, there was no difference regarding Hb and Hct values between groups. Thirty min after the application of the glue, the decrease in hemoglobin expressed as percent of the control values is only significantly

lower in the Biocol group when compared to control. No significant difference was observed with the other groups in comparison to control. The commercial fibrin glue (Biocol) is more efficient than other preparations. This efficacy is likely due to a higher fibrinogen concentration.

Tissue glue as an adjunct to wound healing in the porcine model.

Authors: Maxwell G.L., Soisson A.P., Brittain P.C., Harris R., Scully T.

Publication Date: 1998

Abstract:

Objective: A prospective animal study of six domestic swine was performed to determine whether fibrin glue (porcine fibrinogen as cryoprecipitate plus commercial bovine thrombin) application in sutured porcine skin incisions could improve tensile wound strength. Methods: Eight pairs of paramedian incisions were made on the back of each animal 3 cm lateral from the midline. The length (5 cm) and depth (1.5 cm) of each incision were exactly the same in each animal. One half of the incisions were closed using interrupted sutures (2-0 Nylon, and one half were closed in the same manner after adding fibrin glue to the wound. All wounds were surgically excised on postoperative day 7. Using a special cutting instrument, the entire incision was harvested and cut into 1 cm strips perpendicular to the incision. All tissues were snap frozen at -60degreeF in a cryobath and stored at -70degreeC. Tensile strength required to disrupt the surgical incision in each tissue strip was measured with an Instron tensiometer. Tensile strength was recorded in pounds per square inch (psi). Results: Two hundred forty-seven specimens were analyzed. The mean tensile force required to disrupt the incisions was 0.13 psi (sd = 0.17 psi). The mean tensile strength for 130 specimens from glued incision was 0.13 psi (sd = 0.166 psi), compared with a mean tensile strength of 0.12 psi (sd = 0.1 psi) for 117 specimens that were not. There was no significant treatment effect based on the mixed linear model (0.87). Conclusion: Fibrin glue does not significantly improve the tensile strength of superficial porcine wounds during the first week after surgery.

Acute thrombogenic effects of fibrin sealant on microvascular anastomoses in a rat model.

Authors: Marek C.A., Amiss Jr. L.R., Morgan R.F., Spotnitz W.D., Drake D.B.

Publication Date: 1998

Abstract:

Topically applied bioadhesives and hemostatic agents have gained wide acceptance in various surgical endeavors. However, the effect of thrombin- based fibrin sealant (fibrin glue) when applied to microvascular anastomoses has not been evaluated thoroughly. Although fibrin sealant has been used directly on vascular anastomoses in macrovascular surgery, there has been little exploration into the utility and potential complications when used in the microsurgical setting. This study explored the influence of fibrin sealant containing increasing concentrations of bovine thrombin on microvascular anastomoses in a rat epigastric free flap model. The survival of the free flap in this model appeared to be inversely proportional to the concentration of thrombin in the fibrin sealant. When thrombin alone was applied to the anastomoses, the rate of thrombosis was the highest. Venous anastomosis was the most sensitive to the deleterious effects of topically applied thrombin.

New developments in the use of fibrin sealant: A surgeon's perspective.

Authors: Spotnitz W.D.

Publication Date: 1997

Abstract:

Fibrin sealant, a surgical tissue adhesive, has gained widespread use for its ability to achieve three major clinical goals: reducing hemorrhage, increasing tissue adherence, and allowing drug delivery. The object of this state-of-the-art review is to clarify the most recent developments in this field from a surgical perspective. The areas of greatest interest and progress relating to surgical uses for fibrin sealant-specifically, new methods of sealant production, new experimental or clinical uses, and new potential complications-are explored in this review.

Platelet deposition on ePTFE grafts coated with fibrin glue with or without FGF-1 and heparin.

Authors: Zarge J.I., Gosselin C., Huang P., Greisler H.P.

Publication Date: 1997

Abstract:

Introduction. The disappointing long-term patency of small-caliber prosthetic grafts may be due in part to early thromhogenicity of the prosthetic surface. We previously reported that the coating of expanded polytetrafluoroethylene (ePTFE) with fibrin glue (FG) containing fibroblast growth factor type 1 (FGF-1) and heparin accelerated spontaneous endothelial coverage of ePTFE grafts in an animal model; however, FG's effect on platelets remains unclear. This study was done to evaluate platelet deposition onto FG/FGF-1/heparin-coated vs FG-coated vs whole-blood- preclotted ePTFE surfaces. Methods. Twelve 5-cm ePTFE grafts were treated either with FG (thrombin, 0.32 U/ml, and fibrinogen, 32.1 mg/ml, n = 8) or with FG containing FGF-1 (11 ng/ml) plus heparin (250U/ml, n = 4). Twelve control ePTFE grafts were preclotted with canine (n = 8) or human (n = 4) whole blood. These treated grafts were placed onto a loop pulsatile perfusion system in pairs (preclotted with either FG or FG/FGF-1/heparin) and perfused with a M-199/10% FBS/¹¹¹indium-labeled platelet suspension. After 60 min the grafts were gamma counted and CPM/mm² were determined. Results. In both trials, the preclotted ePTFE grafts demonstrated similarly increased platelet deposition when compared to grafts treated with FG/FGF-1/heparin or FG alone ($P < 0.001$ for each). Conclusion. The decrease in platelet deposition on the FG/FGF-1/heparin-coated grafts vs preclotted grafts is not due to heparin and is not specific to canine or human platelets. FG-coated grafts may induce a decrease in early graft thrombogenicity when compared to whole blood preclotting.

Arthroscopic meniscal repair using fibrin glue. Part I: Experimental study.

Authors: Ishimura M., Ohgushi H., Habata T., Tamai S., Fujisawa Y.

Publication Date: 1997

Abstract:

An experimental study of rabbit menisci was carried our to evaluate the healing-promoting properties of fibrin glue and fibrin glue-containing marrow cells. A full-thickness defect, 1.5 mm in diameter, was made within the avascular portion of the meniscus and left empty in 20 menisci (C group), filled with fibrin glue in 20 menisci (F group), and filled with fibrin glue- containing marrow cells in 20 menisci (M group). Measurements of the remaining defects and histological examinations were performed 1, 3, 6, and 12 weeks after each procedure. Overall, the remaining defects in the F group and, particularly, in the M group were significantly smaller than those in the C group at the various time points. Furthermore, the results of histological study showed earlier mature healing of the defects in the M group than of those in the F group. Our results suggest that fibrin glue, especially in a preparation containing marrow cells, may enhance meniscal healing.