# Hemoglobin

# 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.

# Use of hemostatic sealant in tubeless percutaneous nephrolithotomy: Experience of a single institution from Taiwan.

Authors: Lan C.Y., Tzou K.Y., Hu S.W., Ho C.H., Chiang Y.T., Wu C.C., Kao W.T., Liu C.H., Chen K.-C.

Publication Date: 2017

## Abstract:

Objective Tubeless percutaneous nephrolithotomy (PCNL) offers several advantages over standard PCNL, including a shorter hospital stay, less analgesic requirement, and less postoperative pain. Using a fibrin sealant to seal the nephrostomy tract had become a widely accepted technique at the conclusion of tubeless PCNL. Our objective is to evaluate the efficacy and safety of tubeless PCNL using hemostatic matrix. Materials and methods This is a retrospective review of PCNL database at our hospital between June 2014 and March 2016. During this period, a total of 139 PCNLs were performed, including 41 with tubeless technique with adjunct of hemostatic matrix (Floseal; Baxter, Deerfield, IL, USA) at the conclusion of the PCNL procedure. The standard PCNL group and the tubeless PCNL group were compared in terms of demographic characteristics, perioperative data, stone characteristics, and complication rate. Results Of all 123 patients included in this study, 41 underwent tubeless PCNL. Demographic data of the two groups were comparable except for a higher proportion of male patients in the tubeless PCNL group (73.2% vs. 53.7%). Stone characteristics were also comparable in the two groups. Perioperative variables, including operative time, drop of serum hemoglobin level, and perioperative complication rate, revealed no statistical difference between the two groups. Tubeless PCNL was associated with less postoperative pain, less analgesic requirement, and a shorter hospital stay ($p < 0.01$). Conclusion Tubeless PCNL with adjunct use of a hemostatic sealant can be considered as a safe treatment option for renal calculi with favorable outcome, without an increase in complications. Compared with standard PCNL,

tubeless PCNL with hemostatic sealant use is associated with less pain, use of fewer narcotic agents, and a shorter hospital stay.

# The efficiency and safety of fibrin sealant for reducing blood loss in primary total hip arthroplasty: A systematic review and meta-analysis.

Authors: Wang Z., Xiao L., Guo H., Zhao G., Ma J.

Publication Date: 2017

## Abstract:

Objective Total hip arthroplasty (THA) is associated with substantial blood loss. The objective of present systematic review and meta-analysis is to provide evidence from randomized controlled trials (RCTs) on the efficiency and safety of administration of fibrin sealant (FS) for reducing blood loss in patients undergoing primary THA. Methods Potential relevant studies were identified from electronic databases including Medline, PubMed, Embase, ScienceDirect, web of science and Cochrane Library. Gray academic studies were also identified from the reference list of included studies. There was no language restriction. Pooling of data was carried out by using RevMan 5.1. Results Six randomized controlled trials (RCTs) met the inclusion criteria. Current meta-analysis indicated that there were significant differences in terms of total blood loss (MD = -153.77, 95% CI: -287.21 to -20.34, P = 0.02), postoperative hemoglobin level (MD = -0.25, 95% CI: -0.46 to -0.05, P = 0.02) and transfusion rate (RD = -0.12, 95% CI: -0.22 to -0.03, P = 0.01) between groups. No significant differences were found regarding the incidence of deep venous thrombosis (DVT) (RD = 0.00, 95% CI: -0.01to 0.01, P = 0.51) or other side effects. Conclusion Administration of fibrin sealant in total hip arthroplasty may reduce total blood loss, postoperative hemoglobin decline and transfusion requirements. Moreover, no adverse effect was related to FS. Due to the limited quality of the evidence currently available, higher quality RCTs are required.

# EVICEL fibrin sealant and bloodless protocol in orthopaedic surgery: Clinical evidence and cost-analysis-Italian experience at Humanitas Research Hospital.

Authors: Martorelli F., Scardino M., D'Amato T., Gurgone A.

Publication Date: 2017

## Abstract:

Introduction: Blood transfusion and haemostasis are becoming important aspects of preoperative planning and intraoperative decision making in orthopaedic surgery. Humanitas Research Hospital (ICH) uses a new patient blood management (PBM) protocol. Perioperative strategies include the use of autologous blood donation and administration of erythropoietin and iron, intraoperative use of tranexamic acid, intraoperative and postoperative blood salvage, and the EVICELfibrin sealant (human fibrinogen and high concentration of human thrombin, Johnson & Johnson, Ethicon) that improves haemostasis and reduces the volume of blood loss in postoperative. Objectives: The potential role and cost saving obtained from use of EVICEL in the PBM protocol to control blood loss, avoid blood transfusions and reduce length of hospital stay in patients undergoing revision THA or TKA and patients with coagulopathy. Methods: In a retrospective observational study, we evaluated two different groups of patients undergoing revision THA or TKA: one group was treated with EVICEL and the other group with the same protocol but without fibrin sealant. The outcomes measured were numbers of patients exposed to allogeneic red cells, amount of blood/plasma transfusions, and the number of hospital length of stay. An economic model was quantified the cost saving of EVICEL at ICH. Results: Results showed that application of EVICEL reduces the number of transfused RBC and plasma, postoperative haemoglobin loss, and days of hospital stay in these particular orthopaedic procedures and patients. In the hospital cost analysis, EVICEL predicts resource reduction with average cost savings of  1676 per patient. Conclusion: Overall, the results

suggest that EVICEL is efficacious in reducing both postoperative blood loss and hospital stay. The protocol with EVICEL produces clinical appropriateness and cost savings.

# Topical fibrin sealant versus intravenous tranexamic acid for reducing blood loss following total knee arthroplasty: A systematic review and meta-analysis.

Authors: Gao F., Ma J., Sun W., Guo W., Li Z., Wang W.

Publication Date: 2016

## Abstract:

Purpose Efficacy and safety of topical application of a fibrin sealant (FS) compared with intravenous administration of tranexamic acid (TXA) for reducing blood loss after total knee arthroplasty (TKA) is controversial. We undertook a meta-analysis to compare the effects of topical application of FS or intravenous administration of TXA on blood loss after TKA. Methods PubMed, Medline, Embase, Web of Science and the Cochrane Library were searched to identify studies comparing FS with TXA for TKA patients. The mean difference (MD) of blood loss, hemoglobin value, and odds ratios (ORs) of transfusion requirements and adverse events in FS and TXA groups were pooled throughout the study. Relevant data were analyzed using RevMan v5.3. Results Five studies involving 359 patients were included (181 FS vs. 178 TXA). TXA use had a significantly lower prevalence of blood transfusion (OR = 3.14; 95% confidence interval (CI), 1.67 to 5.90, P = 0.0004) and higher hemoglobin level (MD = -1.23; 95% CI, -2.19 to -0.27, P = 0.01) than FS in the early postoperative period. No significant difference was seen in total blood loss between the two groups (MD = 198.06; 95% CI, -267.45 to 663.57; P = 0.40). There were no significant differences in adverse events, superficial infections, or deep-vein thrombosis among study groups. Conclusions Our meta-analysis suggests that intravenous administration of TXA for patients undergoing TKA may reduce blood-transfusion requirements and maintain higher hemoglobin levels compared with topical application of FS in the early postoperative period. There were no significant differences in total calculated blood loss and prevalence of complications between the two groups. However, owing to

the variation of included studies, no firm conclusions can be drawn.

# The efficacy of fibrin sealant in knee surgery: A meta-analysis.

Authors: Yang T.Q., Geng X.L., Ding M.C., Yang M.X., Zhang Q.

Publication Date: 2015

## Abstract:

Background: Fibrin sealant is frequently used in knee surgery as an adjuvant method for reducing postoperative bleeding, however, there is no consensus regarding the efficacy of fibrin sealant. Hypothesis: Fibrin sealant achieves better efficacy in terms of blood loss control, transfusion rate and units in knee surgery compared with controls. Methods: A search of the Cochrane Collaboration (2013 Issue 09), Embase (1974-2013.09), PubMed (1966-2013.09) and Chinese databases (up to 2013.09) were conducted. The Cochrane Collaboration's tool was used to assess for bias and data were analyzed by RevMan 5.29 software. Results: This study included nine RCTs and four prospective comparative trials with a total of 1299 patients. Compared to the control, fibrin sealant achieved a decrease in hemoglobin reduction [MD. = 1.14, 95% CI (0.61-1.67)], transfusion rate [OR. = 0.36, 95% CI (0.25-0.51)], transfusion units [MD. = 0.47, 95% CI (0.24-0.71)], hospital stay [MD. = 2.22, 95% CI (0.56-3.88)] and the incidence of complications [OR. = 0.56, 95% CI (0.38-0.83)]. And it also reduced total blood loss, while there was no significant difference [MD. = 155.83, 95% CI (-525.02-213.15)]. Conclusion: Patients undergoing knee surgery would benefit from high-dose fibrin sealant with reduced transfusion rate and unit, hospital stay and complications, while they might benefit little from it in total blood loss. However, the effects of a low-dose of fibrin in knee surgery remain inconclusive. Level of evidence: Level III.

# 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.

# Fibrin sealants does not impact perioperative blood transfusions rate in patients undergoing partial nephrectomy.

Authors: Abu-Ghanem Y., Dotan Z., Kaver Y., Ramon J.

Publication Date: 2015

## Abstract:

INTRODUCTION AND OBJECTIVES: Despite the relatively low incidence of bleeding after partial nephrectomy (PN) it remains one of the most serious complications. Hemostatic agents like fibrin sealant are commonly used during PN to reduce this risk despite a paucity of data supporting its efficacy. The aim of this study was to evaluate whether using fibrin sealant impact the rate of perioperative blood transfusions (PBT) in patients undergoing PN for renal masses. METHODS: Six hundred and fifty four patients who underwent elective PN for renal masses between the years 2004-2013 were reviewed. Fibrin sealant was used in 315 patients. In this group, fibrin sealant were placed in the partial nephrectomy bed after performing renorrhaphy. The remaining 339 patients had renorraphy performed without the use of any hemostatic agents. PBT was defined as transfusion of allogeneic red blood cells during PN or postoperative hospitalization. The associations between PBT and patient demographics, surgical characteristics and pathologyrelated variables were assessed by univariate and multivariate analysis. RESULTS: The groups were comparable in age, gender, Body Mass Index (BMI), pre-operative hemoglobin levels, tumor size, location and number of central tumors. Univariate analysis demonstrated no association between use of fibrin sealants and ischemia time, estimated blood loss, perioperative blood transfusion or postoperative urine leak. Since the use of fibrin sealant was significantly higher in patients undergoing laparoscopic surgery, groups were further divided based on the type of operation. Univariate analysis demonstrated no association between use of fibrin sealants and decreased complications in both surgical approaches. Multivariate analysis showed omission of fibrin sealants was not a significant predictor

of perioperative outcomes. CONCLUSIONS: In the current study, the use of fibrin sealants during PN did not decrease the rate of PBT administrations. Furthermore, no impact was seen on ischemia time or other negative outcomes, including urinary leak. If Homeostasis is performed well with stitches alone, there is no need for additional adhesive agents.

# Effect on Blood Loss and Cost-Effectiveness of Pain Cocktails, Platelet-Rich Plasma, or Fibrin Sealant After Total Knee Arthroplasty.

Authors: Bernasek T.L., Burris R.B., Fujii H., Levering M.F., Polikandriotis J.A., Patterson J.J.

Publication Date: 2012

## Abstract:

This study evaluated the effect of periarticular pain cocktail, platelet-rich plasma, or fibrin sealant injections on blood loss, transfusion rate, and hospital costs after total knee arthroplasty. A retrospective review of 400 patients undergoing primary total knee arthroplasty with one of the different periarticular treatments as stated above was performed. Postoperative blood loss, hemoglobin levels, allogenic blood transfusion rates, and per-case hospital injection cost were reported. Although platelet-rich plasma and fibrin sealant decreased blood loss compared with the control group ($P < .001$), there was no significant difference in blood loss in the pain-cocktail group or in postoperative hemoglobin levels or transfusion rates between all groups. Significant efficacy and cost-effectiveness for these modalities could not be identified and have, therefore, been discontinued at our practice. Level of evidence: level III. 

# A randomized prospective double blind controlled trial on effects of fibrin sealant in cementless hip replacement.

Authors: Randelli F., Banci L., Visentin O., Ragone V., Pavesi M., Randelli G.

Publication Date: 2010

## Abstract:

Total hip replacement (THR) surgery can expose patients to significant perioperative blood losses. This prospective, controlled, randomized, double blind study evaluated the efficacy in reducing postoperative bleeding and blood transfusion using a commercially available human fibrin sealant in primary cementless THR. Sixty-eight patients, who were planned to undergo THR and who met the inclusion criteria, were randomised in a 1:1 ratio into two groups: a treatment group, in which fibrin sealant was used after prosthesis implantation and a control group using saline. Twenty patients had provided autologous blood through self-transfusion and forty-eight patients had not. Patient randomization did not consider predeposit of autologous blood. Each group followed the same haemostatic procedures, anaesthesiological protocol and venous thromboembolic prophylaxis. Intra- and post-operative blood loss was evaluated through standardized protocols. Haemoglobin (Hb) and haematocrit (Ht) levels were registered preoperatively and on post-operative day 1, 2, 3 and 7. The number of transfused blood bags was recorded. Six patients (17 percent) of the control group required homologous transfusions and one patient (3 percent) of the treatment group required homologous transfusions ($p<0.05$). The mean number of transfused homologous blood units in the control group was 0.34 compared with 0.05 in the treatment group ($p<0.05$). Comparing for the whole autologous and homologous transfusions, a selected control group, who had done blood deposit through self-transfusion, received a mean of 1.22 autologous bags, while a selected treatment group who had not done any self-blood predeposit before surgery received a mean of 0.08 homologous bags with a mean difference of 1.14 ($p<0.001$). Considering only patients who did

not undergo autologous blood predeposit, average Hb concentration in second and seventh day after surgery was respectively 10.28 and 10.26 g/dl in treatment group compared with 9.68 and 9.61 g/dl in control group, with a mean difference of 0.60 and 0.65 g/dl ($p<0.05$). Surgical use of human fibrin sealant reduced the requirement of homologous blood transfusions after primary standard cementless THR, and maintained higher post-operative Hb levels. Moreover routine use of this off the shelf topic fibrinogen-based haemostatic could, in the future, possibly be used as an alternative to autologous blood pre-deposit.

# Efficacy and safety of the haemostasis achieved by Vivostat System during laparoscopic partial nephrectomy.

Authors: Gidaro S., Cindolo L., Lipsky K., Zigeuner R., Schips L.

Publication Date: 2009

## Abstract:

Introduction: Haemostasis remains the greatest challenge during laparoscopic partial nephrectomy. We describe the use of the VivostatTM system helping effective haemostasis during laparoscopic partial nephrectomy (LPN). Patients and method: Twenty-eight patients underwent LPN. Autologous fibrin sealant was prepared with the VivostatTM system and applied to the resection bed. This system is an automated medical device for the preparation of an autologous fibrin sealant from the patient's blood. Pre and postoperative clinical parameters and laboratory values were evaluated, for acute and delayed bleeding. Results: Median patient's age was 58 years (range, 25-75). All patients underwent LPN for renal tumors (mean size 2.5 cm; range 0.9-4.5 cm). Six resection were performed without vessels clamping, and 22 were realized with selective arterial Bulldog clamping. Haemostasis was achieved by a cellulose bolster (80%), by stitches (67%) and by sealant application after declamping (100%) (mean amount applied: 5.1ml). The mean warm ischemia time was 26 minutes (range, 16-45) for 22 interventions. Mean blood loss was 128cc (range, 20-500). Pre-operative and post-operative creatinine values (mean, 0.91 vs 1ng/ml) did not differ significantly; whereas mean Hb levels slightly decreases after surgery (mean, 14.7 vs 12.5 g/dl). Mean operative time was 131 minutes (range, 60-190). All but one had negative surgical margins. One intraoperative bleeding occurred needing blood transfusion (1 unit). Postoperatively, we observed only 1 perirenal hematoma treated conservatively requiring blood transfusion. Conclusions: In this study, an effective haemostasis was achieved and maintained after kidney reperfusion. These data support the previous finding with the same system and encourage its use in LPN.

# Percutaneous stone surgery utilizing tubeless technique with fibrin sealant: Report of our first 100 cases.

Authors: Durbin J., Stroup S., L'esperance J., Auge B.

Publication Date: 2009

## Abstract:

Background: Percutaneous nephrolithotomy (PCNL) is the preferred treatment for large renal stones, and the tubeless technique for select patients has recently gained popularity. Several iterations of the procedure have been described. We report on our first 107 PCNL patients utilizing fibrin sealant as a hemostatic agent within the access tract. Methods: A retrospective review was completed for PCNL performed without nephrostomy tube from January 2002 to July 2008. We assessed demographics, length of hospital stay, stone size, stone free rates and complications. Stone free results were obtained by post-operative CT scan the morning following the procedure. Results: Fifty-nine men and 48 women with a mean age of 43 years were included in the analysis. Mean stone size was 2.9 cm and the average length of hospital stay was 1.07 days. Immediate targeted stone free rate in the tubeless group was 72% (77/107) which improved to 90% when considering residual fragments <=4 mm as stone free. The change in serum creatinine, hemoglobin and hematocrit were all statistically different when comparing preop and postop values, however, the change in creatinine was clinically insignificant (0.92mg/dl preop to 0.96mg/dl postop). Complications included seven asymptomatic subcapsular hematomas, one pseudoaneurysm requiring selective embolization, one urine leak and 5 return visits to the emergency room for pain. Conclusion: Tubeless PCNL remains a viable option for select patients. The specific technique utilized is dependent upon physician preference. The application of fibrin sealant to the nephrostomy tract can alleviate drainage in the immediate postoperative period.

# Autologous platelet gel and fibrin sealant enhance the efficacy of total knee arthroplasty: Improved range of motion, decreased length of stay and a reduced incidence of arthrofibrosis.

Authors: Everts P.A.M., Devilee R.J.J., Oosterbos C.J.M., Mahoney C.B., Schattenkerk M.E., Knape J.T.A., Van Zundert A.

Publication Date: 2007

## Abstract:

In this study we describe the potential role of autologous platelet gel and fibrin sealant in unilateral total knee arthroplasty to improve the postoperative range of motion and to reduce the incidence of arthrofibrosis. Total knee arthroplasty is often associated with a considerable amount of post-operative blood loss. Persistent limited motion directly after surgery may ultimately result in arthrofibrosis. To counteract these effects we investigated whether the use of autologous derived platelet gel and fibrin sealant would reduce postoperative blood loss, decrease the impaired range of motion and the incidence of arthrofibrosis. All patients were consecutively operated and assigned to the study or control groups. Study group patients (n = 85) were treated with the application of autologous platelet gel and fibrin sealant at the end of surgery. Eighty patients were operated without the use of platelet gel and fibrin sealant, and served as the control group. The postoperative hemoglobin decrease, range of motion and length of hospitalization were recorded. During a 5-month postoperative period patients were followed to observe the incidence of arthrofibrosis. In patients in the treatment group the hemoglobin concentration in blood decreased significantly less when compared to the control group. They also showed a superior postoperative range of motion when compared to those of the control group ($P < 0.001$). The incidence of arthrofibrosis and subsequent forced manipulation was significantly less ($P < 0.001$) in patients managed with platelet gel and fibrin sealant. We conclude that peri-operatively applied platelet gel and fibrin sealant may

improve the range of motion after total knee arthroplasty, decreases the length of stay and may reduce the incidence of arthrofibrosis. 

# A pilot study of the effects of vivostat patient-derived fibrin sealant in reducing blood loss in primary hip arthroplasty.

Authors: Lassen M.R., Solgaard S., Kjersgaard A.G., Olsen C., Lind B., Mittet K., Ganes H.C.

Publication Date: 2006

## Abstract:

A pilot study evaluated the effectiveness of Vivostat patient-derived fibrin sealant in reducing blood loss in patients who underwent primary hip arthroplasty. Eighty adult patients undergoing elective surgery were randomized to receive either Vivostat sealant or control (no additional hemostatic treatment). Patients allocated Vivostat sealant donated 120 mL of blood, which was then processed perioperatively to produce a fibrin sealant that was applied to the bleeding wound surfaces just before closure. Transfusion requirements, blood loss during surgery, drain volumes, and daily hematocrit and hemoglobin levels were measured. Hospitalization times, adverse events, and postoperative wound complications were also monitored. Blood loss during surgery and wound drainage volume was lower in the Vivostat group than in the control group, although the differences were not significantly different. Transfusion requirements (median, 270 mL of packed red blood cells) and hospitalization times (both median 7 days) were the same for both groups. No adverse events related to the use of Vivostat occurred. There were indications of a possible reduction in the incidence of postoperative wound oozing (15% vs 25%) and hematomas (6% vs 11%) with the use of Vivostat compared with the control group, although differences were not statistically significant. In conclusion, in this pilot study, use of Vivostat patient-derived fibrin in hip arthroplasty was not associated with a significant reduction in blood loss. Further studies, with larger numbers of patients, may be warranted to investigate a possible benefit of Vivostat in reducing postoperative wound complications. 

# Autologous Fibrin Glue Using the Vivostat System for Hemostasis in Laparoscopic Partial Nephrectomy.

Authors: Schips L., Dalpiaz O., Cestari A., Lipsky K., Gidaro S., Zigeuner R., Petritsch P.

Publication Date: 2006

## Abstract:

Objectives: Haemostasis remains the greatest challenge during laparoscopic partial nephrectomy. Use of fibrin sealant currently is increasing. We describe first a technique for achieving effective haemostasis during laparoscopic partial nephrectomy using the VivostatTM system. Methods: Ten patients underwent laparoscopic partial nephrectomy. Autologous fibrin sealant was prepared with the VivostatTM system and applied to the resection bed. This system is an automated medical device for the preparation of an autologous fibrin sealant, generating up to 5 ml of sealant from 120 ml of the patient's blood. The concentration of fibrin and the volume of sealant are stable; the sealant may be kept at room temperature for up to 8 hours before application without a loss of properties and effectiveness. The patients were evaluated for acute and delayed bleeding. Results: Mean patient's age was 54 years (range, 31-68). Haemostasis was immediate in all cases after application of the sealant for 1 to 2 minutes to the resection site; no additional haemostatic measures were required. Mean warm ischemia time was 23 minutes (range, 20-27); mean blood loss was 90 cc (range, 20-200). Pre-operative and post-operative serum haemoglobin did not differ significantly (mean, 14.9 vs 12.6 g/dl) and creatinine values (mean, 0.91 vs 0.95 ng/ml). Mean operative time was 136 minutes (range, 60-180). No postoperative bleeding or other complications occurred. Conclusions: In this study, immediate haemostasis was achieved and maintained after the kidney was reperfused. Our initial experience with the VivostatTM system in laparoscopic partial nephrectomy has been encouraging. 

# Effectiveness of a new carrier-bound fibrin sealant versus argon beamer as haemostatic agent during liver resection: A randomised prospective trial.

Authors: Frilling A., Stavrou G.A., Mischinger H.-J., De Hemptinne B., Rokkjaer M., Klempnauer J., Thorne A., Gloor B., Beckebaum S., Ghaffar M.F.A., Broelsch C.E.

Publication Date: 2005

## Abstract:

Background and aims: A new carrier-bound fibrin sealant, TachoSil, is expected to be efficacious and safe as a haemostatic treatment in hepatic resection. Design: A prospective, randomised, open and controlled multicentre trial with intraoperative as well as postoperative assessment of efficacy and a 1 month follow-up period. Setting: Tertiary care centres. Patients/methods: One hundred and twenty-one patients requiring secondary haemostasis during planned liver resection. Patients with coagulation disorders and patients with persistent major bleeding after primary haemostatic measures were excluded. Intervention: Application of either carrier-bound fibrin sealant (n=59) or argon beamer (argon beam coagulator) (n=62) as secondary haemostatic treatment. Main outcome measure: Time to intraoperative haemostasis. Results: There was a significant superiority of TachoSil over argon beamer with regard to time to haemostasis (3.9 min, median 3.0, range 3-20 min vs 6.3 min, median 4.0, range 3-39 min) (P=0.0007). Haemoglobin concentration of drainage fluid was significantly lower on day 2 after surgery in TachoSil patients (1.1 mmol/l) than in argon beamer patients (2.3 mmol/l) (P=0.012). Overall, the frequency and causality of adverse events did not differ between the two treatment groups. Conclusion: TachoSil is superior to argon beamer in obtaining effective and fast intraoperative haemostasis. The safety data show TachoSil to be tolerable and safe for haemostatic treatment in liver resection. 

# The use of single-donor fibrin glue prepared by recycled cryoprecipitation in experimental liver surgery.

Authors: Balint B., Cernak I., Petakov M., Bugarski D., Malicevic Z., Mandic-Radic S., Taseski J.

Publication Date: 2002

## Abstract:

The purpose of the study was to evaluate the hemostatic effectiveness of fibrin glue (FG) prepared by a modification of cryoprecipitation technique in experimental rat liver surgery. FG component 1 was prepared by triple or 'recycled' cryoprecipitation method from single-donor plasma. Rats subjected to liver incision, partial and total lobectomy were treated with FG on the surgical cut surface or underwent standard surgical technique. The efficacy of FG-treatment was evaluated on the basis of the 24-hour survival ratio and peripheral blood hematological parameters. The mean values of fibrinogen, FXIII, fibronectin and horizontal tensile strength of FG were 54.2 +/- 19.9 g/l, 13.5 +/- 3.6 IU/ml, 3103.1 +/- 148.9 mg/l, and 1.076 +/- 0.18 N/cm<sup>2</sup>, respectively. The survival of FG-treated rats subjected to partial and total lobectomy was significantly higher in comparison to the FG-nontreated animals, accompanied with higher values of red blood cell counts, hemoglobin concentration and hematocrit. When liver incision was performed, although there were no differences in survival rate, FG-treated animals had significantly higher values of the tested hematological parameters. The presented results demonstrated that by using 'recycled' cryoprecipitation it is possible to obtain high quality single-donor FG with successful hemostatic therapeutical effects, as confirmed in the experimental rat model of liver surgery.

# Perioperative blood transfusions: Indications and options.

Authors: McFarland J.G.

Publication Date: 1999

## Abstract:

A reevaluation of the indications for and alternatives to transfusion of allogeneic blood was precipitated by transfusion-induced HIV. The transfusion trigger has shifted from an optimal hemoglobin level and hematocrit (10/30) to that level of hemoglobin necessary to meet the patient's tissue oxygen demands. This critical level can best be determined by physiologic measurements. A number of autologous blood options can reduce the patient's allogeneic blood needs. Pharmacologic measures to increase hemoglobin levels (erythropoietin) and to decrease blood loss at surgery are discussed as are the potential contributions of blood substitutes to transfusion support of the surgical patient.

# 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.

# Hemostasis for the Ramstedt procedure: Use of a fibrin adhesive.

Authors: Yamazaki Y., Yoshida T., Mizuno R., Yuno S., Hara A., Yoshizawa J., Sakurai K.

Publication Date: 1994

## Abstract:

Pre- and postoperative blood counts were retrospectively compared between patients with no hemostatic management (group A, n = 30) and patients with a fibrin adhesive (Beriplast P) applied to the cut edges (group B, n = 8) when pyloromyotomy was performed for hypertrophic pyloric stenosis. Postoperative red blood cell count, hematocrit, and hemoglobin were significantly decreased in group A ($P < 0.01$) while there was no significant change in group B. It has been stated that the Ramstedt operation does not require any special hemostatic management. However, as postoperative peritoneal bleeding is suspected, hemostatic management with a fibrin adhesive applied to the incised region of the serosa and muscle layer is recommended.

# Laparoscopic injection of fibrin glue to arrest intraparenchymal abdominal hemorrhage: An experimental study.

Authors: Salvino C.K., Esposito T.J., Smith D.K., Jacobs H.K., Candel A.G., Dries D., Gamelli R.

Publication Date: 1993

## Abstract:

The laparoscope offers a novel avenue for the diagnosis of intra-abdominal injury and the use of fibrin glue (FG) as a treatment for hemorrhage in trauma patients. This study was undertaken to assess the practicality and effectiveness of FG injection under laparoscopic direction to arrest hemorrhage in solid viscera. Twenty dogs were randomized into a control group (CG) and a treatment group (TG). All animals underwent laparotomy to surgically induce uniform injuries to the hepatic and splenic parenchyma. The TG animals (n = 12) were allowed to hemorrhage for 30 minutes. The injuries were then visualized and FG injected intraparenchymally under laparoscopic direction. The average duration of the procedure was 25 minutes (range, 15- 50). No hemostatic interventions were performed on the CG animals (n = 8). Mortality in the CG was 63% (5 of 8); there were no deaths in TG animals prior to sacrifice. Necropsy of TG animals revealed progressively healing hepatic and splenic injuries with no gross evidence of pulmonary FG emboli, intraparenchymal microemboli, or increased adhesion formation. No other complications were noted. This study demonstrates that hemorrhage from the liver and spleen can be successfully controlled using the laparoscope to direct the intraparenchymal injection of FG. In this experimental model, the procedure can be performed expeditiously. It is associated with reduction of mortality to zero when compared with controls. No complications associated with laparoscopy or FG injection were recognized. This technique may have potential for application in the management of stable patients who manifest evidence of intraperitoneal hemorrhage as a result of solid organ injury.

# Use of evicel fibrin sealant for improving hemostasis following transurethral prostate debulking surgery in patients with BPH.

Authors: Tabatabaei S., Talab S.S., Kloc L.S., Siddiqui M.M., Akhavein A., Vazquez R., Ko D.S.C.

Publication Date: 2014

## Abstract:

INTRODUCTION AND OBJECTIVES: In this exploratory study we aim to determine the feasibility and effectiveness of application of EVICEL fibrin sealant into the prostatic cavity for improvements in hemostasis after transurethral prostate surgery. METHODS: We conducted a prospective, subject and assessor blinded, randomized controlled study in 29 patients with LUTS/ BPH. Following completion of the transurethral debulking procedure, the following steps were taken in EVICEL group (n = 15): bladder and urethra were emptied of fluid and filled with 15mmHg CO2 gas employing a standard CO2 insufflator. EVICEL was applied inside the prostatic cavity under direct visualization. In 14 control patients, the procedure was ended following standard debulking techniques. Post-op bleeding was evaluated at 1, 6 and 24 hrs after surgery by measuring hemoglobin level in the bladder irrigation fluid. Patients were followed for 3 months evaluating urinary symptoms and possible complications. RESULTS: The mean patients' age was 63 and 68 yrs in control and EVICEL groups, respectively. Application of sealant added in average 13 (7-20)min to the standard surgery.Hemoglobin level in irrigation fluid 1, 6 and 24 hrs after surgery was 11.25 +/- 18.65 vs. 5.97 +/- 6.03mg/dl, 9.25 +/- 10.22 vs. 8.68 +/- 6.31mg/dl and 11.37 +/- 12.6 vs. 5.23+/- 2.84mg/dl in control and EVICEL groups, respectively (P > 0.05). Patients in EVICELgroup have 46.9%, 8% and 46.2% less bleeding 1,6 and 24 hrs after surgery, respectively. Both groups were comparable in terms of post-op voiding symptoms, surgical outcome and QOL questionnaires. CONCLUSIONS: This is the first report of successful application of fibrin sealant following endoscopic prostate debulking procedure with some improvements in reduction in

bleeding. Further studies are warranted.

# A prospective study of the efficacy of clinical application of a new carrier-bound fibrin sealant after liver resection.

Authors: Briceno J., Naranjo A., Ciria R., Diaz-Nieto R., Sanchez-Hidalgo J.-M., Luque A., Rufian S., Lopez-Cillero P.

Publication Date: 2010

## Abstract:

Objective: To examine the effectiveness of fibrin sealants as supportive treatment to improve hemostasis and decrease the incidence of bile leakage and intra-abdominal collections. Design: Prospective, controlled, quasiexperimental study. Setting: Tertiary referral center, University Hospital Reina Sofia. Patients: A total of 115 patients (58 in the control group and 57 in the collagen sponge group) scheduled for conventional hepatectomies. Interventions: Patients were distributed into groups for major and minor hepatectomies with or without application of a carrier-bound collagen sponge on the raw surface of the liver. Main Outcome Measures: The main outcome measures were postoperative mortality, incidence and severity of postoperative surgical complications, and length of hospital stay. The secondary outcome measures were postoperative drainage output volume, transfusion requirements, and changes in biochemical parameters (hemoglobin, bilirubin, alanine aminotransferase, and platelet levels). Results: The fibrin sealant after major liver resection was effective for decreasing drainage volume (mean [SD] volume, 1124.7 [842.8] mL in the control group and 691.2 [499.5] mL in the collagen sponge group; P=.007) with a higher volume of output by drain each postoperative day in the control patients (P=.003); postoperative blood transfusion requirements (18.9% vs 7.0%, respectively; P=.04); moderate to severe postoperative complications (21% vs 8%, respectively; P=.03); and mean (SD) hospital stay (12.6[6.7] vs 9.6[5.1] days, respectively; P=.03). Conclusion: The use of a new carrier-bound collagen sponge after major liver resection may be recommended because of its clinical and cost-savings effectiveness. ©2010

# 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.