Ultrastructure

Perivenous application of fibrin glue reduces early injury to the human saphenous vein graft wall in an ex vivo model.

Authors: Stooker W, Niessen HW, Wildevuur WR, van Hinsbergh VW, Fritz J, Jansen EK, Wildevuur ChR, Eijsman L

Publication Date: 2002

Abstract:

OBJECTIVES: From animal and clinical studies it is known that prevention of 'over-distention' of vein grafts by using extravascular support ameliorates the arterialization process in vein grafts with subsequent more favorable patency. The most ideal support is a biodegradable, porous, elastic graft (Biomaterials, 15 (1994) 83). However, a specific graft meeting these criteria is not available yet. Fibrin glue on the other hand, although used for other purposes in cardiac surgery, theoretically meets the criteria for ideal extravascular support. In this ex vivo study, we evaluated the possible beneficial effect of perivenous application of fibrin glue. METHODS: Segments of human vein graft obtained during CABG procedures in 14 consecutive patients were placed in a side loop of the extracorporeal perfusion circuit. In this way the study vein grafts did meet identical circumstances as the vein grafts implanted. Perfusion in the loop was started with a flow just enough to counteract the collapse of the vein, usually about 8 mm Hg, and alternately around the segments fibrin glue was applied or no perivenous support was administered as control. After 1 min of soldification, perfusion was started with a pressure of about 60 mm Hg (non-pulsatile flow). Perfusion was maintained for 60 min, after which the grafts were collected for light microscopic and electron microscopic assessment. RESULTS: Light microscopy and electron microscopy showed remarkable attenuation of endothelial cell loss and less injury of smooth muscle cells of the circular muscle layer of the media in the fibrin glue supported vein grafts compared to the non-supported group. CONCLUSION: Fibrin glue is able to accomplish adequate external vein graft support, preventing overdistention, in an ex vivo model. This provides a basis for clinical application. Further investigation is necessary to evaluate long-term effects.

Evaluation of application techniques of fibrin sealant to prevent cerebrospinal fluid leakage: a new device for the application of aerosolized fibrin glue.

Authors: Sawamura Y, Asaoka K, Terasaka S, Tada M, Uchida T

Publication Date: 1999

Abstract:

OBJECTIVE: This report evaluates the sealing effects of fibrin sealant applied on the dura mater using different techniques. METHODS: Three application methods were studied: a sequential layer method, a simultaneous method using a cannula, and a spray method using a newly developed spray device. The sealing effects of these methods were compared using in vitro histological analysis and a pressure resistance test. The clinical efficacy of the fibrin sealant to prevent water leakage through the dura mater was retrospectively analyzed in a total of 509 patients. The process of absorption of a clinically applied fibrin clot in vivo was examined using surgical specimens. RESULTS: The fibrin plate made using the spray method withstood a hydrostatic pressure greater than 200 cm H2O. A scanning electron microscopic study of the fibrin clots showed that the sequential and simultaneous methods produced a fibrin fiber network; in contrast, our spray method formed a dense fibrin tissue in which the fibrin molecules fused together forming stratified laminae. Of the 295 supratentorial craniotomies during which spraying was used, postsurgical cerebrospinal fluid leakage occurred in 9 cases (3.1%), whereas of the 214 craniotomies during which spraying was not used, cerebrospinal fluid leakage occurred in 19 cases (8.9%). Histological examinations of 10 surgical specimens obtained during second craniotomies revealed that the spray-made fibrin clots had been gradually replaced by mature granulation composed of collagenous connective tissue. CONCLUSION: The optimal technique for applying fibrin sealant is the spray method that aerosolizes fibrin glue and produces a tough fibrin plate.

Healing of meniscal tissue by cellular fibrin glue: An in vivo study.

Authors: Scotti C., Pozzi A., Mangiavini L., Vitari F., Boschetti F., Domeneghini C., Fraschini G., Peretti G.M.

Publication Date: 2009

Abstract:

Menisci represent fundamental structures for the maintenance of knee homeostasis, playing a key role in knee biomechanics. However, their intrinsic regenerative potential is poor. As a consequence, when a lesion occurs and the meniscus is partially removed by surgery, knee mechanics is subject to dramatic changes. These have been demonstrated to lead often to the development of early osteoarthritis. Therefore, menisci should be repaired whenever possible. In the last decades, tissue engineering approaches have been advocated to improve the reparative processes of joint tissues. In this study, the bonding capacity of an articular chondrocytes-fibrin glue hydrogel was tested as a biologic glue to improve the bonding between two swine meniscal slices in a nude mouse model. The composites were wrapped with acellular fibrin glue and implanted in subcutaneous pouches of nude mice for 4 weeks. Upon retrieval, a firm gross bonding was observed in the experimental samples while none of the control samples, prepared with acellular fibrin glue at the interface, presented any sign of bonding. This was consistent with the histological and scanning electron microscope findings. In particular, a fibrocartilaginous tissue was found at the interface between the meniscal slices, partially penetrating the native meniscus tissue. In order to overcome the lack of regenerative properties of the meniscus, the rationale of using cellular fibrin glue is that fibrin provides immediate stability while carrying cells in the site of lesion. Moreover, fibrin gel is recognized as an optimal scaffold for cell embedding and for promoting fibrocartilaginous differentiation of the cells which synthesize matrix having healing property. These results demonstrated the potential of this model for improving the meniscal bonding. However, further orthotopic studies in a large animal model are needed to evaluate its potential for clinical application.

Platelet-rich fibrin (PRF): A second-generation platelet concentrate. Part I: Technological concepts and evolution.

Authors: Dohan D.M., Choukroun J., Diss A., Dohan S.L., Dohan A.J.J., Mouhyi J., Gogly B.

Publication Date: 2006

Abstract:

Platelet-rich fibrin (PRF) belongs to a new generation of platelet concentrates geared to simplified preparation without biochemical blood handling. In this initial article, we describe the conceptual and technical evolution from fibrin glues to platelet concentrates. This retrospective analysis is necessary for the understanding of fibrin technologies and the evaluation of the biochemical properties of 3 generations of surgical additives, respectively fibrin adhesives, concentrated platelet-rich plasma (cPRP) and PRF. Indeed, the 3-dimensional fibrin architecture is deeply dependent on artificial clinical polymerization processes, such as massive bovine thrombin addition. Currently, the slow polymerization during PRF preparation seems to generate a fibrin network very similar to the natural one. Such a network leads to a more efficient cell migration and proliferation and thus cicatrization.

In vitro-lined endothelium: Initial integrity and ultrastructural events.

Authors: Zilla P., Preiss P., Groscurth P., Rosemeier F., Deutsch M., Odell J., Heidinger C., Fasol R., Von Oppell U.

Publication Date: 1994

Abstract:

Background. The early fate of in vitro-endothelialized prosthetic vascular grafts was assessed in the nonhuman primate. Methods. Each of 17 male chacma baboons received a control and a confluently endothelialized 4 mm polytetrafluoroethylene graft in femoro-femoral positions (8.2 +/- 0.8 cm). All experimental grafts were precoated with fibrinolytically inhibited fibrin glue and lined with cultured autologous endothelial cells (EC) from the external jugular vein. The average time period needed to obtain first- passage mass-cultures sufficient for preconfluent graft endothelialization was 19.8 +/- 5.2 days. Before implantation in vitro-lined grafts were kept in culture for another 16.1 +/- 4.3 days to achieve complete confluence and maturation of the EC cytoskeleton. Results. After 9 days of implantation, endothelial-lined grafts still showed a confluent endothelium that was free of any fibrin deposits. However, the EC density was significantly lower than at implantation (39.7 +/- 7.6 x 10^3 versus 59.9 +/- 8.5 x 10^3 EC/cm^2; $p < 0.05$), and occasional 10-mum-wide intercellular gaps with adherent platelets and leukocytes were visible. Transmission electron microscopy showed leukocytes and cell debris in the underlying fibrin glue. After 4 weeks of implantation, the endothelium of experimental prostheses had regained a high cell density (72.7 +/- 10.5 x 10^3 EC/cm^2) with a mature and well- differentiated morphologic appearance. At both observation periods, the surface of control

grafts showed a wide range from fibrin deposits to an amorphous protein coverage containing spread platelets. Conclusions. The endothelium of in vitro-endothelialized vascular prostheses remains confluent after implantation and is nonthrombogenic in spite of a moderate initial cell loss.

Morphology and fertility after re-anastomosis of the rabbit Fallopian tube with fibrin glue.

Authors: Gauwerky J.F.H., Kubli F., Forssmann W.G.

Publication Date: 1988

Abstract:

Morphology and fertility were studied in 20 female New Zealand White rabbits after re-anastomosis of the Fallopian tube with fibrin glue and conventional microsurgical techniques. All oviducts were patent postoperatively. No intraperitoneal adhesions were observed. There were no significant differences with regard to the number of corpora lutea, implantations and the nidation index. Morphological studies demonstrated a normal fold pattern and ciliation at the side of anastomosis in the sealed oviducts as well as in the sutured oviducts. No intraluminal fibrin deposits were found. For re-anastomosis of the Fallopian tube with fibrin glue, splinting is necessary. In some instances this may by related to a mucosal trauma. However, under optimal conditions the use of fibrin glue is equivalent to conventional microsurgical anastomosis of the oviduct. For tubocornual, ampullary-ampullary and isthmic-ampullary anastomoses with luminal disparity, fibrin glue seems to be inappropriate.

The venous graft as an effector of early angiogenesis in a fibrin matrix.

Authors: Polykandriotis E, Tjiawi J, Euler S, Arkudas A, Hess A, Brune K, Greil P, Lametschwandtner A, Horch RE, Kneser U

Publication Date: 2008

Abstract:

The arteriovenous loop (AV loop) model is gaining importance as a means of initiating and sustaining perfusion in tissue engineering constructs in vivo. This study represents an attempt to dissect the morphology of early arterialization and angiogenesis in the AV loop in a fibrin matrix with special focus on the interpositional venous graft (IVG) segment. An AV loop was constructed in 30 rats using the femoral vessels and an IVG. The AV loop was encased in an isolation chamber filled with a fibrin matrix. Evaluation methods included scanning electron microscopy (SEM) of corrosion casts, immune histology and micro magnetic resonance angiography (MRA). Direct luminal neovascular sprouting was evident between day 10 and day 14 from the vein and the IVG but not from the arterial segment. Arterialization of the IVG manifested itself on the corrosion casts as a gradual reduction in luminal caliber with onset after day 7. Microdissection of the microvascular replicas could demonstrate for the first time the presence of direct luminal sprouts from the IVG. MRA was used to display the shunt pattern of perfusion in the patent AV loop. From the three segments of the vascular axis in the AV loop the IVG is the most versatile for applications in the clinical as well as the experimental setting. Kinetics

of angiogenesis warrant further investigation in the IVG.

Novel sutureless transplantation of bioadhesive-coated, freeze-dried amniotic membrane for ocular surface reconstruction.

Authors: Sekiyama E, Nakamura T, Kurihara E, Cooper LJ, Fullwood NJ, Takaoka M, Hamuro J, Kinoshita S

Publication Date: 2007

Abstract:

PURPOSE: To evaluate the efficacy and safety of a novel sutureless transplantation of bioadhesive-coated, sterilized, freeze-dried amniotic membrane (FD-AM) for ocular surface reconstruction. METHODS: A bioadhesive-coated, freeze-dried amniotic membrane was made by freeze drying the denuded AM in a vacuum, applying the minimum amount of fibrin glue (mixture of fibrinogen and thrombin) necessary to retain adhesion on the chorionic side, and sterilizing it by gamma-radiation. The resultant AM was characterized for its biological and morphologic properties by immunohistochemical and electron microscopic examination. In addition, fibrin glue-coated, freeze-dried (FCFD) AM was transplanted onto a rabbit scleral surface without sutures, to examine its biocompatibility. RESULTS: Immunohistochemistry of the FCFD-AM revealed that fibrinogen existed on its chorionic side, and the process of applying fibrin glue did not affect its biological and morphologic properties. Moreover, electron microscopic examination of the chorionic side of the FCFD-AM revealed tiny microfibrils (which are probably fibrinogen protofibrils), and showed that the epithelial surface of FCFD-AM consisted of intact basal lamina similar to that of FD-AM. FCFD-AM transplantation was very easily performed, and the graft adhered to the bare sclera immediately. Though the fibrinogen naturally biodegraded within 2 weeks, the FCFD-AM remained for at least 12 weeks after transplantation. Epithelialization on the FCFD-AM was achieved within 2 weeks, as was the case with FD-AM transplantation. The conjunctival epithelium on the FCFD-AM was well stratified and not keratinized, suggesting that FCFD-AM supports normal cell differentiation. CONCLUSIONS: The FCFD-AM retained most of the biological characteristics of FD-AM. Consequently, this sutureless method of transplantation of FCFD-AM is safe, simple, and useful for ocular surface reconstruction.

[Healing of tubal anastomoses--microsurgery vs. fibrin gluing: morphologic aspects]. [German]

Authors: Gauwerky JF, Klose RP, Forssmann WG

Publication Date: 1994

Abstract:

The healing of anastomoses either by microsurgical suture technique or by fibrin sealant technique has been examined in an experimental morphological study. With view to morphological criteria the healing of tubal anastomoses after one month is completed. Afterwards only little areas of regeneration could

be found in the region of the anastomosis. These statements are valid for both types of anastomoses. In single cases a more progressive regeneration of the mucosa could be demonstrated. Using fibrin glue a more pronounced fibrosis could not be seen.