FIBRIN SEALANT AS TISSUE GLUE: PRELIMINARY EXPERIENCE IN COMPLEX GENITAL RECONSTRUCTIVE SURGERY

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ABSTRACT

Objectives. To report the outcomes of graft take and wound healing in the first reported series in which fibrin sealant was used as a tissue glue in the reconstruction of complex genital skin loss.

Methods. Between July 2001 and July 2005, 18 men requiring complex genital reconstruction underwent repair by two surgeons at our medical centers. Skin graft reconstruction was required in 6 men. Complete scrotal disassembly with extensive scrotal or thigh flaps was required for reconstruction of 12 others. In the skin graft cases, a thin layer of dilute fibrin sealant was sprayed on the recipient site immediately before graft apposition. In flap cases, fibrin sealant was injected beneath the flap to promote tissue adherence and prevent fluid accumulation. All wounds were followed up postoperatively and observed for evidence of graft take, seroma or hematoma formation, drainage, and infection.

Results. The 6 skin graft patients required a total of nine split-thickness skin grafts, all of which had 100% take. Of the 12 patients requiring flap reconstruction, 11 had excellent results. One flap case had a partial wound breakdown, but this reconstruction was performed immediately subsequent to a significant debridement and irrigation procedure in the same setting. Overall, 17 (94.4%) of 18 patients had no wound infection, seroma, hematoma, or other complications.

Conclusions. Fibrin sealant performs very well as a tissue glue and appears to be a useful adjunct in cases of complex genital skin loss reconstruction. UROLOGY 67: 688–692, 2006. © 2006 Elsevier Inc.

 Necrotizing genital infections usually produce extensive tissue loss. Multiple debridements are usually required within a period of several days or weeks. The resulting tissue defects often require complex reconstruction involving flaps or grafts. These surgeries are challenging given the mobility and multiple contours of the male genitalia.

Previous initial clinical experience from our institution suggested that fibrin sealant, when used as a tissue glue, would be a useful adjunct to complex genital reconstructive surgery.1 Furthermore, extensive evidence supporting the use of fibrin sealant to aid in graft and flap placement exists in published plastic surgery and burn reports.2–4 We now present our experience with complex genital reconstruction using fibrin sealant as a tissue glue.

MATERIAL AND METHODS

Complex genital reconstructive surgery was performed on 18 men from July 2001 to July 2005. Fourteen men underwent surgery at Brooke Army Medical Center by one of us (A.F.M.). The remaining 4 patients underwent surgery at Wayne State University Medical Center by another one of us (R.A.S.). Several patients at Brooke Army Medical Center with Fournier's gangrene required care in the Burn Unit because of their extensive tissue losses.

Skin Grafts

A total of nine split-thickness skin grafts (STSGs) were performed on 6 patients. Three patients with Fournier's gangrene underwent serial debridements (range two to four) with a resultant bed of healthy granulation tissue before STSG placement. Two patients with a tethered penis secondary to circumcision injury and infection underwent release of the penis with
 excision of the scar tissue and STSG coverage of the penile shaft. A patient with hidradenitis suppurativa underwent scrotectomy and perineal skin excision, with STSG coverage of both areas. In all STSG cases, the thrombin component of the fibrin sealant (Tisseel, Baxter AG) was diluted from 500 IU/mL to 5 IU/mL, the standard dilution regimen recommended by the manufacturer (Table I).

Using the Tissomat application device and Spray Set device, the two components of the fibrin sealant were passed through separate outlets in the spray head and then mixed and atomized using pressurized air. A thin layer of the diluted sealant was sprayed on the wound bed before graft placement. A few interrupted quilting sutures were used as needed to further secure the graft to the underlying tissue. Grafts were covered with Xeroform gauze and then with fluff gauze for additional immobilization. The dressings were left intact for 3 to 5 days, and then daily changes were performed with Xeroform gauze until a physician deemed them unnecessary.

**SKIN FLAPS**

Fibrin sealant was used in 12 patients who underwent flap reconstruction. In 3 of 4 patients with Fournier’s gangrene, the flaps were rotated after multiple debridements for several weeks. In 1 of these patients, the flaps were placed in the same setting as that of an extensive debridement 2 weeks after the initial presentation. Two patients with invasive penile cancer required penectomy and partial or complete scrotal excision (Fig. 1). Thigh flaps were rotated to cover the scrotal defects in both cases. In all these cases, fibrin sealant was injected or sprayed evenly on the tissue bed and the overlying flap was placed and secured with interrupted sutures. This allowed for optimal adherence of the tissues and helped prevent fluid accumulation. Direct manual pressure was applied over the flap for 1 to 2 minutes to ensure good apposition. Dilution and aerosolization were not routinely used in all the skin flap cases, because flaps have an intact blood supply and do not depend on direct vascular imbibition and inosculation.

The scrotum was completely bivalved in 6 cases (four urethral strictures, one scrotal phlegmon, and one urethrocystaneous fistula) to provide access to the distal bulb. After reconstruction, the scrotal and perineal tissues were then reapprroximated and glued together with fibrin sealant. Interrupted sutures were used to secure the closure. Penrose drains were left in place for 2 to 3 days in both patients with penile cancer and the patient with scrotal phlegmon. Drains were not required in any other flap or graft case.

All grafts and flaps were followed up closely for evidence of graft take and the presence or absence of hematoma, seroma, infection, or wound breakdown.

**RESULTS**

In the skin graft cases, the diluted fibrin sealant allowed time for meticulous graft positioning. The excellent tissue adherence decreased the need for time-consuming quilting sutures. The grafts healed extremely well, with 100% graft take in all 6 patients. No patient developed infection, hematoma, or seroma formation.

In the flap cases, the fibrin sealant promoted excellent flap adherence and outcomes in 11 of the 12 patients. The lone patient who had breakdown at the edges of 25% of his flap had undergone extensive debridement of necrotic tissue in the same setting as his flap placement. The other 11 patients had no evidence of infection, hematoma, or seroma formation.

**COMMENT**

Fibrin sealant appears to function extremely well as a tissue glue and overcomes some of the obstacles to graft and flap success. Despite a paucity of evidence in published urologic reports, the nonurologic data (burn, plastic surgery, and otolaryngology) strongly suggest a potential benefit for fibrin sealant in the reconstruction of complex skin loss. Buckley et al. reported greater than 95% graft and flap take in 45 of 50 complex trauma patients using fibrin sealant, noting the advantages of quick application, a decreased need for sutures, and a decreased incidence of hematoma formation.

Improvements in outcomes have been reported when grafting over complex skin contours and mobile sites. Vibe and Pless noted 88% success with, and only 44% success without, fibrin sealant when grafting over mobile muscle or skin folds. Similarly, Stuart et al. noted 99% take when fibrin sealant was used with 26 skin grafts on the hands of burn victims. Fibrin tissue adhesive has also been shown to eliminate or decrease the need for sutures, pressure dressings, and significant postoperative wound care on facial, axillary, perineal, and gluteal fold burns, as well as other difficult sites.

Because of its excellent adherence on difficult skin contours, fibrin sealant has also been associated with decreased seroma formation. Oliver et al. noted a significant decrease in the drainage from under flaps when fibrin sealant was used in face lifts. Depondt et al. noted a decreased need for drain placement under flaps when fibrin sealant was used after parotidectomy. Moore et al. noted significantly decreased axillary drainage after node dissection in modified radical mastectomy when fibrin sealant was used.

It is important to recognize the significance of sealant dilution in grafting procedures. Dilution of the thrombin component extends the polymerization time from a matter of seconds to several minutes.
without affecting the adhesion or tensile strength of the sealant. In our experience, when sealant was not used, multiple time-consuming quilting sutures must be placed every few millimeters along the graft edge. With the diluted fibrin sealant, the graft may be meticulously placed without the need for nearly as many of these, thus expediting the procedure. Furthermore, diluting and aerosolizing the sealant creates a thin, highly mixed layer that allows adequate adhesion without acting as a barrier to imbibition and inosculation. Dilution and spraying is essential for grafts because the thin layer does not impair the necessary ingrowth of an adequate blood supply to the graft. The process of

FIGURE 1. Fibrin sealant application in skin flap for invasive penile cancer. (A) Invasive penile cancer, (B) fibrin sealant injection during reconstruction to glue scrotal flap into large defect after penectomy, left hemiscrotectomy, orchiectomy, and perineal urethrostomy, (C) immediate postoperative result, (D) 1-week postoperative photograph with no edema, drainage, or ecchymosis.
time of surgery. A patient who had tissue that appeared viable at the need for further debridement in a critically ill patient. This was done in an attempt to minimize the risk of fluid accumulation. In skin flap cases when injected directly beneath the flap, fibrin sealant was used to transfix large skin flaps. A direct comparison of genital reconstructions with decreased bruising, edema, hematoma formation, and operative time and the lack of a necessity for drain placement. As described elsewhere, the need for sutures was often obviated when direct manual pressure was applied for several minutes afterward.

Excellent outcomes were achieved in 11 of 12 patients undergoing flap placement, with the complete absence of wound breakdown, hematoma, seroma, or infection. The lone case of 25% flap dehiscence occurred after the flap was glued in the same setting as that of an extensive debridement of gangrenous tissue. This was done in an attempt to minimize the need for further debridement in a critically ill patient who had tissue that appeared viable at the time of surgery.

One limitation of our study was the lack of a control group undergoing similar treatment without fibrin sealant. A direct comparison of genital grafts performed without sealant was not performed in this series. Several series of genital skin reconstructions have reported “excellent outcomes” with the use of nonsealed STSGs, and one series of complicated burn patients requiring STSGs reported success rates of 85% to 93%. In our experience, although nonsealed STSGs and skin flaps work well in genital reconstruction, their application is time-consuming, tedious, challenging, and associated with the risk of seroma and hematoma formation.

CONCLUSIONS

Fibrin sealant performed effectively as a tissue glue in complex male genital reconstruction. Dilution of the fibrin sealant in skin graft cases allowed time for meticulous graft positioning without compromising adherence. The challenges posed by the complex contours of the male genitalia were overcome by the excellent adherence promoted by the fibrin sealant. The fibrin sealant was also effective in skin flap cases when injected directly beneath the flaps to promote tissue adherence and prevent fluid accumulation.

REFERENCES


EDITORIAL COMMENT

An increasing number of reports have documented the use of fibrin sealant in urology. Morris and colleagues reported the use of fibrin sealant in a series of 18 men undergoing complex genital reconstruction with skin graft and skin flap reconstruction. Because skin flaps have an intact blood supply and do not depend on vascular imbibition and inosculation, the fibrin sealant was injected under the flap without dilution, and direct manual pressure was subsequently applied for 1 to 2 minutes to ensure correct positioning. With the STSGs, the thrombin component of the fibrin sealant was diluted from 500 IU/mL to 5 IU/mL, and a thin layer of the diluted sealant was sprayed on the wound in an aerosolized fashion. The dilution and application of a
Thin layer was performed because imbibition and inoscula-
tion are necessary for skin graft survival and presumab-
ly would have been inhibited by a thicker layer of fibrin. The
authors report excellent results with no infection, hema-
toma, or seroma. Six patients with skin graft placement had
100% graft take, and 11 of 12 patients with skin flaps also
had excellent results. The authors concluded that fibrin
sealant is an effective tissue glue in reconstructive opera-
tions with complex contours such as male genitalia that
saves time by decreasing the need for sutures.

This series has demonstrated promising results from fi-
brin sealant with the possibility of broader applications in
reconstructive urology. However, before adopting this
technique, several factors must be considered. As noted by
the authors, their results did not differ significantly from
those of other reports of genital skin reconstruction with
skin grafts or flaps performed without fibrin sealant. Al-
though the authors’ opinion was that the use of fibrin seal-
ant saved time, the amount of time saved, as well as the
reduction in the number of sutures placed, was not deter-
 mined. Furthermore, the lack of a control group limited the
validity of their recommendations to the technical descrip-
tion. Finally, fibrin sealant is derived from pooled fresh
frozen human plasma and, therefore, carries a potential risk
of transmission of infectious particles. Despite these limi-
tations, the excellent results to date warrant further evalu-
ation of this technique in a controlled fashion.

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REPLY BY THE AUTHORS

As the reviewer points out, our lack of a control group certainly
limited the gravity of this preliminary experience. Although a
large, randomized, prospective, multi-institutional study would
provide important confirmation, genital gangrene cases are un-
common and vary greatly in their presentation. Also, a matched
comparison of operative times, number of sutures required,
and outcomes would be nearly impossible, given the problems
associated with controlling the varying sizes and locations of
tissue defects, let alone other important factors such as patient
age, nutritional status, and comorbidities. Such a study would
require at least a decade to complete, if it were possible at all.

Our experience evaluating fibrin sealant as a tissue glue on
split-thickness genital skin grafts and flaps (the largest yet re-
ported) adds to the mounting clinical and scientific evidence in
nonurologic published reports suggesting its use is both safe and
effective in promoting wound healing. The senior author noted
that the sulcus between the testes, in particular, is often a difficult
area in which to achieve a perfect neoscrotal graft take without
fibrin sealant use. Edema and hematoma are other troublesome
complications often associated with major genital reconstruction
procedures that are hard to quantify.

The risk of viral transmission from a Food and Drug Admin-
istration-approved fibrin sealant compound is so vanishingly
small that its use does not require informed consent. The va-
por heating procedure used has been proven to be safe in
millions of cases worldwide during the past three decades. We
firmly believe that fibrin sealant is a major advance in the care
of complex genital wounds.

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