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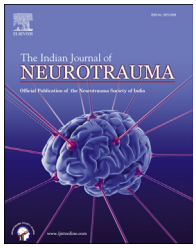

Review Article

Use of fibrin glue in the repair of brachial plexus and peripheral nerve injuries

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ABSTRACT

Background: Brachial plexus and other peripheral nerve injuries present with considerable functional impairment. Surgical outcomes following repair of such injuries are generally considered to be poor. Traditionally nerve repairs are performed with synthetic micro sutures under high power magnification. This not only takes considerable operating time, but also may induce local inflammatory response and fibrosis, which hampers the distal migration of axonal sprouts. An alternative technique for nerve repair is the use of fibrin glue.
Methods: Commercially available fibrin glue has been used in the repair of brachial plexus and peripheral nerve injuries. This technique has been evaluated for the ease of performance, time spent in nerve fixation, strength at coaptation sites and ultimate functional recovery.
Results: Coaptation of nerves with fibrin glue is a relatively simple technique performed under loupe magnification without the need of an operating microscope. The strength at coaptation site is good enough to hold the nerve ends together. No untoward effects directly related to the use of fibrin glue are observed in the operated patients. The most important aspect in using fibrin glue is a reduction in operating time by almost 30%, when compared with conventional suturing techniques using synthetic micro sutures. Functional results are comparable to those usually obtained with sutures.
Conclusion: Use of fibrin glue is an alternative and effective technique in the repair of brachial plexus and peripheral nerve injuries. This technique of nerve coaptation considerably reduces the operating time which is an important factor in the management of nerve injuries.

1. Introduction

Conventionally brachial plexus injuries are repaired under operating microscope with synthetic micro suture (nylon thread). This not only takes considerable operating time but also requires an expertize in microsurgical techniques. Synthetic suture also induces local inflammatory reaction that may affect nerve regeneration.[1]

1.1. *Fibrin glue*

Fibrin glue is a compound containing a high concentration of plasma proteins and their plasma activator. When blended, these produce an insoluble and stable fibrin clot, which exhibits an adhesive action in tissue repair. Fibrin glue has been used as an alternative technique in nerve coaptation. A recent study[2] has compared the use of fibrin glue and micro sutures

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in the repair of rat median nerve and found that nerve repairs performed with fibrin sealants produced less inflammatory response and fibrosis, achieved better axonal regeneration and better fiber alignment than the nerve repairs performed with micro sutures alone. The technique is simple, strength at coaptation site is good and there is a considerable reduction in operating time.

Commercially available fibrin glue consists of two components in freeze dried form – first component consisting of clottable protein fibrinogen, plasmafibronectin, factor XIII, plasminogen and aprotinin, where as the second component consists of thrombin and calcium chloride. The fibrinotherm device is used for the reconstitution of lyophilized fibrin sealant. When the two components are mixed together, they quickly form a white, elastic mass which firmly adheres to the tissues. This fibrin mass acts as a regeneration chamber for the growing axons. There is enough evidence to suggest that the presence of glue between the two nerve ends is not a barrier to the passage of axons.[3]

1.2. *Animal studies*

Experimental studies on the sciatic nerves of Wistar albino rats clearly indicate presence of less inflammation, minimal fibrosis and absence of granuloma formation with fibrin glue repair, when compared with synthetic suture anastomosis.[1] There is also a better axonal regeneration and fiber alignment when compared with suture repairs.[4]

1.3. *Use of fibrin glue in brachial plexus repair*

With fibrin glue repair there is considerable gain in operating time while bridging nerve gaps with nerve grafts, in both the adult as well as obstetric brachial plexus injuries (Fig. 1). In situations where suture application is difficult due to technical reasons (e.g; repairs close to the spinal foramina, repair of thin nerves), gluing of nerves is a simple and effective technique in nerve coaptation (Fig. 2). In obstetric palsies where anesthesia time is critical, nerve repairs are preferably performed with fibrin glue.

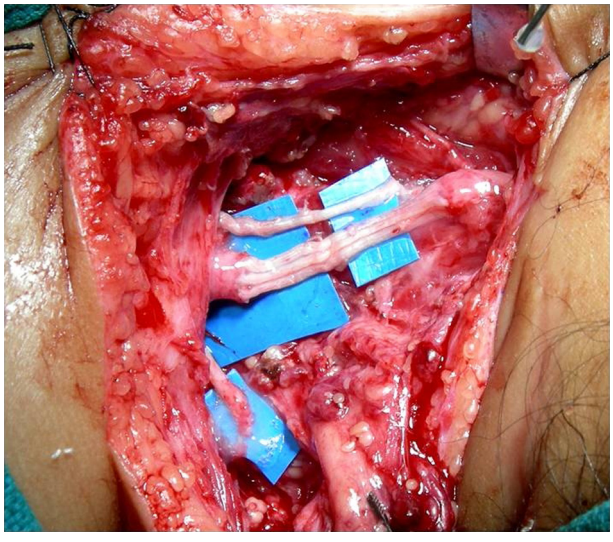

Fig. 1 – Use of fibrin glue in nerve graft fixation in obstetric palsy.

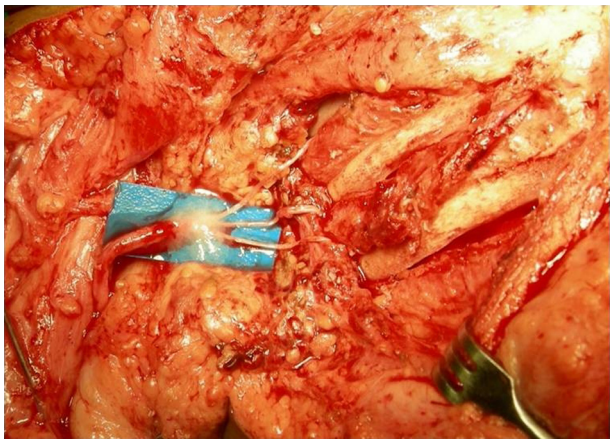

Fig. 2 – Glueing of three intercostal nerves with the musculocutaneous nerve.

1.4. *Use of fibrin glue in peripheral nerve repair*

Nerve repairs, when performed with multiple cables of nerve grafts, not only under takes considerable operating time, but also leads to wastage of axons at the graft coaptation sites. Fibrin glue repair is a simple and quicker technique in peripheral nerve repairs (Fig. 3) with functional outcomes equal, if not superior, to that of micro suture repair.[4] The strength at coaptation site is good enough to hold the nerve ends together (Fig. 4).

2. Discussion

Conventionally micro sutures have been used in the repair of peripheral nerves. However, suture material may produce an inflammatory reaction and retard the process of nerve regeneration. Suture placement has been suggested to cause

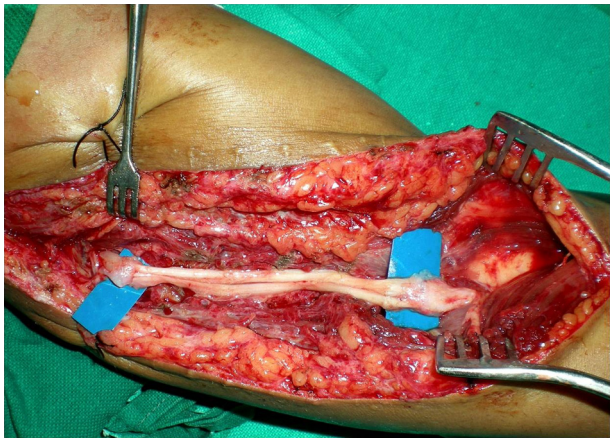

Fig. 3 – Radial nerve repair with sural nerve grafts using fibrin glue.

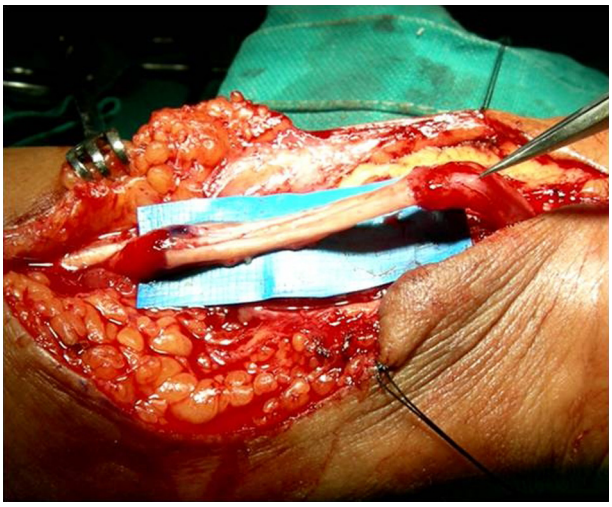

Fig. 4 – There is sufficient strength at anastomotic site to hold the nerve ends in a 'glued' median nerve.

hindrance to the sprouting axons and compress the blood supply to the fascicles.[5] Besides this, suturing of thin caliber nerves may be difficult and technically challenging. Repairing with fibrin glue is an alternative to conventional suture repair. Use of fibrin glue in nerve repair dates back to the experimental work of Young and Medawar[6] and Tarlov et al,[7] in the early 1940s. However, the method remained purely experimental till 1970s, when Matras et al,[8] Kuderna et al,[9] Narakas,[10] and Smahel et al[11] developed it further. Fibrin glue is a compound containing high concentration of plasma proteins and their plasma activators. Commercially available fibrin sealant essentially consists of two kits – lyophilized protein concentrate (fibrinogen, plasmafibronectin), factor XIII, plasminogen and aprotinin solution in first kit, and lyophilized thrombin and calcium chloride in second kit. Lyophilized protein concentrate is reconstituted in aprotinin solution to give the first component of the sealant. The lyophilized thrombin is reconstituted in the calcium chloride solution to give rise the second component. The two components are mixed immediately before application. This forms a viscous solution that quickly sets to form a white, elastic mass which firmly adheres to the tissues.

In nerve repair, fibrin glue should form an adhesive cylinder around the stumps of the nerve. It is not meant to as an adhesive between the cut end surfaces of fascicles. Gluing offers a distinctive advantage in the repair of fine caliber nerves (digital, facial and intercostals nerves). Here repair with 11 or 12/0 sized micro suture is technically difficult and also introduces a lot of foreign material. The gluing of nerves is a simple, least traumatic technique which considerably reduces the operating time. Functional results with both the techniques of nerve fixation are comparable.

2.1. *Ethical issues*

Though the fibrin glue is prepared from pooled human plasma, the risk of transmission of diseases is virtually zero,[12] because during manufacturing each plasma pool is tested for the presence of genome sequences of human immunodeficiency and hepatitis A, B, and C viruses, using polymerase chain reaction.

3. Conclusion

Nerve repair with fibrin glue produces less inflammatory response and fibrosis than repairs with micro sutures. In addition the technique is simple, quicker and least traumatic to the delicate nerves. Fibrin glue represents a good alternative technique to micro suture for the peripheral nerve repair.

Conflicts of interest

The author has none to declare.

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