The purpose of this study was to compare the suture of a microvascular anastomosis with and without the aid of sodium hyaluronate. The divided femoral arteries of ten Sprague-Dawley rats were sutured using sodium hyaluronate on one side. Operating time, bleeding, and patency rates were studied and compared. No significant differences were found in the measured parameters. However, the clinical impression is that the use of sodium hyaluronate facilitates the suture of a microanastomosis.

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SODIUM HYALURONATE AS AN AID IN MICROVASCULAR SURGERY

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The development of microvascular surgery has been a gradual process. It involves many techniques, both surgical and biotechnical, as well as searching for suitable materials for sutures and for bridging defects in vascular continuity.[1] The use of a viscoelastic material, sodium hyaluronate, in performing suture of a microanastomosis has, to the best of my knowledge, never been reported.

Sodium hyaluronate is a physiological substance that is present, for example, in the vitreous and aqueous humor of the eye. This substance has a high molecular weight, is viscoelastic, and is noninflammatory. It is used in ophthalmic surgery because of its viscoelastic properties. It acts as a resilient buffer to inadvertent intraoperative mechanical damage to tissues and cell layers.

This report describes a study of the use of sodium hyaluronate when suturing vascular microanastomoses.

MATERIAL AND METHODS

Ten Sprague-Dawley rats, weighing 390 ± 6 (mean ± SEM) g were used in the investigation. The rats were anesthetized with ether by inhalation. The anesthesia level was adjusted with supplemental ether inhalation administered by a ball of cotton wool.

The operations were performed with a clean but not sterile technique. An operating microscope, Zeiss OPMI-6 at ×25–40 magnification was used.

The groins were shaved bilaterally, and the rats were secured in a supine position. The skin and subcutaneous tissues on the medial aspect of the thighs and inguinal area were longitudinally incised and retracted, exposing the femoral vascular seen through the operating microscope. The femoral arteries were exposed and freed from surrounding structures. Any excess adventitia was trimmed away. Each artery was then isolated between the jaws of arterial clamps and cleanly divided with a pair of microscissors. The vessel lumen was then irrigated with heparinized saline.

Microanastomosis was then carried out using six interrupted sutures of 8–0 silk on a taper C-1 needle (Ethicon®). The same operative procedure was used on both sides. On one side of each rat 1 ml sodium hyaluronate was dropped into the operating field surrounding the ends of the divided femoral arteries to bridge the defect in between them. In five rats the sodium hyaluronate was used on the right side and in five rats on the left side.

The rats were kept under general anesthesia. The operating time was measured. Bleeding was measured by absorbing the blood with a ball of cotton wool that was weighed afterwards. The patency of the anastomosis was checked by means of the radical pressure test[2] 1, 2, and 5 to 6 hours after the operation.

Sodium hyaluronate (US Patent No. 4,141,973, 1979) is a polysaccharide (glucosaminoglycan) with a repeating disaccharide unit of sodium glucoronate and N-acetylglucosamine. The average molecular weight of the sodium hyaluronate substance used in the manufacturing of HEALON® is 5 million. HEALON® is sterile and nonpyrogenic, containing 10 mg of sodium hyaluronate per ml with less than 50 μg protein/ml in a physiologically buffered saline solution. The unusual viscoelasticity of HEALON® is due to the extreme length of its molecular change, its specific confirmations, and its extensive interactions. The substance exerts very little osmotic activity and has a colloid-osmotic pressure of 9 mm Hg. The average viscosity of HEALON® is more than 200,000 times greater than that of aqueous humor and balanced salt solution. HEALON® can behave as an elastic body.

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Table 1. Results of a comparison of suturing the femoral arteries in the rat with and without the aid of sodium hyaluronate (HEALON®).

Variables	Sodium hyaluronate Used (n = 10)	Not used (n = 10)
Operating time (min), Mean (SD)	14 (2)	17 (3)
Bleeding (ml), Mean (SD)	1.5 (0.8)	1.8 (0.5)
Patency rate		
1	9/10	10/10
2	8/10	7/10
5	7/10	6/10

RESULTS

The results of the measurements of the studied parameters are summarized in Table 1. No significant differences were found between the measured parameters when suturing the anastomosis with and without the aid of sodium hyaluronate.

DISCUSSION

An attempt to quantify the performance of a microvascular anastomosis in terms of operating time, bleeding, and patency rates presents many problems. Obviously this study of factors to measure performance in suturing microanastomosis has many drawbacks and is rather arbitrary. However, the clinical impression after finishing this study is that the use of sodium hyaluronate makes the suture of a microanastomosis easier.

As demonstrated in Table 1, the operating time on the side on which sodium hyaluronate was used is slightly lower than on the control side. This difference, not significant, is explained by the viscoelastic property of sodium hyaluronate. Placed in between and surrounding the ends of the vessels, sodium hyaluronate behaves as an elastic body keeping the ends of the vessels in place and reducing all movement in the area.

Although the amount of blood measured on both sides was almost equal, an important difference was noted. On the side on which sodium hyaluronate was used the small amount of bleeding from the surrounding tissues was kept outside the sodium hyaluronate substances, thereby leaving the operating field clear.

The immediate patency within the first hours after surgery is probably related to technical expertise and should give information about any eventual gain from the use of sodium hyaluronate. On the other hand, a late patency is probably more closely related to histopathologic changes that might be caused by this substance. The study here performed cannot give any information about eventual histologic changes caused by the use of sodium hyaluronate. For that purpose a study of the anastomosis weeks after the operation is necessary. On the other hand, studies of rats given intraperitoneal injections of sodium hyaluronate 0.25 ml, 0.5 ml, or 1.0 ml daily for 14 days showed no pathological changes attributable to sodium hyaluronate.[3]

The use of sodium hyaluronate prevented tissue dislocation during surgery. It also kept the bleeding from surrounding tissues away from the operating field. The clinical impressions of the suture of microanastomosis using sodium hyaluronate are favorable and even astonishing. But for obvious reasons, a reliable statistical comparison is difficult. This viscoelastic material, by nature of its characteristics, will stay where put. It can be compared to a mechanical instrument rather than to a liquid. It can be applied directly at the target when needed and removed later on when it has accomplished its task. Although the statistical studies have failed to support my conclusions, my clinical impression is that the sodium hyaluronate facilitates surgical perfection.

The elasticity of sodium hyaluronate absorbs mechanical stress, thereby providing protection to tissues. Further studies using microscopy of the microvascular anastomosis will reveal whether this property of sodium hyaluronate can be considered to be of significant importance. This substance should be properly tested in order to reach a better judgement regarding its value. Its potential value for use in microsurgery remains to be studied in further detail.

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