EFFECTS OF TRANSVERSE AND LONGITUDINAL VENOTOMIES OF RECIPIENT MICROVEINS ON PATENCY RATES IN END - TO - SIDE MICROVENOUS ANASTOMOSIS

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SUMMARY

As diameter of microvessel becomes smaller in end-to-side anastomosis, some problems in the maintenance of patency may accompany the process.

Transverse and longitudinal venotomies were performed onto the femoral veins of rats, as recipient vessels, to create spaces for appropriate anastomoses with superficial eqigastric veins as donor vessels. The patency rates were assessed and compared on the 7th and 21st days.

In spite of differences in clamping and anastomosis times and number of sutures, the patency rates have been observed as 100 % in both groups, in the early postoperative period. But, in the late postoperative period, the results have differred in patency rates in favor of transverse venotomy group.

This method, similar to the studies about micro-arterial anastomosis, can be considered as an appropriate technique of end-to-side microvenous anastomosis in clinical practice, because of its high patency rate, reduced operation time and decrease in the number of sutures.

Key Words : Microveins, end-to-side anastomosis, patency

INTRODUCTION

Microsurgical techniques have been adopted by many surgical specialties; in each specialty a similar evolutionary pattern occurs. Recently, the progress of microsurgery has been due mainly to the improvement of the surgical techniques.

After Linton's study on end-to-side anastomosis, the hemodynamical principles of them were put forward in details by Lazzarini and Robertson (1, 2). Many investigators have determined some advantages of end-to-side anastomosis when compared to end-to-end ones (3, 4). Most of the experimental studies have been made on microarteries because they could be manipulated easier than veins (5, 6).

Techniques, used for microvenous anastomosis should be selected according to anatomic sites of the vessels. If there is no critical vessel network distal to the recipient vessel, or the diameter ratio of vessel is less than 2:1, end-to-end anastomosis is preferred (7, 8).

When selecting the most appropriate technique for a result with a high patency rate, the simplest one with less sutures should be preferred.

The effect of incision type of recipient vessel on patency rate was studied in arteries and it was determined that transverse incision did better than longitudinal one (9-11). But, it has not been studied on microveins yet.

MATERIAL AND METHOD

The study was made on 37 Wistar Albino, male rats weighing 250-350 g. Femoral veins were selected as recipient veins, while superficial epigastric veins (SEV) were preferred as donor ones, bilaterally. Longitudinal venotomies were performed on femoral

veins on the right side, while transverse ones were done on the left side. All rats were anesthetized with intraperitoneal 30 mg/kg ketamin injection. Their inguinal regions were shaved and cleaned with povidoniodine solution. Zeiss opmi 6 microscope was used for vision. The external diameters of femoral veins were 1-1.2 mm., while they were 0.5-0.6 mm. for SEVs. After exploration, the superficial epigastric veins were clamped distally and, ligated next to the connection of them with femoral veins and transected in both groups. After that, femoral veins were clamped at their both sites. Incisions either longitudinal or transverse (Fig. 1), were performed by just incision with a scalpel. No tissues on the vessel wall were excised. The lengths of both incision type were about as long as the external diameter of the lumens of the SEVs. Then, lumens were irrigated with lactated ringer solution including heparin 20 IU/ml. Veins were anastomosed with interrupted 10/0 nylon sutures by using "back wall first" technique. When performing the procedure, we noticed that 6 sutures in longitudinal venotomy group and 5 sutures in the other group were necessary for an appropriate anastomosis. In longitudinal venotomy group, 2 sutures were placed at the corners 180 degrees apart. Thereafter, 2 sutures were placed on the back wall first and 2 others on the other side, each 60 degrees apart. In transverse group, firstly, 2 sutures, approximately 75 degrees apart, were placed on the back wall and then 3 others, at the same angles were put on the other side (Fig. 1).

After anastomoses were completed, clamping and anastomosis times were noted (Table I). Firstly, the proximal clamp on femoral vein was released and it was observed whether there was a back-flow or not. After that, the clamp on SEV was released and any leakage from anastomosis site was observed. At last, the distal clamp on femoral vein was released. Anastomosis sites were observed and patencies were tested by direct inspection and milking test at 30 and 120 minutes after clamps were released. Results were noted when all the procedures were completed. Muscles and skin were closed by interrupted and continuous suture techniques. The rats were taken to separate cages.

Equal numbers of rats from both gropus (n=9) were re-explorated on the 7th and 21st days following the operation for testing of patency rates by using direct inspection, milking test and microangiographic evaluation. Positive sign of patency on inspection was dilated vessels confirmed by milking test. This test was not traumatic when performed gently. Two pairs of smooth forceps were used to occlude the vessels distal to the anastomosis. The more downstream forceps was then removed gently creating the empty segment between the forceps. The proximal compression was then released and rapid filling of the empty segment indicated patency of the anastomosis. In suspected cases, patency was studied and was confirmed by microangiography. When it was performed, all attempts indicated that these anastomoses were patent. Negative signs of patency in milking test revelated occluded SEVs. Occluded femoral veins occompanying the occluded SEVs were observed only in two cases from each group on the 21st day of exploration.

Tissue specimens from anastomosis sites of both groups were excised randomly for histopathological assessment. The data was analysed statistically using chi-square test.

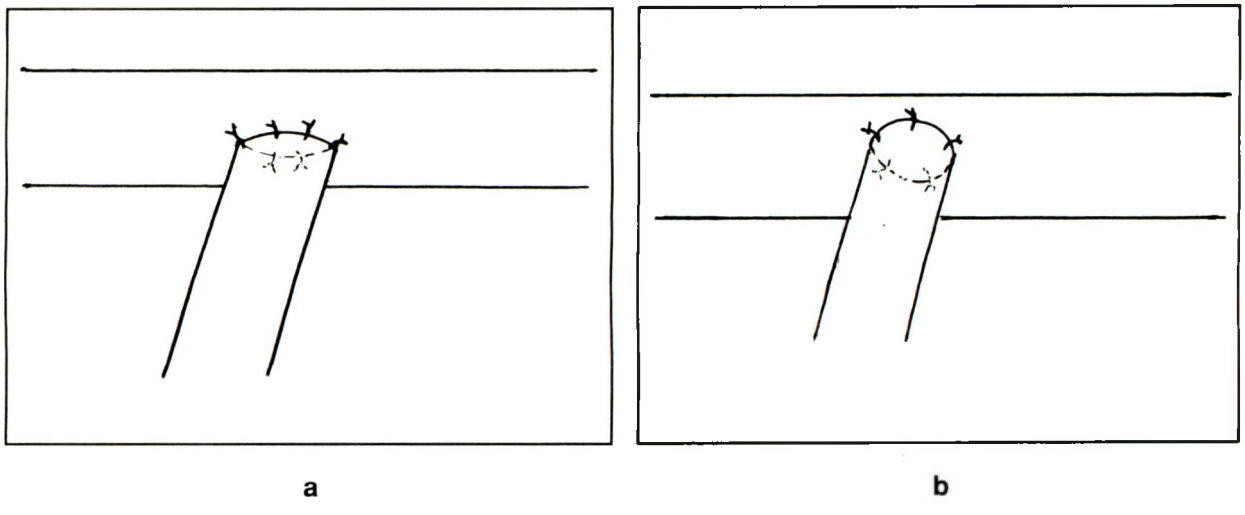

Fig. 1: Schematic appearance of anastomoses in (a) longitudinal, (b) transverse venotomy groups.

Table I: Types of venotomy with comparison of their mean anastomosis and clamping times

Type of Incision	Mean Anostomosis Time (min.)	Mean Clamping Time (min.)
Transverse Venotomy	13.94	18.07
Longitudinal Venotomy	21.95	31.83

RESULTS

We observed that all the anastomoses were patent at 30 and 120 minutes. The anastomosis and clamping times, were both considerably low in transverse venotomy group when compared to the other group ($p<0.001$).

Of the 9 rats, explorated on the 7th day following operation, 6 anastomoses in the longitudinal venotomy group and all anastomoses in the transverse group were patent. None of the rats were sacrificed and they completed the study. On the 21st day of exploration 25 (67 %) of 37 anastomoses were patent in the former group, while it was 33 (89%) in the latter.

In microangiographic exam, radiopaque materials (iohexol) were injected into the lumens of femoral veins 10 mm apart the anastomosis site and serial graphies (2 pictures in a second) were taken. In the transverse venotomy group, radiopaque materials filled the SEVs by passing the anastomosis sites in two seconds following injection. (Fig. 2). The filling procedures took place 2 seconds later in the other group.

In the histopathologic study of specimens taken from patent anastomosis sites on the 21 st day, all the intimal, medial and adventitial tissues were intact at the anastomosis and peri-anastomotic sites in both groups. Inflammatory reaction, deposition of hemosiderin pigment or collagen were not observed. In some specimens of longitudinal venotomy group, blood cell aggregates in the lumen and pre-anastomotic dilation were noticed (Fig 3 a, b)

The difference in patency rates between transverse and longitudinal venotomy groups was statistically significant in the favor of transverse venotomy group ($p<0.05$, Table II).

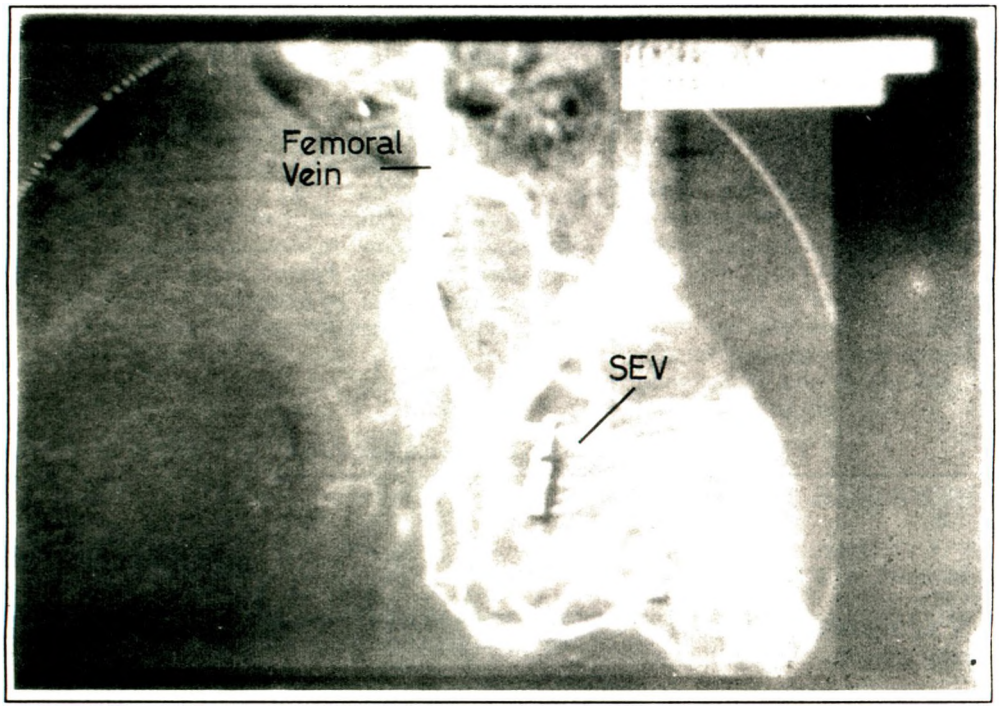

Fig. 2: Radiopaque material injected into femoral vein filling the SEV by way of anastomosis site on the 21 st day.

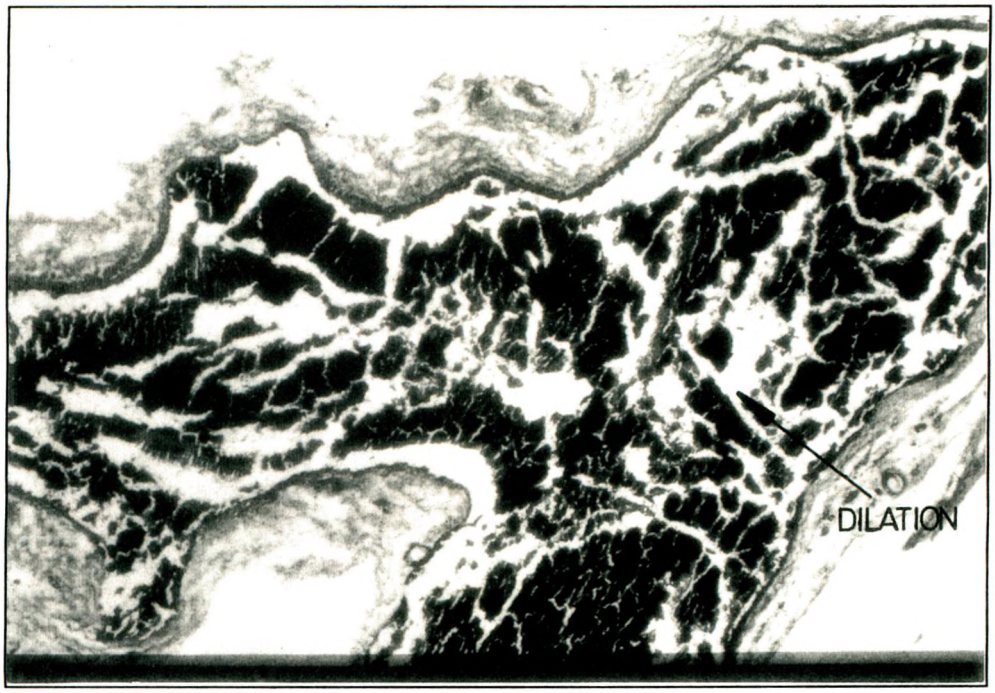

Fig. 3 - a: Dilation at the pre-anastomotic site (arrowed) and healthy erythrocytes in the lumen of transverse venotomy group on the 21 st day. (Trichrom X 60)

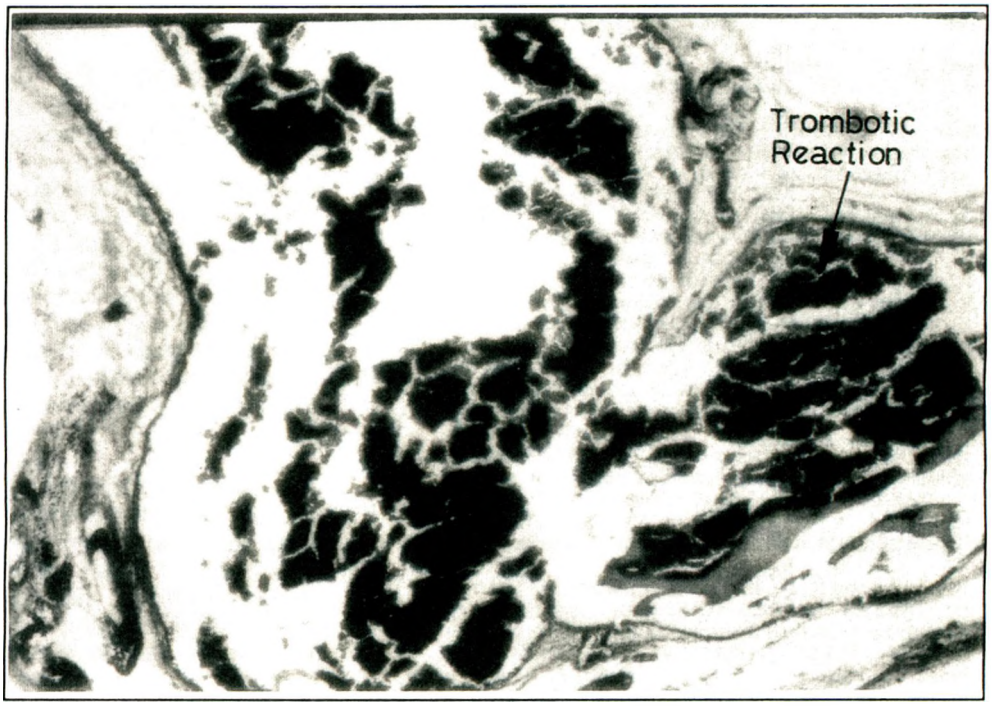

Fig. 3 - b: Thrombotic reaction (arrowed) and aneurysmatic dilation at the anastomosis site in the specimen of longitudinal venotomy group on 21 st day. (Trichrom X 60)

Table II: Patency observed in each rat and their rates in transverse and longitudinal venotomy groups.

Rat No.	TRANSVERSE VENOTOMY	LONGITUDINAL VENOTOMY
	7. day exploration	
1	P	Occ.
2	P	P
3	P	P
4	P	Occ.
5	P	P
6	P	Occ.
7	P	P
8	P	P
9	P	P
	21. day exploration	
1	P	Occ.
2	Occ.	Occ.
3	P	P
4	P	Occ.
5	P	P
6	P	Occ.
7	P	P
8	Occ.	P
9	P	Occ.
10	P	P
11	P	P
12	P	P
13	Occ.	P
14	P	Occ.
15	P	P
16	P	Occ.
17	P	P
18	P	Occ.
19	P	P
20	P	P
21	P	P
22	P	P
23	P	P
24	P	Occ.
25	Occ.	Occ.
26	P	P
27	P	P
28	P	Occ.
29	P	P
30	P	P
31	P	P
32	P	P
33	P	P
34	P	P
35	P	P
36	P	Occ.
37	P	P
Patency Rates	89 %	67 %

Chi-square with continuity corr. fac.: 3.907, Prob.: 0.0481
* $p<0.05$

DISCUSSION

Problems, manifested during anastomosis of the vessels with different diameters made the surgeons to consider end-to-side technique. Thus, lots of experimental studies were carried out for comparing the end-to-end and end-to-side techniques. High patency rates in end-to-side anastomoses have been reported in many instances, so the surgeons have begun to perform this technique in clinical practices (1, 3, 4).

In spite of all these advances in microsurgical techniques and materials, there are still many problems about thrombus formation at the anastomosis site at either early or late phases (10). Many procedures and methods have been experienced to find out an effective way to prevent it (11, 12). However it is an inevitable end for a traumatized lumen. Changes in blood composition, statis, intimal rupture, injury to the lumen, clamping, sutures accelerate the phenomenon (13).

Using light and scanning electron microscopic studies the accelerating role of suture materials on thrombus formation was indicated by showing platelet aggregates on the sutures just after a few minutes following the clamp release (14, 15). Techniques with no sutures have been tried, but the results are usually unsuccessful (16, 17). So, it is decided that decreasing the number of sutures is the best way for preventing thrombus formation.

In this study, we notice that ovale space of transverse incision of recipient vein at the anastomosis site necessitates less sutures than fusioform space of longitudinal incision, because the former divided the anastomosis site to equal spaces.

In order to maintain patency it is very important to select the most appropriate incision type on recipiend vessels for anastomoses. Excision of a little piece of tissue from the wall of the vessel with larger diameter can often suffice. But, it can become a difficult and devastating procedure for the vessels as large as 0.5 mm. in diameter, especially for the microveins including thinner vessel walls. (5, 6). Various techniques and instruments have been developed to overcome all these difficulties (6-9). Storrie et al, comparing transverse and longitudinal incisions of recipient arteries in end-to-side anastomoses, suggested that transverse arteriotomy had a higher patency rate (18).

Heden et al proved that longitudinal tensive force on vessels was greater than transverse tension (19). So, a space open enough for a higher patency rate at the anastomosis site can be ensured just in transverse incision. Besides, anastomosis of a donor vein to recipient one with an open space is an easier manipulation. Both necessity of less sutures and easiness in manipulation ensured less clamping time and traumatizing effect on the vessel wall, which can all caus . low patency rates.

In the present study we determined that, only transverse venotomies ensured wide enough open spaces at the anastomosis sites, due to their elastic and muscular structures although they were thinner in the microveins. We were able to perform anastomoses with less sutures, easy manipulation and higher patency rates.

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