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MICROVASCULAR FEMORAL VEIN ANASTOMOSIS IN EXPERIMENTAL RATS—A HISTOPATHOLOGIC STUDY

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SUMMARY

In the present work we have carried out end-to-end anastomosis in 40 femoral veins with an average diameter of 1 mm in experimental rats. The patency was achieved in 80 percent. Histopathological examination of the representative specimen of anastomosed veins were carried out at the end of 7 to 14 day and the findings are reported. Correct apposition of the cut ends of the vein and minimal medial damage were found to be the most important factors in the success of microvenous anastomosis.

(*Key Words* : Platelet Aggregation, Microsurgery, Rats, Histological technics.)

Establishing and maintaining vascular patency are particularly difficult with regard to anastomosis of small veins because of the increased technical difficulty, modest venous blood flow favouring post-operative thrombosis and the tendency of prolonged venospasm to occur (Hayhurst et al, 1972). In transferred tissues with large supplying vessels, the thrombosis of end-to-end venous anastomosis has been a greater problem than that of arterial thrombosis in some reports (May et al, 1983, and May and Gallico, 1982).

We carried out end-to-end anastomosis on 40 femoral veins with an average diameter of 1 mm in experimental rats. Histopathological changes were studied after 7 to 14 days following anastomosis. An attempt has been made to delineate factors determining patency of venous anastomosis.

Material and Methods

Forty femoral vein microanastomoses were performed on 40 adult Albino rats of Charles-Foster strain (weight 250-300 gms). The rats were anaesthetised with chloral hydrate 4% (4 gm /100 ml) injected intraperitoneally in the dose of 0.75 cc per 100 gm of rat body weight. The common femoral vein was exposed in one leg of each animal through an inguinal incision. The mean femoral vein diameter was 1.1 mm. Using an 8 mm Acland's double approximating clamp the end-to-end anastomosis were performed with 10/0 Ethilon on 4 mm round bodied curved needle. Approximately 8 to 9 stitches were used in each anastomosis. Warm normal saline for irrigation and 0.5% marcain to relieve the spasm was used. No attempt was made to strip the adventitia.

The patency was assessed by an uplift test and double clamp milking test 15 minutes after repair and on 7 to 14 day in a separate exploratory procedure. Representative specimens of end-to-end anastomosis of femoral veins were taken. An ex-vivo fixation procedure (Mazer et al, 1986) was used to prepare vessels for histopathology and the tissues were serially sectioned after fixation in formal saline (10 percent). The sections were stained with Hematoxylin and Eosin stain. The light microscopy observations were made for accuracy of apposition of cut vein ends, medial disruption, subintimal hyperplasia, adventitial damage, re-endothelisation, luminal size for luminal narrowing and aneurysm formation at the anastomosis site.

Results

In 80 percent (32 animals) the patency of the anastomoses could be demonstrated by double clamp milking test and the remaining 8 veins (20%) were found to be occluded. The anastomosis sites were re-explored in the second post-operative week and those vessels which appeared patent on naked eye examination also showed accurate appositions of the cut ends of the vein on microscopic examination. In these veins, coagulum was always seen between the apposing edges which were in continuity with mural thrombus (Fig. 1). The veins biopsied during the second week showed shrinkage of the thrombus and invasion by newly formed connective tissue fibrils.

Extensive thrombosis was seen where accurate apposition of vessel ends could not be achieved and veins showed complete or partial blockage of the lumen (Fig. 2).

Medial disruption was observed commonly in the veins where accurate apposition of the vein ends could not be obtained and where insertion of suture was not evenly placed. The

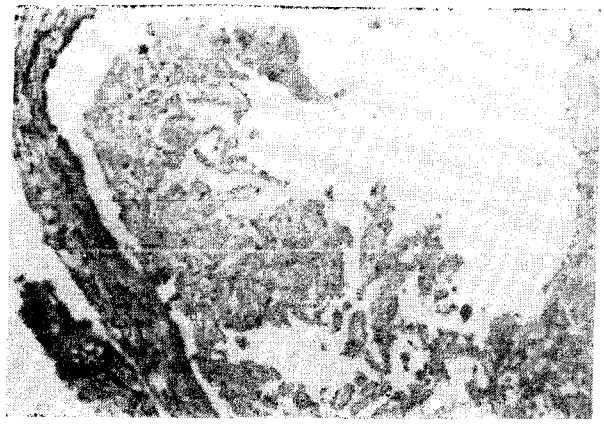

Fig. 1. Transverse high power section of a patent vein showing mural thrombus and minimal subintimal hyperplasia. Biopsied at 2 weeks (Mag. 125 X)

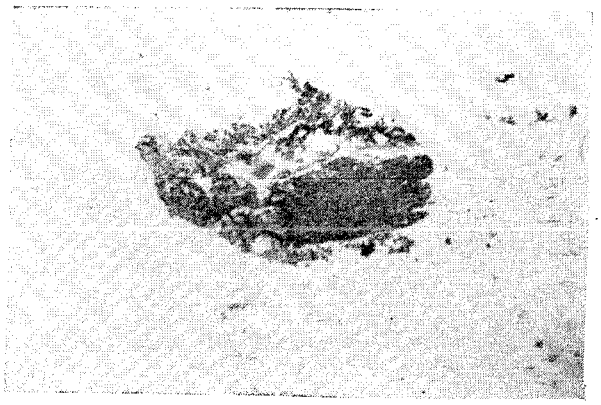

Fig. 2. Transverse section of the vein showing partial blockage of the lumen by thrombus with disruption of vein wall by the insertion of sutures. Biopsied at one week (Magnification 50 X).

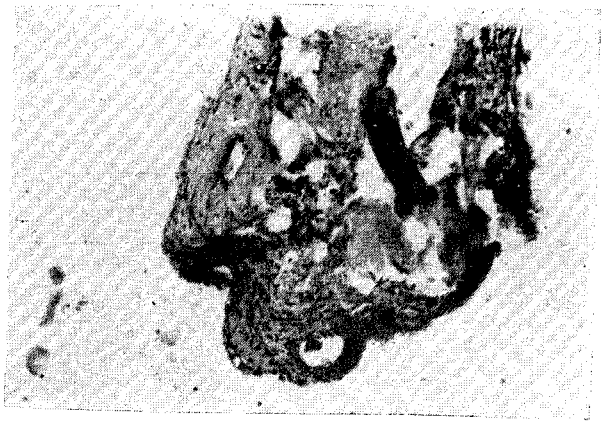

Fig. 3. Transverse high power section of patent vein at the anastomosis. Suture is surrounded by an area of hyaline necrosis. Biopsied at 2 weeks (Mag. 125 X).

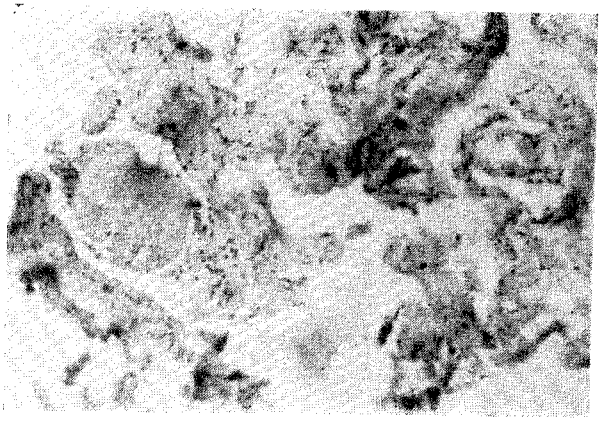

Fig. 4. Transverse section of the vein showing mycotic aneurysm of the wall at the anastomosis. Biopsied at 2 weeks (Mag. 125 X).

amount of medial necrosis was greatest where there was suture crowding but this was not found to be deterimental to the patency in the small calibre thin vein wall. The sutures were surrounded by fibroblast, smooth muscle cells, and macrophages in the venous anastomosis biopsied at 7 day. These cells became less numerous and after 14 days most of the sutures were surrounded by an area of hyaline necrosis (Fig. 3). Medial viability was found to be a critical factor in determining the success of anastomosis. The passage of interrupted suture through full thickness vein wall damaged the medial as well as internal elastic lamina at the anastomosis site. Since the medial component in the thin vein wall is very small, the repairative process showed minimal amount of subintimal hyperplasia at the end of two weeks.

Some degree of luminal narrowing was seen at the site of anastomosis but it did not appear to affect to any significant degree their ultimate patency. The mycotic aneurysm formation was seen in two veins (Fig. 4).

Discussion

Venous occlusion in microsurgery continues to be a problem. Venous thrombosis after anastomosis is primarily caused by platelet aggregation and the formation of an occluding platelet thrombus. This leads to vascular stasis, simultaneous activation of the coagulation cascade and the formation of permanent fibrin clot (Hardisty, 1977). Previous reports of venous patency have ranged from 70 to 92 percent (Hayhurst et al, 1975 and Daniel and Terzis, 1977) with no pharmacological manipulation.

It was observed that the thin flimsy wall structure of the small veins is difficult to handle with the result that venous anastomoses are technically more difficult. Venous repairs are therefore generally technically less perfect than arterial repairs and this is an additional major cause of lower patency rates seen in veins.

Histopathology of the anastomotic sites in femoral veins in the experimental rats in our study has shown that correct apposition of cut vein ends and minimal medial damage are the most important factors in the success of venous anastomosis. This fact has also been emphasized by other workers (Baxter et al, 1972). It is evident from our study that even with the most careful suturing techniques the vein suffered appreciable disruption because of the thin vessel wall. Re-endothelisation was noted at the end of 2 weeks in our study as against 4 weeks reported by some authors (Baxter et al, 1972). Subintimal hyperplasia was less marked in venous anastomosis in our study which may be attributed to thin medial component in the small calibre vein wall.

Conclusion

Considerable disruption of internal elastic lamina and media has been demonstrated in histopathology of anastomosed femoral vein with an average diameter of 1 mm in experimental rats. It has been found desirable to avoid excessive damage to these structures and the aim should be to achieve an edge-to-edge approximation of vessel ends in microvenous anastomosis. A rather early re-endothelisation has been noted at the anastomosis site in our study.

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