A NEW OPERATIVE METHOD OF CAUSING THROMBOSIS IN VARICOSE VEINS

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Massive retrograde sclerosant injections of the saphenous vein at the groin have been criticized lately for a variety of reasons. The method is said to be relatively uncertain and it occasionally produces severe local and general reactions. Above all, x-ray studies after injection of radio-opaque sclerosants have shown rapid entrance of the solution into adjoining deep veins (Boyd, 1948).

In the investigation conducted by Professor Boyd retrograde injections were made into the distal end of the saphenous vein divided at the groin. In every case large quantities of solution passed into the femoral vein through a perforating vein in the lower third of the thigh. Ten minutes after injection further x-ray films showed radio-opaque sclerosant still present in the femoral vein. Evidently there is a possibility that serious deep-vein thrombosis, leading to permanent disability, may be caused by a commonly practised treatment of varicose veins.

It is not surprising, therefore, to find that at the present time there is a tendency towards abandoning the use of sclerosants in the form of massive retrograde injections. A number of alternative methods of treatment are being currently developed, but there is no unanimous opinion on which is the best of them. The method described here in application to a small series of cases has been the subject of detailed clinical study checked by histological investigations. It leads to a thrombosis at least as effective as that caused by the chemical sclerosants, without possessing any of their known disadvantages. Briefly, the method consists in leaving at operation a length of silk ligature within the lumen of the vein.

Evidence is produced to show that a firm non-bulky clot is thereby obtained, the thrombus organizing to produce complete obliteration over any desired length of vein. No ill effects have so far been observed, and identical results have invariably been produced in each case. Theoretical disadvantages have been kept in mind and are discussed below. The method of introducing the silk ligature is quite simple, and is combined in other respects with orthodox operative procedure.

Operative Procedure

Skin Preparation and Towelling.—The whole limb from groin to foot is carefully prepared, and the foot is wrapped in a sterile towel and threaded through the aperture in an abdominal towel. The skin has been previously marked at the site of visible or palpable tributaries in the ordinary manner.

Operation.—Through the usual oblique inguinal incision a sapheno-femoral ligation is performed, with ligation of all tributaries according to the orthodox procedure. However, before division of the main vein and excision of a portion, a narrow tape is passed round the vein and handed to an assistant. The vein is then incised and the smallest head of a Babcock vein-stripper is inserted into the lumen. The vein-stripper is then passed gently downwards until its head is felt in the region of the knee. At the same time the

assistant crosses over the two ends of the tapes so as to prevent haemorrhage from the vein, which otherwise can be fairly considerable.

A longitudinal incision is then made over the head of the vein-stripper so as to expose a reasonable length of vein in order to identify and ligate any tributaries at the knee. The head of the stripper is identified inside the vein and another tape passed round the vessel distal to it. Through an incision in the vein wall the stripper head is extruded and attached to a long silk ligature of No. 3 twisted silk, prepared by soaking for 30 minutes in 50,000 units of penicillin solution. The thread is touched only with forceps, in order to avoid accidental contamination, and is not allowed to touch the skin at any point. Its end is knotted round the vein-stripper just behind the head, which is then withdrawn groinwards, carrying the length of thread with it into the lumen of the vein. When the stripper head emerges from the vein in the groin the whole length of the silk thread is of course lying in the vein. It is secured by ligating the vein round it above and below, and the upper end is detached from the vein-stripper. A portion of vein between this and the flush ligation is excised in the groin and the skin wounds are sutured.

The process is then repeated with the remainder of the vein below the knee. It is better to enter this part of the vessel at the ankle, as the head of the vein-stripper will not catch on the remnants of any valves when it is passing in the direction of the blood flow. This consideration does not apply to the vein above the knee, because the calibre there is much greater compared with the diameter of the vein-stripper head, and valve remnants can always be negotiated by a little gentle manoeuvring. Extreme tortuosity of the vein is, however, likely to cause difficulty, and a flexible vein-stripper with a smaller head would be a great advantage in use (Webb, 1951).

Results

Up to the present time only a small series of cases have been treated, as it was desired to study the mechanism of the thrombosis produced and to anticipate any dangers or disadvantages in using the method on a larger scale.

Detailed observations have been carried out on each vein treated, the clinical impression being checked by microscopical examination of repeated vein biopsies. At first only small sections of vein were treated. Later, as results were found to be invariably the same and no ill-effects were noted, larger sections were treated and the technique described above was worked out.

Case Reports

Case 1.—Mrs. A. Marked internal saphenous varicosity. No pigmentation, eczema, oedema, or ulceration. **Treatment:** (1) Sapheno-femoral ligation. (2) 4 in. (10 cm.) of vein in calf isolated and threaded with silk ligature. **Result:** Firm thrombosis followed by obliteration, confirmed by biopsy ten days and one month after operation.

Case 2.—Mr. B. Internal saphenous varicosity. No complications. **Treatment:** (1) Sapheno-femoral ligation. (2) 6 in. (15 cm.) of vein below knee threaded with silk ligature. **Result:** Firm thrombosis followed by obliteration, confirmed by biopsy ten days and one month after operation.

Case 3.—Mrs. C. Large varicose ulcer nearly encircling leg, 21 years' duration; followed injection treatment. Varicose veins had recurred after high ligation carried out at another hospital 25 years previously. **Treatment:** (1) Ligation at sites of recurrence in thigh. (2) Length of silk thread left in lumen of large vein feeding ulcer. (3) Local streptomycin treatment to ulcer followed by patch grafts of split skin to remaining unhealed areas. (4) Compression by one-way stretch bandage. **Result:** Feeding vein thrombosed. Incidentally, ulcer healed completely.

Case 4.—Mr. D. Internal saphenous varicosity. No complications. **Treatment:** (1) Sapheno-femoral ligation. (2)

2 in. (5 cm.) of vein at ankle threaded with silk ligature. **Result:** Clinically firm thrombosis. No biopsy.

Case 5.—Mrs. E. Internal saphenous varicosity. Small indolent ulcer at ankle, present for three years. Pigmentation. **Treatment:** (1) Sapheno-femoral ligation. (2) Whole length of internal saphenous from groin to knee threaded with silk ligature. **Result:** Firm thrombosis followed by obliteration of whole length of vein treated. Biopsy at ten days. Ulcer healed. No patent veins visible or palpable. Free of symptoms.

Case 6.—Mr. F. Internal saphenous varicosity. No complications. **Treatment:** (1) Sapheno-femoral ligation. (2) Whole length of saphenous vein threaded with silk ligature; in two portions, from groin to knee and from knee to ankle. **Result:** Firm thrombosis followed by obliteration of whole length of vein treated, confirmed by biopsy at ten days and one month after operation. Had transient difficulty in fully extending knee owing to presence of tight cord representing thrombosed internal saphenous vein. Final result very satisfactory. No patent veins visible or palpable. Free of symptoms.

Case 7.—Mrs. G. Internal saphenous varicosity. No complications. **Treatment:** (1) Sapheno-femoral ligation. (2) Whole length of vein from groin to 4 in. (10 cm.) below knee threaded with silk ligature. **Result:** Firm thrombosis followed by obliteration of vein, confirmed by biopsy. Clinically very satisfactory.

Comment.—In each case the line of the treated vein was clearly palpable within 48 hours of operation. On the evening of the second day after operation in the cases in which silk thread was left in lengths in vein exceeding 6 in. (15 cm.) there was slight fever without constitutional disturbance. The vein became tender and easily palpable along the whole length treated, and the skin overlying the vein was slightly reddened. At the end of a further two days tenderness was very much less and the fever had abated, although the vein was still clearly palpable. By the tenth day after operation, when the first biopsy was taken under local analgesia, the veins were hardly tender, but were easy to locate.

Report on Vein Biopsies

Macroscopic

After incising the skin on taking the first biopsy, a layer of oedematous subcutaneous fat was encountered. Lying on this was the somewhat enlarged rubbery vein, opaque white in colour and rigid to the touch. On dividing the vein to remove the biopsy specimen no bleeding from either end was noted. On inspecting

FIG. 1.—Photograph of $\frac{1}{2}$ -in. (1.3-cm.) length of varicose vein removed 10 days after treatment. Cut surface viewed end on. A—A: silk thread protruding from lumen B, which is filled with dark clot. Pale grossly thickened vein wall clearly shown at C.

the cut surface about two-thirds of the thickness was seen to be composed of firm white tissue, representing gross fibrous thickening of the original vein wall. The original lumen was occupied by a small dark-coloured thrombus and by the silk ligature, which was of course completely unchanged in appearance (Fig. 1).

At the second biopsy, taken one month after the original operation, the vein was still easily palpable, though very much smaller. It was completely painless, and there was no pigmentation of overlying skin. Oedema of the surrounding tissues had subsided. Again no bleeding was noted on dividing the vein. On this occasion the whole of the vein lumen was seen to be occluded by firm white tissue, and there was no recognizable clot present. The silk ligature appeared unchanged.

Microscopical

Serial sections were carried out on all specimens. Every tenth one was stained with haematoxylin and eosin, and at least one section of each specimen was stained with van Gieson and elastic, and one with reticulin stain. Transverse, oblique, and longitudinal sections of the various specimens were made. In all of them the process illustrated was almost identical. The biopsy specimen of an untreated varicose vein was also sectioned for comparison with the treated veins. (Fig. 2).

Report on the sections was as follows: "All the sections show that the vein walls contain an excess of fibrous tissue in all layers; in the transverse sections the silk thread is well shown with a surrounding aseptic inflammatory reaction, including in some cases giant cells; the thrombus is in successive states of organization — namely,

FIG. 2.—Untreated varicose vein. (H. and E. $\times 11$.)

FIG. 3.—Varicose vein 10 days after treatment. A=silk thread; B=thrombus in early stages of organization. (H. and E. $\times 9$.)

(a) Ten-day Biopsy: There is an early fibrous replacement, beginning at the periphery of the thrombus and centrally round the silk. There is already a thickened and fibrous intima (Fig. 3). (b) One-month Biopsy: The lumen is largely filled by young vascular fibrous tissue, with a considerable foreign-body giant-cell reaction round the thread. Again, here the intima shows some old fibrous thickening (Fig. 4). In general, the veins show fibrous replacement of tissues in the walls, and the intima appears thickened and fibrosed; the obstruction to the lumen is by thrombus undergoing fibrous replacement, and this fibrosis appears to begin at the periphery of the thrombus and round the silk thread and to spread from these two places to obliterate the lumen."

FIG. 4.—Varicose vein one month after treatment. A=silk thread; B=young fibrous tissue completely replacing thrombus. (H. and E. $\times 18$.)

Discussion

Raeburn (1951) has restated the initiating causes of thrombosis as (a) venous stasis; (b) disordered metabolism of vascular endothelium, leading possibly to increased adhesiveness; (c) intimal trauma; and (d) sepsis. Venous stasis would certainly result from partial occlusion by a foreign body. The presence of aseptic inflammation has been shown by vein biopsy. Intimal damage may occur from repeated small traumata produced by limb movements with a foreign body in the vein lumen. Some of the criteria, therefore, for the production of venous thrombosis appear to be satisfied. Clinical implications of the method are obvious. The relation of the method to other forms of treatment has yet to be determined. A more definite assessment awaits the progress of adequate follow-up studies.

Summary

A new method of causing intravascular thrombosis is presented, with particular reference to the treatment of varicose veins.

It consists in leaving a length of silk ligature within the lumen of the vein.

Clinical and histological evidence is produced to show that complete obliteration of the vein invariably results without any ill effects, general or local.

The mechanism and clinical implications of the method are discussed.

I wish to thank Mr. Peter Martin for allowing me to publish these cases and for help in preparing this report. My thanks are also due to Dr. J. P. Whitehead, Director, Morbid Anatomy Laboratory, St. Margaret's Hospital, Epping, for preparing and reporting on the histological material, and to Mr. Kenneth G. Moreman for the photomicrographs.

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FRICION INJURIES FOLLOWING ROAD ACCIDENTS

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Modern road transport causes injuries which were unknown a few decades ago. The lesion described below is a torsional one, usually produced by the tyre of a motor vehicle trapping or passing over part of the body. It is not always recognized and the best treatment can be given only if its nature is understood. The one constant feature is the stripping of the skin and subcutaneous tissues from the deeper structures. The skin itself may be intact, but more often it is split wide open, and in these cases the friction may damage tendons and nerves. Fractures are present in less than half the cases, and are produced by some other mechanism—for example, angulation. Experience of 20 cases provided the basis for this paper.

Early Experiences

The first case encountered was that of a man aged 48 who was run over by a car and sustained a compound fracture of the right femur. There was a rather large puncture wound

on the antero-medial aspect of the upper part of the thigh. This was treated by excision, the wound being extended and quite a large haematoma evacuated. When the wound had been closed the fracture was controlled by skin extension in a Thomas splint. The patient had an irregular pyrexia. A week later the whole of the skin of the thigh was seen to be badly bruised and blistered, and after a few days became converted into the black leathery slough of local gangrene. Skeletal traction solved the problem of the femur, but the skin loss became very troublesome (Fig. 1).

FIG. 1.—Late stage of a "closed" injury. Initially a fractured femur with a puncture wound only, the leg is here photographed after the slough had separated. There is complete skin loss from abdomen to knee on all aspects of the thigh.

FIG. 2.—Late stage of an "open" injury. Healing time, six months. The skin flaps were so badly damaged that they were completely lost. Earlier healing would have followed a primary excision and skin graft.

Antibiotics were not available, and the extensive area became secondarily infected. Skin grafts were quite ineffective, and the man gradually became more toxic and emaciated. Four months after his accident he died.

The second case appeared to have little in common with the above when it was first seen. A boy aged 4 was run over by a van and was brought to hospital with a massive wound extending from the big toe to the top of the thigh. Enormous flaps of skin had been peeled off the muscles, which were heavily contaminated with road dirt. In spite of the widespread skin damage, x-ray examination revealed no injury to bone. After an extensive wound toilet and suture the child's progress was good. There was some sloughing of the skin, which was grafted one month later, but the leg was completely healed in just over three months.

Mechanism

In these injuries, with the assistance of the patient, eye-witnesses, and the police, one of three stories was obtained: (1) The patient was truly "run over"; (2) the vehicle pulled up with one wheel trapping the patient, and sometimes had to be reversed to release the patient; or (3) the patient was flung clear of the vehicle, skidding along the ground with some force.

It seems that the skin is gripped by the rubber of the tyre, and as the wheel is lifted a very strong rotational force