During the 1940's Bauer (1948) wrote enthusiastically on the benefits of ligation of the popliteal vein for the relief of ulceration of the leg. He had operated on over 200 persons complaining of bursting pain, swelling, induration, eczema, and ulceration with good results. He had had a few failures due to the presence of other incompetent superficial veins, arterial disease and constitutional factors. Varicose long saphenous and perforating veins at the lower thigh were tied, a lumbar sympathectomy helped the arterial supply whilst adjustments of anaemia, diabetes, etc., improved others.

Several British surgeons adopted the operation, but Boyd (1954), Moore (1953) and Goligher (1953) reported indifferent results. I ligated a few popliteal and superficial femoral veins with but little improvement although with no apparent harm.

In 1953, Cockett and Elgan Jones described the anatomy, clinical presentation and ligation of incompetent ankle perforating veins. So convincing was this, that it was immediately adopted, and ligation of the popliteal vein and lumbar sympathectomy fell into disuse. Division of the incompetent ankle perforating veins seemed to be the long-sought solution for ulceration and eczema of the leg. Combined with ligation of the varicose long and short saphenous veins and other occasional incompetent perforators, control of the causes of venous lesions seemed to be complete. Great improvement followed. In 1955, several patients at operation were found to have leaking tributaries of the superficial femoral vein (passing through Hunter's canal), and others had defective gastrocnemial veins passing independently to the popliteal vein, irrespective of the state of the short saphenous vein. These varicosities were new to me, although Bauer had spoken of trying “incompetent perforators in the lower thigh”. Venograms too had occasionally shown these veins to be allowing an outward flow. Between 1955 and 1961, two incompetent tributaries of the popliteal vein occurred often enough to demand recognition: they arose from gastrocnemius muscle and the skin and fat over the popliteal fascia. At first they were referred to as pseudo short saphenous veins, but gastrocnemial veins and popliteal-area veins are the names used to designate them for some years. Their division and also of those varicosities passing into Hunter's canal improved the results further.

By 1960, over 400 people with popliteal varicos had been treated, but amongst them were a few whose ulceration and eczema refused to heal or readily recurred although all their diagnosable superficial varicosities had been tied, and complications like arterial disease and diabetes were absent. The search for other causes continued.

Since 1955, the exploration of the popliteal space has improved, and, besides finding varicose short saphenous, popliteal-area veins, and incompetent tributaries from the gastrocnemius, manifest abnormalities of the popliteal vein itself were occasionally observed, such as fusiform enlargements on it, irregularities in its size and consistency, and also persistence of the posterior tibial venae comites to the upper popliteal space (incidence around 4%). Because of the belief that the diagnosis and stopping of all the superficial leaks of high pressure would relieve swelling and ulceration, these changes were disregarded, based on the premise that the deep vein would take care of itself, but, of the large number treated, a few patients were not cured and still required relief.

In 1962, one such person seemed to have a leaking vein from the popliteal space, although the short saphenous and gastrocnemial veins had been divided. The popliteal space was re-explored: besides the incompetent vein, the popliteal vein itself was irregularly enlarged and indubitably incompetent. Its size varied with the pulse and respiration, and the tests for its efficiency (described later) proved it to be faulty. Bauer's advocacy of ligation of the popliteal vein was recalled, and it was forthwith divided between ligatures. The swelling, ulcer and colour of the leg improved, and this alerted me to the possible significance of the state of the deep veins. Bauer's work obviously contained substance, and the quest began for the signs and symptoms of a defective popliteal
vein. Since then, 10 further cases have been done with benefit.

Clinical Picture

The clinical presentation of the incompetent popliteal vein appears to be as follows. In the history of 6 patients, 2 had had rheumatic fever at the ages of 7 and 17, one diphtheria, and the fourth scarlet fever. These illnesses, with their cardiac and circulatory effects, may have been complicated by silent thrombosis of the deep veins. Two persons gave a history of deep thrombosis. These agents could damage the values of the main deep veins. Of the remainder, nothing significant was elicited in the past events.

Patients with incompetent deep veins, after all varicose superficial tributaries have been efficiently ligated, are those with aching swollen firm legs, ankles, feet, and toes. The colour is noticeable, being dusky and cyanotic almost up to the knee. There are numerous venules in the skin, at the sides and dorsal of the foot and ankle. The eczema and ulceration seldom fully subside, or easily recur, although the leg is continuously and skilfully pressure-bandaged. The calves are usually enlarged and perceptibly hard. If only one leg is affected, on measurement just below the knee, the mid-calf, ankle and waist of the foot, an increase is found in the affected member. These legs readily ache on standing, walking, sitting, and lying. They are quickly fatigued. The pain is described as bursting and tight and deep.

Good venograms will show incompetent valveless deep veins, and perhaps faulty perforating veins. The necessity of first diagnosing and dividing the latter is stressed because it relieves many patients. Venograms are valuable aids to the diagnosis, but here the emphasis is on the clinical and operative findings.

When the deep veins are valveless, some signs and symptoms will persist. The division of the popliteal vein is kept in reserve until incompetent veins of the long or short saphenous, ankle perforating veins, and tributaries of the superficial femoral vein have been dealt with. These are divided first because Bauer showed that ligation of the popliteal vein alone did not bestow complete or permanent benefit. When operating on the short saphenous vein, since I became aware of the valveless popliteal vein, whenever this is large or the leg is swollen or dusky, it is checked as will be described. Occasionally I have found it inefficient although externally the only notable item was that it was as large as the common femoral vein. As its efficiency can be tested without injury or risk, this is always done if any suspicion is raised.

Tests at Operation for the Competence of the Popliteal Vein

Its irregular size and shape have been mentioned. Adherent perivenuous tissue occurs, probably a remnant of former deep thrombosis. The vessel may be noticeably dilated and thin walled, or on the contrary whitish and round like an artery.

After dissection, the vein is taken firmly between the finger and thumb. A thickening of fibrous tissue, possibly eccentric from organized thrombus, may be felt in it. This is proof of a faulty vein, a test easily omitted.

A strand of softened catgut is passed round the popliteal vein twice; on tightening this, it occludes atraumatically. The vein is watched for 3 to 5 minutes. Above the constriction, a normally valved vessel would shrink as it is no longer being filled from below, especially when it is stroked upwards by the finger tip. Sound valves would not allow a back flow, but a faulty vein fills immediately from the reversed current in it. When the vein below the ligature is normal, it becomes distended and tense, but if abnormal, as there is little forward circulation in it, it remains soft and the same size or even a little smaller because it is no longer filled by a retrograde stream. A rapid centrifugal injection of 20 ml. of saline is made into the vein distal to the ligature; if it is sound, it will not accept more than 2-5 ml. because of the valves. It becomes distended, and on a further injection, the saline squirts out beside the puncture, and continues when the needle is withdrawn. Incompetent veins will accept much fluid rapidly without distension or leak.

Thus a valveless popliteal vein with a reversed flow is diagnosed and divided. No change in its size will occur, whereas in a healthy one the upper end would shrink and the lower become tensely distended. An extra test is to snick the vein above the first ligature when, because of the retrograde pressure and faulty valves, blood will squirt out briskly. The vessel is again secured above this and then divided.

Three patients whose superficial veins had been tied but without complete relief, and who have had their popliteal veins divided, are interesting. In one, the posterior tibial veins persisted to above the knee joint, one division being thin-walled and large, and the other thickened like an artery. Both were incompetent on testing, and divided. The
thickened division was recanalized after thrombosis, and consisted of 50% fibrous tissue, and the rest of two separate open channels. This patient’s toes, became pinkish, whereas before they had been ‘purple for years’. The foot and leg shrank, and intransigent eczema and ulceration of 7 years’ standing has cleared although this had been efficiently pressure-bandaged for years, and the long saphenous and ankle perforating veins already tied. Another patient now has a smaller and better looking leg than the good leg.

One surprising temporary ill-effect has been seen. The skin and fat of the leg from the groin to the ankle swelled considerably and inconveniently above and below the bandaged incision. It subsided on continuous pressure-bandaging after 3 months. As the incision was only at the knee, I find it difficult to understand the enlargement of the thigh in this patient. Could it have been an interference with the lymphatic drainage into the popliteal space, or possibly a recurrence of the white leg she had had years before? She was able to keep going as a wife and mother, but understandably found the size and bulk of the limb awkward. Both legs are now the same and improved by the bilateral division of the popliteal veins.

Discussion

Stopping the superficial leaks and then tying incompetent popliteal veins may be criticized on the grounds that the venous return might be permanently encumbered. This is conceded, but if no superficial vein is ligated unless it gives clear-cut clinical signs of incompetence tested at operation if considered necessary and similarly if no deep vein is tied unless it is proved to have a reversed flow, then alternative channels for the venous return must already be functioning. Bauer showed radiologically that it occurred through small muscle veins.

Conclusion

In a series of over 400 patients with swelling, ulceration, and eczema of the legs, after ligation of their discernible incompetent superficial veins, a nucleus of at least 10 remained incompletely relieved. Their popliteal veins have been proved to be incompetent and divided with relief. The physical signs and symptoms suggesting this are described. This is considered to be a worth-while step in overcoming persistent swelling and ulceration of the leg. The incompetence of the popliteal vein at the operation must always be established before its division. It may not be severed empirically. A surgeon has authority to divide defective veins only!

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