Annals of the Royal College of Surgeons of England (1985) *vol.* 67

A comparison of preoperative long saphenous phlebography with operative dissection in assessing the suitability of long saphenous vein for use as a bypass graft

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Key words: SAPHENOUS VEIN; PHLEBOGRAPHY; CONTRAST MEDIA: ARTERIAL OCCLUSIVE DISEASE; BLOOD VESSEL PROSTHESIS

Summary

A technique for assessing the anatomy and luminal diameter of the long saphenous vein by direct injection phlebography in patients being considered for reversed femoropopliteal vein bypass surgery is described. In 25 consecutive patients, 20 single veins, four double veins and one network of veins were all correctly delineated by this technique and subsequently confirmed at operation. Five saphenous veins could not be demonstrated above the knee but at operation one vein was found to be present and double from knee to groin. The minimum mean luminal diameter of the saphenous vein estimated from the X-ray after correction for magnification was 3.5 mm ± 1.12 which was significantly less than the mean external diameter found at operation, 4.6 mm ± 1.33 ($P<0.001$). The vein diameter found at operation invariably proved to be larger than the luminal diameter estimated from the X-ray. This allows a confident preoperative assumption of the minimum diameter that will be obtained after dissection and distension of the vein.

Introduction

Autogenous long saphenous vein remains the graft material of first choice for bypassing atherosclerotic arterial obstruction below the inguinal ligament *(1,2)*. The position of the vein in the leg together with its length and wall strength combine to make it a satisfactory arterial graft for femoropopliteal occlusion. It is also the material of first choice for coronary artery surgery and a number of other arterial bypass operations *(3)*.

Although assessment by arteriography is standard practice before arterial surgery, the saphenous vein has until recently *(4)* not been routinely evaluated by phlebography because of the risk of thrombosis as the result of endothelial damage from the contrast media. The introduction of less thrombogenic contrast material *(5)* has allowed us to investigate a series of patients being considered for saphenous vein bypass surgery with preoperative phlebography designed to provide information on the luminal size and anatomy of the vein. This may be important in patients who have had previous varicose vein or arterial surgery and in whom no record is available to assess the extent of vein removed. This paper compares the findings of saphenous phlebography with those of surgical dissection and discusses the place, value and drawbacks of this investigation as a means of preoperative evaluation of the long saphenous vein.

Patients and methods

Patients admitted over a 2-year period under the care of the Department of Surgery at St Thomas' Hospital, with femoropopliteal atherosclerotic obstruction were included in the study if they were considered suitable for vein bypass grafting. Patients with severe ischaemia of the forefoot were excluded since it was felt that dorsal venepuncture might cause an extension of established ischaemic change. Thirty-five patients who ranged in age from 45 to 79 years (mean 63.48 years) were enrolled in the study. Twenty-six were men and nine were women. Three were subsequently found to have arterial disease which was unsuitable for surgery and two patients with claudication and poor distal run-off did not undergo operative exploration as their saphenous veins were judged to be too small on the phlebograms (less than 3 mm in diameter). Thirty veins have been assessed by both phlebography and operative dissection. Patients complained of intermittent claudication in 14 of the limbs (mean ankle pressure 99.5 ± 21.4 mmHg), and rest pain or digital gangrene in the other 16 limbs (mean ankle pressure 38.6 ± 44 mmHg).

TECHNIQUE OF SAPHENOUS PHLEBOGRAPHY

The patients were positioned supine on a tilting fluoroscopy table. A 21-gauge butterfly needle, attached by flexible

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transparent tubing to a syringe, was introduced into the long saphenous vein at the medial malleous. Hexabrix 320® (2 : 1 sodium and meglumine ioxaglate) was injected into the vein by hand and its progress followed on a television monitor as it passed up the vein, spot films being taken of the entire long saphenous system. The flow of contrast was controlled to give optimal demonstration of the long saphenous vein by tilting the table from a slightly foot-down to a head-down position during the course of the injection. An ankle tourniquet was not used as this directs contrast into the deep veins. About 30 to 50 ml of contrast was required for each leg. On completion of the examination the vein was flushed with physiological saline and active movements of the foot and ankle were encouraged to clear the vein of residual contrast medium.

ASSESSMENT OF A VEIN SIZE

Two or more ball bearings of a known diameter were placed over the anatomical course of the long saphenous vein, one at the knee and the other over the mid-thigh region, in order to be able to correct the vein size for magnification (Fig. 1A and 1B). The diameter of the ball bearing was divided by its measured size on every film to obtain a magnification factor. The segment of vein likely to be used was then measured at its narrowest point, usually near the knee, using calipers which were read off against a ruler. The measured luminal diameter was then multiplied by the magnification factor to obtain the correct luminal diameter which was used for comparison with the operative measurement.

OPERATIVE ASSESSMENT

The long saphenous dissection was carried out through a single long vertical incision placed directly over the vein. An appropriate length of vein was exposed and the branches were ligated with fine silk ligatures before the vein was excised and distended with heparinised saline. The narrowest point in the vein was then found and measured with calipers which were again read off against a sterile steel ruler. The vein was then reversed and anastomosed and the site previously determined as the narrowest point was re-measured after 5 minutes, distension at arterial pressure. This was invariably at or close to the top anastomosis and was the measurement that was subsequently used in comparison with the corrected vein size obtained from saphenography.

Results

The veins from 30 limbs were assessed by phlebography and operative dissection. The venous anatomy was variable and the saphenous vein was reduplicated in its entirety or in part in a quarter of the limbs examined (Fig. 1B and 1C). The anatomical findings are summarised in Table I. Two of the five saphenous veins that were not outlined on phlebography were in patients who had had previous varicose vein surgery for which the operative records were not available. Two others had had earlier arterial surgery and it was possible that vein damage had occurred at this time. In all these limbs a segment of usable vein might have been present. The absence of a vein on phlebography was later confirmed at operation. In two of these patients a human umbilical vein graft was used to bypass the block and in a third the long saphenous vein was taken from the opposite leg. In the fourth patient a segment of usable vein was found and a reconstruction was combined with a short vein patch. One vein appeared to be double to the knee on phlebography but did not fill in the thigh. This vein was found at operation to continue above the knee as two channels which joined at the saphenofemoral junction. This vein appears in Table I as (+1).

A comparison of the diameter of the vein lumen estimated from phlebography with that found at operation is shown in Figure 2A. The mean diameter found at operation (4.6 mm ± 1.33) was significantly greater than the size estimated from the X-ray (mean 3.5 mm ± 1.12; $t = 6.54$ $P<0.001$ by paired t test). Only two veins were found to be marginally smaller than the predicted size on X-ray and in the other 23 limbs the postdistension operative diameter was greater than the luminal diameter estimated from the X-ray (Fig. 2B). A good correlation was found between the luminal diameter predicted on X-ray and the operative measurement (r 0.79; $P<0.001$).

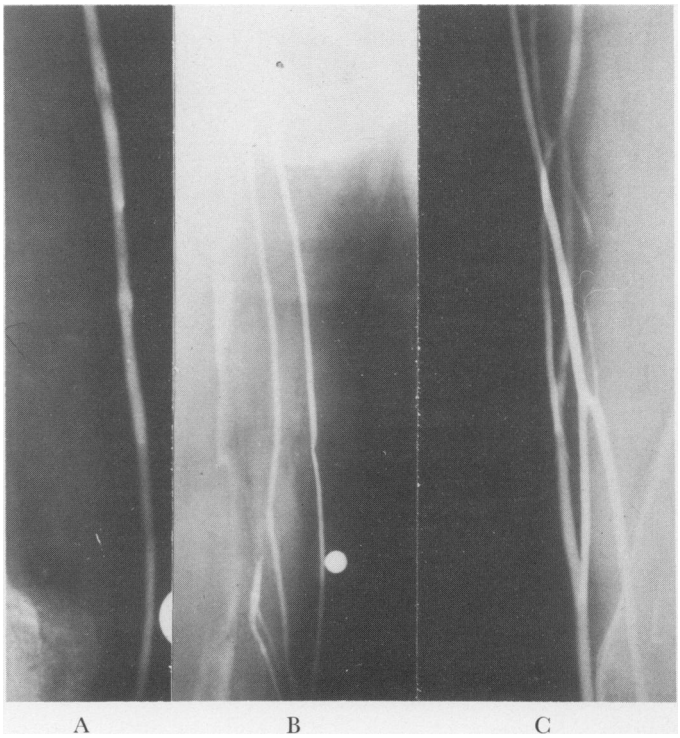

FIG. 1 (A) A single long saphenous vein. (B) A phlebogram showing a double long saphenous vein which was successfully used for sapheno-femoral bypass. A ball bearing of known size has been placed along the course of the vein to allow correction for magnification. (C) A phlebogram showing a long saphenous network. A successful bypass was carried out using this vein. The X-rays are of different magnification.

TABLE I *A comparison of the anatomy of the long saphenous vein seen on X-ray with that found at operation*

	X-Ray	*Operation*
Absent	5	4
Single	20	20
Double	4	4(+1)
Network	1	1

One patient died after 48 hours of myocardial infarction, leaving 24 veins for assessment. The early patency rate was 92% suggesting no damage had been caused by the contrast. The two veins which occluded in the early postoperative period were both of 5 mm diameter and graft failure was related to poor distal run-off. There was no difference in the size of the veins found in patients with claudication (mean 4.4 mm) than those in patients with rest pain or gangrene (mean 4.5 mm).

Discussion

The saphenous vein may have to be discarded in between 10 and 30% of patients in whom a vein bypass graft is planned because of previous damage, unusual anatomy or a poor internal diameter *(6,7)*. The minimum internal diameter capable of sustaining adequate blood flow remains a matter of opinion *(7,8)*. Veins of less than 3 mm in diameter are rarely considered satisfactory for reversed bypass although smaller veins may be used with the in-situ technique *(9,10)*.

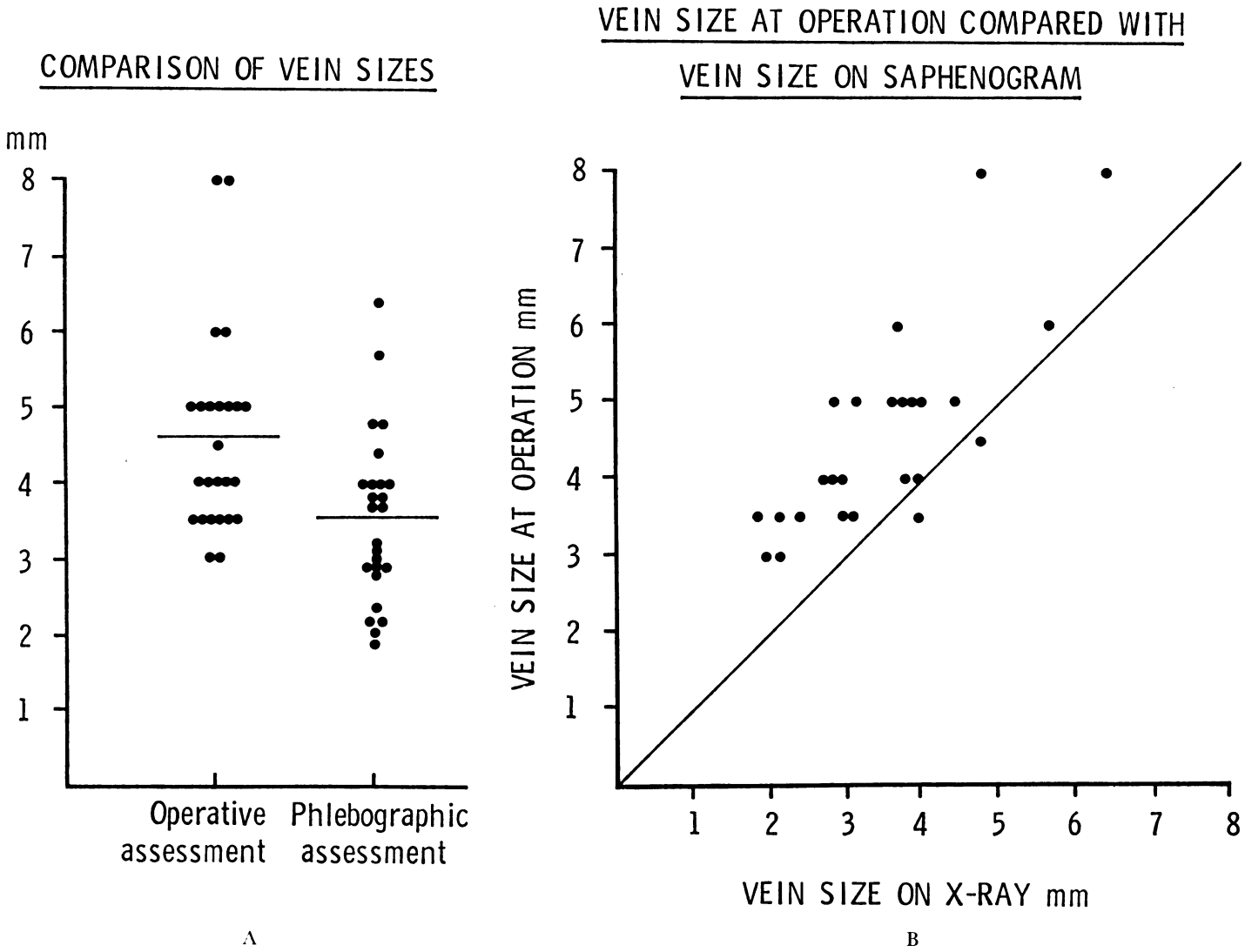

FIG. 2 (A, B) Graphs comparing the vein size on saphenogram with the vein size at operation. The bar in 2A represents the mean value. The line of identity between the two sets of results is shown in 2B.

Clinical estimates of the vein size are notoriously difficult above the knee in all but the thinnest of limbs, and at present the luminal size of the vein is confirmed by a full operative dissection. Until now the use of long saphenous phlebography has not been widely adopted to assess the size of the vein because conventional contrast media are known to predispose to thrombosis. The contrast medium Hexabrix®, used in this study, has a low osmolality and is known to produce significantly less scintigraphically detectable thrombophlebitis than conventional contrast media *(11)*.

There have been a few reports of the use of saphenous vein phlebography using conventional contrast media *(4, 12–15)*, but their main purpose appears to be to obtain an assessment of the anatomy rather than the size of the vein before surgery. The most recent paper *(4)* shows similar results to our own but a direct comparison between operative and radiological methods was not provided. A subjective radiographic assessment of the vein was made and retrospectively compared with the surgeon's preoperative assessment.

We have found that long saphenous phlebography made a correct prediction of the venous anatomy in 29 out of 30 examinations. One double saphenous vein was not outlined above the knee. This mistake was readily discovered when the groin dissection was made to expose the femoral artery.

Phlebography consistently underestimated the size of the vein which was obtained after arterial distension. This discrepancy is partly explained by the knowledge that the luminal diameter was measured from the radiographs and compared with the external diameter measured at operation, the width of the vein wall representing a small but constant error. The other relevant factor was the degree of distension to which the vein was subjected. No attempt was made to distend or obstruct the saphenous vein at phlebography while the final operative measurement was taken with the vein distended at arterial pressure. The corrected size of the vein lumen estimated from phlebography will be the minimum size that can be achieved at operation with the possibility that the final diameter after arterial distension will be up to 25% greater.

Accurate prediction of the luminal diameter of the vein may influence the selection for operation of patients known to have a femoropopliteal occlusion with claudication and also prevent unnecessary large dissections in ischaemic limbs.

We have elected not to operate on two patients with intermittent claudication recently on the basis of poor veins diagnosed on phlebography and have only explored the top segment of the vein in a number of ischaemic limbs to confirm the finding of an inadequate vein shown on X-ray.

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Notes on books

Transsphincteric Surgery of the Rectum by A Huber, A H C von Hochstetter and M Allgöwer. 83 pages, illustrated. Springer-Verlag, Berlin. DM 124.

This describes the topographical anatomy and operation technique used especially for low tumours, rectal prolapse, fistulas and strictures, as well as injuries and malformations that can be treated from below. The first part describes the principles followed by the topographical anatomy, then the operative technique, finally giving the results and discussion. The book is illustrated by line drawings and excellent colour photographs.

The Cementless Fixation of Hip Endoprostheses edited by E Morscher. 284 pages, illustrated. Springer-Verlag, Berlin. DM 124.

This is the proceedings of a symposium held in Basel in June 1982. Papers were delivered by an international group of Orthopaedic surgeons on various aspects, and clinical experience in, cementless fixation.

Tutorials in Surgery 4. Surgical Pathology I by F G Smiddy and P N Cowen. 238 pages, illustrated, paperback. Pitman, London. £14.50.

This is a collection of vignettes on various aspects of surgical pathology linked to the clinical picture. It deals with bacterial infections, skin lesions, salivary gland diseases, gastrointestinal, endocrine and vascular diseases. It makes an excellent review manual for the Fellowship candidate and for the practising surgeon.

Traumatic Disorders of the Ankle edited by William C Hamilton. 293 pages, illustrated. Springer, New York. $66.40.

An attractively produced book which attempts to bring together under one cover the wealth of extant information on the management of ankle injuries. There is relatively little original material but the book admirably summarises current knowledge and is extensively illustrated and referenced.

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