Upsala J Med Sci 87: 87–90, 1982

Peroperative Assessment in Arterial Surgery—Flow Determination or Angiography?

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ABSTRACTS

Complete data from flow measurement and intraoperative angiography were obtained in 70 femoro-popliteal vein by pass procedures. The results were compared in respect to their predictability of early outcome after arterial reconstruction. A correct prediction was given in 65 of 70 cases (92 per cent) by angiography. The corresponding figure for flowmeter determination was 52 of 70 (74 per cent). Angiography was found to be preferable to flow determination especially when low flow values were registered.

INTRODUCTION

Immediate or early occlusion after vascular surgery is usually due to technical errors and surgical shortcomings or to adverse hemodynamic factors. Measurement of blood flow in a reconstructed area is an established procedure to ensure immediate control and for prediction of the early operative results (2, 3, 8). During the last decade peroperative angiography has also been recommended for this purpose (1, 6, 7).

In our department peroperative angiography has been used routinely along with flow determination for assessment of the immediate surgical result. In this report a comparison between these methods has been made in regard to their predictive validity of the early operative result.

MATERIAL AND METHODS

Complete data from flow measurements and intraoperative angiography were obtained in 70 femoro-popliteal vein bypass procedures in 60 patients. There were 14 females and 46 males with a mean age of 61 and 65 years, respectively. Indications for surgery were intermittent claudicatio in 41 limbs and rest pain or gangrene in 29. Ten patients were diabetics.

The operative procedure was a femoro-popliteal vein bypass with the distal anastomosis proximal (42 limbs) or distal (28 limbs) to the knee joint. Based on the preoperative angiographic appearance run off was considered poor or fair (0-1 open lower leg arteries) in 20 limbs and good or excellent (2-3 open arteries) in 50. The patients were followed 6 to 39 months postoperatively. Early failure was defined as a re-occlusion occurring within 6 months.

Blood flow of the vein graft was recorded with a Nycotron^R electromagnetic flowmeter. The measurements were performed after correction of the blood volume, which was judged clinically from continuous monitoring of blood pressure, puls and urine production. Steady state flow and maximal flow after 40 mg papaverine intraarterially were recorded. Flow values below 80 and 200 ml/min, respectively, were considered abnormal.

Angiography was performed within 10 min after flow determination. The common femoral artery was punctured with a 1.7 mm Venflon^R cannula. Twenty ml of contrast medium (Angiografin^R 65 per cent) was injected manually and exposures were made with a film changer (AOT, Siemens-Elema) at a frequency of 1-2/s for 3-6 s. Usually two angiographic series were necessary to cover the whole reconstructed area.

RESULTS

The comparison of findings at angiography and flow determinations appears in Table 1. Identical results were found in 55 examinations (78 per cent) while differential findings were obtained in the remaining 15. In 13 of these cases

Table 1. Comparison of findings at angiography and flow determination and early surgical results

Angiograms	Flow values	Number	Occluded within 6 months (n)
normal	normal	46	3
pathological	pathological	9*	3
normal	pathological	13	0
pathological	normal	2**	0

* immediate reoperation in 5 cases
** immediate reoperation in one case

normal angiograms but abnormally low flow values were registered. At follow up 6 months later these reconstructions were all found to be patent. In the remaining two cases normal flow values were obtained despite pathological angiograms.

In one of them a non-occluding thrombosis resulting from an intimal lesion due to a vascular clamp was removed at immediate reoperation. The angiogram of the other case (which was not reoperated) showed discrete irregularities at the distal anastomosis. The graft was still open at the follow up 31 months postoperatively.

In the 22 cases with pathological flow values 9 were combined with pathological angiograms.

On the basis of our definitions a correct prediction of the early operative results was given in 65 of 70 cases (92 per cent) by angiography as the reference method (Table 2). The corresponding figure for flowmeter determination was 52 of 70 (74 per cent).

Table 2. Prediction of early operative results (6 months)

Prediction	Correct	Incorrect	
		Open with abnormal findings	Occluded with normal findings
Angiography	65/70	2/70	3/70
Flow determination	52/70	14/70	4/70

DISCUSSION

The need for a reliable peroperative control method during vascular reconstructions has been accepted by most surgeons. The two methods used in this study are well established but have previously not been compared in regard to their reliability in predicting the early surgical results. It should be pointed out, however, that the flowmeter determination reflects the physiological events while the angiogram depicts the anatomical appearance of the recontructed area.

Basal flow rates of 100 ml/min and maximal flow rates of 250 ml/min in femoro-popliteal vein bypass grafts have been considered satisfactory. According to Dedichen (5) values below 80 and 200 ml/min, respectively, should be suspected for technical imperfection and result in immediate reexploration.

Technical errors or adverse hemodynamic factors are the main causes of pathological flow values. The individual case evaluation of abnormal flow values raises problems as to the adequate peroperative management of the reconstruction. In this study 22 reconstructions showed abnormally low flow rates. 13 of these had normal angiograms and remained patent. Possible explanations for these differential findings include high peripheral resistance and flow registration during unrecognized remaining hypovolemia (4).

Our results indicate that angiography is preferable to flow determination in the peroperative assessment of arterial reconstructions. If angiography is not used routinely it should at least be performed in cases with abnormally low flow values. A further advantage of the angiographic method is the possibility of obtaining an exact localization of a technical error.

REFERENCES

1. Bowald, S., Eriksson, I. & Fagerberg, S.: Intraoperative angiography in arterial surgery. Acta Chir Scand 144: 463, 1978.
2. Cappelen, C. & Hall, K.V.: Electromagnetic blood flowmetry in clinical surgery. Acta Chir Scand Suppl 368, 6, 1967.
3. Cronestrand, R. & Ekeström, S.: Blood flow after peripheral arterial reconstruction. Scand J Thorac Cardiovasc Surg 4: 159, 1970.
4. Cronestrand, R., Brismar, B., Jorfeldt, L. & Juhlin-Dannfelt, A.: Leg blood flow and central circulation at varying blood volumes. Acta Chir Scand 144: 75, 1978.
5. Dedichen, H.: Prognostic significance of intra-operative flow and pressure measurements in reconstructive vascular surgery. Scand J Clin Lab Invest, Suppl. 128, 31, 189, 1973.
6. Dickson, A.H., Strandness, D.E. & Bell, J.V.: The detection and sequell of operative accidents complicating reconstructive arterial surgery. Am J Surg 109: 143, 1965.
7. Plecha, F.R. & Pories. W.J.: Intraoperative angiography in the immediate assessment of arterial reconstruction. Arch Surg 105: 902, 1972.
8. Vänttinen, E.: Electromagnetic measurement of the arterial blood flow in the femoropopliteal region. Acta Chir Scand 141:353, 1975.

Received October 15, 1981

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