

Femoropopliteal Vein Grafts for Claudication Analysis of 100 Consecutive Cases

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One hundred consecutive femoropopliteal venous grafts in 85 patients with claudication were followed for five years. At this time, three limbs had been amputated, approximately one quarter of the patients had expired, and 70% of the grafts in surviving patients remained patent. It is concluded that this operation does not appear to increase the risk of amputation and in fact, may lessen it. Moreover, it is associated with minimal risk and generally provides long term relief of claudication, thus enhancing the quality of life in most patients.

DESPITE ONE-QUARTER of a century of cumulative experience with reconstructive procedures on the femoropopliteal arterial system, there still remains a profound lack of agreement as to the indications for the procedure. After Kunlin¹⁰ described the use of reversed saphenous vein grafts to bypass chronic occlusion of the superficial femoral artery, the use of this procedure was generally restricted to those patients in whom amputation was imminent because of rest pain, ischemic lesions, or frank gangrene. The results of this type surgery were often gratifying in relieving pain and preventing amputation. As experience was gained, the indications for this operation were liberalized by many surgeons to include claudication, especially if it interfered with the patient's occupation. While this appears to be a reasonable approach if good results may be expected, some surgeons still feel that the long term results do not justify this operation for simple claudication.^{1,11,17} We have considered surgery for claudication to be an effective and safe procedure at the Hospital of the University of Pennsylvania and undertook the following review to see if our continued use of bypass grafts for simple claudication is justified.

Clinical Material

One hundred consecutive reversed femoral popliteal venous bypass grafts, all done for claudication alone, were reviewed. These cases extended from January,

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Submitted for publication: August 19, 1977.

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1963 to June, 1971 and all patients were thus followed for a minimum of five years. The patients in this group had had little or no improvement with nonoperative management, and were seriously bothered by their inability to walk far. These 100 consecutive grafts were performed on 85 patients. Fifteen patients had bilateral operations but none simultaneously. All bypass operations done in this hospital were included, and thus this report represents the results of private and service patients and of staff and resident surgeons. This series does not include any graft inserted distal to the popliteal artery or grafts done for aneurysms.

The determination of patency of the grafts was primarily clinical, *i.e.*, the presence of a pulse distal to the graft and/or symptomatic improvement in walking ability. Occasionally arteriography was used if warranted. During this same period an additional 225 femoropopliteal vein grafts for limb salvage were performed, thus surgery for claudication represented 30% of the femoropopliteal venous bypasses done in this hospital.

Age and Sex

The age of the patients at the time of the operation and their sex is given in Table 1. Over three-quarters of the patients were in their sixth or seventh decade. The ratio of male to female was nearly six to one and 94% of these operations were done for white patients.

Associated Disease

There were 20 known diabetics in the group of 85. Other associated diseases in these patients were common, particularly cardiovascular disease. Most patients exhibited some other evidence of vascular disease as can be seen in Table 2. Of the 100 operations (36%) were done for patients with known cardiac disease and five patients had had a previous stroke. Nineteen opera-

TABLE 1. Age and Sex Distribution of 100 Consecutive Femoropopliteal Vein Grafts for Claudication

Age—Years	No. of Operations	Female	Male
30–39	3	1	2
40–49	11	2	9
50–59	37	2	35
60–69	41	10	31
70–79	8	0	8
Total	100	15	85

tions were on patients with a significant degree of pulmonary insufficiency, usually of a chronic obstructive type and associated with heavy smoking.

Smoking

The smoking habits of the patients were recorded in the charts of only 65 patients. Sixty-two of the 65 were smokers.

Arteriography

Preoperative arteriography was used routinely. The quality of runoff was recorded as good or excellent if the popliteal artery was patent and two or three vessels were patent distal to the patent popliteal. Of the 100 operations, 85 were in limbs having good or excellent runoff and 15 were judged to have fair or poor run-off. Among the 22 diabetic limbs 18 had good or excellent and four had fair or poor runoff whereas in the nondiabetic limbs, the corresponding numbers were 67 and 11.

Since all patients in this series were operated upon more than five years ago, our results can be expressed as actual findings five years after surgery. Four patients in the group were lost to followup with patent grafts when last seen, and an additional patient was lost after he was known to have occluded his graft.

Results

Mortality

There was no operative mortality. Twenty-one of the remaining 80 patients died within five years of their operation, mainly from cardiac disease. Thus, at the end of five years, there were 59 (74%) patients alive. The mortality rate in diabetics was 37% compared to 23% in nondiabetics. It was interesting and somewhat surprising that the mortality rates were essentially the same in patients with good and bad runoff, Table 3.

Graft patency

The graft patency rate was calculated by the life table method¹⁶ as shown in Table 4 and indicates a

five year cumulative patency rate of 68.5%. The actual patency of the grafts among the 59 surviving patients was 70% (50/71). The presence of diabetes did not appear to effect this patency but poor runoff was associated with a lower patency (55%) in the nine surviving patients.

Limb Survival

In the five year period following these operations, three limbs eventually were lost. The amputations were done at one and one-half, two and five years following grafting and all were preceded by occlusion of the graft in patients who continued to smoke. The amputations done at one and one-half and two years were both in patients with cardiac disease and fair to poor run-off at the time of the operation. One of these patients was diabetic. The third patient whose leg was amputated five years later, was not diabetic but hypertensive, and had good run-off at the time of operation.

Discussion

Although this series is incomplete with regard to the history of the use of tobacco, it would appear that it adds further weight to the evidence that there is a major connection between the use of tobacco and the development of peripheral vascular disease. We feel a surgeon may be justified in refusing to operate for claudication if the patient refuses to discontinue the use of tobacco⁶ although we have not yet taken this position. However, we strongly advocate the discontinuance of smoking, for it is the major factor in the etiology of peripheral vascular disease over which patients have complete control.

We have long been convinced that an autogenous vein graft is the best presently available material for reconstructive procedures on the femoropopliteal system and have used it in preference to endarterectomy or other grafts. When truly no suitable autogenous vein is available, we have "fallen back" and used these other methods, but rarely in patients with claudication alone.

Our typical procedure takes about two–three hours in time and results in approximately 100–200 cc blood loss. It can easily be done under general or regional

TABLE 2. Profile of Associated Diseases (100 Cases)

	No. of Operations
Diabetes	22
Hypertension	30
Heart Disease	36
Cerebrovascular (pressure stroke)	5
Pulmonary Insufficiency	19

TABLE 3. Factors Influencing Results in 100 Consecutive Vein Grafts for Claudication

	No. of Patients	Patients Lost to Follow-up	Five Year Mortality (%)	Five Year Patency Rate Among Survivors
Diabetes Mellitus				
Absent	65 78*	4	14/61 (23%)	40/57 (70%)
Present	20 22*	1	7/19 (37%)	10/14 (70%)
Out-Flow Tract:				
Good—Excellent	70 85*	4	16/66 (24%)	45/62 (72%)
Fair—Poor	15 15*	1	5/14 (35%)	5/9 (72%)

* Indicates number of grafts.

anesthesia and is tolerated well even by the elderly. Patients are allowed out of bed the evening of operation, and we have started small doses of heparin on the following day as prophylaxis against thrombophlebitis. Broad spectrum antibiotics have been given prophylactically with the preoperative medication and continued for three days.

In the past, there has been a strong tendency to gather together all cases of femoropopliteal reconstruction, whatever the indication, when reporting them^{3-7,9} and, from these results, judgments were made with regard to the likelihood of grafts remaining open or of actual harm being precipitated by the operation. All authors have found, however, that their results tend to be better in those patients who have the least diseased arterial tree and, one should anticipate better results in patients with simple claudication than in those whose limbs are threatened. Despite this fact, there are vascular surgeons of high quality and experience who feel the long term results in claudication do not warrant operating on these patients and advise against it, whereas others are equally convinced of the value and propriety of such operations. It is for this reason that we went back over our cases to see what in fact have been our long-term results in such patients.

In determining the propriety or impropriety of any operation, one obviously must examine not only the good but also the poor effects of the procedure. When we look at our postoperative results at five years and find more than two-thirds of the grafts patent and functioning in the surviving patients, it seems clear that these patients have had a more enjoyable life and for them the operation was worthwhile. What, however, are the possible ill effects in the remaining patients or in those who died? As can be seen in Table 3, there was no operative mortality in these patients. Such a result, no doubt involved an element of luck, but certainly the risk of an operative death appears to be very low in this procedure and operative risk is not a major argument against operation. The same has been the experience of others. Since the risk to life is minimal, what chance is there of making the limb worse? In no case in this series was an amputation immediately precipitated by the operation. It is, of course, impossible to know exactly what would have happened to these 100 claudicating limbs had operation not been carried out, but we have some indication from reported experience. Table 5 summarizes several reports of claudicators who were not treated surgically but followed, and from these reports, we may gather some indications of

TABLE 4. Life Table Analysis of 100 Consecutive Femoropopliteal Vein Grafts for Claudication

Interval	Grafts at Risk	Grafts Patent	Grafts Failing	No. not observed throughout interval due to		Interval Patency Rate	Cumulative Patency Rate
				Death	Lost to Follow-up		
0-30 days	100	97	3	0	0	97	97
3 mos.	93	89	4	2	2	95.6	92.7
6 mos.	88	86	2	1	0	98.8	90.6
12 mos.	84	80	4	1	1	95.2	86.3
18 mos.	79	76	3	1	0	96.2	83.1
24 mos.	75	74	1	1	0	98.2	81.9
30 mos.	74	74	0	0	0	100	81.9
3 years	70	68	2	3	1	97.2	79.5
4 years	62	59	3	6	0	95.2	75.5
5 years	55	50	5	4	0	91.1	68.5

TABLE 5. Amputation Rate of Intermittent Claudicators—Untreated

	Per Year (%)	Five Years (%)
C. Rob (Br. Med. J., 1960)	1.46	7.3
A. M. Boyd (Proc. R. Soc. 1962)	1.4	7.0
C. Newton Peabody, et al. (Arch. Surg. 1974)	0.52	2.6
A. M. Imparato, et al. (Surgery 1975)	2.3	11.5
F. McAllister (Am. J. Surg.) 1976	1.4	7.0
Average	1.4	7.8

the "natural history" of the condition. Most authors find that about 1.4% of claudicating limbs per year come to amputation, or 7% within five years, with a higher rate among diabetics. The lowest reported rate is that of Peabody, et al.¹³ in the Framingham study, which gives a rate of 0.5% yearly or 2.5% at five years and, the highest rate was found by Imparato, et al.⁸ with an annual rate of 2.3%, or approximately 11% at five years. At the end of five years, our amputation rate was 3% with none precipitated by operation. It would appear, therefore, that we have not increased the likelihood of amputation by such operations and may in fact have reduced it by about one half.

We are then left with the group of patients whose grafts occluded early or late and who survived. If a graft thromboses, the thrombus may be more extensive than the original occlusion and thus the circulation may be worse than before operation but this fortunately has not been common in our experience. Certainly, we have not seen more amputations than one would have anticipated without operation, and claudication when it returns is usually about as it was before. On the basis of these results, we feel that our previous belief that these operations may be indicated for simple claudication is justified, and we will continue to advise its use in appropriate patients.

We also wish to point out that the average operation in this series was done more than eight years ago (*et al.* minimum of five years in 1976) and, hopefully, our technique is better at this time, and present day results might, therefore, be even better. Certainly, we are now using smaller suture material (6-0 prolene) and today we almost never start a graft from the superficial femoral artery, which we occasionally did before, with less satisfactory long term results. Likewise, we are also more apt to run our grafts below the level of the knee joint now than we were previously. All of these technical factors may add up to give slightly improved future results. In addition, we are now able to follow our grafts more precisely by means of noninvasive studies and, hopefully will pick up those grafts

or anastomoses which are showing progressive narrowing before occlusion occurs and at a time when reoperation is most likely to be beneficial. In this series, it is noteworthy that 10 grafts occluded between three and five years and some of these occlusions might well have been prevented by reoperation. Arteriography on a routine basis would clearly be the best method of detection in this regard but our patients as a group are less than enthusiastic about such a routine.

It is not surprising that 26% of our patients (21 or 80) died within five years of operation and in most of these patients (79%) the grafts were patent at death. Certainly, in these patients too their life postoperative was more enjoyable than it would have been without the operation. Our diabetic patients, as expected, had a considerably poorer life expectancy than the nondiabetics, but similar to other reports¹⁶ we did not find a significantly increased rate of graft failure among these patients. We do not feel the presence of this disease, therefore, should preclude this operation in a claudicator.

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