Axillofemoral bypass
A 2-decade experience reviewed

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Summary
A retrospective study of axillofemoral bypass performed at Groote Schuur Hospital over a period of 2 decades was undertaken to analyse the results and to re-examine current criteria for patient selection.

During this period 109 patients underwent surgery. The primary indication was critical ischaemia (in 88% of cases). Operative mortality was 6.4%. Graft thrombosis and sepsis were identified as the major reasons for graft failure. Overall graft patency at 3 years was 43% and at 5 years 30%. Successful graft thrombectomy improved the overall cumulative patency rate at 5 years to 43%, and patient survival in the same period was 56%. Modern advances in the assessment of anaesthetic risk together with improved postoperative intensive care have allowed more patients who in the past would have been considered candidates for axillofemoral bypass to undergo direct aortic reconstruction.

While the results of axillofemoral bypass are inferior to those of aortic grafts, the technique remains a valuable method of limb salvage for the poor-risk patient and a life-saving treatment for aortic graft sepsis.

In June 1963, Louw1 was the first to publish a report on 3 patients who underwent axillofemoral bypass. The procedure was devised as a limb salvage operation for patients suffering from ischaemic rest pain in whom conventional aorto-iliac reconstruction was considered a prohibitive risk because of poor general medical status. Later in 1963 Blaisdell and Hall,2 who had independently devised a similar operation, reported on their initial clinical experience. These reports, together with the description of femorofemoral bypass by Veto3 in 1962 and other techniques described earlier,4-6 firmly established the concept of extra-anatomical bypass which has since become widely accepted. In 1966 Sauvage and Wood7 described the axillofibemoral technique as a logical extension of the unilateral procedure for poor-risk patients with severe bilateral limb ischaemia.

The purpose of the present study was to review our total experience with axillofemoral bypass and to assess changing trends in patient selection while re-evaluating the current role of this procedure for lower limb revascularization, especially in view of the good results reported.8,9

Methods
A retrospective study was undertaken of axillofemoral bypass grafts performed at Groote Schuur Hospital during the period 1962-1980 and included cases previously reported up to mid-1975.10 Patient records were reviewed and supplemented by a personal interview whenever possible. For those patients residing outside the greater Cape Town metropolitan area, additional data were obtained by sending a questionnaire to the patient or his doctor. Follow-up data were not available for 15 patients operated on in the earliest part of the study. Analysis was therefore based on the remaining 94 patients.

Socio-economic and geographical factors made follow-up data to a definite 'end-point' incomplete in some cases. The available data were, however, included in the analysis. Results for both survival and cumulative graft patency were calculated by the life-table method.11,12 Analysis of patency rates for prethrombectomy and post-thrombectomy groups were also performed to establish the effect of graft thrombectomy on the overall patency rate.

The adequacy of axillary artery flow was determined by clinical evaluation alone. Lower-limb angiography was not considered mandatory and was performed in less than 50% of cases. Clinical evaluation of absent femoral pulses and segmental Doppler pressures was considered adequate evidence of proximal occlusion. As previously reported, the majority of patients had occluded superficial femoral arteries (SFA), reliance for run-off being placed entirely on an adequate profunda femoris flow.10

The indications for axillofemoral bypass were critical limb-threatening ischaemia in 88% of cases, aortic graft sepsis in 7% and severe claudication in 5%. Factors precluding standard vascular reconstruction were both local and general.

Of the local factors, a failed previous aorto-iliac procedure (23%) was the most frequent. General medical risk factors were severe hypertension (55%), ischaemic heart disease (45%), respiratory disease (40%) and impaired renal function (14%). Local and general factors frequently coexisted. Over 80% of patients were smokers.

The operative technique as described in 197710 has remained unaltered (Fig. 1). All procedures were performed under general anaesthesia with prophylactic antibiotic cover. Emphasis was placed on early isolation of the superficial and deep femoral vessels with evaluation of superficial femoral artery and especially profunda femoris backflow, since more than 75% of our patients had an occluded superficial femoral artery. The distal anastomosis was constructed end-to-side to the superficial femoral artery and/or profunda femoris. The proximal anastomosis was to the first part of the axillary artery, although some still favour the third part as originally

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Axillary Artery–Anastomosis

Subcutaneous Tunnel

Counter incision

Femoral Anastomosis

Profunda

Superficial femoral artery

AXILLO–FEMORAL

Fig. 1. Technique for unilateral axillofemoral graft.

described. A subcutaneous tunnel in the mid-axillary line was utilized, there being no advantage to other recently described routes. Although the value of postoperative anticoagulation has been challenged, we have used the antiplatelet agents dipyridamole and acetylsalicylic acid for long-term prophylaxis.

Axillofemoral grafts have not been performed as a routine. When undertaken, the cross-over limb was taken from as close as possible to the ‘hood’ of the lower anastomosis of a standard axillofemoral graft (Fig. 2). The reduced flow in the long limb of the graft resulting from a higher femoral cross-over was thus avoided.

Saphenous vein, Teflon and Wesolowski weave-knit grafts were used in the early part of the series. Knitted Dacron velour (8 mm and 10 mm) grafts were subsequently used for the majority of patients, polytetrafluoro-ethylene (PTFE) grafts being used in the latter part of the study.

Results

During the period reviewed, 109 patients underwent 112 primary axillofemoral grafts (Table I), with limb-threatening ischaemia as the primary indication in 88% of cases. Of the 94 patients in the follow-up study 83 were males and 11 females, their ages ranging from 28 to 85 years (mean 61 years). Of the grafts performed, an ipsilateral axillofemoral graft was the most common (71% of cases). During the 6-year period 1970 - 1975, 56 grafts were performed, of which 51 were for critical ischaemia. During the subsequent 5-year period 1976 - 1980 only 30 grafts were performed, of which 24 were for critical ischaemia.

| TABLE I. TOTAL NUMBER OF INITIAL AXILLOFEMORAL GRAFTS, 1962-1980 |
|-----------------------------|----------------|
| No. Axillary-ipsilateral     | 80 71.4 |
| Axillary-bifemoral           | 25 22.3 |
| Axillary-contralateral       | 1 0.9 |
| Bilateral axillofemoral      | 6 5.4 |
| **Total**                   | **112** |

Our operative mortality rate was 6.4% (Table II), which compares favourably with figures from other reported series and for aortic grafting while being lower than the 20 - 33% mortality quoted for amputations for vascular disease. Our 5-year cumulative survival rate was 56% (Fig. 3), reflecting the poor general medical condition of these patients.

Graft sepsis and graft thrombosis were the only major complications experienced. We have not experienced upper extremity embolism, brachial plexus injury, vascular steal or upper limb gangrene. The graft sepsis rate of 5.5% (6 cases), although low, was significant in that all but 1 patient required graft removal and consequent amputation.

The 5-year cumulative patency rate from the time of initial operation to the first graft thrombosis was 16% for unilateral

| TABLE II. THIRTY-DAY OPERATIVE MORTALITY RATE AND CAUSES OF DEATH |
|--------------------------|-------|
| No. of patients         |       |
| Myocardial infarction    | 2     |
| Postoperative pneumonia  | 1     |
| Mycotic aneurysm, renal failure and septicaemia | 1 |
| Ruptured aortic aneurysm and renal failure | 2 |
| Haemorrhage from aortic false aneurysm | 1 |
| **Total**                | **7** |
| **(6.4%)**               |       |
axillofemoral grafts and 44.7% for bifemoral grafts (Fig. 3). The cumulative patency rates for all grafts at 3 and 5 years were 43% and 30.5% respectively. Successful graft thrombectomy following an episode of thrombosis increased the overall patency rate for the same periods to 58.3% and 43% respectively (Fig. 4).

**Discussion**

Since the initial description of axillofemoral bypass and subsequently axillobifemoral bypass, both procedures have gained wide acceptance. Enthusiastic support for the procedure has resulted in excellent long-term patency results being reported in the literature. By comparison, our current results and those recently reported by Corbett et al. are inferior.

The age and sex distribution of our patients reflects the general pattern of atherosomatous vascular disease seen at our institution and is similar to that seen in other centres. A similar high proportion of smokers (over 80%) was also noted. In reported series differences may exist in terminology. Limb-threatening ischaemia and rest pain are the usual criteria cited as indications for surgery. However, by today's standards these terms are scientifically inexact. For future studies and for results to be meaningful and comparable, the 'critically ischaemic limb' needs redefinition in terms of precise scientific criteria based on clinical and non-invasive vascular assessment. Similarly, the terms 'high-risk' and 'poor-risk' patients need re-evaluation. Criteria used to define them 20 years ago are no longer applicable and the use of such aids as the Cardiac Risk Index would permit standardization of terminology.

Further differences exist in patient selection criteria, which have varied from the stringent to the liberal. Our group, like others, has taken an intermediate stance. Those using stringent criteria restrict the procedure to cases of aorto-enteric fistula or aortic graft sepsis. Other centres have been more liberal, with claudication as a reported indication in between 15% and 60% of cases. It is in these latter patients, with better peripheral run-off generally and in whom bifemoral grafts were performed, that excellent long-term patency has been reported. Coupled with the low morbidity and mortality rates, these results have encouraged the use of the axillofemoral graft as an alternative to aortic grafts or in patients over a certain age.

The difference in graft patency between patients requiring a graft for limb salvage and those with claudication (50% v. 81%) has been emphasized by Ray et al. The better results achieved when claudication was the indication applied to both unilateral and bifemoral grafts. Their patency rate for limb salvage at 5 years for unilateral grafts was 50.4% and at 3 years for bifemoral grafts 68.6%. The routine use of axillobifemoral bypass has been recommended because this operation is thought to achieve better long-term patency than a unilateral axillofemoral bypass. However, when performed for limb salvage, two recent studies have failed to show a statistical difference between the two procedures with respect to both cumulative patency and limb salvage.

Our experience would indicate that late graft failure is not always accompanied by recurrence of rest pain or the need for
amputation. This has recently been well documented. The tendency of many of our patients with graft thrombosis to present late to a vascular unit has, however, jeopardized the chances of a successful graft thrombectomy (20 patients). This has accounted for our low post-thrombectomy patency rate compared with that of Burrell et al. 17

Graft failure due to thrombosis is a major problem associated with axillofemoral bypass. It is uncertain whether this is contributed to by external pressure, neo-intimal hyperplasia or advancing disease in the run-off vessels. The use of the newer graft materials — PTFE and non-crimped, externally supported Dacron — could improve patency results in the future. 34

Absence of adequate run-off is probably the most important single factor contributing to graft failure. In our patients operated on for limb salvage (88%), more than 75% had occluded superficial femoral vessels. The incidence of graft thrombosis is known to be significantly higher in patients in whom only the profunda femoris is patent compared with those in whom both the superficial and deep vessels are patent. 17

The results of conventional aorto-iliac and aortofemoral bypass still remain the reference standard when achieved with a low mortality rate and a 5-year patency rate in excess of 85%. 26 The comparable patency rates achieved with axillofemoral bypass in certain centres 9, 21, 31, 33 have resulted in the axillofemoral procedure being advocated as an alternative to aortic bypass in a growing number of patients with claudication. These patency figures have, however, not been achieved without significant recourse to thrombectomy in addition to the cumulative morbidity and expense, and suggest that such a recommendation should be viewed with caution.

Conclusion

Axillofemoral bypass retains a place in modern vascular surgery as the procedure of choice for the treatment of septic aortic grafts and aorto-enteric fistulas and in a proportion of poor-risk patients with limb-threatening ischaemia. 1, 2, 19 However, internationally acceptable standards of terminology and the indications for surgery need to be reviewed and criteria redefined in terms of current scientific and medical knowledge.

The critically ischaemic limb remains the principal indication for surgery. In these cases we still advocate unilateral axillofemoral grafting, there being no statistically significant difference in patency rates between this and axillofemoral grafting when used for this indication. 12, 32

Aortic bypass still remains the treatment of choice from the haemodynamic point of view. However, there are patients in whom major surgery would constitute a prohibitive risk and in whom life expectancy is limited. In these few cases, axillofemoral bypass with its low morbidity and mortality rates remains the safe and logical alternative.

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REFERENCES