

# Axillo-axillary Bypass Grafting for Proximal Subclavian Artery Obstructions

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## SUMMARY

The current popular method of surgical correction of symptomatic proximal subclavian arterial occlusions by carotid-subclavian bypass, although it has given good results in several reported series, is not without hazard. Operative manipulation of the carotid vessel, which includes clamping, placing of intraluminal shunts, and construction of suture lines from which adherent platelet or fibrin thrombus may embolise, carries a definite risk of postoperative stroke. An alternative reconstruction, which does not involve the carotid artery at all, would seem preferable.

Axillo-axillary bypass grafting is a safe and effective method of revascularising the distal subclavian vessel and of treating the subclavian steal syndrome. The procedure is simple to perform and has not been associated with any significant side-effects in the cases followed-up to date, and is recommended when the surgeon has any doubt about using a carotid vessel in his reconstruction procedure.

*S. Afr. Med. J.*, 48, 2174 (1974).

Since its initial description by an Italian radiologist in 1960, the subclavian steal syndrome has been widely reported both from the surgical and the radiological aspects. A variety of surgical approaches has been advocated and some of them have been abandoned. The currently popular surgical procedure is the carotid-subclavian bypass graft.

It is the purpose of this report to discuss the procedure of axillo-axillary bypass grafting and to indicate its simplicity, safety and efficacy as a method of treatment for the subclavian steal syndrome or other symptomatic proximal subclavian occlusions.

## Surgical Approach

In a person of average build the tip of the coracoid process can usually be palpated, without any difficulty, as a prominence in the slight concavity below the outer third of the clavicle. Using this landmark, the axillary artery can often be palpated as it crosses this area behind the pectoral muscles. In this relatively superficial situation, access to the artery may readily be obtained by incising just below the outer third of the clavicle. The deltopectoral

groove is then developed by separating the deltoid muscle from the lateral border of the clavicular head of pectoralis major, to expose the underlying pectoralis minor. Alternatively, additional exposure can be obtained by dividing the clavicular head of pectoralis major across its midportion.

At the inferolateral border of pectoralis minor the third part of the axillary artery presents with the musculocutaneous and lateral head of median nerves lying on its lateral aspect. The medial head of the median nerve crosses the artery anteriorly at this point, and should be carefully avoided during exposure. On the medial side of the artery lies the ulnar nerve, while the circumflex and radial nerves are closely applied posteriorly. It may be wise to divide the tendon of pectoralis minor, thus exposing additional proximal length of artery, avoiding the risk of a large nerve crossing anteriorly at this point. In addition, this manoeuvre will allow the graft to lie more satisfactorily from its point of origin, without being angled across the outer border of pectoralis minor.

A similar exposure on the opposite side can be performed simultaneously by an assistant, and a subcutaneous premanubrial tunnel completes the exposure before the anastomoses are started. The tunnel is best made at this stage and packed with gauze soaked with a penicillin solution for haemostasis while the first anastomosis is being done.

At the completion of the graft the wound is irrigated with saline, and no attempt is made to resuture divided muscle. The use of a Portovac suction drain is optional. At the completion of the operation, normal blood pressure should have been restored to the recipient subclavian-axillary-brachial axis. A soft bruit has been present along the graft immediately after operation in all our cases.

## CASE REPORTS

### Case 1

A woman aged 65 years had episodes of giddiness for 8 months. These were related to posture, being precipitated by neck extension or looking to the left while recumbent. She also experienced intermittent bouts of 'pins and needles' at the tips of the fingers of her left hand, often associated with numbness of the lower forearm and hand. More recently use of the hand became limited by tiredness and weakness of the entire limb.

Examination revealed a weak left radial pulse. The blood pressure was 145/70 in the right arm and 85/65 mmHg in the left. There was also evidence of arteriosclerosis obliterans involving both ileofemoral arterial segments.

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Arch angiography showed a typical proximal left subclavian obstruction. Later films showed filling of the ipsilateral vertebral artery which emptied into the distal left subclavian artery and a second stenosis appeared at the side of crossing of the artery by the scalenus anterior.

At operation, scalenotomy resulted in progressive dilatation of this narrowed segment. An 8-mm Dacron graft was placed between the right and left axillary arteries in their third portions. Immediately after operation the left brachial blood pressure was noted to be consistently 5 mmHg higher than on the right side. This has persisted to date.

The patient has been almost totally relieved of her symptoms during the 10-month follow-up, except for slight aching in both arms on prolonged abduction beyond 90°.

## Case 2

A woman aged 57 years was referred by a neurologist for management of intermittent claudication of 6 months' duration. During this period she experienced frequent dizzy spells, with tinnitus, which came on without warning and associated with a feeling of syncope. These episodes were usually transient and on occasions were definitely related to rotation of her neck.

Examination showed a weak left radial pulse with a blood pressure of 105/80 mmHg compared with 145/80 mmHg on the right side. There was also evidence of marked aorto-iliac stenotic disease bilaterally.

Angiography showed a double stenosis of her left subclavian artery and absent left vertebral filling even on delayed films, and severe aorto-iliac disease. She was referred for management of the latter condition with the

diagnosis of associated vertebrobasilar ischaemia because of an occluded left vertebral artery.

Uneventful aortofemoral grafting was performed, but during follow-up assessment it became apparent that her vertebrobasilar symptoms were increasing. Review of the arch angiography, together with a further drop in the left radial pulse volume and blood pressure, led to a decision to perform selective right vertebral angiography, to see if any portion of the left vertebral artery was patent. With low-pressure manual injection, dye was introduced via the right transaxillary route, and showed a patent left vertebral artery with reverse flow and delayed filling into the left subclavian artery.

This confirmation of the subclavian steal syndrome was followed by an axillo-axillary bypass graft. The symptoms are almost fully relieved and she remains well one year later.

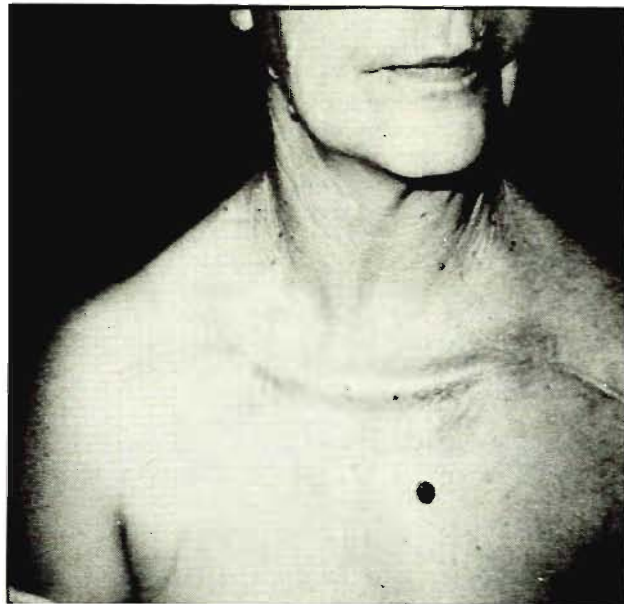


Fig. 2. Case 2. Axillo-axillary graft visible, readily palpable and available for auscultation 9 months postoperatively.



Fig. 1. Case 2. Operative incisions placed below outer half of clavicles.

## Case 3

A man aged 58 years presented for neurological examination because of frequent occipital headaches and two recent attacks of transient blurring of vision. His family commented on a dulling and slowing-down of his personality.

Examination showed a weak left radial pulse, with blood pressure recordings of 160/95 and 115/90 mmHg in the right and left arms respectively. Arch angiography demonstrated a typical vertebral subclavian steal syndrome with proximal left subclavian occlusion.

An 8-mm knitted Dacron graft was placed premanually from the right to the left axillary artery below the clavicle. Postoperative blood pressures equalised at normal pre-operative levels and have remained so. To date, head-

aches have not recurred, and his family remarks on his improved mental well-being.

## DISCUSSION

Axillo-axillary bypass grafting, first reported by Jacobson *et al.*<sup>1</sup> in 1973, is an effective and simple method of revascularisation of the distal subclavian and axillary arteries in the presence of significant proximal obstruction of these vessels. In the presence of reversed vertebral flow due to proximal subclavian occlusion, normal antero-grade flow may be restored with complete relief of vertebrobasilar ischaemic symptoms.

Although the currently popular carotid-subclavian bypass has given good results in several reported series,<sup>2-5</sup> this procedure is not without inherent hazards. Any operation on the carotid artery involving cross-clamping, intraluminal manipulation of an inlying shunt, and an anastomosis which may later be the site of stenotic narrowing or adherent platelet thrombus, carries the risk of producing damaging cerebral ischaemia. Blaisdell *et al.*,<sup>6</sup> reporting from the joint study of extracranial arterial occlusion, noted a 7% incidence of new strokes in a series of 247 revascularisations involving the proximal common carotid artery. Such an operation is best avoided if a suitably effective alternative is available.

In the subclavian steal syndrome, some surgeons maintain that carotid to subclavian bypass merely duplicates the physiological defect of reversed flow,<sup>7</sup> thus tending to produce an additional carotid steal, but the majority of clinical evidence would seem to suggest that such a phenomenon is quite unlikely to be clinically significant if and when it does occur.

Other experimental data<sup>8</sup> have shown that pressure in the distal carotid beyond the carotid-subclavian bypass does not drop significantly when the peripheral resistance in the arm is lowered by injection of papaverine at the distal end of the graft. This fall of resistance is greater than one would expect to result from simple exercising of the arm, so that the provocative clinical situation is unlikely to arise.

The other condition under which distal carotid flow would be reduced in the presence of a functioning carotid-subclavian bypass, is stenosis of the origin of the internal carotid itself.<sup>7</sup> Such a distal stenosis in the bifurcation/origin of the internal carotid should be corrected before any attempt at correction of the subclavian steal phenomenon itself. In the presence of a vertebral-subclavian steal together with proximal common carotid stenosis, the use of the latter vessel as a donor for a carotid-subclavian shunt is contra-indicated. It is of paramount importance to know the exact pressures in the common carotid and distal subclavian in order to predict the likely direction of flow across such a shunt in this instance.

The use of the axillary artery as a donor source for revascularisation of the lower limb was initially put

forward by Louw<sup>9</sup> and others,<sup>9</sup> and is a well-accepted vascular procedure at present. More recently the femoral vessel has been used to 'donate' blood into the axillary artery for revascularisation of the extracranial system.<sup>10</sup> The ease of access of the axillary artery appealed also to Shumaker,<sup>11</sup> who now prefers carotid-axillary bypassing to the previous carotid-subclavian grafting.

Preference has been expressed for the use of the first or second parts of the axillary artery,<sup>12</sup> as the site for the donor anastomosis in axillofemoral grafting, because this portion is more fixed as it crosses beyond the outer border of the first rib. This relative lack of mobility is thought to be advantageous in that kinking or stretching of the graft is less likely to occur with movement of the shoulder joint. We utilised the junction of the 2nd and 3rd parts of the artery after division of the pectoralis minor, and have not encountered this problem to date.

In patients who have had previous neck surgery, including previous carotid endarteriectomies, or who have had cervical irradiation, the axillo-axillary graft would achieve the same results without the difficulties or hazards of surgery in a previously damaged area.

The subcutaneously placed graft can readily be seen (Fig. 2), palpated, and auscultated in postoperative assessment. External pressure at this site is unlikely to occur and so the danger of graft failure from this cause would appear to be negligible, as distinct from this real possibility in the case of axillofemoral grafts.<sup>12</sup>

As yet there are no haemodynamic data available to support the established clinical efficacy of axillo-axillary bypass. However, subclavian-subclavian bypassing, which has also been advocated for the subclavian steal syndrome,<sup>13</sup> has been shown in dogs to provide adequate haemodynamic restoration from flow values found after proximal left subclavian ligation. The reversal of left vertebral flow was restored to an antero-grade direction, while left distal subclavian flow and pressure reached control values after opening the shunt between the right and left distal subclavian vessels. Further data on human patients are awaited.

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