ARTERIAL COMPLICATIONS OF TOTAL KNEE REPLACEMENT
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J. H. RUSH, J. D. VIDOVICH, M. A. JOHNSON

From St Vincent's Hospital, Melbourne

Arterial complications occurring in association with knee replacement surgery are rare, even though most patients having this operation are elderly and therefore more likely to have peripheral vascular disease. We report a patient who developed an arterial complication during the course of a knee replacement operation, as well as the results of a survey of Fellows of the Australian Orthopaedic Association. Recommendations to minimise this serious complication are proposed.

Each year in Australia a significant number of total knee replacement operations are performed and, although the exact figures are uncertain, it is estimated that in 1985 about 1800 knee prostheses were inserted. In 1974 approximately 50,000 hip replacements and 5000 knee replacements were performed in the United States and in 1976 these figures rose to approximately 80,000 hip replacements and 40,000 knee replacements (Hori et al. 1978). Since 1972 one of the authors (JR) has performed 350 total knee replacements using either Geomedic or Insall/Burstein prostheses.

Despite these many operations, there have been only sporadic reports of major vascular complications during or immediately after surgery. In a report on 7073 joint replacements performed in 22 Sydney metropolitan hospitals from 1969 to 1976, there were no recorded cases of major arterial complications (Bloch 1979, unpublished data). McAuley, Steed and Webster (1984) reported two cases of arterial complications: one was acute and the other occurred 16 months after knee replacement. Robson, Walls and Swanson (1975) described a case of popliteal artery obstruction resulting from the restoration of full extension of the knee after a Shier's total knee replacement.

It is surprising that more cases have not been reported, especially since most patients having this operation are elderly and perhaps more likely to have peripheral vascular disease. Moreover, in most cases the operation is performed using a pneumatic tourniquet, a procedure which has its own risks: thus, Giannestras, Cranley and Lentz (1977) have reported a tourniquet-induced injury of the superficial femoral artery in a foot operation.

We report a patient who, after a knee replacement operation, suffered a major arterial complication. After our experience a circular was sent to all Fellows of the Australian Orthopaedic Association in an attempt to determine the incidence of such complications. The results of this small survey are presented, as well as recommendations to prevent this serious complication.

CASE REPORT

A 58-year-old retired clerk presented with a 20-year history of generalised rheumatoid arthritis. He had increasing pain and swelling in the right knee and difficulty in walking because of pain and instability in the joint. There was a flexion contracture of 15°, mild swelling, laxity of the medial collateral ligament, a valgus deformity on weight-bearing and a range of movement from 15° to 85° with pain and crepitus. A radiograph of the knee revealed significant erosions and osteoporosis, with marked secondary degenerative changes and some collapse of the lateral tibial condyle. He was taking 400 mg of ibuprofen four times a day and 2 mg of prednisolone per day. He had sustained a myocardial infarct many years before but his heart condition was stable. He also had peripheral vascular disease, with claudication in the calf more marked on the left side. The right femoral pulse was palpable but not the left; no pulse below the femoral was felt on either side.

The patient was treated with an Insall/Burstein knee replacement. A pneumatic thigh tourniquet was used and was inflated for 1.5 hours. The operation was uncomplicated but, at the time of release of the

J. H. Rush, FRACS, Orthopaedic Surgeon
J. D. Vidovich, FRCS, FRACS, Vascular Surgeon
Medical Centre, 55 Victoria Parade, Fitzroy 3065, Victoria, Australia.
M. A. Johnson, FRACS, Orthopaedic Registrar
St Vincent's Hospital, Melbourne 3065, Australia.

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tourniquet after the insertion of the prosthetic components, bleeding from the bone and tissue below the level of the knee joint was noted to be unusually slight. The operation was concluded and poor capillary return was observed in the toes. Four hours later the right foot was pale and there was no capillary return and no movement. A femoral angiogram demonstrated a blocked superficial femoral and popliteal artery and, because the foot was severely ischaemic, urgent exploration of the popliteal artery was performed.

At operation the superficial femoral artery was found to be occluded by atheroma and the popliteal artery was occluded by fresh thrombus. A thrombectomy and femoropopliteal by-pass graft with reversed long saphenous vein was carried out. Fasciotomies of the lower leg compartments were performed. The procedure was successful and amputation was avoided.

During the postoperative period the patient suffered a mild myocardial infarct. Although the anterior compartment fasciotomy wound broke down and took many months to heal, he subsequently made a good recovery from the operation and regained 100° of flexion with primary wound healing and no pain. When discharged from hospital, he was walking well with the aid of a stick; he had no pain in the right knee but complained of pain in both feet due to ischaemia.

Subsequently further arterial surgery was successfully carried out for ischaemic pain at rest caused by progressive peripheral vascular disease. The patient died about eight months after the initial operation from another myocardial infarct.

After our experience of this case all orthopaedic surgeons in Australia (470 Fellows of the Australian Orthopaedic Association) were contacted and asked to report any similar experience of major arterial complication which may have occurred within the past 10 years. They were also asked if they took any particular precautions to prevent this occurring. One hundred replied and reported 12 cases: of these, seven were of femoral/popliteal artery thrombosis and five were due to direct trauma to major vessels (see Table I).

In summary, four cases were due to direct injury to the popliteal artery and on one occasion to the geniculate vessels at the time of operation; these were due to technical problems. The other eight cases were of acute ischaemia due to superficial femoral or popliteal artery thrombosis.

**DISCUSSION**

It would seem clear that the key factor in producing arterial thrombosis is the use of a tourniquet to provide a bloodless field during the operation. This causes a cessation of blood flow and, in atheromatous vessels, may result in intra-arterial thrombosis. The mechanical pressure of the tourniquet may traumatisate atheromatous
vessels, causing fractures of plaques. Finally, an athero-
matous popliteal artery which has lost its elasticity could
be damaged by the distortion and traction caused by the
various manipulations of the knee during the procedure.

The management of postoperative ischaemia of the
limb under these circumstances depends upon its
immediate recognition. If the foot becomes hyperaemic
after removal of the tourniquet, then clearly ischaemia is
not present; on the other hand, ischaemia should be
suspected if a previously present pulse is absent, if the
foot remains pale or if capillary return is either poor or
absent. The presence or absence of skin sensation is not
likely to be a reliable sign immediately after operation
because the patient may not be fully awake to appreciate
the test; the effects of a spinal anaesthesia may also still
be present. When the diagnosis of ischaemia is suspect-
ed, an urgent consultation with a vascular surgeon is
required. The sooner operation is performed the better,
since a delay of over four hours may lead to loss of the
limb due to irreversible ischaemia. Overall, it is
important that, in all cases, the circulation of the limb be
assessed immediately after removal of the tourniquet.

To avoid this serious complication, the following
recommendations are made:
1. When planning total knee replacement, the possibility
of peripheral vascular disease should always be consid-
ered. The limb pulses should be carefully palpated and
the findings recorded. Calcification of the popliteal
artery should be sought on the plain radiographs and the
popliteal area palpated for an arterial aneurysm. When-
ever there is any doubt, it is wise to consult a vascular
surgeon.
2. If there is significant peripheral vascular disease with
no popliteal or distal pulses and knee surgery is required,
the operation should be performed without a tourniquet.
This does not make the operation too difficult, but care
must be taken in cleaning the bare bone surfaces before
inserting the cement. Hydrogen peroxide and/or oxycel
may help in this regard.

Some surgeons insist on using a tourniquet. If this is
the case, then the patient should be treated with heparin,
the tourniquet inflated and the appropriate dose of
protamine sulphate given.
3. A careful record should be kept of the pulses, colour
and circulation in the feet immediately after the
operation and, if necessary, a vascular surgeon asked to
assess the patient by physical examination, Doppler
studies and perhaps femoral angiography.

Conclusion. Arterial complications are usually prevent-
able if proper care is taken. There is little point in
undertaking a total knee replacement in a leg where there
is severe peripheral vascular disease, particularly if such
disease is causing significant symptoms and signs.

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