

Tourniquet Failure During Total Knee Replacement Due to Femoral Arterial Calcification

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CASE REPORT

A 67 year old obese female patient with a 7-year history of osteoarthritis and severe pain in both knees restricting activity was admitted for a right total knee replacement. Patient was not having any pre-existing co-morbid conditions. As per anaesthetic plan, an Epidural block was instituted with a mixture of Bupivacaine 100 mg. and Lignocaine 200 mg. in a volume of 24 ml. Patient was sedated with Inj.Diazepam 10 mg IV. The use of a tourniquet was not contraindicated as the popliteal and dorsalis pedis pulses were palpable. After exsanguinations, the tourniquet was inflated to 350 mm Hg and surgical site prepared and operation commenced. Upon incision, significant bleeding was noticed from the skin and subcutaneous planes. Suspecting tourniquet inadequacy, inflating pressure was increased to 425 mm Hg, which resulted in increased bleeding. Surgery was temporarily interrupted and the tourniquet cuff and inflator were changed, but with similar results. Suspecting bleeding due to incompressible artery and venous tourniquet effect, the tissues were closed and surgery deferred pending investigation and workup. Review of patient's radiological data revealed signs of femoral arterial calcification, confirmed by vascular Doppler study. Left total knee replacement was planned two weeks later with adequate blood components in reserve. Trial of tourniquet was decided. Under Epidural anaesthesia, after exsanguination, tourniquet was inflated to 425 mm Hg and venous congestion of the leg was noticed. 10 minutes prior to tourniquet inflation, Inj. Tranexamic acid 10 mg/kg was given as a bolus i.v. On incision, excessive bleeding was encountered. Subsequently the tourniquet was deflated and the operation continued. Surgery was completed with intraoperative loss of 600 ml and transfusion of two units of packed red cells. Subsequent course in the hospital was uneventful.

DISCUSSION

Total knee replacements are generally done under central neuraxial blockade with intraoperative pneumatic tourniquet usage. In comparison to other lower extremity surgeries, the tourniquet is thought to play an important role in TKR considering the highly vascular tissues around the knee.

This approach has been questioned by Tetro AM, et al.¹ who observed no difference in intraoperative or total blood loss, transfusion requirements, hospital stay or other outcomes. Similar observations were noted by Smith TO, et al.² in their meta-analysis and review of 15 studies with 991 patients undergoing TKR's. There was an increased trend for complications in the tourniquet group than the non tourniquet group. Inadequate haemostasis due to tourniquet failure is occasionally encountered intraoperatively and has been attributed to various factors (Table-1).

Arterial calcification and joint degeneration are common in the elderly, and thus arterial calcification is often seen in the radiographs of patients undergoing joint replacement.³ Calcified incompressible arteries are uncommon but have been reported. There are only few previous reports of tourniquet failure in the literature, but blood pressure cuffs unable to compress calcified arteries have been reported more frequently. Arterial calcification has been observed commonly in the intima as in atherosclerosis and end-stage renal disease, or in the media as in diabetes mellitus and Monckeberg medial calcinosis. The calcification has been noted more often in the medium and small peripheral arteries. With the calcification of the arterial media, the impairment of peripheral perfusion is uncommon unless atherosclerosis co-exists.³ A high Ankle Brachial Index (ABI) may be an integrative marker for arterial intimal and medial calcification, and has a high positive predictive value for artery calcification.⁴ The literature search for failure of pneumatic tourniquet intraoperatively due to incompressible arteries in patients undergoing total knee replacements revealed three published reports.^{3,5,6} In one case the procedure was abandoned and in the other two instances, the surgery was continued with the tourniquet deflated and completed uneventfully.

The primary concern is that the use of pneumatic limb tourniquet in the presence of arterial calcification without proper preparation could result in serious adverse outcomes. Increased blood loss from the surgical field could result due to the inflated tourniquet cuff compressing the veins but failing to compress the artery, resulting in the 'Venous tourniquet'. When the possibility of incompressible arteries

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Table 1
Inadequate Haemostasis

1. Inadequate tourniquet pressure - Arterial and venous leakage
2. Tourniquet Ooze - Apparent tourniquet failure; < 30 minutes into procedures, ooze can occur secondary to medullary flow of blood in bone. Increasing tourniquet pressure is of no value and increases risk of complications
3. Calcified, incompressible arteries
4. Inadequate exsanguination

and tourniquet failure is considered preoperatively, alternate perioperative management should be planned with adequate allogenic transfusion reserve, autologous transfusion plan & use of cell saver device perioperatively.⁶

Patients with peripheral vascular calcification may have undetected coronary artery disease and may not tolerate the anaemia due to surgical blood loss. Proper transfusion strategy may minimize the risk of cardiac ischaemic events. Inj. Tranexamic acid is an antifibrinolytic agent which reduces perioperative blood loss.⁷

More hazardous are the arterial complications which may occur on either an acute or chronic basis, leading to ischemia of the lower extremity. The mechanism may be the disruptive forces applied to the calcified atherosclerotic vessels by the pneumatic tourniquet or rarely during intraoperative manipulation leading to dislodgement of an atheromatous plaque and distal ischemia.⁸

Prevention of tourniquet related vascular complications during total knee replacements consists of several steps. Thorough preoperative vascular evaluation should be performed in patients with preoperative risk factors and baseline Doppler segmental pressures obtained. In case of any doubt, a vascular surgeon should be involved in the preoperative evaluation and planning. Ankle pressures should be measured and the Ankle-Brachial Index should be calculated.⁹

In patients with extensive arterial calcification and ABI > 1.4, the use of a tourniquet should be questioned. If a tourniquet is necessary in spite of existing risk factors, intraoperative manipulation of the knee must be minimized and thorough postoperative clinical investigation should be done. Any postoperative signs of ischemia must be considered to be caused by a major arterial injury until proven otherwise.¹⁰

To conclude, through preoperative evaluation and

preparation are a must, irrespective of the nature of the case. Evidence of vascular calcification should prompt a thorough cardiovascular evaluation and ABI calculation. Patients with cardiovascular disease have very low tolerance for blood loss and adequate preoperative preparation is essential. Proper planning and management helps to avoid unnecessary delays and postponement or cancellation of scheduled cases thus improving efficiency and cost-containment.

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