Deep vein thrombosis following prolonged kneeling: a case report

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Abstract
This report describes a fibreglass mould maker in the yacht building industry who developed a deep vein thrombosis (DVT) after 6 weeks of working in a kneeling position. We propose that his prolonged kneeling combined with constrictive knee pad straps caused vascular compression, precipitating his DVT. A hypercoagulability diathesis was suspected but not confirmed. Operator and employer education, modified work practices and strapless knee pads are suggested as possible preventive measures.

Key words Boat-building; deep vein thrombosis; fibreglass; kneeling; knee pads.

Introduction
Deep vein thrombosis (DVT) of the lower limbs is a serious condition, with the potential life-threatening consequence of pulmonary embolism or the long-term complication of post-thrombotic syndrome which may limit the patient’s occupation and quality of life. Occupation-related DVT has been described as a consequence of prolonged immobility, usually while seated1, but has rarely been described following prolonged kneeling. One case has previously been reported in a tiler wearing tight knee pads2. We describe a similar case of DVT following venous stasis due to prolonged kneeling and constriction by knee pad straps.

Case report
A 41-year-old male mould maker at a fibreglass yacht factory presented to his occupational health clinic with a 3-day history of pain and swelling of the left calf. He was referred to a hospital where a diagnosis of DVT was made. There was no past medical history of note, no recent long distance travel, surgery, trauma or medication use. He was a soccer player with a normal body mass index, and had smoked about one pack of cigarettes daily since 18 years of age.

He had worked in the tooling department for 2 years, making the fibreglass moulds on which fibreglass boat parts are laminated. Prior to presentation he was assigned to relay the antislip areas of a 39-foot catamaran deck mould.

This was an unusually lengthy task which he had previously performed for periods of only 2–3 h per day. The job required electric sanding of the mould until the surface was flush. He then laid antislip sheeting to which he had applied resin. Air bubbles were pressed out of each block by hand. For ~6 weeks he worked in a kneeling position on this task for most of his 8-h working day. He stood up only at meal breaks (15 min mid-morning and 30 min for lunch) and toilet breaks (averaging three daily). Materials were fetched by a coworker. He wore hard foam knee pads held in place by 3-cm straps of hard webbing with slide fasteners (Fig. 1).

To relieve pressure over the tibial tuberosities further, he...
worked with his knees almost fully flexed and his ischial tuberosities resting on his heels. The task of pressing out air bubbles required slow and meticulous effort. Leg movement while kneeling was limited to three 45-min periods daily during the fitting of panels. He reported that the knee pads fitted comfortably while standing but tightened when bending his knees. For 3 weeks prior to presentation he had experienced stiffness and numbness in the leg while standing. A few days prior to presentation he noticed swelling of the left leg and difficulty weight bearing.

On presentation he was not distressed, tachypnoeic or cyanotic. Cardiovascular, respiratory, abdominal and neurological examinations were normal. The left calf was swollen, tense and moderately tender but not erythematous. The left mid-calf was 2 cm larger in diameter than the right. Peripheral pulses were palpable bilaterally and examination of the right lower limb normal. Ultrasound of the left leg showed normal flow and compressibility of the common femoral and popliteal veins, but reduced flow and compressibility in the superficial femoral vein with thrombus present. DVT was diagnosed and he was treated with enoxaparin injections for 4 days while warfarin was started. No other special investigations were done and international normalized ratio (INR) monitoring was commenced. He returned to work and was placed in alternative work which did not involve kneeling.

It proved difficult to stabilize his INR and he suffered persistent leg pain. He subsequently underwent further investigations for coagulopathy. Full blood count, liver, renal and thyroid function, human immunodeficiency virus antibodies, fibrinogen and thrombin time were all normal. Partial thromboplastin time was prolonged due to the warfarin. Tests for β-2 glycoprotein and antiphospholipid syndrome could not be confirmed.

**Discussion**

Occupational DVT has previously been described as seated immobility thromboembolism syndrome following prolonged sitting at a computer [1]. This case suggests that the interaction of prolonged kneeling at work with constricting knee pad strapping increases the risk of DVT. Two of the three components of Virchow’s triad [3] contributing to venous thromboembolism may have been present in this case, namely venous stasis due to prolonged immobility with external compression and vascular endothelial microtrauma from the tight straps. A hypercoagulability diathesis was suspected but not confirmed.

In the previous report of the floor tiler who worked in a crouched position for much of the day, causation was attributed to knee pads with tight elastic bands which encircled the knees posteriorly [2]. In this current case, the period of kneeling was extreme, namely six working weeks. Extrinsic venous compression causing venous thromboembolism has been described in various contexts [2,4–6]. DVT has also been described in three individuals who died of pulmonary embolism after 3 days of prolonged praying while kneeling although dehydration due to fasting may have been a contributing factor [7].

Although the occupational risk of DVT from kneeling or strap-held knee pads has rarely been documented, it may be more prevalent than currently appreciated. Numerous occupations require employees to kneel for prolonged periods, for example, when laying floors. Occupational factors should be sought in patients presenting with DVT to identify opportunities for prevention. Employees performing kneeling work, as well as their employers, should be educated about the possible risks of such work and about preventive work practices. Prolonged kneeling should be limited and regular mobilization breaks with calf exercises and adequate fluid intake encouraged. Tasks requiring prolonged kneeling should where possible be redesigned to allow alternative work positions. The use of padded trousers [2] or strapless knee pads, which fit into pockets on work trousers or which are held in place by neoprene or elasticated knitted fabric, may reduce the risk of venous constriction.

**Key points**

- Prolonged kneeling in an occupational setting and constricting strap-held knee pads are proposed as risk factors for the occurrence of deep vein thrombosis.
- Protective measures should include frequent mobilization breaks and the use of non-constrictive knee pads.
- Employers and employees need to be educated about the risks of prolonged kneeling and about protective work practices.

**Conflicts of interest**

None declared.

**References**


