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Case report

Lower limb compartment syndrome as a complication of radical hysterectomy

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1. Introduction

Well-leg compartment syndrome (WLCS) is a rare but life-threatening complication of lithotomy position that has been reported in the general surgery, gynecologic, urologic and orthopedic literature. The term refers to an iatrogenic etiology of compartment syndrome to distinguish it from cases resulting from trauma. Most cases have been reported after surgeries at least 6 h in duration but some cases have been diagnosed after surgeries less than 4 h in duration (Harris and Karanjia, 1996; Neagle et al., 1991; Turnbull et al., 2002). One retrospective case review estimated the risk of WLCS at 1/3500 surgeries (Crinnion et al., 1996). Although lithotomy position and prolonged surgery are the central risk factors for this complication, a number of additional risk factors have been identified that may contribute to the development of WLCS.

The lower limb is divided into 4 compartments by non-compressible fascial envelopes. WLCS is thought to occur when increased compartment pressures compromise perfusion, leading to cellular edema that further raises intracompartmental pressures. Once pressure in one or more compartments is equal to or greater than the capillary pressure, tissue perfusion is obstructed. If sufficient edema develops, inadequate perfusion can persist even after normal positioning is restored. In such cases, decompressive fasciotomy is required to prevent this cycle from progressing to tissue infarction, rhabdomyolysis, loss of the limb and even death.

Multiple factors have an additive effect on decreasing lower extremity perfusion during surgery. The combination of lithotomy and Trendelenburg positioning has been shown to decrease systolic pressure at the ankle by nearly half (Peters et al., 1994), thereby substantially lowering the compartment pressure required to surpass capillary pressure and impede tissue perfusion. A number of intraoperative events can contribute to hypotension that further decreases perfusion of the lower extremities. These include epidural anesthesia, administration of vasoactive medications, and hypovolemia due to blood or fluid loss.

During surgery, the patient's lower extremity capillary pressure must overcome compartment pressures, which can be abnormally increased in multiple ways. Some of these are patient specific: body mass index (BMI) over 25 and muscular lower extremities have been associated with higher compartment pressures in lithotomy position (Peters et al., 1994; Tan et al., 2000). Pressure from the lower extremities resting against stirrups or leg supports and use of compression stockings and intermittent pneumatic compression devices (IPCDs) also raise compartment pressures (Halliwell et al., 1998) and contribute to the overall risk of inadequate lower extremity perfusion.

We present a patient who underwent a lengthy gynecologic oncology procedure with multiple risk factors for the development of WLCS. Immediately afterwards, she was diagnosed with compartment syndrome of her left leg and required emergent lower extremity decompression fasciotomy to avoid amputation of her left leg. Implementation of preventive measures in high-risk surgeries has the potential to decrease the incidence of this rare but devastating complication.

2. Case report

A 39 year-old para 1 woman underwent robotically-assisted laparoscopic radical hysterectomy, bilateral salpingo-oophorectomy and pelvic and para-aortic lymph node dissection for adenocarcinoma of the cervix and a concurrent 8 cm malignant left ovarian mass. Total time in lithotomy with Trendelenburg positioning was approximately 6 h. The patient was generally healthy with a body mass index (BMI) of 32 kg/m².

Upon waking in the post-anesthesia care unit, the patient reported excruciating left leg pain. On exam the leg was warm, erythematous and exquisitely tender to palpation. She was unable to tolerate passive dorsiflexion of her left ankle. Left posterior and deep posterior compartment pressures were measured at 60–70 mmHg (normal range

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<12 mmHg). Anterior and lateral compartment pressures were normal, there was no pain with passive eversion or inversion, and this aspect of her leg was supple on exam. She was emergently transferred to the operating room for a medial fasciotomy with decompression of the posterior and deep posterior compartments by orthopedic surgery.

On postoperative day 1, the patient continued to experience excruciating pain associated with sensory loss over the plantar surface of her left foot and inability to dorsiflex the left ankle. Progressive compartment syndrome now involving the anterior and lateral compartments was diagnosed and the patient was taken to the operating room where a lateral fasciotomy incision allowed completion of a 4-compartment decompression of the left leg. Closure of the lateral incision was delayed 48 h to allow improvement in edema.

The patient's postoperative course was complicated by cellulitis of the left leg that prompted reopening of the incisions for washout on

postoperative day 12. There was no evidence of deep infection and incisions were allowed to heal by secondary intention (Fig. 1). Split thickness skin grafting was performed several weeks later to improve the cosmetic appearance of her lateral calf incision. Three months after her original surgery, the patient is fully ambulatory, with slowly improving mild persistent paresthesia of the left leg and foot.

3. Discussion

WLCS can develop during lengthy surgeries in lithotomy position and risk of this complication is compounded by Trendelenburg position, patient's body habitus and intraoperative hypotension. Gynecologic surgeons should be aware of the potential for WLCS to occur, as prompt diagnosis and decompression reduces acute and long-term morbidity from compartment syndrome, which can include muscle necrosis,



Fig. 1. Medial and lateral views of the fasciotomy incisions following washout.

acute renal failure, neurologic deficits and loss of limb. A call from the post-anesthesia unit about severe lower extremity pain should prompt immediate evaluation with consideration of several possible diagnoses, including venous or arterial thrombosis, muscle spasm, nerve compression and, as in this case, compartment syndrome. The mainstay of diagnosis of acute postoperative lower extremity complications is physical examination with attention to the presence of erythema, swelling, tightness, pulses, loss of sensation, inability to dorsiflex, and pain out of proportion to examination findings. Measurement of compartment pressures with a handheld device and/or Doppler ultrasound evaluation of lower extremity vascular flow may assist in determining the diagnosis when physical exam is inconclusive.

In gynecologic oncology, technologies to facilitate complex surgeries through minimally invasive techniques have reduced overall complications and improved outcomes. Certainly the advantages in terms of reduced blood loss, length of stay, infectious and thromboembolic complications have benefited our patients, but there are new risks to be aware of in undertaking lengthy cases with that require positioning that alters patients' normal physiology. WLCS is one such hazard in complicated gynecologic laparoscopic surgery.

Preoperative identification of high-risk patients may, however, allow surgeons to incorporate risk-reduction measures into the surgical plan in coordination with the operating room team. Measures described to prevent WLCS include efforts to maintain adequate blood pressure and to relieve excessive pressure on the lower extremities. Communication with the anesthesia team is of heightened importance in high-risk cases and can include discussion of a patient's comorbidities and baseline physiology, the use of epidural anesthesia, blood loss expectations and avoidance of intraoperative hypotension. Combined use of compression stockings and IPCDs is one source of iatrogenic pressure on the lower extremities that can be reduced by using IPCDs alone; this is compatible with current guidelines regarding perioperative VTE prophylaxis (Gould et al., 2012; Rahn et al., 2011). Finally, careful regular reassessment of lower extremity positioning and even brief repositioning during surgery can reduce the deleterious physiologic effects of prolonged lithotomy position.

In conclusion, given the severe consequences of this complication, we propose that surgeons identify high-risk patients preoperatively and incorporate risk-reduction measures into the surgical plan.

Whenever extraordinary lower extremity pain is experienced by the patient upon reversal of anesthesia, the surgeon and recovery room staff must promptly consider a diagnosis of compartment syndrome. If the diagnosis is confirmed, prompt surgical intervention is critical to reducing the morbidity associated with this condition.

Conflict of interest statement

The authors have no affiliations or involvement in any organization or entity with any financial or non-financial interest in the subject matter or materials discussed in this manuscript.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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