



# Postoperative Acute Compartment Syndrome in the Nonoperated "Well Leg"

## Implications to Orthopaedic Nursing

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Acute compartment syndrome after fractures and injuries and in operated limbs is a dreadful complication and is well known to orthopaedic nursing community. Acute compartment syndrome in a nonoperated leg after an orthopaedic procedure has been infrequently reported and discussed. It has been more commonly discussed in colorectal, gynecologic, and urologic practice. It is vital to realize the possibility of this iatrogenic injury on the nonoperated limb. The article reviews the literature to identify and discuss the risk factors for this limb-threatening condition and thus the implications to orthopaedic nursing.

**A**cute compartment syndrome is well described in orthopaedic nursing literature as a serious complication after fractures, injuries, and operative procedures on limbs (Altizer, 2004; Ross, 1991). Its incidence in uninjured and nonoperated leg after orthopaedic procedures is relatively uncommon and has been occasionally mentioned as "well-leg" compartment syndrome (Anglen & Banovetz, 1994; Christodoulou, Garofalo, Echeverri, Pelet, & Mouhsine, 2002; Tan et al., 2000). Acute compartment syndrome in legs positioned in lithotomy and hemilithotomy position has also been reported after colorectal, gynecologic, and urologic procedures (Chow, Friedell, Freeland, & Dejesus, 2007; Ikeya et al., 2006; Simms & Terry, 2005; see Figures 1 and 2). The hemilithotomy position is a unilateral elevation of the uninjured leg above the plane of the body, with the knee flexed while the hip is abducted and flexed. It is commonly used in orthopaedic surgery to provide better access to the injured leg for imaging particularly during intramedullary nailing procedures (Christodoulou et al., 2002; Dugdale, Schutzer, Deafenbaugh, & Bartosh, 1989; Heppenstall & Tan, 1999).

### Discussion

Various causes such as blunt or penetrating trauma, infection, burns, vascular injury, and bleeding disorders have been described to cause acute compartment syndrome. Tissue swelling within a closed osseofascial

compartment decreases the transmural pressure in capillaries and venules, which, in turn, diminishes local blood flow, thus leading to tissue hypoxia and cell death. A vicious cycle is started because of increased capillary permeability resulting from endothelial damage, which further increases the compartment pressure.

Absolute and differential compartment pressure monitoring has been advocated by various authors for an early diagnosis of acute compartment syndrome. McQueen and Court-Brown (1996) described the differential ( $\Delta$ ) pressure of less than 30 mm between the tissue pressure and the diastolic pressure as a reliable threshold for fasciotomy.

Some other authors have used the differential pressure between the tissue pressure and the mean arterial pressure for such measurements.

The pathogenesis of well-leg acute compartment syndrome is described as a combination of increased intramuscular pressure due to external compression from the calf support and decreased perfusion pressure due to the elevated position. This causes a significant decrease in the difference between the diastolic blood pressure and the intramuscular pressure and has a potential for nerve and muscle damage (Meyer, White, Smith, Groppo, Mubarak, & Hargens, 2002; Wilde, 2004).

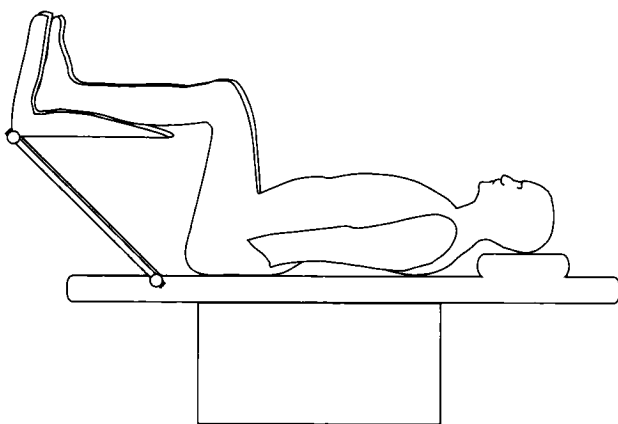
### RISK FACTORS FOR WELL-LEG COMPARTMENT SYNDROME

The risk factors for well-leg compartment syndrome (see Table 1) include the following: (a) prolonged surgery, (b) decrease in perfusion to leg due to intraoperative systemic hypotension, hypovolemia, hypothermia, and vasoconstrictive drugs (Meyer et al., 2002), (c) increase in intramuscular pressure due to external compression to the leg, such as elastic bandage wraps, dressings, antiembolization stockings, and pneumatic

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**FIGURE 1.** Lithotomy position.

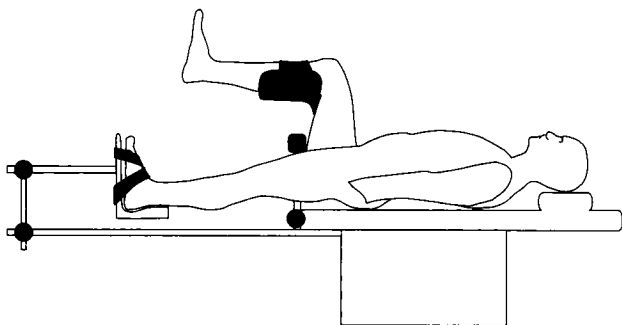
compression, (d) in polytrauma patients, it is possible that the well leg is not entirely uninjured, (e) any injury to the thigh or leg could contribute to increase in intramuscular pressure and decrease in local blood pressure, and (f) high body mass index. However, some authors have suggested no correlation (Meyer et al., 2002).

### MEASURES TO REDUCE RISK OF WELL-LEG COMPARTMENT SYNDROME

The measures described to reduce the risk include (a) decrease in duration of surgery, (b) removal of leg from predisposed position at regular intervals and passive mobilization, (c) use of alternate positions for well leg, for example, use of heel support rather than calf support for well leg. This allows the calf to be free from compression (see Table 2). A significant decrease in intramuscular pressure of calf has been demonstrated in the heel support when compared with conventional calf support in the experimental study of Meyer et al. (2002), (d) use of alternate procedures like retrograde nailing instead of antegrade nailing where possible, and (e) maintenance of adequate perfusion pressure to leg and avoiding external compression devices where possible.

### Case Study

A 25-year-old female car driver was admitted with several injuries after a road traffic accident. After initial as-



**FIGURE 2.** Hemilithotomy position.

**TABLE 1. RISK FACTORS FOR WELL-LEG COMPARTMENT SYNDROME**

Prolonged surgery
Decreased perfusion to leg
Increased intramuscular pressure
High body mass index

essment and resuscitation, she was diagnosed to have a splenic laceration and a Grade 1 open tibia fracture on left leg. An explorative laparotomy with splenic laceration repair and tibial interlocking nailing with wound management was performed. The patient was positioned as hemilithotomy on a fracture table to aid the tibial nailing and the uninjured right leg was placed in a leg holder with compression stocking. The whole procedure took about 5 hr and the patient was hypotensive on several occasions because of associated splenic injury and internal bleeding. Postoperatively, the patient complained of intense pain and was using large doses of morphine through the patient-controlled analgesia pump. During routine limb observations by the recovery nurse, the operated leg was unremarkable apart from some soakage of dressing. On further examination, the patient seemed to have most discomfort on the nonoperated right leg. Compartment pressures were measured on both the legs and the right leg showed an absolute pressure of 40 mm and delta pressure of 25 mm. An immediate fasciotomy was performed on the right leg. The patient recovered without any significant sequelae of compartment syndrome on follow-up.

### IMPLICATIONS TO ORTHOPAEDIC NURSING

The nursing implications include the ability to recognize this potential limb-threatening condition at an early stage. This is particularly relevant to perioperative orthopaedic nursing (Wilde, 2004). The nurse should be aware of the symptoms of acute compartment syndrome such as disproportionate pain, paresthesia, paralysis, pallor, and pulselessness. Pain on passive stretch of involved muscle groups is a useful sign in diagnosis of this condition.

It is vital to realize that compartment syndrome can occur in both operated and nonoperated legs. The operating room personnel should be aware of the risk factors and use measures to reduce such risk for well-leg compartment syndrome.

Further in perioperative situation, where the patient may still be under the influence of anesthesia, it is

**TABLE 2. MEASURES TO REDUCE RISK OF WELL-LEG COMPARTMENT SYNDROME**

Decrease in duration of surgery
Removal of leg from predisposed position at regular intervals
Use of alternate positions for well leg
Use of alternate procedures
Maintenance of adequate perfusion pressure to leg

difficult to diagnose compartment syndrome because of the paucity of symptoms such as pain and paresthesia. A high index of suspicion is needed in such situations and signs such as disproportionate swelling or tightness of leg should be looked for. Compartment pressure monitoring is particularly useful in these situations to diagnose acute compartment syndrome.

Appropriate documentation of the events leading up to this condition and alerting medical staff at an early stage is important (Cascio, Wilckens, Ain, Toulson, & Frassica, 2005). A delay in diagnosis and treatment of such compartment syndrome can lead to permanent damage to nerve and muscle (Mathews, Perry, & Murray, 2001; Meldrum & Lipscomb, 2002; Wiger, Zhang, & Styf, 2000).

## Conclusion

A high index of suspicion should be maintained in considering this complication if the patient complains of pain in the uninjured nonoperated leg after any long duration procedure where the leg may have been placed in a predisposed position. Nurses should realize that compartment syndrome can happen in either the operated or the nonoperated limb in such situations. Any delay in diagnosis or management can lead to catastrophic consequences due to this iatrogenic injury.

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**LEARNING OBJECTIVES:** After reading this article and taking this test, you should be able to:

1. Discuss the risk factors for, pathogenesis, and causes of acute compartment syndrome in the "well" leg.
2. Outline the prevention, treatment, and complications of acute compartment syndrome in the "well" leg.

**1. In addition to orthopaedic surgery, compartment syndrome has been reported after**

- a. brain surgery.
- b. gynecologic surgery.
- c. ocular surgery.
- d. thoracic surgery.

**2. A unilateral elevation of the uninjured leg above the plane of the body, with the knee flexed while the hip is abducted and flexed is the**

- a. knee-chest position.
- b. lithotomy position.
- c. hemilithotomy position.
- d. prone position.

**3. The position described above is particularly useful for imaging during**

- a. intramedullary nailing procedures.
- b. open reduction of Bennett's fractures.
- c. percutaneous pinning of the distal radius.
- d. subtalar arthrodesis.

**4. Which of the following is *not* a cause of acute compartment syndrome?**

- a. burns
- b. osteochondritis
- c. infections
- d. penetrating trauma

**5. One of the factors in the pathogenesis of "well leg" acute compartment syndrome is**

- a. increased difference between diastolic blood pressure and intramuscular pressure.
- b. increased local blood flow.
- c. increased perfusion pressure due to the elevated position.
- d. increased intramuscular pressure due to external compression from the calf support.

**6. Acute compartment syndrome results in potential damage to**

- a. nerves and muscles.
- b. bones.
- c. kidneys.
- d. cartilage.

**7. Which of the following is a risk factor for "well leg" compartment syndrome?**

- a. increased perfusion to the leg from intraoperative systemic hypertension
- b. use of loose wraps made from undercast padding
- c. prolonged surgery
- d. use of vasodilating drugs

**8. A measure to reduce the risk for "well leg" compartment syndrome is**

- a. use of heel support for the "well leg" rather than calf support.
- b. antegrade nailing rather than retrograde nailing, where possible.
- c. removal of leg from positioning at regular intervals and active range of motion.
- d. use of calf and thigh support.

**9. Treatment for acute compartment syndrome is**

- a. compression bandage.
- b. intravenous heparin infusion.
- c. vasoconstrictive medications.
- d. fasciotomy.

**10. A symptom of acute compartment syndrome is**

- a. bounding pulses.
- b. paresthasias.
- c. relatively minor pain.
- d. ruddy color.

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