

Compartment Syndrome, Acute

ICD-9
958.8

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Description/Etiology

Acute compartment syndrome (ACS) occurs when nerves or blood vessels become compressed within an anatomic compartment, which then compromises the supply of blood and oxygen to that area. Compartments are spaces surrounded by thick layers of inelastic fascial tissue comprised of muscle tissue, nerves, and blood vessels. There are 46 compartments in the body, 36 of which are in the arms and legs, so ACS occurs more frequently in the extremities.

ACS most commonly develops in the anterior tibial compartment after a tibial fracture. ACS may also occur in the thigh; in the arm, including the upper arm and the three compartments of the forearm; and in the shoulder. There are four types of compartment syndrome: acute, chronic, abdominal, and crush. ACS, abdominal compartment syndrome, and crush compartment syndrome usually have a rapid onset and are considered surgical emergencies. Chronic compartment syndrome results from a gradual increase in pressure within a compartment, usually from excessive exercise, and is not a medical emergency. (See *Quick Lesson About...Compartment Syndrome, Chronic*; *Quick Lesson About...Compartment Syndrome, Abdominal*; and *Quick Lesson About...Crush Injury and Crush Syndrome: an Overview*).

ACS usually develops after an external force (e.g., traumatic injury, a tight cast or splint); it may also occur after internal trauma, such as edema or hemorrhage. Perfusion pressure falls below tissue pressure, interstitial pressure increases, muscles and nerves become necrotic, and infection, gangrene, contractures, paralysis, and loss of limb may occur if ACS is not treated immediately. Systemic damage may lead to further impairment, such as renal failure and myoglobinuria (see *Laboratory Tests That May Be Ordered*, below). The diagnosis of ACS is usually made by observing key signs and symptoms (see *Signs and Symptoms/Clinical Presentation*, below) and by taking frequent pressure measurements within the affected compartment. The syndrome generally develops quickly after a precipitating event (e.g., it can develop within 30 minutes after trauma or fracture). The treatment for ACS is emergency partial or complete surgical fasciotomy to relieve pressure within the affected compartment. If surgery is not performed within 12 hours of ACS onset, permanent limb damage and systemic complications are likely.

Facts and Figures

ACS affects an estimated 3.1 per 100,000 people per year and affects men 10 times more often than women. Tibial fracture and blunt soft-tissue injury are the causes of 36% and 23% of cases of ACS, respectively. Fasciotomy for ACS can result in complications that lead to major morbidity and mortality; 10–20% of patients require limb amputation, and 27% have decreased limb function. Mortality ranges from 11–15%.

Risk Factors

External factors that increase risk for ACS include a tight cast or splint, braces, or traction; prolonged use of a tourniquet or military antishock trousers (MAST); lying on an arm or leg for a prolonged period of time; and overuse of an automatic blood pressure monitor. Internal factors that increase risk (due to edema or hemorrhage) include fractures, crush injuries, bleeding disorders, anticoagulation therapy, burns, vascular damage, inactivity after surgery, obstruction of a vein, infiltrated I.V. sites, frostbite, and envenomation from snake or spider bites.

Signs and Symptoms/Clinical Presentation

The primary sign of ACS is severe pain that is out of proportion to injury severity or extent and which is not relieved by pain medication or by elevating the affected area. (Farrow et al., 2011) Pain that occurs or intensifies with passive range-of-motion (ROM) exercises is also an indication of ACS. During examination, the patient may experience severe pain when a muscle that passes through the compartment is moved; patients may state the affected muscle feels tight or “wooden.” Patients may have sensory deficits and loss of two-point discrimination (i.e., the ability to tell whether one or two points on the skin are being pressed). The skin over the affected compartment may appear swollen, shiny, and cellulitic.

Assessment

▶ Physical Findings of Particular Interest

- See *Signs and Symptoms/Clinical Presentation*, above

▶ Laboratory Tests That May Be Ordered

- WBC and erythrocyte sedimentation rate (ESR) may be elevated, indicating inflammation and possible infection
- Urine myoglobin levels may be elevated (i.e., myoglobinuria), indicating muscle tissue necrosis

▶ Other Diagnostic Tests/Studies

- Direct pressure measurements of the affected compartment are taken using either a traditional slit and wick catheter or a transducer-tipped probe, which is a newer device. Normal compartment pressure is 0–10 mm Hg. In high-risk situations (e.g., a tibial fracture after leg trauma), continuous differential pressure measurements (i.e., intracompartmental pressure subtracted from the diastolic blood pressure) > 30 mm Hg may indicate ACS
- MRI may reveal edema, loss of normal muscle design, and a strong outline of the affected compartment using contrast dye

Treatment Goals

▶ Assist with the Assessment, Supportive Care, and Surgical Management of ACS

- Monitor vital signs, assess all physiologic systems, and assess for signs and symptoms of ACS; assess the type of pain (e.g., deep, throbbing, unrelenting) and level of pain (e.g., using a scale of 1 [patient reports no pain] to 10 [patient reports worst pain ever]), and compare pain report with level of injury to evaluate for/identify the level of discordance
 - Assess the patient’s response to pain medication; patients with ACS typically report no alleviation of pain despite opioid administration
- Elevate the affected area at, not above, the level of the heart to avoid compromising arterial perfusion
- If ACS is caused by a constrictive cast or bandage that is too tight, it should be split, loosened, or removed to relieve the pressure
- Follow facility pre- and postsurgical protocols if patient becomes a surgical candidate; reinforce pre- and postsurgical education and ensure completion of facility informed consent documents
 - Frequently assess surgical sites postoperatively; pack with sterile, normal saline-soaked wet dressings, keep dressings and incisions wet, and change dressings, as ordered
 - ▶ Fasciotomy incisions are usually left open and are closed a few days later after edema has decreased
 - Intensively monitor vital signs, level of consciousness, skin color, temperature

▶ Promote Emotional Well-Being and Educate

- Assess anxiety level and coping skills because the patient may be facing permanent disability or loss of a limb. Provide sensitive, empathetic emotional support and encourage discussion of feelings. Request referral to a mental health clinician, if appropriate, for evaluation and ongoing counseling and support
- Reinforce pre- and postoperative education on postoperative surgical site care (for details, see *What Do I Need to Tell the Patient/Patient’s Family?*, below)
- Educate the patient/family about mobility and ROM restrictions and recommendations for the affected area, and that physical therapy may be necessary to restore full ROM

Food for Thought

- ▶ The traditional diagnostic signs of ACS—known as the five “P’s:” pain, pallor, paralysis, paresthesia, and pulselessness—are no longer considered reliable indicators of ACS
- ▶ Surgery for ACS was first identified by the German surgeon Richard von Volkmann in his 19th century study of traumatic limb injuries; these injuries included post-trauma hypoperfusion caused by overly tight bandaging after an elbow fracture, resulting in permanent neurovascular limb damage. The term “Volkmann’s ischemic contracture” refers to this post-trauma contracture

Red Flags

- ▶ Fracture blisters are an indication of tissue necrosis over a fracture site and should be viewed as a warning sign of ACS
- ▶ Anticoagulation therapy (e.g., warfarin) is a major risk factor for the development of ACS; patients being evaluated for ACS should be asked if they take anticoagulants

What Do I Need to Tell the Patient/Patient’s Family?

- ▶ If the patient is discharged before surgical site incisions have been closed, educate the patient/family members on discharge instructions, including in-home surgical site care (e.g., sterile technique, keeping incisions and dressings continually wet with normal saline, and changing dressings as ordered); assess for knowledge deficits by observing the patient/family members performing the surgical site care before discharge

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