



THE UNIVERSITY OF TOLEDO MEDICAL CENTER

# ORTHOPAEDIC MONTHLY

VOLUME 5, ISSUE 2 MARCH 2014

## UT Orthopaedic Residents Score in 92nd Percentile on AAOS OITE

Every academic year, orthopaedic residents take the Orthopaedic In-Training Exam (OITE). This is a test that is produced by the American Academy of Orthopaedic Surgeons. The OITE covers the 11 areas of orthopaedics and is comprised of 275 questions.

This past November, the Orthopaedic Residency Program's 20 residents took this test and scored in the 92nd percentile which

places them in the top 20 residency programs in the nation. One chief resident scored in the 99th percentile!

We wish to congratulate the residents on a job well done!

The Orthopaedic Residency Program is a five-year program fully accredited by the Accreditation Council for Graduate Medical Education (ACGME).

## Trendelenburg Gait

During the stance phase of the gait cycle, the gluteus medius works to maintain both hips at the same level. Trendelenburg gait is an abnormal gait that is usually found in people with weak abductor muscles of the hip which are supplied by the superior gluteal nerve.

When a patient with weakness of his hip abductors on one side is asked to perform a single-leg stand on that same side, the pelvis on the contralateral side will drop. This is called the Trendelenburg Sign.

The gluteus medius plays a very important role during the stance phase of the gait cycle in maintaining both hips at the same level. The stance phase accounts for about 60% of the gait cycle. Three times the body weight is transmitted through the hip joint during the stance phase. The actions of the hip abductors account for 2/3 of that body weight. We can identify this weakness of the stance phase if the pelvis drops to the other side. Weakness can also occur in patients with L5 radiculopathy or avulsion of the abductor muscle tendon which occurs with increasing frequency after hip replacement surgery. Injury of the superior gluteal nerve is a major cause of this type of gait.

A positive Trendelenburg sign occurs when there is dysfunction of the abductor muscles and the body is unable to maintain the center of gravity on the side of the stance leg. The patient will show an excessive lateral lean towards the affected side, in order to bring the center of gravity over the leg that's in stance. With bilateral weakness of the abductor muscles, the patient will demonstrate dropping of the pelvis on both sides during walking which leads to a waddling motion. This type of gait is seen in patients with myopathies; Positive Trendelenburg Gait, Bilateral Trendelenburg Gait.

### Trendelenburg Gait

Trendelenburg gait is an abnormal gait that is usually found in people with weak abductor muscles of the hip which are supplied by the superior gluteal nerve.

**ABNORMAL**



# Hypothermia

Hypothermia is a drop in core body temperature below 95°F. This temperature is below what is required for normal metabolism and bodily function (97.7 – 99.5°F). The body's thermoregulation mechanism adjusts to weather changes.

During extreme cold, a signal from the brain causes vasoconstriction of the arterioles in the skin which allows the body to shift the blood to more vital areas of the body. Another signal from the brain goes to the skeletal muscles which quickly contracts them causing shivering that helps to keep the body warm. If the body is exposed to cold and the thermoregulation mechanism is unable to preserve the heat, a drop in the core body temperature will occur. As the body temperature drops, characteristic symptoms will occur such as shivering and mental confusion.

Hypothermia can be mild, moderate, severe or profound. Heat is produced by the muscle, heart and liver and is lost through the skin. Muscle contractions occurring during exercise or shivering increase body heat production by 2-4 times. Accurate core body temperatures can be measured by a special low body temperature thermometer. Hypothermia may also be associated with frostbite.

Symptoms of Hypothermia include: shivering and bluish discoloration of the lips and extremities. The patient may have an altered mental status due to decreased CNS electrical activity, such as confusion, poor judgment, etc (this is due to decreased nervous system electrical activity). The patient may slowly lapse into an unconscious state

Only a core body temperature below 95°F indicates hypothermia.

Causes of hypothermia include:

- exposure to low temperatures
- alcohol use during exposure to the cold- increases the blood flow to the skin and extremities which may make the patient feel warmer, however, it increases the heat loss by vasodilation
- poor clothing
- trauma
- swimming or diving into cold water (heat is lost more in water than on land)
- patients who perform outdoor sports such as skiing or mountain climbing
- patients who have had major surgery
- excessive blood and fluid loss

Elderly people are most prone to hypothermia as they have a lower body fat content and are more fragile. They also tend to have worse outcomes if they have a history of cardiac problems. It is best to keep elderly individuals home and warm during cold temperatures.

## Bedside Fasciotomy

If there is more pain than what should be expected from surgery or injury, combined with an increase in narcotic requirements as well as



Children are also susceptible to hypothermia. Children have smaller sized bodies and thus less body surface area. A child's head is larger relative to the rest of their body and a lot of heat is lost through their heads. When outside in the cold, make sure to cover the heads of children.

A large percentage of deaths occur from hypothermia when the patient becomes confused and disoriented, they may remove their own clothing thinking they will feel better. When this occurs it only increases the rate of heat loss and the condition of hypothermia gets worse. This is called paradoxical undressing.

The heart rate may slow in patients with hypothermia and it may be difficult to find a pulse, so keep trying. Hypothermia increases the heart's need for oxygen and lethal cardiac arrhythmia may occur.

Hyperthermia is different from hypothermia. Hyperthermia occurs due to elevated body temperature that is present during heat exhaustion and heat strokes.

Immediate action is required. Treatment includes: moving the patient from water and to a safe place as well as removing the wet clothing and wrapping the patient with a warm, dry blanket. Do not massage the patient or apply dry heat. Warming of the patient should be done gradually.

Treatment at the hospital or in the field includes: warm blankets, warm IV fluids, warm humidified oxygen, EKG, and blood warmer.

If you begin to shiver during exposure to cold, this is the point where you should get out of the weather and warm up. Prolonged exposure to the cold beyond this point can be dangerous and it is not a good idea to remain exposed to these cold temperatures.

tense swelling and pain with passive stretch, this is an indication that the patient is suffering from impending compartment syndrome.

*Continued on page 3*

Inspection and examination for the presence of compartment syndrome should be done early. Tight dressings and casts should be split or removed. The extremity should be examined for:

1. Pain / swelling
2. Pain with passive stretch

Do not wait for all 5 P's to appear, as these findings are considered to be late findings.

1. Pain / swelling
2. Paralysis
3. Pallor
4. Paresthesia
5. Pulselessness

These represent late presentation (irreversible damage). Only rarely does the compartment pressure become elevated enough to occlude a major artery. Pulses usually are not affected!

The combination of pain, swelling, and pain with passive stretch is an indication of compartment syndrome.

If compartment syndrome is suspected, measure the compartment pressure if you can. If the compartment pressures is greater than 30 mmHg (absolute measurement), or within 30 mmHg of the diastolic pressure, then immediate fasciotomy should be done. The most commonly involved compartment of the lower leg is the anterior compartment. The anterior muscle compartment of the lower leg contains the deep peroneal nerve. The deep peroneal nerve provides a sensory branch to the web space between the first and second toes. A high index of suspicion in addition to measuring the compartment pressure is necessary for the diagnosis. Do not rely on late clinical findings such as pulselessness, paresthesia, or weakness.

## Frostbite

The body tries to maintain a core body temperature by the process of thermoregulation. During extreme cold, the brain receives a signal from sensory receptors. These receptors are present in areas such as the hands and the feet. They will respond to cold and send a signal up to the brain. The posterior hypothalamus is responsible for regulating body temperature during exposure to cold. The anterior hypothalamus responds to heat. Once the signal reaches the brain, the brain responds by sending another signal to different parts of the body in order to maintain an appropriate core body temperature for vital organs to function properly. This signal stimulates the contraction of the smooth muscles that line the arteries and arterioles supplying less important organs such as the muscles and skin. This in turn leads to the shifting of blood away from those less important organs and directing it to those vital organs such as the brain, heart and liver. The brain will send a signal to the smooth muscle cells of the blood vessels of the skin and also to the skeletal muscles. The smooth muscle cells line the arteries and arterioles.

Another signal from the brain goes to the skeletal muscles which

The elevated pressure affects the microcirculation and perfusion of the tissues.

The muscle compartment needs to be released within 6-8 hours. Irreversible damage can occur after 8 hours. Formal release of the muscle compartment in the operating room under general anesthesia continues to be the standard of care.

Bedside fasciotomy under local anesthesia was developed by Dr. Ebraheim in order to avoid delay in fasciotomy surgery.

Bedside fasciotomy is done in patients with:

1. Delayed presentation.
2. Anticipated delay in their surgery.
3. Contraindication to general anesthesia in the operating room.

Time is critical in compartment syndrome. It is advisable to do fasciotomy early.

If fasciotomy is done within 3 – 4 hours the damage is reversible. At 6 hours there will be variable muscle damage.

Delay can occur due to a medical comorbidity that needs clearance for general anesthesia.

It is not easy to predict when the exact onset of compartment syndrome will occur. Bedside fasciotomy is a good procedure for patients with delayed presentation or in those with an anticipated time delay of more than 6 – 8 hours. The procedure can be done in the ICU, ER, or on the floor.

The patient is given conscious sedation (midazolam 3-7 mg and Fentanyl 100-200 mg). These doses are appropriate for a normal sized healthy adult but may not be appropriate for patients with sleep apnea or other medical comorbidities. 1% lidocaine without epinephrine infiltrated in the marked skin incision line.



quickly contracts them causing shivering that helps to keep the body warm.



THE UNIVERSITY OF TOLEDO  
**MEDICAL CENTER**

Department of Orthopaedic Surgery  
The University of Toledo  
3000 Arlington Ave.  
Toledo, Ohio 43614

Non-Profit  
Organization  
U.S. POSTAGE  
PAID  
Toledo, OH  
Permit No. 161



*Frostbite continued*

As the body forces the muscles to work (shivering), it breaks down ATP that will also release energy. ATP is converted into ADP and releases free phosphate and energy to warm up the body.

The condition of frostbite usually affects the hands and the feet. When the temperature drops below  $-2^{\circ}\text{C}$ , ice crystals are formed in the extracellular fluid. The water moves from the intracellular compartment to the extracellular compartment causing cell dehydration and death. The sensory nerve endings are affected early and the condition of frostbite can be painless.

Causes of frostbite include: inadequate circulation in below freezing weather, inadequate or wet clothing, wind chills, poor circulation, tight boots, and cramped position. The following increase the risk of frostbite: smoking, alcohol use, diabetes, peripheral neuropathy and certain medications such as beta blockers.

Patients may present with skin erythema, edema, and mottled skin. In most significant cases there will be blisters present. Blisters may be painless. There are usually two kinds of blisters present: 1) superficial blisters are due to partial thickness injury. These are white clear blisters. 2) The second kind are hemorrhagic blisters from a deeper lesion which indicates a full thickness injury.

Treatment includes: splinting or wrapping the involved extremity, and warming the person by wrapping a blanket around them (rapidly warming at a temperature of  $40 - 42^{\circ}\text{C}$  for about 15-30 min). Do not rub or massage the involved extremity. If blisters are present and if they are clear and white (superficial lesion), then debridement should be done. If the blisters are hemorrhagic, drain the blisters but leave the overlying skin intact. Amputation for necrotic tissue is always delayed. It is necessary to wait for demarcation of the zone of injury (they used to say if frozen in January, amputate in July) except in severe infection or gas gangrene. If the condition of frostbite occurs in children, it may lead to a cartilage or growth plate injury and the child may later on develop short digits.

THE UNIVERSITY OF TOLEDO MEDICAL CENTER  
**ORTHOPAEDIC  
MONTHLY**

Editors:

**Dr. Nabil Ebraheim**,  
department chairman  
and professor of orthopaedics,  
and **Amanda Kaverman**,  
assistant to the chairman.

Neither Dr. Ebraheim nor  
Amanda Kaverman have any  
relationships with industry to  
disclose.

**Department of  
Orthopaedic Surgery**  
The University of Toledo  
3000 Arlington Ave.  
Toledo, Ohio 43614

For appointments, call  
419.383.3761.