



THE UNIVERSITY OF TOLEDO MEDICAL CENTER

ORTHOPAEDIC MONTHLY

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Wound Healing

Wound healing will depend on three things:

1. Nutrition of the patient
2. Blood supply
3. Immune status of the patient

About 40% of orthopaedic patients are malnourished. In general, about 60% of elderly patients are malnourished. Fracture of the femur or hip may increase the metabolic demand on the patient by up to 25%. When evaluating the body for wound healing, we look at certain parameters. Albumin should be more than 3.5 because it indicates good nutritional status of the patient. The total lymphocyte count should be more than 1500 and this will indicate the immune response of the patient. Hemoglobin should be more than 10, this will indicate the oxygenation of the tissues. The transferrin level should be more than 200, this indicates the condition of the iron and hemoglobin and deals with the oxygenation of the tissues. These are the lab values that you will probably get in a patient that has suspected malnutrition. Up to 50% with low values will have poor wound healing or infection. Elective surgery should be delayed or rescheduled until these values are improved by nutritional support.

What can alert the physician about the nutritional status of the patient? What are the red flags that may indicate that the patient may be malnourished? Ask the patient about weight loss, if they have more than 5% of weight loss over the course of one month or more than 10% over the course of six months, then this is a problem that can indicate that the nutritional status of the patient is poor.

What are other things that can measure the patient's nutritional status?

Wound Healing
Wound healing will depend on three things:

- ① Nutrition of the patient.
- ② Blood supply.
- ③ Immune status of the patient.

The infographic includes a silhouette of a person using a cane, with a glowing globe on their back, symbolizing the global impact of these factors on wound healing.

- Arm muscle circumference: if it is less than 60%, then this signals severe malnutrition. Between 60%-90%, this signals moderate malnutrition.

- Triceps skinfold (thicker the better): 30 mm, 5% infection. 20 mm, 10% infection.

Blood Supply: transcutaneous oxygen tension should be more than 30 mmHg. In an ideal situation it should be about 45 mmHg. The toe pressure should be more than 40 mmHg. So approximately 40 mmHg for both the transcutaneous oxygen tension and the toe pressure will get you close to the answer of the question! If the toe pressure is less than 20 mmHg, then the wound will not heal. The ankle-brachial index (ABI) pressure should be more than 0.45.

Axillary Nerve Injury - Shoulder Dislocations

The axillary nerve is the most commonly injured nerve due to shoulder dislocation. It occurs in about 5% of shoulder dislocations.

After a shoulder dislocation, the patient will be unable to abduct the shoulder, and the deltoid will have no muscle tone.

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Axillary Nerve Injury continued

There will be decreased sensation or absence of sensation on the area of the lateral shoulder.

If the patient is older, the inability to abduct the shoulder may be attributed to tear of the rotator cuff, which is common in that age group with shoulder dislocation. This can be a confusing scenario. Rule out a rotator cuff tear. Examine the shoulder sensation.

The intact rotator cuff muscle may abduct the shoulder and confuse the examiner. It is important to check the sensation over the skin of the shoulder. It does not matter if the rotator cuff is intact or torn. The sensation over the skin of the lateral shoulder will tell you if there is axillary nerve palsy or not. Injury of the axillary nerve varies from neuropraxia to a complete tear of the nerve.

The axillary nerve passes over the subscapularis and then curves backwards below it and underneath the shoulder joint capsule to enter the quadrangular space. Within the quadrangular space, the axillary nerve is accompanied by the posterior circumflex humeral artery. This artery is important because it is believed that this artery is the main blood supply to the humeral head. After passing through the quadrangular space, the axillary nerve divides into anterior and posterior divisions. The anterior division curves under the deltoid muscle. The deltoid muscle is innervated by this anterior division of the axillary nerve. The posterior division supplies the teres minor muscle and the remaining posterior portion of the deltoid muscle as well as the skin over the shoulder. The anterior branch of the axillary nerve is located 5-7 cm distal to the lateral edge of the acromion. Do not exceed deltoid splitting approach more than 5 cm below the acromion or you risk injury to the axillary nerve.

During surgery, adduction and external rotation moves the nerve away from the surgical field.

What do you do if the axillary nerve is injured?

- Give the patient a sling for comfort
- Physical therapy
- Follow the patient's progress clinically (usually the nerve will recover)
- Get EMG and nerve studies
 - o Biphasic waveforms will be seen at 3-4 weeks if the nerve recovers
 - If the nerve does not recover:
 - o You will get fibrillation potentials and P-waves
 - Failure to abduct the shoulder after 4-6 months despite physical therapy means that the condition is permanent and the patient may not achieve abduction of the shoulder without recovery of the deltoid muscle (too late for deltoid to recover).
 - Since the intact rotator cuff muscle failed to abduct the shoulder and to take over the job of the deltoid muscle, then this condition is permanent.

When the condition is permanent you have two options:

- Exploration of the nerve for release, repair or reconstruction of the nerve (reconstructed by a nerve graft).
- Do tendon transfer
 - o Transfer of the trapezius to the proximal humerus
 - o The result of this transfer is usually poor

Malignant Hyperthermia

Malignant hyperthermia is autosomal dominant (50% of offspring can be affected).

Dantrolene is a life-saving drug that stops the release of calcium from the sarcoplasmic reticulum into the cell. Dantrolene blocks the calcium, decreases the intracellular calcium and stabilizes the sarcoplasmic reticulum.

You can do other things like:

- Cool the patient
- Hydrate the patient
- Get electrolyte balance

The patient will get succinylcholine, halothane, or other inhalation agents and this will trigger the initiation of malignant hyperthermia. Anesthetic agents (such as succinylcholine and halothane) impair the function of the sarcoplasmic reticulum and calcium hemostasis.

The condition associated with MH is usually central core disease, Duchenne Muscular Dystrophy (DMD), Arthrogryposis, or Osteogenesis Imperfecta (OI).

Malignant hyperthermia is usually diagnosed during anesthesia by family history. There is no special, simple test for MH. You can do a

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AUTOSOMAL DOMINANT

muscle biopsy and testing that is only done in a few centers. Because there is a problem in the ryanodine receptor, there will be uncontrolled release of calcium. You will get sustained muscle contraction, rigidity, spasms, muscle damage, myoglobinuria, rhabdomyolysis, and acute renal failure.

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Malignant Hyperthermia continued

You can also find metabolic acidosis and hyperkalemia, which may give the patient dysrhythmia. The CO₂ production increases. You will have increased end-tidal CO₂ (ETCO₂), which can't be explained, it is the earliest sign, and probably the most specific and sensitive finding. End-tidal CO₂ is what anesthesia will find. A rise in the end-tidal CO₂ concentration is probably the earliest indication that the patient may have malignant hyperthermia.

For diagnosis of malignant hyperthermia, you will probably need to know three things:

1. Sarcolemma – membrane of the cell.
2. T-tubule – like a divot into the cell or a cliff.

Adamantinoma

Adamantinoma affects young adults usually over 20 years of age. It usually affects the tibia. It is a low grade malignant tumor.

When it is a low grade bony tumor, you treat it by wide excision alone, because chemotherapy and radiation therapy will not work for low grade malignant bony tumors such as adamantinoma and parosteal osteosarcoma. Chemotherapy and radiation therapy will also not work with chondrosarcoma. Treatment of chondrosarcoma is a wide resection. For the treatment of adamantinoma, parosteal osteosarcoma and chondrosarcoma, do a wide resection.

There is doubt that the adamantinoma tumor arises from the osteofibrous dysplasia (OFD). Osteofibrous dysplasia (OFD) occurs in children and is benign. The treatment of osteofibrous dysplasia is observation and not a wide resection. Osteofibrous dysplasia (OFD) looks similar to fibrous dysplasia, but it has an osteoblastic rimming.

Presentation of Adamantinoma:

- Usually is pain for a long time
- There may be tenderness over the tibia or a mass
- There may be bowing of the tibia
- It occurs within the tibial diaphysis

X-rays:

- Classic with multiple lucent and sclerotic defects
- Soap bubble appearance
- No periosteal reaction

Differential Diagnosis:

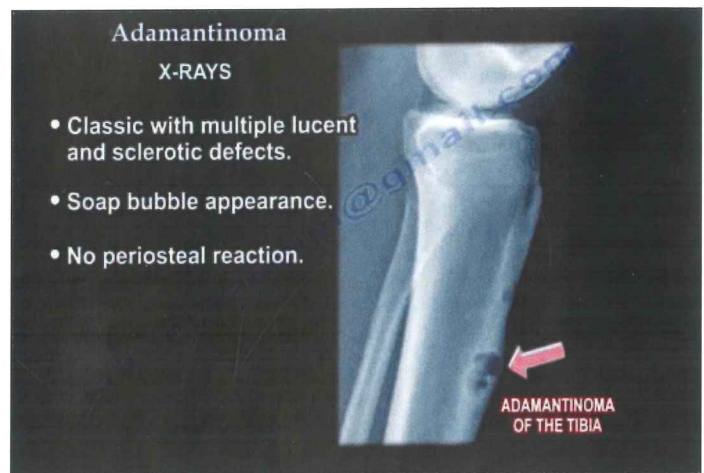
- Chondromyxoid fibroma
- Fibrous dysplasia

Psoriatic Arthritis

Psoriatic arthritis is a very important topic for any orthopaedic exam! Seronegative spondyloarthropathies affect approximately 10% of patients with psoriasis.

3. Sarcoplasmic reticulum – storage for calcium and container for calcium when the muscle is relaxed. A larger protein is embedded into the wall that serves as a calcium release channel. After the muscle contracts, the calcium is taken up by the sarcoplasmic reticulum (storage site).

When there is decirculation of this process because the ryanodine receptor is defective, then ryanodine triggers the release of calcium to the inside of the cell in larger quantities than normal. The intracellular concentration of calcium increases substantially and will have sustained contracture of these muscles, which is how you get malignant hyperthermia.



- Osteofibrous dysplasia

Pathology:

- Adamantinoma is a biphasic tumor
- There will be a cell nest of epithelial cells in a fibrous stroma
- Keratin-positive

Treatment

- Wide resection and reconstruction
- o Lung metastasis occurs in about 25% of the patients
- o Need to do patient follow up for a long period of time

In the exam, they may give you an x-ray of a tibia and the lesion is located in the diaphysis of the tibia. The slides may show epithelium-like tissue embedded in fibrous stroma.

If the spine is affected, the Human Leukocyte Antigen B27 (HLA-B27) is positive in more than 50% of the time.

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Psoriatic Arthritis continued

The clinical presentation of psoriasis in the cervical spine could be similar to rheumatoid arthritis, but in general it is different than ankylosing spondylitis (debatable and controversial). Psoriatic arthritis will have a negative rheumatoid factor and negative antinuclear antibody (ANA) tests.

Psoriatic arthritis presents itself with patchy, plaques, and scales that can be red or silvery in color. It usually occurs before the arthritis and usually occurs at the elbow or the knees. It usually occurs at the extensor surface of the extremity. Always check the elbows! In about 20% of the cases, the arthritis usually occurs before the scales and the plaques.

Psoriatic arthritis most commonly affects the hands, the feet, the spine, and the sacroiliac (SI) joints.

Hand: This is very important information for clinical practice and also for the exams.

- Dactylitis – sausage digits.
- Pencil-in-cup deformity – the DIP is involved. Some believe this is an x-linked recessive trait.
- Nail pitting – fragmentation and discoloration.
- Onycholysis – lifting of the nail plate starts distally.
- Arthritis mutilans

You may get uveitis, Achilles tendonitis, plantar fasciitis, and conditions similar to Reiter's syndrome (reactive arthritis).

Treatment is usually medical treatment with nonsteroidal, methotrexate and TNF – alpha inhibitors. Surgery is used occasionally. There is a high infection rate with surgery. Try to avoid skin incisions through the active psoriatic lesions (there is a high colonization with bacteria). Do preoperative treatment of such lesions.

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Dr. Ebraheim, Amanda Critton, Julie Anderson and Ellen Finch do not have any relationships with industry to disclose.

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