Gas gangrene

A surgical emergency - Part 1

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Gas gangrene is caused by a local infection with anaerobic, spore forming, gram positive *Clostridium perfringens* or *Clostridium septicium.* It is masked by the presence of gas in the soft tissues. Because gas gangrene is a lethal process, it is imperative that the muscle necrosis be recognized quickly and that the appropriate treatment be initiated immediately. This "Clostridium myonecrosis," as it is called, is a rapidly progressive medical-surgical emergency.

Etiology

There are a number of Clostridium species but 80-95% are caused by *Clostridium perfringens. Clostridium septicemia* is the second most common etiologic agent. *Clostridium perfringens* is prominent among normal bowel micro flora, and is 10 to 100 times more prevalent than *E-Coli* in fecal specimens. Clostridium can be found on the skin, especially over the buttocks, thighs and perineum, and less frequently in the vagina and in the diseased biliary tract. Our environment is heavily contaminated with Clostridium, which is on clothing, in the air of operating theatres, in water, on food, in dust and soil. The ability of Clostridium to form spores allows them to persist in the environment under adverse conditions.

Isolates from normal bowel flora and from fatal cases of myonecrosis are no different in toxin production. Rather, myo-necrosis occurs because damaged tissue presents this anaerobic organism with an opportunity to proliferate. When *Clostridium perfringens* invades soft tissue, it produces thrombosis of regional blood vessels, tissue nec-rosis and localized edema. The necrosis releases both carbon dioxide and hydrogen subcutaneously, which produces interstitial gas bubbles.

Sign and symptoms

Between 60% and 70% of gas gangrene follows trauma, usually a major injury that breaks the skin, crushes tissue, compromises vascular supply and introduces dirt. Between 20% and 30% of cases follow clean surgical procedures such as common bile duct exploration, bowel surgery or attempted vascular repair. The remaining 10%-15% of cases occur after I.M. injections, minor trauma, or in immuno-suppressed patients.

The first symptom of myonecrosis is the development of heaviness or pain in the affected area beginning 24-48 hours after injury. The pain is constant and increases steadily. The painful area is not red or inflamed, but appears cool, pale, and swollen, often with bronze or brown discoloration appearing on the skin. Soon the skin and the wound may rupture, revealing dark red or black necrotic muscle. Gas gangrene produces early signs of toxemia and hypovolemia, such as tachycardia, tachy-

pnea and hypotension. Even though they are pale, prostate and/or motionless, most patients remain alert and oriented and are, understandably, extremely apprehensive.

Diagnosis

A history of recent surgery or a deep puncture wound and the rapid onset of pain and crepitation around the wound suggest the presence of gas gangrene. The diagnosis is confirmed by anaerobic cultures. This shows large gram positive, rod-shaped bacteria. These cultures are taken from debrided tissue. Blood cultures are also done.

Treatment

If signs of myonecrosis occur, immediate treatment is necessary. This means a wide surgical incision of all affected tissues and necrotic muscles. If there is a delay, very often the limb cannot be salvaged and must be amputated. Surgery is supplemented with blood, plasma and fluid replacement to correct any existing hypovolemia. Fluid balance, urine output, central venous pressure, cardiac status, and renal function must be monitored.

High doses of penicillin are given. Although the antibiotics cannot penetrate the heavily infected necrotic tissues, they help in preventing the invasion of healthy muscle and can treat bacteremia.

After debridement and/or amputation, hyperbaric oxygenation is used, if available. Every 6-8 hours, the patient is placed in a hyperbaric chamber for between 1-3 hours and is exposed to pressure (usually three atmospheres) designed to increase the oxygen tension and prevent multiplication of the anaerobic clostridia.

Prevention

Probably the most important aspect of prevention is through debridement and cleaning of traumatic wounds, and through the administering of therapeutic doses of anti-microbials.

Hyperbaric oxygen

The objective of hyperbaric oxygen therapy is to raise the oxygen saturation of tissue to a level at which pathogenic Clostridia cannot continue the process of myonecrosis.

"Hyperbaric oxygen earned its stripes in preventing the bends and countering gas gangrene, but it has application in many other acute situations." [1]

Some other uses are in the treatment of air embolism, carbon monoxide poisoning, cyanide toxicity (caused by smoke inhalation), burns, crushing injuries, frostbite, acute blood loss, anemia, closed head injuries, spinal cord injuries, strokes and myocardial infarctions.

"Before the use of hyperbaric chambers, the only treatment for gas gangrene was extensive surgery such as high amputation or 'commando' debridement, such as the removal of the entire abdominal wall. Without such drastic action, death occurs within as little as six hours." [2]

With hyperbaric oxygen therapy, morbidity and mortality are greatly reduced, and surgery can be less drastic, permitting the salvage of entire limbs. Hyperbaric oxygen therapy chambers come in two basic types - monoplace and multiplace.

A monoplace unit looks like an over-sized iron lung with clear plastic sides. The patient can be on a ventilator that fits inside the unit, but is controlled from the outside. All I.V. lines - arterial line, B.P. and EKG monitors - are capable of being established and monitored outside. The chamber is pressurized with 100% oxygen, so the patient breathes the oxygen without a mask.

These chambers cut the isolation time because the patient can be brought back to surface pressure in 10-15 seconds, if necessary, because they are breathing pure oxygen. If breathing air, which is 80% nitrogen, an air embolism would be a possibility.

Monoplace hyperbaric chambers are about one-tenth of the cost of a multiplace chamber and are readily adaptable to a hospital setting.

The multiplace chambers are walk-in or climb-in units that allow physicians, nurses and technicians to enter and attend to the treatment needs of several patients at a time. Patients breathe 100% oxygen via mask or endotracheal tube. The multiplace chamber is pressurized with air rather than oxygen. This makes them a bit safer than monoplace units, as flash fires are possible when oxygen is greater than 27%.

"Whether a multiplace or monoplace chamber is used, the bottom line is delivering oxygen according to guidelines." [3] ■

References

1. Emergency Medicine, March 15, 1986; 18(5):33.
2. Ibid: 39. 3. Ibid: 48.