

## GAS GANGRENE FOLLOWING AN OPEN TIBIAL FRACTURE - A CASE REPORT

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Gas gangrene is an invasive anaerobic infection, usually found in deep wounds with injury to large muscle masses that are contaminated with germs from the group of anaerobic clostridia. It is characterized by massive, acute progressive muscle necrosis and severe intoxication of the organism. The importance of gas gangrene is in its rapid evolution and high mortality. Untreated gas gangrene is fatal. This paper presents a patient in whom, after an open fracture of the femur and tibia, gas gangrene of the lower leg developed. Injury occurred during processing of agricultural land with a tiller, when cutter blades cut the bones of the leg and contaminated the wound with the soil in which clostridium microorganisms were present. After being admitted to hospital, due to lesions of the femoral vessels, hemostasis was performed, followed by the primary surgical treatment of the wound and external skeletal fixation. In the postoperative period, in the first 48 hours, there was a development of gas gangrene in the right calf with a bad general condition. For vital reasons, the patient underwent femoral amputation. Early amputation stump, after meticulous hemostasis was left open and was closed with the delayed secondary suture. After healing of the amputation stump, the patient was referred to physical therapy for prosthesis and gait training. *Acta Medica Medianae* 2012; 51(2):25-30.

**Key words:** open fracture of the tibia, the external skeletal fixation, gas gangrene, femoral amputation

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### Introduction

Gas gangrene is an invasive anaerobic infections with massive, acute, progressive muscle necrosis, and severe intoxication of the organism (toxemia). It is characterized by swelling and necrosis of the muscle tissue, the appearance of gas in the tissue and severe general symptoms. The importance of gas gangrene is in its rapid evolution and high mortality (1).

Toxins and anaerobic decomposition products of necrotic muscle are responsible for the clinical signs and symptoms in gas gangrene. It can be most frequently found in the wounding of the lower extremity, thigh, calf, gluteal and lumbar regions. Less commonly, only one muscle is affected. More often, a group of muscles or the whole limb are affected (2).

Causes of gas gangrene are anaerobic bacilli from a group of clostridia - toxigenic clostridia (*Clostridium perfringens*, *Clostridium oedemaciens*, *Clostridium septicum*, *Clostridium histolyticum*, *Clostridium sporogenes*). Clostridia, as the causes of gas gangrene, are among the most widespread anaerobic microorganisms in nature. The digestive tract of animals and humans is their reservoir. Through the digestive tract, they come into the environment in agricultural soil. Their spores are found in dust, air, soil, water and in the environment. Gas gangrene is not transmitted from person to person (3).

Gas gangrene is usually found in deep wounds with injury to large muscle masses that are contaminated with germs from the group of anaerobic clostridia. In infection, in one person, one can find several species of clostridia where their representation is different. *Clostridium perfringens* produces alpha toxin, which is haematotoxic, neurotoxic and necrotic. *Clostridium histolyticum* produces beta toxin and causes muscle breakdown. *Clostridium oedemaciens* creates gelatin swelling and disrupts the vascular permeability. The incubation period for the development of gas gangrene is usually brief and lasts one to four days from sustaining an injury, but can range from eight hours to six days. In most cases, it is shorter than twenty-four hours (4).

The aim of the paper was to present a patient with gas gangrene after an open tibial fractures who was treated at the Department of Orthopedics and Traumatology and the Department of Surgery, Clinical Center Niš.

### Case report

Patient AT, 40 years old, sustained an open fracture of the right thigh and right shin during agricultural work. He cultivated an orchard with a tiller. At the end of the orchard he suddenly turned the tiller to avoid a young seedling. Tiller hit the mound, changed direction and started moving backwards, towards him. He tried to pull back and avoid the tiller, but because of the dike that was behind him, he could not. The tiller caught him, and shovels for digging, dirty from the ground, hit the right thigh and lower leg and caused open fractures. He was admitted to the Department of Orthopedics and Traumatology, Clinical Center Niš in a state of traumatic shock under the following diagnoses:

Dg: Polytrauma. Schok traumaticus. Vulnura lacerocotusum regio ingvinalis et regio cruris lat. dex. Fractura aperta comminutiva femoris pars. proximalis lat. dex. Fractura aperta cruris lat. dex. Laesio arterije et venae femoris in obs.

On admission to hospital, the injury of blood vessels was not registered. Antishock therapy was included. X-ray diagnosis was performed on the right thigh and lower leg (Figure 1).



Figure 1. On the X-ray of the right thigh and lower leg, the fractured femoral neck, the right femoral trochanter, and the right tibial fracture in the middle third can be seen.

After stabilization of the general patient's condition, sudden bleeding occurred from the femoral artery. Digital compression was done, followed by clamping of blood vessels. Due to the urgency of surgery on blood vessels, the patient was transferred to the Department of Surgery. After vascular injury was managed, and

after stabilization of general condition, orthopedic surgery was performed because of an open fracture of the right tibia. We approached the fragments of the tibia through the existing open wound at the fracture site. They were cleansed and repositioned. Fracture was stabilized with external skeletal fixation. The wound was closed with situational sutures and dressed. Then, we set the Stajman's pin through tuberositas tibiae.

Op: Fixatio extrema cruris lat. dex. Extensio sceletalis tibiae lat. dex.

The following night, at about 10 p.m, a duty general surgeon examined the patient. He complained of severe pain in the right lower leg. "When entering a room in which the patient was, heavy, sweetish, unpleasant odor could be felt. Nurse, who attended the examination of the patient, said that the patient was admitted directly from agricultural field after sustaining the injury, and that the present smell was coming from his feet. I asked the nurse to undertake all necessary hygienic measures and wash the patient's legs. Despite detailed toilet, heavy, oily, foul odor still could be felt in the room. "

On examination, the patient was conscious, oriented in time, space and to the others, could fully reconstruct the events related to the injury. The injured patient said: "I worked with a tiller in agricultural field. In the corner of the field there was a small cherry tree that had just started to grow. I went directly with tiller on it. In order not to cut a cherry tree, I suddenly turned and struck the embankment soil. The tiller bounced and fell off my hands, after which it changed direction and started moving towards me. Blades for digging, which were full of soil, hit me in the thigh and lower leg, cut my skin and broke my bones. "

The patient complained of severe pain in the right lower leg, which, despite analgesic therapy, did not vanish. In the area of the right tibia, on the front-inner surface, there was an open wound of irregular shape with a diameter of 5 x 10 cm, with signs of necrosis at wound edges and present serous contents, which filled the wound as a small "pond". On the surface of the liquid content in the wound, small gas bubbles appeared occasionally, as the "swamp land". After clinical examination, anaerobic infection - gas gangrene was highly suspected. Surgical intervention was indicated. Early in the morning, when we made a new consultative examination, the patient was unconscious and intoxicated.

On the dorsal surface of the right foot, there were the signs of necrosis with bubbles that were filled with hemorrhagic content and gas. The patient immediately underwent surgery. In the operating room, the external skeletal fixator was removed (Figure 2, 3).

For vital reasons, the right femoral amputation was done. Amputation stump wound, after meticulous hemostasis, was left open (Figure 4).



Figure 2. Open wound of the right tibial fracture with irregular edges and early signs of necrosis and serous, blurred content present, that fills the wound as a small "pond". On the surface of the liquid content in the wound, occasionally, small gas bubbles appear.



Figure 3. On the dorsal surface of the right foot, visible signs of necrosis with bubbles filled with hemorrhagic content and gas.



Figure 4. Right thigh stump after guillotine amputation of the right thigh in the middle third. The wound was left open after meticulous hemostasis.

Op: Amputatio femoris lat. dex.

Early postoperative course was normal. The general condition of the patient improved after the amputation. The patient was dressed regularly. Early amputation stump, after guillotine amputation, was closed by secondary suture.

Op: Sutura secundaria.

After the sutures were removed from the amputation stump, the patient was referred to the Department of Physical Medicine and Rehabilitation for the prosthesis and gait training.

## Discussion

The diagnosis of gas gangrene is mainly based on clinical symptoms. The main symptom is a sudden deterioration in general condition—with strikingly soil-pale color of skin, rapid pulse and a rapid onset of pain in the wound. Pain in the region of the wound could start so suddenly and abruptly that it can arouse the suspicion of acute vascular occlusion. Sudden onset of pain in the wound with a sudden worsening of general condition should always arouse suspicion of the possibility of gas gangrene in a patient with an open fracture or wound (5).

For the development of gas gangrene after open fractures, the following factors are responsible: disposal of surgical wound, insufficient excision of necrotic tissue of the wounds, primary closure of wounds, the presence of foreign bodies in the wound, early muscle anoxia due to insufficient blood flow during vascular injury, prolonged use of Esmarch bandage, too tight compression bandage or a circular plaster (6).

The general condition of the injured rapidly deteriorates. Pulse is accelerated, blood pressure falls. Breathing is rapid. The face is pale, eyes are sunken, and the tips of the nose and lips are cyanotic. At first, the patient is agitated, later on, apathy can be observed, and in the final stage, patient falls into delirium. Initially, the injured patient complains of bandage tightness and sudden onset of pain in the wound. After removing the bandage, embedded bandage threads on the skin can be seen. Wound surrounding is painful and swollen. The skin is edematous and mottled brown with dark spots. Drainage from the wound is not profuse but watery and clouded, with bubbles of gas. Subcutaneous adipose tissue is swollen and dark in color. Dark and brown muscles can prolapse out of the wound. The smell of wound could be sweet or rot. Very often, there is a characteristic smell of the rotten meat. Gas that is produced spreads along the muscle and through the openings in the fascia passes into the subcutaneous tissue. From the wound, the infection spreads rapidly up and down the muscles and tends to spread to other healthy muscles (7).

Differential diagnosis should include: anaerobic cellulitis (anaerobic fasciitis), anaerobic streptococcal myositis, anoxic gangrene, impregnation of the soft tissue with propellant gases and

air in shooting from the close vicinity. Thorough excision of devitalised wound tissue without primary closure of open fracture wounds with the use of antibiotics (crystalline penicillin, cephalosporins, metronidazole, clindamycin) is the best prophylaxis of gas gangrene. Clostridium microorganisms, which causes gas gangrene, are sensitive to penicillin, erythromycin and tetracycline. Despite wide use of antibiotics in the treatment of infected wounds, they are not a substitute for the excision of devitalised tissue and for general surgical principles such as adequate wound excision and drainage. Early and adequate primary surgical treatment of the wounds (gunshot wounds), leaving the wound open and use of antibiotics is the safest prevention of gas gangrene (8).

Treatment of gas gangrene includes: preoperative resuscitation of patients, surgery, antibiotics, hyperbaric oxygenation and rehabilitation after amputation.

Preoperative preparation includes: replacement of circulatory volume (infusion solutions, blood transfusions) and antibiotic therapy. The wound is wide open along the longitudinal axis of the limb. If only one muscle or muscle group is affected, the affected muscle tissue should be completely removed from attachment to attachment. Every muscle, whose color is not normal, that does not contract and does not bleed at the cross section should be completely removed (rule 4C) (9). If all the muscles are affected on one extremity, amputation is indicated. If the infection has spread beyond the reach of amputation or when gas gangrene affected abdomen and back, chest and neck, these regions should be opened by generous incisions, cutting off the subcutaneous tissue and fascia to reduce tension and establish a broad drainage (10). Treatment with antibiotics is an important auxiliary method. The following antibiotics are usually given: penicillin amp. Benzil penicillin (crystalline penicillin) amp. Longacef, amp. Metronidazol or tetracycline. Antibiotics are given before and after surgery. Antibiotic therapy after surgery, at such high doses, should continue for three to five days. Antibiotics such as penicillin, chloramphenicol, and erythromycin are effective against clostridia microorganisms, but they can reach tissues that have good perfusion. Dead muscles allow only diffusion, and concentration of antibiotics in the

depth of the wound is very small and inefficient (11). The application of hyperbaric oxygen may reduce mortality rate and reduce disability. In the postoperative period, adequate resuscitation is necessary (crystalloid solutions and blood transfusions), with good control of laboratory parameters, diuresis, and other vital signs.

### Conclusion

Gas gangrene is an invasive anaerobic infection with massive, acute, progressive muscle necrosis and severe intoxication of the organism (toxemia). Gas gangrene is usually found in deep wounds with injury to large muscle masses that are contaminated with germs from the group of anaerobic clostridia. It is characterized by swelling and necrosis of muscle tissue, the occurrence of gas in the tissue and a very difficult pathophysiological disturbance and poor general condition.

The importance of gas gangrene is in its rapid evolution and high mortality. For the development of gas gangrene after open fractures the following factors are responsible: disposal of surgical wound, insufficient excision of necrotic tissue of the wounds, primary closure of wounds, presence of foreign bodies in the wound, early muscle anoxia due to insufficient blood flow during vascular injury, prolonged use of Esmarch bandage, too tight compression bandage or a circular plaster. Thorough excision of devitalised tissue wounds without primary closure of open fracture wounds with the use of antibiotics (crystalline penicillin, cephalosporins, metronidazole, clindamycin) is the best prophylaxis of gas gangrene. Despite wide use of antibiotics in the treatment of infected wounds, they are not a substitute for the excision of devitalised tissue and for general surgical principles such as adequate wound excision and drainage. Early and adequate primary surgical treatment of the wounds (gunshot wounds), leaving the wound open and use of antibiotics is the best prevention of gas gangrene.

### Acknowledgement

This paper is part of project III 41017 Virtual human osteoarticular system and its application in preclinical and clinical practice, funded by the Ministry of education and Science of Republic of Serbia.

## References

1. Hoffman S, Katz JF, Jacobson JH. Salvage of a lower limb after gas gangrene. Bull N Y Acad Med. 1971 ; 47(1): 40-9. [[PubMed](#)]
2. Košutić M. Infekcija ratne rane. In: Dragović M, Todorčić M, editors. Urgentna i ratna hirurgija. Beograd (Serbia): Velarta; 1998. p. 813-21. Serbian.
3. Alvarez-García JF, Chiquero M, Sánchez-Sánchez T, Costo A. [Gas gangrene]. Cir Esp. 2005 ; 78(1): 58. Spanish. [[PubMed](#)]
4. Morris WE, Fernández-Miyakawa ME. [Toxins of Clostridium perfringens]. Rev Argent Microbiol. 2009 ; 41(4): 251-60. Spanish. [[PubMed](#)]
5. Dragičević S. Infekcija i antibiotici u hirurgiji. In: Dragović M, Todorčić M, editors. Urgentna i ratna hirurgija. Beograd (Serbia): Velarta; 1998. p. 147 – 69. Serbian.
6. Golubović Z, Stojiljković P, Mačukanović-Golubović L, Milić D, Milenković S, Kadija M, et al. Lečenje otvorenih preloma potkolenice metodom spoljne skletne fiksacije. Vojnosanit Pregl. 2008; 65(5): 343-7.
7. Schexnayder SM, Klein SG. Images in clinical medicine. Gas gangrene. N Engl J Med. 2004 ; 350(25): 2603. [[CrossRef](#)] [[PubMed](#)]
8. Golubović Z, Stanić V, Trenkić S, Stojiljković P, Stevanović G, Lesić A, et al. [Penetrating injury of the lungs and multiple injuries of lower extremities caused by aircraft bombs splinters]. Vojnosanit Pregl. 2010 ; 67(8): 688-93. Serbian. [[PubMed](#)]
9. Golubović Z, Vidić G, Trenkić S, Vukasinović Z, Lesić A, Stojiljković P, et al. Treatment of open tibial shaft fracture with soft tissue and bone defect caused by aircraft bomb--case report. Srp Arh Celok Lek. 2010 ; 138(7-8): 510-4. [[PubMed](#)]
10. Bryant AE, Stevens DL. Clostridial myonecrosis: new insights in pathogenesis and management. Curr Infect Dis Rep. 2010 ; 12(5): 383–91. [[PubMed](#)]
11. Golubovic Z, Stojiljković P, Mitković M, Trenkić S, Vukasinović Z, Lesic A, et al. [Treatment of multiple fractures in a patient wounded by aircraft bombing]. Srp Arh Celok Lek. 2010 ; 138(5-6): 362-6. Serbian. [[CrossRef](#)] [[PubMed](#)]

## **GASNA GANGRENA NAKON OTVORENOG PRELOMA POTKOLENICE PRIKAZ BOLESNIKA**

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Gasna gangrena je invazivna anaerobna infekcija koja se najčešće sreće kod dubokih rana sa povredom velikih mišićnih masa koje su kontaminirane anaerobnim bacilima iz grupe klostridija. Karakteriše se masivnom, akutnom progresivnom nekrozom mišića i teškom intoksikacijom organizma. Značaj gasne gangrene je u brznoj evoluciji i visokoj smrtnosti. Nelečena gasna gngrena je smrtonosna. U radu se prikazuje bolesnik kod koga je nakon otvorenog preloma butne kosti i potkolenice došlo do razvoja gasne gangrene potkolenog segmenta. Do povrede je došlo prilikom obrade poljoprivrednog zemljišta frezom, pri čemu su lopatice freze presekle kosti potkolenice i kontaminirale ranu poljoprivrednim zemljištem u kojoj su prisutne klostridije. Nakon prijema, urađena je hemostaza zbog lezije femoralnih krvnih sudova, a zatim primarna obrada rane otvorenog preloma i spoljna skeletna fiksacija. U postoperativnom toku u prvih 48 sati došlo je do razvoja gasne gangrene na desnoj potkolenici sa teškim opštim stanjem. Natkolena amputacija desne noge urađena je iz vitalnih razloga. Rana amputacionog patrljaka, nakon pedantne hemostaze ostavljena je otvorena i odloženo je zatvorena sekundarnim šavom. Po zarastanju amputacionog patrljaka pacijent je upućen na fizikalnu terapiju radi protetisanja i osposobljavanja za hod sa natkolenom protezom. *Acta Medica Medianae 2012;51(2):25-30.*

**Ključne reči:** *otvoreni prelom potkolenice, spoljna skeletna fiksacija, gasna gangrena, amputacija natkolenice*