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Case report

A CASE OF GAS GANGRENE WITH FATAL OUTCOME
(GAS GANGRENE – A CASE REPORT)

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Summary

Introduction: *The clinical course of gas gangrene is often rapidly progressive, with a fatal outcome in up to 80% of treated cases. The disease is most commonly a consequence of trauma. or surgical interventions. The causative agents are bacteria of the genus Clostridium. Tissue changes are induced by bacterial toxins.* ***Case presentation:*** *We analyzed the case of an 84-year-old, obese, female patient admitted for treatment due to weakness and dysuric symptoms. She fell at home the day before and sustained superficial skin changes. Previous medical documentation indicated poorly managed arterial hypertension. A few days after admission, the patient experienced worsening symptoms with the onset of edema and crepitus of the soft tissues, dyspnea, and renal insufficiency. Ultrasound examination revealed gas inclusions in muscular tissue, while radiography showed bilateral basal pulmonary changes. Laboratory findings initially showed lymphocytosis and elevated C-reactive protein. Anemia, increased muscle enzymes, and elevated nitrogenous compounds followed the progression of the disease. Urine culture isolated Escherichia coli. Clostridium spp. was identified in the soft tissue aspirate. Ceftriaxone and metronidazole were administered initially, followed by penicillin G. The disease progressed and resulted in a fatal outcome.* ***Conclusion:*** *The nature of gas gangrene is extremely severe due to the potential for multisystemic damage. It is necessary to suspect this condition more frequently, regardless of the circumstances of the injury. Clinical symptoms should be closely monitored, and antibiotic therapy should be initiated as early as possible to improve the chances of a favorable outcome.*

Key words: *gas gangrene, Clostridium, multiple organ failure*

Introduction

Gas gangrene is a condition characterized by rapid progression of myonecrosis, the development of systemic disease, and sepsis. The causative agents are bacteria from the *Clostridium* genus, most commonly *Clostridium perfringens*, but also *Clostridium septicum* and *Clostridium histolyticum. [1]* The infection rarely occurs spontaneously. It is most often the result of physical trauma, with *Clostridium perfringens* or *Clostridium histolyticum* being the typical causative agents.[1] *Clostridium septicum* usually causes gas gangrene following various abdominal conditions, most commonly cancer, and may also develop after surgical or gynecological interventions.[2]

Gas gangrene was a common condition throughout the history of war injuries.[3] Such injuries are typically contaminated by soil. Soil, along with the digestive systems of humans and animals, serves as the environment for *Clostridium* bacteria. These bacteria survive in unfavorable conditions in their spore form.

Tissue hypoxia is a condition for the spread of infection. Oxygen deficiency in tissues most often occurs as a result of trauma. It is also present in cases of circulatory changes caused by other diseases, such as cardiovascular diseases, diabetes, and similar conditions.[4]

Gas gangrene is a 100% fatal disease if left untreated. In treated patients, the mortality rate ranges from 5% to 80%, depending on the affected

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region of the body. The best prognosis is seen in infections of extremities, while the worst prognosis is associated with infections of the soft tissues of the abdomen or chest.[3, 5]

Patients with gas gangrene are most often treated in intensive care units. In addition to antibiotic therapy and surgical management, hyperbaric oxygen therapy is beneficial.[4]

The most important step is early surgical debridement or amputation, depending on the extent of the infection. This approach enables timely collection of tissue samples for microbiological examination.[6]

The diagnostic algorithm for soft tissue infections includes early local and systemic signs and symptoms, laboratory and radiographic findings, as well as microbiological isolates of the causative agents. In the presence of a systemic response, the differential diagnosis is made between gas gangrene and types I and II necrotizing fasciitis.[7]

The aim of the work is to highlight the importance of the timely recognition and appropriate treatment of this severe infection, which is exceptionally rare in the practice of infectious disease specialists at the General Hospital in Užice. The goal is also to emphasize the necessity of surgical intervention, which is crucial for achieving a favorable disease outcome.

Case report

An 84-year-old female was admitted for treatment due to weakness, chills, shivering, and dysuric symptoms. The symptoms began a few days prior to admission. She did not measure her body temperature. The patient fell at home the day before admission. The fall was caused by a feeling of weakness. She sustained superficial abrasions on her right hand and right thigh. She consulted a doctor, and X-rays of both injured areas were performed, showing no bone injuries. Analgesic therapy was recommended. In her medical history, she reported a diagnosis of hypertension for which she had not received regular treatment. She denied any food or drug allergies.

Upon admission, a urine sample was taken for a urine culture and antibiotic therapy was initiated. Upon the onset of fever, a blood sample was taken for a blood culture.

Upon admission, the patient was conscious, oriented, pale, afebrile, obese (body mass index 32.6), cardiologically compensated, and normotensive, with a blood pressure of 140/80 mmHg. She had a hematoma with a maximum diameter of approximately 2 cm, accompanied by a small superficial laceration, on her right palm. A similar lesion, measuring about 5 cm, was located on the upper third of the outer side of the right thigh. The abdomen was soft, with palpatory tenderness noted suprapubically. The rest of the clinical examination did not reveal any pathological changes. Laboratory findings revealed leukocytosis with granulocytosis, elevated C-reactive protein, and a large number of leukocytes and bacteria in the urine. Laboratory parameters are presented in Table 1.

Antibiotic therapy (ceftriaxone and metronidazole) was initiated immediately. On the third day of the illness, edema began to spread around the injury site on the thigh, and erythema and edema developed on the right lower leg. The patient became tachycardic and dyspneic, with percutaneous oxygen saturation (SpO2) on room air dropping to 88%. The serum hemolyzed multiple times. Oxygen support was provided via a nasal cannula, 6 L O2/min. Over the next two days, the disease progressed rapidly, with swelling affecting all extremities. Palpation of the swollen tissues revealed a crackling sensation. Auscultation of the lungs revealed late inspiratory crackles at the bases. The patient became hypotensive. The blood count showed anemia and thrombocytopenia, while the biochemical findings indicated hypoalbuminemia, elevated alanine aminotransferase, aspartate aminotransferase, lactate dehydrogenase, and creatine kinase levels. (Table 1). Diuresis was reduced, and serum urea and creatinine levels were elevated.

Coagulation status: activated partial thromboplastin time (aPTT) was 32.2 sec (normal range 25-36 sec), prothrombin time (PT) was 13.3 sec (normal range 10-14.5 sec), and D-dimer was 410 ng/mL (normal range 0-230 ng/mL).

Escherichia coli sensitive to the already administered ceftriaxone was isolated in the urine culture. Treatment continued in the intensive care unit. Due to further deterioration of oxygen saturation, the patient was connected to mechanical ventilation in spontaneous breathing mode, with the use of a continuous positive airway pressure (CPAP) device, FiO2 40%.

Table 1. Laboratory analyses of the patient

Parameters (normal range)	On admission	On the 5th day
Red blood cells (4-5.9 x 10^{12}/L)	4.9	2.7
Hemoglobin (g/dl)	6.5	3.9
White blood cells (4–10 x 10^9/L)	11.2	8.5
Neutrophil count (1.9–8.0 x 10^9/L)	9.6	5.8
Platelet count (150.0–450.0 x 10^9/L)	320	116
Blood urea nitrogen (2.8–7.2 mmol/L)	21.5	22.9
Serum creatinine (59.0–104. Umol/L)	177	223
Alanine aminotransferase (<45 U/L)	60	93
Aspartate aminotransferase (15.0-60.0 U/L)	73	126
Unconjugated bilirubin (0.2–0.8 mg/dL)	0.4	3.2
Sodium (132–146 mmol/L)	139	141
Potassium (3.5–5.5 mmol/L)	3.8	5.0
Lactate dehydrogenase (208.0–378.0 U/L)	317	952
Creatine kinase (32.0–294.0 U/L)	299	1102
Blood proteins (57–82.0 g/L)	64	48
Albumin (35.0–52.0 g/L)	33	22
C-reactive protein (<5 mg/L)	343	175

The chest X-ray showed reduced lung parenchymal transparency bilaterally at the bases. Electrocardiogram (ECG): atrial fibrillation pattern, average ventricular response around 100/min, normal axis, flattened T wave in most leads, no ST changes, no QT interval changes, no extrasystoles.

Ultrasound examination of the right thigh revealed enlarged inguinal lymph nodes, pronounced edema of the muscles and subcutaneous tissue. The thigh muscles showed increased echogenicity and altered structure. Gas inclusions were observed in the muscles and subcutaneous tissue. No abnormalities were detected in the blood vessels. Abdominal ultrasound indicated hepatosplenomegaly.

A puncture of the soft tissue lesions was performed, and a turbid substance with an extremely unpleasant odor was obtained. *Clostridium spp.* was identified in the culture. Antibiotic therapy was continued with benzylpenicillin. No isolates were found in the blood culture.

After one week, further deterioration occurred, with hypotension and oliguria. Dual inotropic support (dobutamine, norepinephrine) was initiated, and diuresis was stimulated, monitored via a urinary catheter. No new changes were observed in the ECG.

On the sixteenth day of treatment, the disease ended with a fatal outcome. The fatal outcome was preceded by severe hypotension and anuria, along with further progression of muscle enzyme levels and a decline in oxygen saturation.

The patient's family declined the requested autopsy.

Discussion

Gas gangrene is a severe, life-threatening condition, with its outcome dependent on the toxic effects of the causative agent and the host's immune response. The mechanisms of interaction between

the pathogen and the host remain not fully understood. Some researchers have identified a receptor that accelerates granulopoiesis and stimulates the body's defense. Tumor necrosis factor alpha (TNF-α) and interleukin 6 primarily participate in this process.[8] Significant improvement in the immune response is achieved through genetic stimulation of interferon production.[9]

We presented the case of a patient whose symptoms began after a fall at home. The wound sustained during the fall was superficial and did not require surgical treatment. *Clostridium perfringens* is a rapidly growing anaerobe that adapts well to its environment and, in its spore form, is resistant to heat, chemical agents, and radiation.[10] Our patient's case is an exceptionally rare instance of gas gangrene occurring after a fall at home in an urban setting in this region. Similar cases have been reported in the literature, some with a fulminant clinical course.[11 - 13] The described patients often had surgical interventions.[2, 14] Some had cancers and/or had undergone oncological therapy.[15, 16] Rapid disease progression has also been described in patients where the entry route of the pathogen was parenteral drug administration or intravenous heroin injection.[17] Additionally, there have been cases of gas gangrene occurring after venipuncture or platelet transfusions in immunodeficient patients.[18]

We did not identify any other comorbidities aside from those noted upon admission. Long-standing untreated hypertension certainly caused changes. Due to the significant drop in platelet count, we assessed coagulation factors. Their values were within the reference range. We cannot confirm disseminated intravascular coagulation, as previously described in the pathogenesis of gas gangrene.[19] The mentioned case of disseminated intravascular coagulation occurred in a patient after bladder reconstruction using a portion of the ileum, so the source of the disease was gastrointestinal, rather than urinary tract-related.[19] Millard and colleagues presented a rare case of *Clostridium perfringens* found in urine.[20] In our case, no anaerobic pathogens were found in the urine culture, and *Escherichia coli* was isolated. In the literature, there is an example of gas gangrene caused by this bacterium.[21] Based on previous experience with urinary infections and considering the patient's critical clinical condition, we expected urosepsis in our patient. However, the blood cultures were sterile. *Clostridium spp.* was diagnosed from the tissue aspirate sample during treatment.

Although this pathogen was not found in the blood culture, we believe that the route of pathogen spread and the onset of systemic infection was through circulation. Supporting our assumption is the fact that only 15% of patients with gas gangrene have the causative agent identified in blood cultures.[11]

The pathogenesis of traumatic gas gangrene is complex. Vascular damage causes hypoxia, which is a condition that leads to tissue necrosis.[11] Our patient was obese. The relationship between obesity and tissue hypoxia is complex. The presence of adipose tissue can lead to local hypoxia, and hypoxia promotes the accumulation of fat.[22] The main pathogenic mechanism of gas gangrene is mediated by the toxins produced by the causative agent. The toxins are classified into seven groups and labeled with letters from A to G. The most common causative agents of myonecrosis are toxins from group A.[23] These toxins cause the hydrolysis of sphingomyelin and phosphatidylcholine in tissue cells, which is a condition for necrosis and apoptosis.[24]

The clinical picture in our case was characterized by noticeable muscle tissue edema with a palpatory sensation of crepitus. The patient experienced muscle pain. With the development of systemic illness affecting the lungs and later the kidneys, dyspnea, suffocation, and oliguria occurred, and the edema became more pronounced. Similar clinical pictures have been described by other authors.[11, 25] A case was presented where gas gangrene from the soft tissues spread to the central nervous system, myocardium, pericardium, and biliary tract.[12] In our patient, there was a decrease in the synthetic function of the liver and an increase in alanine aminotransferase, which could indicate hepatocyte necrosis. The light pink color of the serum suggested hemolysis, confirmed by laboratory parameters of anemia, reticulocytosis, elevated lactate dehydrogenase, and unconjugated bilirubin. In addition to the clinical findings, the ultrasound findings were also consistent with gas gangrene.

Our suspicion was definitively confirmed by the microbiological identification of the causative agent in the aspirate of the designated soft tissue taken during the period of clinical disease

progression. An autopsy was not performed, at the explicit request of the family.

We treated the patient with ceftriaxone. The decision regarding the type of antibiotic was made immediately upon admission, when a urinary infection or urosepsis was suspected, and the clinical presentation did not suggest gas gangrene. The patient's medical history indicated that she had been feeling weak for a few days prior to the fall. She had not measured her body temperature during this time. We assumed that some infection preceded the fall. We selected a broad-spectrum antibiotic, considering the elevated nitrogenous substances that indicated renal insufficiency. Due to the suspicion that the bacterial pathogen might be of anaerobic nature, we soon added metronidazole. The introduced therapy led to a regression of the inflammatory laboratory parameters. Although the pathogen showed sensitivity to the administered therapy, due to the progression of the clinical picture suggesting gas gangrene, we continued therapy with benzylpenicillin, which is recommended for the treatment of this disease.[26] The literature includes cases of treating gas gangrene with ceftriaxone.[11] We changed the antibiotic therapy because the initially applied antibiotic did not lead to clinical improvement.

However, the disease continued to progress. Testing revealed that *Clostridium spp.* contains genes responsible for antibiotic resistance.[27] We do not have experience with resistance from this pathogen, so we cannot confirm the opinion. We believe that the poor prognosis in our case resulted from the nature of the disease, as well as advanced aged and comorbidities.

Inadequate surgical management undoubtedly contributed to the poor prognosis. On the day of the injury, before hospital admission, the patient was evaluated in the emergency department, where a superficial skin lesion was noted, disinfected, and covered with a dressing. After the development of systemic symptoms and subsequent hospitalization, daily wound care was continued, but surgical debridement was not performed — a critical step that would have significantly improved the chances of a favorable outcome.

In the evaluation of such a multisystemic infection, the autopsy findings are of great importance.[11, 28] Postmortem findings have shown skin emphysema, gases in blood vessels, the thorax, abdomen, and organs. Histological examinations revealed varying dimensions of empty spaces in organs, with a weak inflammatory response.[28] Unfortunately, we lack the autopsy findings.

We have described a rare case of gas gangrene resulting in a fatal outcome. Our case suggests the need to consider improving diagnostic and therapeutic approaches, especially in settings where similar cases are not common. We believe that early suspicion of this condition can contribute to successful treatment, even when epidemiological factors do not point to the typical circumstances for this disease. In this regard, the most important factor is clinical presentation and the need for urgent surgical intervention under any circumstances. Early administration of antibiotics is certainly necessary; however, prompt surgical management offers a greater chance of a favorable outcome compared to antibiotic therapy alone.

References

1. Huang YY, Lin CW, Yang HM, Hung SY, Chen IW. Survival and associated risk factors in patients with diabetes and amputations caused by infectious foot gangrene. J Foot Ankle Res. 2018;11:1.

2. Dempsey A. Serious infection associated with induced abortion in the United States. Clin Obstet Gynecol. 2012;55(4):888-92.

3. Leiblein M, Wagner N, Adam EH, Frank J, Marzi I, Nau C. Clostridial Gas Gangrene - A Rare but Deadly Infection: Case series and Comparison to Other Necrotizing Soft Tissue Infections. Orthop Surg. 2020;12(6):1733-47.

4. Buboltz JB, Murphy-Lavoie HM. Gas Gangrene. 2023 Jan 30. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan. PMID: 30725715.

5. Shindo Y, Dobashi Y, Sakai T, Monma C, Miyatani H, Yoshida Y. Epidemiological and pathobiological profiles of Clostridium perfringens infections: review of consecutive series of 33 cases over a 13-year period. Int J Clin Exp Pathol. 2015;8(1):569-77. PMID: 25755747

6. Stevens DL, Bisno AL, Chambers HF, et al. Infectious Diseases Society of America. Practice guidelines for the diagnosis and management of skin and soft tissue infections: 2014 update by the Infectious Diseases Society of America. Clin Infect Dis. 2014;59(2):e10-52.

7. Stevens DL, Bryant AE. Necrotizing Soft-Tissue Infections. N Engl J Med. 2017;377(23):2253-65.

8. Takehara M, Kobayashi K, Nagahama M. Toll-Like Receptor 4 Protects Against Clostridium perfringens Infection in Mice. Front Cell Infect Microbiol. 2021;11:633440.

9. Liu ZZ, Zhou CK, Lin XQ, et al. STING-dependent trained immunity contributes to host defense against Clostridium perfringens infection via mTOR signaling. Vet Res. 2024;55:52.

10. Sathish S, Swaminathan K. Genetic diversity among toxigenic clostridia isolated from soil, water, meat and asso-

ciated polluted sites in South India. Indian Journal of Medical Microbiology. 2009;27(4):311–20.

11. Di Fazio N, Baldari B, Del Fante Z, De Simone S, Aromatario M, Cipolloni L. Gas gangrene, not a common infection: case report of post-traumatic fulminant death. Clin Ter. 2022;173(1):1-5.

12. Hall AD, Ferreri JM, Baker JE, et al. Clostridial gas gangrene involving the brain, gallbladder, heart, and soft tissue: A case report and literature review. IDCases. 2024;38:e02073.

13. Golubović I, Stojiljković P, Golubović Z, et al. Gas gangrene following an open tibial fracture – A case report. Acta Medica Medianae 2012;51(2):25-30.

14. Wang X, Jiao S, Sun Z, Wang Z, Wang X, Liu T. Case Report: Clostridial Gas Gangrene of Pelvic Wall After Laparoscopic Rectal Cancer Surgery Induced Fatal Sepsis. Front. Surg. 022;9:822605.

15. Fukui S, Kogawa R, Hojo A, et al. A case of fulminant Clostridium perfringens infection: Role of macroscopic examination of the serum and peripheral blood smears. IDCases. 2021;24:e01112

16. Kothadia JP, Wijarnpreecha K, Manatsathit W. An Uncommon Cause of Gas Gangrene. Gastroenterology. 2016;151(5):e9-e10.

17. Grenda T, Jarosz A, Sapała M, Grenda A, Patyra E, Kwiatek K. Clostridium perfringens-Opportunistic Foodborne Pathogen, Its Diversity and Epidemiological Significance. Pathogens. 2023;12(6):768

18. Camargo A, Ramírez JD, Kiu R, Hall LJ, Munoz M. Unveiling the pathogenic mechanisms of Clostridium perfringens toxins and virulence factors. Emerg. Microbes Infect. 2024;13(1):2341968.

19. Takazawa T, Ohta J, Horiuchi T, Hinohara H, Kunimoto F, Saito S. BMC Res Notes. 2016;9:385.

20. Millard MA, McManus KA, Wispelwey B. Severe Sepsis due to Clostridium perfringens Bacteremia of Urinary Origin: A Case Reports in Infectious Diseases. 2016;Article ID: 2981729.

21. Brown A, Gray A, Jenkins L, Mackie W. Escherichia coli gas gangrene in an immunosuppressed diabetic man. ANZ J Surg. 2016;86(4):307-8.

22. Mirabelli M, Misiti R, Sicilia L, et al. Hypoxia in Human Obesity: New Insights from Inflammation towards Insulin Resistance—A Narrative Review. International Journal of Molecular Sciences. 2024; 25(18):9802.

23. Kiu R, Hall LJ. An update on the human and animal enteric pathogen Clostridium perfringens. Emerg Microbes Infect. 2018;7(1):141.

24. Talukdar PK, Banawas S, Sarker MR. Clostridium perfringens. Trends Microbiol. 2025;33(1):130-1.

25. Hussain H, Fadel A, Garcia E, et al. Clostridial Myonecrosis: A Comprehensive Review of Toxin Pathophysiology and Management Strategies. Microorganisms. 2024;12:1464.

26. Stevens DL, Bryant AE, Goldstein EJ. Necrotizing Soft Tissue Infections. Infect Dis Clin North Am. 2021;35(1):135-55.

27. Fourie JCJ, Bezuidenhout CC, Sanko TJ, Mienie C, Adeleke R. Inside environmental Clostridium perfringens genomes: antibiotic resistance genes, virulence factors and genomic features. J Water Health. 2020;18(4): 477–93.

28. Stoyanov GS, Dzhenkov DL, Petkova L. Primary abdominal gas gangrene: a report of two autopsy cases. Autops Case Rep [Internet]. 2021;11:e2021329.