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Posttraumatic clostridial necrotizing fasciitis of the head and neck with descending necrotizing mediastinitis treated by video-assisted thoracoscopic surgery – report of a case

Posttraumatski klostridijski nekrotizirajući fascitis glave i vrata s descendentnim nekrotizirajućim medijastinitisom, liječen video-asistiranim torakoskopskim kirurškim pristupom – prikaz bolesnika

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Summary

Background: Necrotizing fasciitis of the head and neck with subsequent descending necrotizing mediastinitis is a highly lethal condition. The clostridial origin has a particularly aggressive course.

Case presentation: Herein we present a case of a 22-year-old male with clostridial necrotizing fasciitis of the head and neck complicated with descending necrotizing mediastinitis after a traumatic scalp wound. Three days after having sutured the wound at the Emergency Department, the patient became septic with marked cellulitis of the head and neck soft tissue. Urgent surgical wound debridement of necrotic tissue along with transcervical drainage of the upper mediastinum was performed. The patient was ventilator dependent, receiving vasoactive support and empiric broad-spectrum antibiotic therapy. Left-sided pleural effusion and CT signs of infection descent into the middle and lower mediastinum mandated further surgical intervention. A video-assisted thoracoscopic surgical approach was used to drain and debride the affected mediastinal and pleural spaces leading to a gradual stabilization of the patient followed by being transferred to the Surgical Department. Microbiological analysis revealed *Clostridium perfringens* as an infective agent. Further recovery was uneventful and the patient was dismissed on postoperative day 24.

Conclusion: Posttraumatic clostridial gas gangrene of the head and neck is a fulminant and life-threatening infection. It requires urgent clinical and radiological assessment. Treatment should be multidisciplinary based. The invasiveness and extent of surgery should be tailored for individual patients. Video-assisted thoracoscopic surgery technique is a safe and appealing approach to all mediastinal compartments. It offers less invasiveness, superior visibility and equal efficiency in terms of tissue debridement and mediastinal as well as pleural drainage.

Key words: necrotizing fasciitis, mediastinitis, Clostridium perfringens, gas gangrene, video-assisted thoracoscopic surgery

Sažetak

Uvod: Nekrotizirajući fascitis glave i vrata s posljedičnim descendentnim nekrotizirajućim medijastinitisom, potencijalno je smrtonosna bolest. Kada je uzrokovana klostridijom ima osobito agresivan tijek.

Prikaz bolesnika: Prikazujemo 22-godišnjeg mladića s nekrotizirajućim fascitisom glave i vrata, s razvojem descendentnog nekrotizirajućeg medijastinitisa. Infekcija je nastala putem razderotine vlasišta zadobivene u prometnoj nesreći. Tri dana nakon primarnog zbrinjavanja rane u Objedinjenom hitnom bolničkom prijamu, bolesnik je postao septičan sa znacima flegmone glave i vrata. Podvrgnut je hitnom

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debridmanu nekrotičnih areala i transcervikalnoj drenaži gornjeg medijastinuma. Za vrijeme boravka u Jedinici intenzivnog liječenja bio je ovisan o respiratoru, uz vazoaktivnu potporu i empirijsku antibiotsku terapiju širokoga spektra. Lijevostrani pleuralni izljev i CT znakovi širenja infekcije u donji medijastinum, bili su indikacija za daljnju kiruršku intervenciju. Video-asistirani torakoskopski kirurški pristup korišten je za drenažu i debridman inficiranog medijastinalnog i pleuralnog prostora, što je dovelo do postupne stabilizacije bolesnika koji je naposljetku premješten na kirurški odjel. Mikrobiološkom analizom obriska rane izoliran je Clostridium perfringens kao uzročnik infekcije. Daljnji oporavak je bio bez komplikacija i bolesnik je otpušten 24. dan od prijama.

Zaključak: Posttraumatska klostridijska plinska gangrena glave i vrata, fulminantna je i potencijalno fatalna infekcija. Zahtijeva žurnu laboratorijsku i radiološku obradu. Liječenje zahtijeva multidisciplinarni pristup. Opseg kirurškoga zahvata treba pažljivo odmjeriti i prilagoditi pojedinom bolesniku. Video-asistirana torakoskopska kirurška tehnika pruža pouzdan i pogodan pristup svim medijastinalnim prostorima, uz minimalnu invazivnost, izvrsnu vidljivost i podjednaku učinkovitost.

Ključne riječi: nekrotizirajući fascitis, medijastinitis, Clostridium perfringens, plinska gangrena, video-asistirana torakoskopska kirurgija

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Introduction

Necrotizing fasciitis (NF) is a progressive infection of the fascial tissue with secondary spread to the underlying soft tissue. It spreads rapidly, and tissue loss is extensive and systemic toxemia striking. Blood supply to the affected areas is distribubed leading to ischemia and necrosis. It can occur in any part of the body. The most common sites are the extremities, abdominal wall and perineum. The head and neck are affected in less than 5%.[1-3] Regarding the causative agent, NF is divided into several types:

Type I is the most common, with polymicrobial etiology, caused by both aerobic and anaerobic species.

Type II is the monomicrobial, most commonly caused by group A beta hemolytic streptococcus, rarely Staphylococcus aureus.

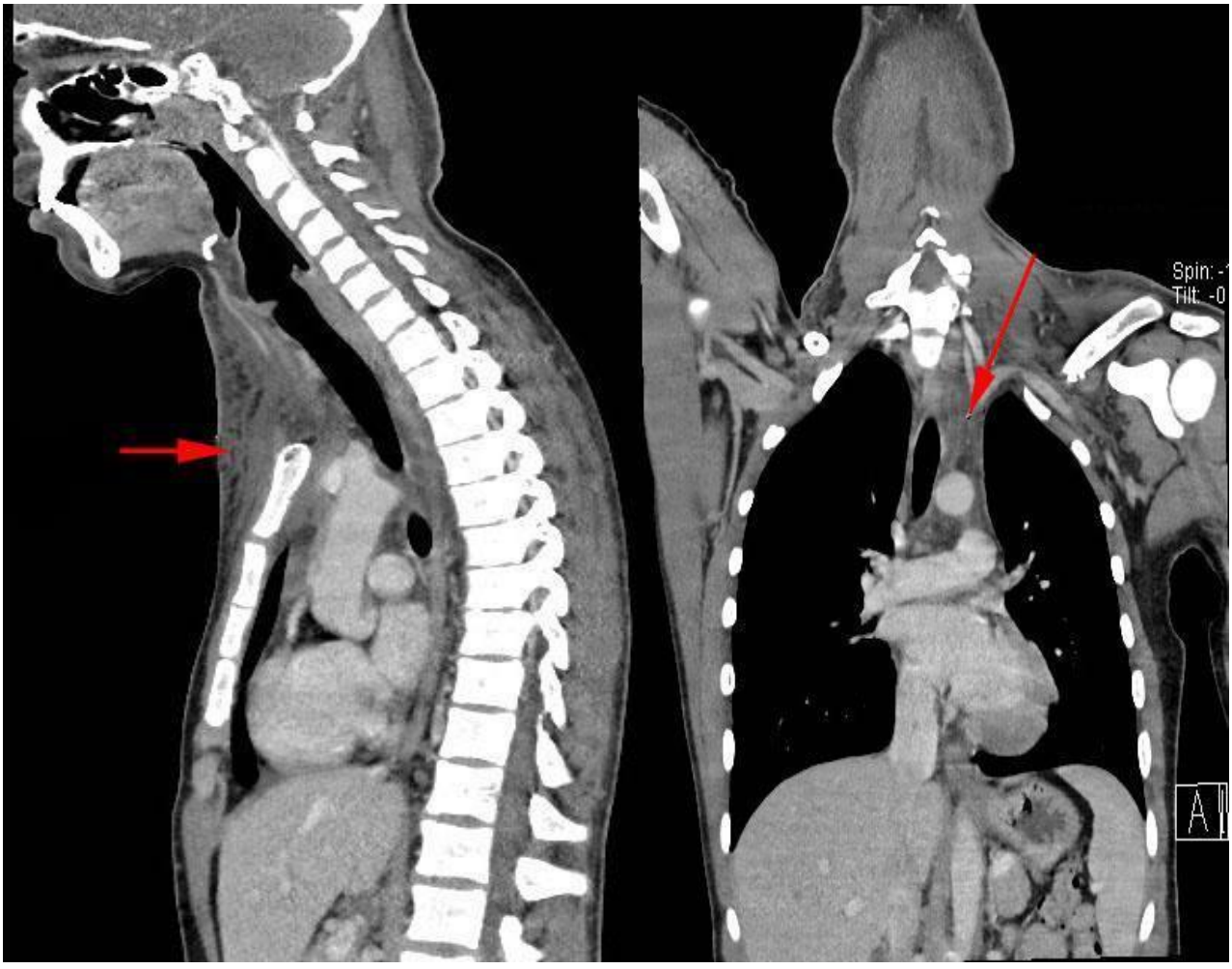
Type III and IV are caused by fish and amphibian pathogens (Vibrio species, Aeromonas hydrophila) and fungi respectively being extremely rare.[4,5]

NF with the formation of gas collections within the affected tissue is a distinct illness historically known as gas gangrene. There are two main subtypes; gas gangrene caused by clostridia species and non-clostridial gas gangrene. Clostridial gas gangrene has a grimmer clinical course than the non-clostridial entity.[6] Clostridium is a genus of anaerobic Gram-positive bacteria widely inhabiting soils and the intestinal tract of animals, including human large bowel and healthy lower reproductive tract of females. Clostridium becomes a pathogen in anaerobic environment typically in extensive, deep, soiled wounds and in crush injuries.[5-7] Clinical signs of the clostridial infection develop when bacteria toxins and enzymes start to damage the tissue. Initially manifesting as cellulitis, it rapidly progresses deeper in a form of miozitis and finally mionecrosis.[7-9] It is an extremely dangerous type of infection readily leading into toxemia, multiorgan dysfunction and death. When the infection starts in the head or neck, it spreads rapidly in the fascial planes descending into the loose mediastinal tissue aided with gravity and negative intrathoracic inspiratory pressure which makes a distinct clinical entity named descending necrotizing mediastinitis (DNM).[10-12] Patients with DNM are at risk of septic shock with a doubling mortality rate compared to isolated NF of the neck.[1,7,13] Pearse described descending necrotizing mediastinitis in 1938, most commonly having dental/odontogenic or oropharyngeal origin.[14] The condition is not rare as generally considered. Sarna and colleagues reported mediastinal descent from the necrotizing infections of the neck in 40-45% of cases.[10] Despite improved medical therapy, the mortality is still high, with case series published in the last 3 years having mortality rates ranging from 18-33%.[15,16] Herein we present a rare case of posttraumatic clostridial gas gangrene affecting the head and neck with DNM successfully treated by a minimally invasive surgical approach.

Case report

A healthy 22-years old male was brought to our hospital's ER because of injuries sustained in a motor vehicle accident. At arrival he was alert, hemo-dynamically stable, apparently intoxicated with a large scalp laceration and clinically evident left clavicle fracture. Cranial and cervical CT showed no signs of injuries to the brain or spine. The wound was dirty, soiled with dirt and grass particles. It was appropriately debrided, copiously irrigated and loosely sutured. Since his clavicle fracture needed surgery, he was admitted to the surgical ward where the next day subcutaneous emphysema of the scalp was noticed. The wound was explored in general anaesthesia,

wound murky secretion was sampled for microbiology and intravenous antibiotic therapy with co-amoxy clavulanic acid and clindamycin was started. During the next 48 hours, the patient became febrile, tachypneic, tachycardic, hypotensive and oliguric. Further swelling, redness and tenderness of the scalp, face and neck were noticed. Laboratory tests showed an increase in the leukocyte count (13.4 to 19.1x10^9/L), C-reactive protein level (from 135 to 159 mg/L) and creatinine level (from 65 to 152 μmol/L). Erythrocyte count, platelets count, haemoglobin concentration and haematocrit were lowered as follows (2.5x10^{12}/L, 110x10^9/L, 9.1 g/L, 27%). The patient was sent for a CT scan of the head, neck and thorax which revealed gas collections with tissue edema along deep and superficial facial and neck compartments. Mediastinum was widened but without gas or liquid collections (Picture 1). The patient was taken for urgent surgery in general anaesthesia. Three separate incisions around the wound through the scalp in bitemporal and occipital directions were made. Extensive necrosis of galeal fascia and periost from the frontal muscle to the occipital region was found. Also superficial and deep temporal muscle fascia was necrotic as well as the subcutaneous fatty tissue. The temporal muscle itself had areas of necrosis. After extensive debridement, several broad drains were placed along the incisions. Superficial and deep neck fascial spaces were incised and debrided. The infrahyoid muscles were only minorly affected with necrotic process. Anterior and posterior mediastinum was drained through cervical incisions (Picture 2).

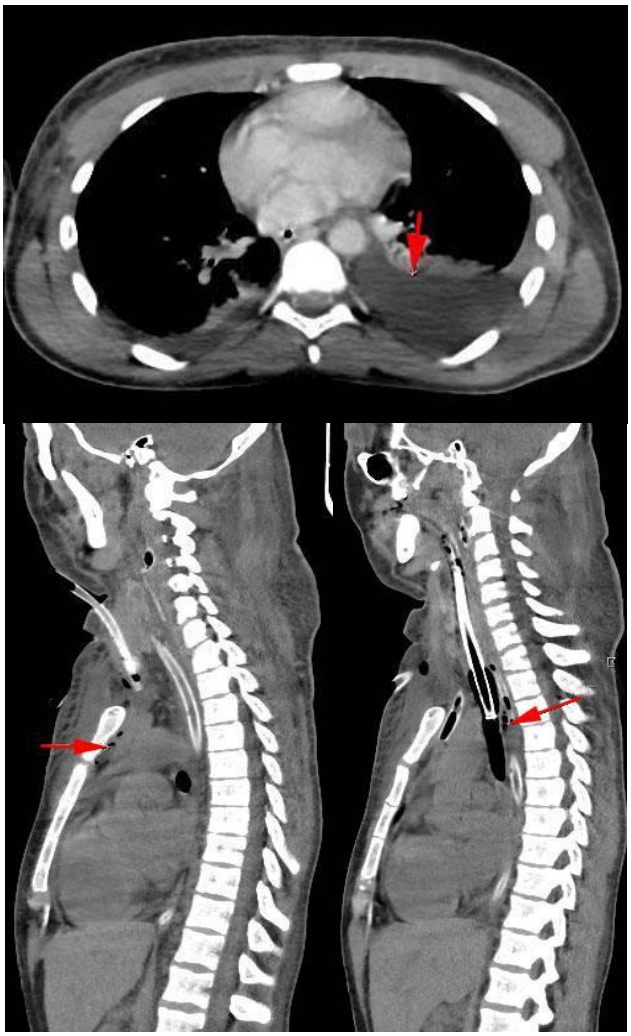


Picture 1 Head, neck and chest CT: (a) tissue edema along deep and superficial facial and neck compartments, (b) widened mediastinum with fat tissue stranding (red arrows).

Slika 1. CT glave, vrata i prsnog koša: (a) edem tkiva duž dubokih i površnih odjeljaka lica i vrata, (b) prošireni medijastinum s nitima masnog tkiva (crvene strelice).

Picture 2 Surgical wound after neck incision and transcervical upper mediastinal drainage
Slika 2. Kirurška rana nakon reza vrata i transcervikalne drenaže gornjeg medijastinuma

Postoperatively, the patient required mechanical ventilation and hemodynamic support in the Intensive care unit (ICU). The wounds were regularly dressed and drains irrigated. The microbiology report was available at the time identifying *Clostridium perfringens* needing a switch to targeted antibiotic therapy (vancomycin, meropenem and clindamycin). Despite intensive care treatment, the patient's condition did not improve. Skin redness and subcutaneous emphysema crepitations were noticed in both the pectoral and axillary regions. A follow-up CT scan 24 hours after surgery revealed increasing pleural effusion on the left side with air bubbles in lower mediastinum (Picture 3)



Picture 3 Follow-up chest CT: (a) left sided pleural effusion, (b) air in anterior mediastinum, (c) air in posterior mediastinum (red arrows)
Slika 3. Kontrolni CT prsnog koša: (a) lijevostrani pleuralni izljev, (b) zrak u prednjem medijastinumu, (c) zrak u stražnjem medijastinumu (crvene strelice)

The bilateral temporal regions and neck contained air bubbles despite incisions and drains (Picture 4). The above described signs of descending mediastinitis urged for a step-up surgical procedure. To secure the airway, surgical tracheostomy was created. Temporal regions and cervical incisions were re-explored and drained, and several incisions were placed along the bilateral pectoral and axillary regions. We proceeded with video-assisted thoracoscopic surgery (VATS) through the left sided uniportal approach which served well to evacuate the pleural effusion, incise and debride mediastinal necrotic tissue and leave a thoracic drain. A day after the surgery, the patient stabilized hemodynamically, his renal function improved and laboratory inflammation parameters decreased. Over the next several days, he was weaned off the ventilator which allowed his transfer to the surgical department on postoperative day 7. Further treatment goals (regular wounds dressing, hyperalimentation and ambulatory independence) were achieved. His clavicle fracture healed spontaneously in a good position obviating the need for orthopedic surgery. The patient was discharged 24 days after the initial injury.

Picture 4 Follow-up CT: (a, b, c) progression of air collections in the neck despite initial incisions (red arrows).
Slika 4. Kontrolni CT: (a, b, c) napredovanje sakupljanja zraka na vratu unatoč početnim urezima (crvene strelice).

Discussion

Isolation of Clostridia from the tissue and gas collections seen on CT scans confirmed the diagnosis of clostridial gas gangrene and DNM. Typical CT signs of mediastinal infection are unenveloped fluid collections and soft-tissue gas infiltration. The widening of the mediastinal space is the most constant yet nonspecific early sign. The principles of diagnostic and management of NF/DNM are the same regardless of the underlying bacteria.[17-20] The Laboratory Risk Indicator for Necrotizing Fasciitis is a scoring system of blood test findings devised by Wong and colleagues in 2004.[21] Our patient had a confirmatory score of > 6. Treatment of NF should start immediately on the grounds of clinical suspicion coupled by CT findings.

Surgical intervention should be prompt and aggressive. It is necessary to remove all of the dead and devitalized tissue with drains left in the wound pockets and tunnels allowing intermittent or continuous irrigation. Cervical surgical intervention has standardized indications unlike mediastinal drainage which is still controversial.[22] We performed initial mediastinal drainage trans-cervically but it was insufficient to halt the descent of the infection to the lower mediastinum which was eventually reached by VATS. The first successful VATS treatment of DNM was reported by Isowa and colleagues in 2004.[23] VATS has a variety of uses in thoracic surgery having several important advantages compared to open thoracotomy. Besides being minimally invasive, it provides an excellent visualisation of the pleural cavity which is crucial for efficient mediastinal debridement and prevention of iatrogenic injuries. Cho and colleagues presented a series of 17 patients with DNM treated minimally invasively with efficiency that was comparable to a more extensive surgical approach.[24] Our study contributes to the body of evidence opposing concerns on the efficacy of VATS to achieve ideal drainage and irrigation in severe cases. The role of tracheostomy in the treatment of DNM is also debatable. Some authors avoid tracheostomy to prevent infection spreading while others praise its importance. Scheduled tracheostomy prevents compromising the airway and avoids a lot of trouble when performed emergently.[16,18,25] Medical treatment includes maintaining an optimal nutritional status, targeted antibiotic therapy and early physical rehabilitation. Hyperbaric oxygen therapy is a useful adjunct in any anaerobic infection.[13,26] We did not use it in our case because once surgical therapy was addressed properly, recovery was swift and uneventful.

Posttraumatic clostridial gas gangrene of the head and neck is a fulminant and life-threatening infection. It requires urgent clinical and radiological assessment, prompt surgical intervention and adequate antibiotic therapy. In cases of mediastinal involvement, tailored surgical drainage is indicated depending on the patient's clinical condition, the extent of mediastinitis, and local expertise in minimally invasive surgery. The best results are obtained with a multidisciplinary approach. VATS is a safe and appealing access to the middle and lower mediastinum. It offers far less invasiveness, superior visibility and equal efficiency in terms of mediastinal and pleural debridement and drainage.

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