



## Diagnosis of Gas Gangrene: Does a Discrepancy Exist between the Published Data and Practice

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### ABSTRACT

The Infectious Disease Society of America has defined gas gangrene as an infection caused by *Clostridium* species. However, in many clinical settings, soft tissue infections that produce subcutaneous gas have been diagnosed as *gas gangrene* without identification of the presence of *Clostridium* species. Instead, the diagnosis was based on clinical and radiographic findings. A chart review was performed of 25 consecutive patients treated at the Atlantic Health System for infections of the lower extremity that were diagnosed as gas gangrene. Wound cultures from the 25 patients grew 31 different species of bacteria. The most prevalent organism was *Staphylococcus aureus*, which accounted for 17 of 31 (54.84%) different organisms identified and 19.77% of 86 separate aerobic or anaerobic cultures. The most prevalent genus was *Streptococcus*, which accounted for 20 (64.52%) of the organisms identified and 23.26% of the cultures. The most prevalent anaerobic genus was *Peptostreptococcus*, which accounted for 8 (25.81%) of the organisms identified and 9.3% of the cultures. None of the cultures grew *Clostridium* species. These findings showed that gas-forming soft tissue infections of the lower extremity, commonly diagnosed as gas gangrene, are rarely caused by *Clostridium* species.

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The Infectious Disease Society of America practice guidelines for skin and soft tissue infections have defined *gas gangrene* as “a rapidly progressive infection caused by *Clostridium*” (1). Although the published data differentiate between gas gangrene owing to *Clostridium* and gas-forming soft tissue infections of nonclostridial origin, in practice, many physicians have used the diagnosis *gas gangrene* for any gas-forming soft tissue infection. Early reports have identified *Clostridium perfringens* as the primary offending organism in gas gangrene (2,3). Chiari (4), in 1893, was the first to describe a non-clostridial aerogenic infection when he described a diabetic patient who presented with a gas-producing infection caused by a colonic gram-negative rod. In 1941, Gillies (5) reported a case series in which 4 diabetic patients, including 1 with a foot infection, presented with infectious formation of gas in the soft tissues caused by gram-negative bacilli. In 1971, Altmeier and Fullen (6) reported the need to distinguish between gas gangrene and other gas-producing bacterial infections. They described *true gas gangrene* as clostridial myositis, which was characterized by its aggressively invasive course. In their

experience, nonclostridial aerogenic infections were much more common than clostridial infections. In 1973, Weinstein and Barza (7) asserted that the diagnosis of clostridial gas gangrene could not be made according to the presence of soft tissue emphysema alone because nonclostridial organisms could produce air in the subcutaneous tissues. Nichols and Smith (8) reported a case series of crepitant soft tissue infections and cultured a variety of organisms, including *Peptostreptococcus*, *Escherichia coli*, *Bacteroides*, *Staphylococcus epidermidis*, *Streptococcus*, diphtheroids, and *Clostridium*. In 1975, Bessman and Wagner (9) described 48 cases of nonclostridial diabetic foot infections with radiographic evidence of subcutaneous gas.

Currently, a general consensus does not seem to have been reached among many surgeons regarding the precise terminology for the diagnosis of nonclostridial gas-forming soft tissue infections, and the term *gas gangrene* seems to be commonly used whenever the clinical and radiographic findings indicate the presence of gas in the subcutaneous tissues. Although the Infectious Disease Society of America has clearly defined gas gangrene as being caused by *Clostridium* species, it has also recognized that nonclostridial organisms can produce aerogenic infections, which they have designated as nonclostridial myonecrosis. Hart et al (10) referred to this type of infection as gas-forming fasciitis, because necrotizing fasciitis is localized to the deep fascia and also to the superficial fascia and subcutaneous fat and is known to produce gas in many cases. In 2003,

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Fig. 1. Clinical photograph of patient diagnosed with gas gangrene.



Fig. 2. Clinical photograph of the same patient diagnosed with gas gangrene in Fig. 1 24 hours later.

Finkelstein et al (11) acknowledged that in practice the term *gas gangrene* has been commonly used to describe any aerogenic soft tissue infection. At our institution, a lower extremity infection with tissue necrosis and clinical and radiographic evidence of subcutaneous emphysema will be given the diagnosis of gas gangrene without consideration given to the specific bacterial culture results. In an effort to determine whether the presence of *Clostridium* species was identified in any of the wound cultures, we reviewed a series of patients diagnosed with gas gangrene at our institution. Because it is generally known that nonclostridial gas-forming infections are commonly responsible for diabetic foot infections, we were also interested in determining the incidence of diabetes mellitus in the cohort of patients we reviewed.

#### Patients and Methods

A medical record review was performed of consecutive patients who presented to the podiatric surgery service of the Atlantic Health System during the 21-month period extending from January 1, 2009 to October 1, 2010, with a lower extremity soft tissue infection diagnosed as gas gangrene. The podiatric surgery service keeps a chronological record of patients, and one author (M.P.B.) used the descriptive diagnosis of gas gangrene to search the database. To be included, potentially eligible cases had to have documentation of clinical findings of lower extremity soft tissue necrosis (Figs. 1 and 2), including crepitus, corresponding radiographic findings of subcutaneous emphysema (Figs. 3 and 4), and wound culture results, all of which were recorded. All corresponding aerobic and anaerobic culture results were recorded, including any preoperative, intraoperative, and postoperative cultures. In addition to these variables, whether the patient had a history of diabetes mellitus was also recorded. Patients were excluded if they did not have subcutaneous emphysema confirmed on the radiographs, if they did not follow-up with our service, and if they did not have both aerobic and anaerobic cultures performed. The corresponding author (M.P.B.) reviewed the

radiographs for subcutaneous emphysema independent of the radiology report, then confirmed that all of the authors concurred with this at the time of presentation. All of the authors concurred because we do not diagnose gas gangrene without the corresponding signs on the radiographs.



Fig. 3. Dorsoplantar radiograph demonstrating soft tissue emphysema medially and laterally.

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