



Case report

***Streptococcus gordonii* empyema: A case report and literature review**Jin-Hao Xu^{a,*}, Chia-Yu Chiu^{b,c}, Yen-Cheng Yeh^a, Jen-Chih Chen^d^a Department of Internal Medicine, Kaohsiung Armed Forces General Hospital, Kaohsiung, Taiwan^b Department of Infectious Diseases, The University of Texas Health Science Center at Houston, Houston, TX, USA^c Department of Infectious Diseases, Infection Control and Employee Health, The University of Texas MD Anderson Cancer Center, Houston, TX, USA^d Department of Surgery, Kaohsiung Armed Forces General Hospital, Kaohsiung, Taiwan

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ABSTRACT

Empyema is often caused by *Streptococcus anginosus* species, followed by *Streptococcus pneumoniae*. The organism *Streptococcus gordonii* belongs to the *Streptococcus mitis* group, which rarely causes empyema. We report the case of a 59-year-old man who presented with exertional dyspnea and chest pain on the right side. The image obtained showed effusion on the right side. *Streptococcus gordonii* was recovered from purulent pleural effusion culture. The patient underwent video-assisted thoracoscopic surgery with decortication, pneumolysis and received antibiotics for 13 days.

A total of seven cases were analyzed after combining six cases in the literature and our presented case. The majority of *Streptococcus gordonii* empyema patients were male (six patients, 86%) and empyema on the right side (five patients, 71%). Common risk factors included poor dental hygiene or recent dental procedure (three patients, 43%), diabetes mellitus (three patients, 43%), and smoking (three patients, 43%). Only a few cases developed empyema-related complications, including bacteremia (one patient, 14%) and spleen abscesses (one patient, 14%). Most patients underwent chest tube insertion (seven patients, 100%) and survived without recurrent empyema (six patients, 86%).

Introduction

Streptococcus gordonii is a commensal, unencapsulated, Gram-positive coccus commonly found in the skin, oral cavity, upper respiratory tract, and intestines. In the human body, *streptococcus gordonii* colonizes mucosal surfaces through biofilm formation, but it can also be found in the environment, such as in water, soil, and plants [1]. Sometimes, it can be an opportunistic pathogen, causing local disease (periodontitis or septic arthritis) or systemic infection (bacteremia, infective endocarditis, or abscesses) [1]. Traditionally, streptococci are divided into three groups (alpha hemolysis, beta hemolysis, and gamma hemolysis) based on the hemolysis patterns on blood agar plates. *Streptococcus gordonii* belongs to the alpha hemolysis group and is part of the viridans group streptococci. Nevertheless, streptococci are a heterogeneous group of bacteria with more than 50 species and classification has changed over time. Recently, streptococci were reclassified into eight groups based on a phylogenetic approach. *Streptococcus gordonii* currently belongs to the *Streptococcus mitis* group [2].

Common bacterial pathogens of community-acquired pneumonia

(CAP) are *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis*, and *Staphylococcus aureus* [3,4]. Despite the fact that empyema is a complication of pneumonia, the proportion of bacterial pathogens recovered from empyema is not the same as that of CAP. Common pathogens of empyema are streptococcal species (50%; the most common is *Streptococcus anginosus* group, followed by *Streptococcus pneumoniae*), anaerobic bacteria (20%), and *Staphylococcus aureus* (14%) [3]. Of note, about 30–50% of CAP and empyema samples are culture-negative [3,5].

Herein, we report a case of empyema caused by *Streptococcus gordonii*, an organism that belongs to the *Streptococcus mitis* group, which rarely causes empyema. We also summarized the current literature on *Streptococcus gordonii* empyema.

Case report

A 59-year-old male with a history of hypertension and uncontrolled type 2 diabetes mellitus (hemoglobin A1c: 13.7%) presented to our emergency department with several days of fatigue, productive cough,

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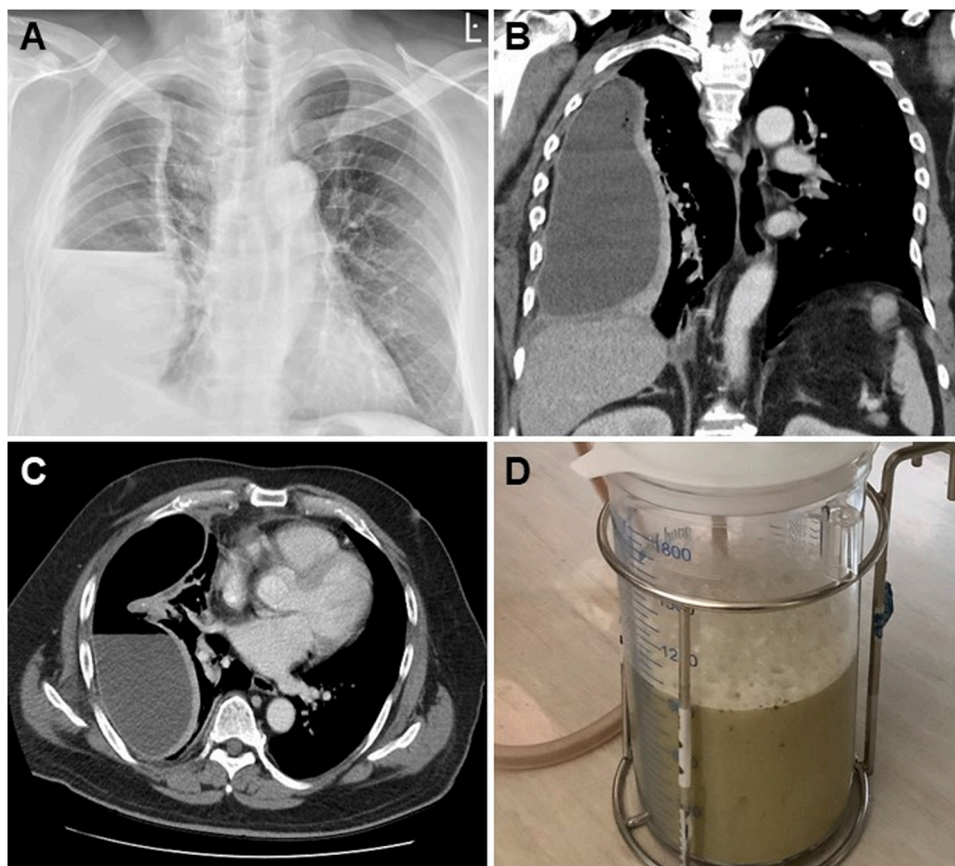


Fig. 1. A Chest x-ray showed right side empyema. B, C: Computed tomography scans showed massive loculated effusion with an air-fluid level in the field of the right lung. D: Frank pus in the chest tube bottle.

dyspnea on exertion, and right anterior lateral chest pain. The patient denied any trauma or injury over the chest wall. He had a fever of 37.8 C (100 F) on the day of the visit. He denied any recent dental procedure. The oral exam did not show any dental caries or periodontal disease. Chest auscultation revealed crackles with diminished breathing sound over the right side of patient's chest. The initial laboratory testing was notable for leukocytosis (11 K/uL) and a high CRP level (29 mg/dL). The chest X-ray and computed tomography (CT) scans showed massive loculated effusion with an air-fluid level in the field of the right lung (Fig. 1A, B, C). He received piperacillin-tazobactam empirically and was hospitalized in the surgical ward.

Ultrasound-guided thoracentesis with chest pigtail catheter placement (Fig. 1D) was completed after hospitalization. It yielded exudates (lactate dehydrogenase of 11,863 U/L) with 353,620 white blood cells/ul (92% neutrophils), a pH of 6.34, and glucose of 0 mg/dL. The pleural effusion culture grew *Streptococcus gordonii*, which was susceptible to penicillin (minimal inhibitory concentration [MIC] 0.06), vancomycin (MIC 0.5), ceftriaxone (MIC 0.5), clindamycin (MIC 0.25), erythromycin (MIC 0.12), linezolid (MIC 2) and tigecycline (MIC 0.06). The patient's blood cultures were negative. We deescalated his antibiotics to flomoxef. On hospitalization day 4, he underwent video-assisted thoracoscopic surgery (VATS) with decortication and pneumolysis. The antibiotic treatment was switched to amoxicillin-clavulanate on day 8. The chest tube was removed on day 11. The patient was discharged on day 12 without antibiotics. Follow-up occurred at an outpatient clinic at 1 week and 2 weeks after discharge. The follow-up CXR showed the complete remission of empyema.

Discussion

We performed a literature search from the inception record to

November 2022 using PubMed, Embase, Scopus, Cochrane Library, and ClinicalTrials.gov. The search protocol was (*Streptococcus gordonii*) AND (empyema). Published articles and abstracts were considered.

A total of 7 cases were analyzed after combining 6 cases in the literature and our presented case. The majority of *Streptococcus gordonii* empyema patients were male (6 patients, 86%) and empyema on the right side (5 patients, 71%). Common risk factors included poor dental hygiene or recent dental procedure (3 patients, 43%), diabetes mellitus (3 patients, 43%), and smoking (3 patients, 43%). Only a few cases developed empyema-related complications, including bacteremia (1 patient, 14%) and spleen abscesses (1 patient, 14%). Most patients received intervention (7 patients [100%] underwent chest tube insertion; 4 patients [57%] later underwent VATS) and survived without recurrent empyema (6 patients, 86%). The detailed characteristics are summarized in Table 1.

Only about 40–60% of empyema cases are caused by pneumonia. Post-thoracic surgery, thoracic trauma, esophageal perforation and spontaneous pneumothorax are responsible for non-pneumonic empyema [4]. In our review, all of the patients with *Streptococcus gordonii* empyema were found with risk factors for empyema [3,6], including diabetes mellitus, dental procedure or poor dental hygiene, smoking, a recent history of pneumonia, recent thoracentesis (for malignant pleural effusion), and pyogenic spondylitis (located at the thoracic spine). The distinction between empyema secondary to pneumonia and non-pneumonic empyema should be made given the difference in treatment (including empirical antimicrobial therapy and surgical plans) [7].

The species identification of non-beta-hemolytic streptococci has been difficult in the past, but now it can be performed easily, at least at the group level, by matrix-assisted laser desorption/ionization–time of flight mass spectrometry [8]. Current studies have shown that different

Table 1
Characteristics and interventions of patients with *streptococcus gordonii* empyema.

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Author	Xu, et al.	Rajevac, et al.	Farooq, et al.	Nakamura, et al.	Domenech, et al.	Krantz, et al.	Akkad, et al.
Year, Country	2022, Taiwan	2020, USA	2019, USA	2019, Japan	2018, Spain	2017, USA	2016, USA
Age	59	58	75	74	45	65	67
Gender	Male	Male	Male	Male	Female	Male	Male
Comorbidities	HTN, DM	HTN, DM, OSA, depression	Depression	None	Asthma, lung cancer (active)	DM, depression	HTN, prostate cancer (on surveillance)
Other associated risk factors	None	Marijuana use, blunt thoracic trauma by MVA	Tobacco use	Periodontal debridement, pyogenic spondylitis at thoracic spine	Thoracentesis for malignant pleural effusion	Tobacco use, dental caries, dental abscess, left middle lobe pneumonia	Tooth extraction, pneumonia
Image finding	R effusion	R effusion	R effusion	R effusion	R effusion	L effusion	L effusion
Intervention, Date	Chest tube insertion followed by VATS	Chest tube insertion followed by VATS	Chest tube insertion followed by VATS	Chest tube insertion followed by VATS	Chest tube insertion	Chest tube insertion	Chest tube insertion
Pleural fluid finding	WBC: 353,620 /ul (N 92%) Protein: 2.4 g/dL LDH: 11,863 U/L Glucose: 0 mg/dL pH: 6.34	N/A	WBC: 34,300	WBC: 12,320	Exudate, neutrophil dominant, glucose: 7 mg/dL	WBC: 4329 (N 79%)	Exudate
Complication	No	No	No	Bacteremia	No	Mechanical ventilation, spleen abscess	Single cavitory lung lesion (biopsy-proven <i>Actinomyces</i> spp.)
Antibiotic regimen (duration)	Piperacillin-tazobactam (1 day) → Flomoxef (7 days) → amoxicillin-clavulanate (5 days)	IV antibiotic (14 days)	Ampicillin-sulbactam (N/A)	Meropenem plus clindamycin (2 wks) → ceftriaxone plus clindamycin (4 wks) → minocycline plus clindamycin (4 wks) → cefcapene (9 wks)	Piperacillin-tazobactam (15 days) → amoxicillin-clavulanate (N/A)	Levofloxacin (1 wk) → IV penicillin (6 wks) → amoxicillin-clavulanate (10 mos)	Levofloxacin (2 wks) → unknown antibiotics (N/A)
Outcome	Survived	Survived	N/A	Survived	Survived	Survived	Survived
Reference	Our case	[10]	[11]	[12]	[13]	[14]	[15]

Abbreviation: DM, diabetes mellitus; HTN, hypertension; IV, intravenous; L, left; N, Neutrophil; LDH, lactate dehydrogenase; mo, month; MVA, motor vehicle accident; N/A, not available; OSA, obstructive sleep apnea; R, right; USA, the United States of America; VATS, video-assisted thoracoscopic surgery; WBC, white blood cell; wk, week.

streptococci species have different risks levels of developing endocarditis in patients with streptococcal bloodstream infections [2,8]. It highlights that different streptococcal species do not microbiologically or clinically behave the same way. All *Streptococcus* species can potentially cause pulmonary infection, but maybe certain species are prone to progression to empyema. By identifying species of streptococci, clinicians can gain better insight into disease pathogenesis, which can affect further workup and patient outcome.

Flomoxef is an oxacephem β-lactam with broad activity against Gram-negative and Gram-positive bacteria (including anaerobes, but not pseudomonads) [9], that is widely used in Asia. In our case, we used 1 day of piperacillin-tazobactam followed by 7 days of flomoxef for broad-spectrum antimicrobial treatment with prompt surgical intervention for source control. Later, we changed antibiotic to 5 days of oral amoxicillin-clavulanate. Although only *Streptococcus gordonii* was isolated from empyema culture, we erred on the side of caution and treated him with amoxicillin-clavulanate which had anaerobic coverage. Compared to existing patients with *Streptococcus gordonii* empyema, our case had the shortest duration of antibiotic use. Shortening the duration of antimicrobial therapy is reasonable for empyema if it achieves adequate source control without other signs of disseminated streptococcal infection (bacteremia, endocarditis, or abscesses).

This is the first narrative review summarizing *Streptococcus gordonii* empyema. We found that most cases could identify risk factors and achieve amicable outcomes by source control. More studies are needed to rethink whether the characteristics and outcomes are different in

empyema caused by different streptococcal species.

Ethical approval

Ethical approval was obtained from ethics committees of the hospital.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

CRedit authorship contribution statement

Jin-Hao Xu: Conceptualization, Data curation, Formal analyses, Methodology, and Manuscript drafting. **Chia-Yu Chiu:** Conceptualization, Data curation, Formal analyses, Methodology, and Manuscript drafting. All the authors were responsible for editing the manuscript. All the authors critically revised and approved the final version of the manuscript.

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Conflict-of-interest disclosure

All authors report no conflicts of interest.

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