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Supraglottitis secondary to *Haemophilus influenzae* serotype f infection: Case report and review of literature

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ABSTRACT

Introduction: *Haemophilus influenzae* is an important human pathogen capable of causing serious invasive disease. The *H. influenzae* serotype b (Hib) conjugate vaccine successfully reduced the incidence of invasive Hib disease globally, revealing the significance of other *H. influenzae* serotypes. The emergence of *H. influenzae* type f (Hif) invasive disease has been reported worldwide.

Case report: We identified a case of supraglottitis secondary to Hif in a 57-year-old female from northwestern Ontario without significant predisposing conditions. We describe the clinical presentation, disease progression, and outcome. The case is discussed in the context of current epidemiology of invasive Hif disease.

Conclusion: This report emphasizes the severity of Hif invasive disease and the need for continued surveillance at the international level. We call for the development of health promotion strategies and the consideration of a vaccine against this organism.

Keywords: *Haemophilus influenzae*; *Haemophilus influenzae* type f; invasive disease; epiglottitis; supraglottitis

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INTRODUCTION

Haemophilus influenzae is a Gram-negative bacterium capable of causing serious invasive disease, including meningitis, septicemia, and epiglottitis [1, 2]. *H. influenzae* asymptomatically colonizes the nasopharynx of healthy individuals [1, 2]. *H. influenzae* serotypes a through f contain polysaccharide capsules, distinguished by differences in their carbohydrate structure and antigenicity; non-encapsulated strains are termed non-typeable [3]. The polysaccharide capsule protects the organism against complement deposition and phagocytosis within the human host [1, 2]. It follows that encapsulated strains are more virulent than non-typeable strains [1]. *H. influenzae* type b (Hib) is the most virulent strain and was a major cause of invasive disease worldwide prior to the development of

the Hib conjugate vaccine [4, 5]. The rates of Hib invasive disease were greatly reduced in Canada following the introduction of this vaccine: 3 cases per 100,000 people in 1988 to 0.03 cases per 100,000 people in 2016 [6, 7].

Canadian rates of non-b *H. influenzae* invasive disease steadily rose from 0.83 to 1.78 cases per 100,000 people in 2007 and 2016, respectively [7]. In the post-Hib vaccine era, *H. influenzae* type f (Hif) became the leading encapsulated strain to cause invasive *H. influenzae* disease in Ontario [8]. Indeed, Hif invasive disease increased from 0.13 to 0.18 cases per 100,000 people between 2004 and 2013 in the province [9]. This increase was particularly remarkable for those aged 40-64 years, rising from 0.05 to 0.21 cases per 100,000 people [9].

Table 1. Cases of invasive *H. influenzae* type f disease causing epiglottitis/supraglottitis in adults

Location	Age (years)	Sex	Clinical presentation	Disease outcome	Underlying conditions	Reference
Northwestern Ontario, CA	45	F	Epiglottitis	Survived	None	[28]
Oklahoma, US	52	M	Epiglottitis with bacteremia	Survived	Cigarette smoker	[26]
Denmark	56	F	Supraglottitis	Survived	None	[27]
Northwestern Ontario, CA	60	M	Epiglottitis	Survived	Multiple myeloma, past history of autologous peripheral blood stem cell transplant (1 year earlier), prostate hypertrophy, chronic pain	[28]

Incidence of Hif invasive disease has been extensively documented globally [10–13]. Epidemiology studies have demonstrated an increasing burden of Hif invasive disease in several countries, including those of North and South America and Europe [8, 9, 11, 14, 15]. Many case reports have been published detailing the severity of Hif invasive disease (Table 1 and supplementary Table 1).

Our ongoing study of invasive *H. influenzae* disease incidence in Thunder Bay, Ontario has uncovered a case of supraglottitis secondary to Hif infection.

CASE REPORT

A 57-year-old female presented to the Thunder Bay Regional Health Sciences Centre (TBRHSC) via emergency services with cough, dyspnea, and odynophagia. Her dyspnea and odynophagia became markedly worse over the past couple of days, noting dysphagia upon drinking water as well as tenderness in her left submandibular region. Pain in the posterior portion of her larynx began that day. She was febrile, tachycardic, tachypneic, and hypertensive. She also had thick right-sided

crackles. Her past medical history was significant for hypertension and previous cigarette smoking. She also remarked on a change in her voice throughout the last month. She denied any exposure to toxins or poisons and had no history of recent neck trauma. Her triage vitals were as follows: blood pressure 159/91; heart rate 133 min⁻¹; respiratory rate 36 min⁻¹; temperature 39 °C; and oxygen saturation 94% on room air. She was prescribed levofloxacin (750 mg orally) and prednisone (50 mg orally).

Approximately nine hours later, the patient relayed that she had some symptom improvement since treatment in the emergency department. She was mildly stridorous and hoarse, with a muffled voice and a sore throat. She appeared to have upper airway congestion, and preferred sitting in an upright position with her head forward; deviation from this position lead to the feeling of choking. Her vitals at this time were as follows: heart rate 112 min⁻¹; respiratory rate 16 min⁻¹; and oxygen saturation 99% on oxygen therapy. On head and neck examination, she had no lymphadenopathy or enlargement of her thyroid gland. Her oropharynx appeared normal. Tenderness of her left submandibular region remained. The epiglottis was not visualized. Examination of her chest revealed wheezing on inspiration and expiration, along with rales and rhonchi. She had a normal heart rhythm with no extra sounds or murmurs. The abdominal exam was unremarkable, and she had no tenderness or edema in her extremities. The patient had a white blood cell count of 26.9 x 10⁹ L⁻¹ (95% neutrophils, 1% lymphocytes, and 4% monocytes) with a marked left shift. A neck radiograph showed mild swelling in the supraglottic region.

A few hours later, the patient choked while sipping water, causing a drop in her oxygen saturation level. Ultimately, it was decided that a definitive airway must be obtained due to rapid deceleration of the patient. She was diagnosed with epiglottitis and prescribed piperacillin-

tazobactam (3.375 g IV) and clindamycin (900 mg IV).

The ENT surgeon was consulted for precautionary measures during intubation by the anesthetist (in the case of requiring tracheotomy). The patient had a temperature of 37.2 °C, blood pressure of 125/65, and an oxygen saturation of 95% on oxygen therapy. The surgeon did not appreciate any hyperpigmentation or masses in her oral cavity. There was tenderness on movement of the larynx, but no evidence of swelling, masses, or lymphadenopathy. The ENT surgeon's overall impression was supraglottitis. The patient was transferred to the operating room, and a size 6.0 microlaryngoscopy tube was inserted. On laryngoscopy, the arytenoid cartilages were swollen, however, the epiglottis did not appear inflamed.

The patient was admitted to the intensive care unit (elapsed time since hospital presentation: about 15 hours) and initiated on pressure support ventilation. Her vital signs were as follows: heart rate 69 min⁻¹ and blood pressure 138/62. She continued to have pain upon palpation of her neck. The patient's dental hygiene was recorded as poor. The rest of her physical examination was unremarkable. A computed tomography (CT) scan of her neck was ordered to rule out the presence of an abscess. CT scan showed extensive generalized soft tissue edema of the hypopharynx, epiglottis, and aryepiglottic folds bilaterally, as well as a small retropharyngeal effusion. There was moderate thickening of the vocal cords and airway. She was prescribed dexamethasone (4 mg) to decrease the inflammation in her larynx. The patient was switched from piperacillin-tazobactam (3.375 g IV) and clindamycin (900 mg IV) to ceftriaxone (1 g IV).

Blood cultures were positive for *Haemophilus influenzae* serotype f (biotype I), sensitive to ampicillin, cefotaxime, cefuroxime, and trimethoprim/sulfa.

The patient remained intubated in the intensive care unit for three days until she had a positive cuff leak test, a procedure to evaluate the risk of post-extubation stridor. Prior to extubation, the patient underwent a repeat CT scan of her neck, which showed mild improvement in glottic edema. The patient was subsequently transferred to the operating room; her vocal cords were visualized via bronchoscope, then she was successfully extubated. She tolerated the procedure well, remaining stable with no signs of dyspnea or stridor.

The patient was discharged home the following day with a diagnosis of Ludwig's angina/epiglottitis secondary to *Haemophilus influenzae* type f infection. Her discharge medications were as follows: (i) ranitidine 150 mg orally twice daily; (ii) cefuroxime 500 mg orally twice daily for 10 days; and (iii) salbutamol 2-4 puffs every four hours as needed. She was to follow-up with the ENT surgeon in two weeks to repeat laryngoscopy and ensure recovery.

DISCUSSION

Supraglottitis is an inflammatory condition of the supraglottic region, which includes the superior half of the ventricle, the false vocal cords, the arytenoids, the aryepiglottic folds, and the epiglottis [16, 17]. While some healthcare practitioners consider the terms 'supraglottitis' and 'epiglottitis' synonymous, there are some epidemiological and clinical differences between these conditions. Supraglottitis more frequently occurs in adults with variable involvement of the epiglottis, while epiglottitis is a more typical presentation in children [18]. Interestingly, with the introduction of the Hib vaccine, the epidemiology of both supraglottitis and epiglottitis has shifted from the paediatric to the adult population [19–22]. Children frequently present acutely with symptoms of stridor, irritability, drooling, and leaning forward in the tripod position [23]. Adults often present with a sore throat, odynophagia, and dysphagia and generally experience a more benign clinical course [23, 24].

In the pre-vaccine era, Hib was the major etiological agent in cases of both child and adult

supraglottitis. While Hib still accounts for cases of supraglottitis, other bacterial pathogens have been implicated in adult cases including group A *Streptococcus*, other *Streptococcus* spp, *Staphylococcus aureus*, non-Hib *H. influenzae* (e.g., serotype f), among others [13, 16, 18, 19, 25–28]. In addition, supraglottitis can originate from fungi, viruses, thermal injury, and trauma [16, 18, 19].

The present case of supraglottitis secondary to Hib infection emphasizes the importance of non-Hib invasive disease in Canada. This case has a number of intriguing aspects, some aligning with the typical presentation of supraglottitis in the present age, and others rather unusual. Supraglottitis/epiglottitis is more common in male rather than female adults, and is more common in the fourth and fifth decades of life [19, 20, 29, 30]. Those with comorbid conditions are at greater risk, notably those with cardiovascular disease (e.g., hypertension); diabetes mellitus; respiratory and infectious disease; gastrointestinal conditions; and substance abuse (especially tobacco) [20]. This patient had a past medical history significant for hypertension and cigarette smoking, both of which may have contributed to her development of supraglottitis.

On discharge, the intensivist suggested a diagnosis of Ludwig's angina, which is a rapidly progressive bilateral cellulitis of the submental, submandibular, and sublingual spaces [31–33]. Like supraglottitis and epiglottitis, Ludwig's angina can cause airway obstruction, but it is unique in its pathogenesis [31–33]. Ludwig's angina causes swelling of the floor of the mouth, as well as inflammation and upward displacement of the tongue [31–33]. Characteristic features of Ludwig's angina include: diffuse submandibular swelling, painful neck swelling, and brawny induration on palpation [32, 33]. The most common etiology is group A *Streptococcus*, and the condition usually has its origins in odontogenic disease [31–33]. Clinical information supporting the diagnosis of Ludwig's angina was limited in this case. This patient had

symptoms suggestive of both Ludwig's angina and supraglottitis: fever, dyspnea, odynophagia, dysphagia, dysphonia, and stridor [16, 19, 23, 32, 34, 35]. However, there was no evidence of bilateral infection of the submandibular region and no clinicians appreciated abnormalities on examination of the oropharynx. There was no neck swelling, rather only pain on palpation. One interesting clinical feature was the presence of poor dental hygiene. Ludwig's angina is associated with dental disease (e.g., tooth infection, abscess), tonsillar and pharyngeal abscesses, mandibular fractures, among other conditions [36]. This patient had a past history of impacted wisdom teeth extraction (in 2012) and intraoral bone grafting of the mandible (in 2015). Although this history reveals long-standing odontogenic issues, the length of time between these procedures and her recent presentation omits causation. To the best of our knowledge, if this patient truly presented with Ludwig's angina, this would represent the first reported case of Ludwig's angina secondary to Hif infection worldwide.

This case is not unique within northwestern Ontario. Over a decade ago, our group described a case of epiglottitis secondary to Hif infection in a 45-year-old female without any predisposing conditions at TBRHSC [28, 37].

H. influenzae is a cause of serious invasive disease, historically due to Hib infection. The introduction of the Hib conjugate vaccine has revealed the importance of other *H. influenzae* strains, notably Hif [10]. Interestingly, Hif appears to show preference for the adult population, especially those with underlying/predisposing conditions, such as tobacco use, chronic obstructive pulmonary disease (COPD), alcohol abuse, diabetes mellitus, malignancy, and others [10]. Hif also has the ability to cause invasive disease in healthy adults with case reports of meningitis, septic arthritis, osteoarthritis and osteomyelitis, cellulitis, pneumonia with bacteremia or pleurisy, and supraglottitis/epiglottitis (supplementary Table 1) [27, 37–42].

CONCLUSION

Hif is an important cause of invasive disease globally and has the ability to cause serious invasive disease, including supraglottitis/epiglottitis, in seemingly healthy adults without predisposing conditions. Clinicians must remain cognizant of Hif as a causative organism in disease historically associated with Hib. This report emphasizes the importance of *H. influenzae* invasive disease surveillance, which will aid in the development of health promotion policies. Considering the widespread distribution of Hif invasive disease cases, a universal vaccine against this organism would be reasonable.

SUPPLEMENTARY MATERIALS

Supplementary table 1: Case reports of invasive disease caused by *H. influenzae* type f.

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