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Case report

A fatal case of empyema thoracis: the price for underestimating odontogenic infections

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ABSTRACT

Most dental infections are often underestimated by both patients and professional health care givers. When poorly managed, odontogenic infections may result in serious morbidity and life-threatening conditions. This article reports a fatal case of empyema thoracis in a 16-year-old male after an odontogenic infection. The challenges of management in our environment are discussed. Furthermore, the importance of understanding the route of spread after odontogenic infections is highlighted.

1. Introduction

Odontogenic infection can result in both local and systemic complications after hematogenous, lymphatic, or direct spread. Although majority of such complications are benign, they sometimes lead to significant morbidity or even death [1]. Intrathoracic complications commonly follow descending neck infection, and the outcome of such infections depends on early diagnosis and aggressive treatment [2]. We report a fatal case of empyema thoracis after a descending odontogenic infection in a young male with no history of underlying systemic disease.

2. Presentation of Case

A 16-year-old male student presented to our hospital with a 15-day history of left facial swelling which was preceded by toothache. The toothache was said to be spontaneous, sharp, disturbing to sleep, and aggravated by chewing/mastication. A few days later, he developed fever, odynophagia, and left facial swelling, which led to his being presented to a traditional healer who made intraoral incisions and applied native medication. However, his condition worsened with additional symptoms of bilateral neck swelling, limitation in mouth opening and neck extension, difficulty in breathing, paroxysmal nocturnal dyspnea, and orthopnea. Ten days into the illness, he developed cough that was initially dry but later became productive of sputum and associated with chest pain which led to his being presented to a primary health center, where he was given supportive treatment with a 5-day course of analgesic and antibiotic, without significant improvement. The patient was subsequently referred to our medical center for further management. He had no known systemic illness, and he is from a low socioeconomic class.

Examination revealed a young man who was dyspneic at rest, febrile to touch, but not pale or jaundiced. Extraoral findings included left facial soft-tissue swelling involving the submandibular space (Figure 1) with tenderness and positive differential warmth. Submandibular lymph nodes were palpable bilaterally and mildly tender. The neck was actively flexed in position, and there was severe pain on attempting to extend the neck. Soft-tissue crepitation was noted around the root of the neck, anterior chest wall, and posterior cervical regions.

On intraoral examination, there was marked trismus, poor oral hygiene, and carious lower left second molar and right first molar. The pharyngeal region could not be examined because of the marked trismus.

Chest findings were a respiratory rate of 40 breaths/min and tracheal deviation to the right. Additional findings were a reduced chest wall expansion, reduced tactile fremitus, percussion note, diminished

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Figure 1. Swelling involving the left submandibular region.

breath sounds, and vocal resonance on the left infraclavicular and infra-axillary regions.

On diagnostic thoracocentesis, 20 mL of frank purulent effluent drained freely (Figure 2). A diagnosis of odontogenic infection complicated by empyema thoracis was made. Lateral oblique view of the jaws revealed the likely source of infection to be the lower left first or second molar (Figure 3).

After confirmatory chest x-ray, the patient underwent chest tube thoracostomy, which yielded about 650 mL of purulent fluid at the point of drainage, and this was submitted to the laboratory for pleural fluid analysis. Lateral view of the neck showed widening of the prevertebral soft-tissue space (Figure 4), whereas a posteroanterior view of the chest showed features consistent with pneumothorax, lung collapse, and pleural effusion on the left (Figure 5). Despite treatment, the patient's condition deteriorated and he died 4 days after admission.

Figure 2. Purulent aspirate on thoracocentesis.

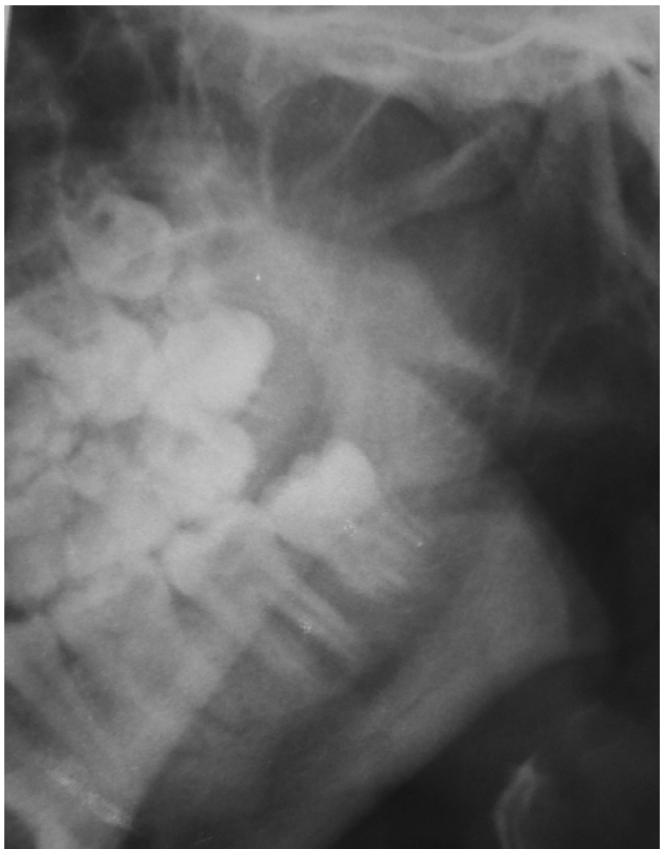

Figure 3. Lateral radiograph of the jaws showing coronal and apical radiolucency (*white arrows*) in relation to the lower left first and second molar.

3. Discussion

Odontogenic infections are as old as man, and clues to its contribution to mortality were revealed in John Graunt's Bills of Mortality in 1662. Teeth were listed as the fifth or sixth leading cause of death. It was associated with a mortality rate of 10%-54% in the preantibiotic era [3,4]. With improved diagnostic techniques, availability of wide range of antibiotics, improved surgical techniques and patient monitoring, the mortality associated with odontogenic infections has significantly reduced [5]. However, life-threatening complications are still encountered. Unfortunately, the medical literature has given little attention to complications associated with odontogenic infections, and most patients and health care givers underestimate its ability to cause morbidity and mortality [5]. In one study, odontogenic infections were responsible for 49.1% of deep neck abscesses [6].

Figure 4. Lateral neck radiograph showing widening of the prevertebral soft-tissue space (*white arrows*).

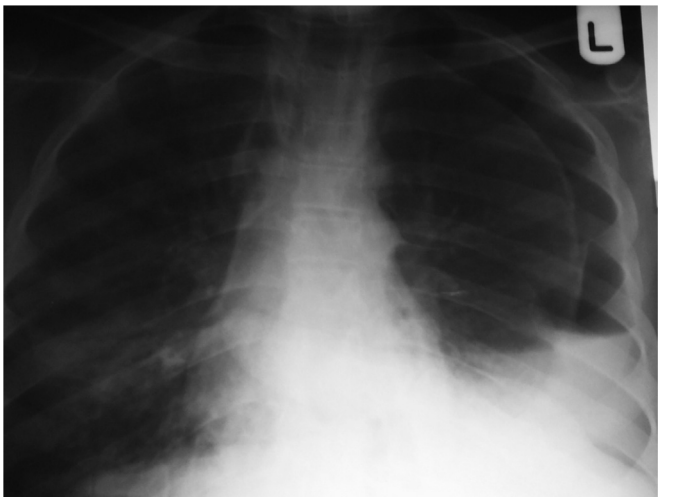

Figure 5. Chest radiograph showing features of effusion (*black arrows*) and pneumothorax with lung collapse (*white arrows*) on the left.

The mouth harbors a large population of microbial organisms, and the predominant floras are anaerobic *Streptococcus*, *Bacteroides*, and *Fusobacterium*. These organisms predominate in mixed infections of odontogenic origin [7]. *Streptococcus viridans* and *Prevotella* species are the most common aerobe and anaerobe isolated respectively [8]. Typical organisms isolated in severe odontogenic infection are *S viridans*, *Prevotella*, *Micromonas micros*, *Actinomyces*, *Staphylococcus*, and *Peptostreptococcus* species [8-10]. However, increased incidence of *Fusobacterium* and *Streptococcus* milleri species has also been noted in these infections [11].

Dental infections may arise from a tooth or its supporting structures. Periapical tooth infection is responsible for most descending neck infections that may result in intrathoracic complications [12]. The spread of odontogenic infections is largely influenced by host factors such as immune status, anatomic factors such as thickness of the lingual and buccal plates of the alveolus, muscle attachments, direction of root apices, and the pathogenicity of the organism which depends on its virulence and the infecting dose. There were no known underlying systemic disease in the patient presented in this case report. Although there were no confirmatory laboratory results, it is likely that the patient was malnourished in view of his low socioeconomic status.

An understanding of fascial planes of the head and neck and the route of spread of infections is vital in the management of descending neck infections of odontogenic origin. When poorly treated, odontogenic infections can result in life-threatening complications such as mediastinitis, empyema thoracis, or pericarditis [13].

The fascial spaces of the head and neck refer to all potential spaces in this region that usually contain loose connective tissues and bounded by bones, muscles, or fascia. They have variously been

classified into primary and secondary fascial spaces based on pattern of involvement from the original focus of infection and suprahyoid (eg, submandibular, masticator, parapharyngeal, and peritonsillar) and infrahyoid (eg, pretracheal, retrovisceral, and visceral) spaces based on their relationship to the hyoid bone [14]. However, the carotid, retropharyngeal, and prevertebral spaces transverse both the suprahyoid and infrahyoid regions. The fascial spaces communicate directly or indirectly with one another, serving as routes by which infection can spread [15].

There are 3 primary routes of spread of odontogenic infections into the neck: the pretracheal space into the anterior mediastinum, viscerovascular space, and the retropharyngeal space into posterior mediastinum. In most cases of odontogenic infection involving the deep neck spaces, the submandibular space is frequently involved [16,17]. Direct spread of odontogenic infections into the submandibular space commonly arises from either the second or third mandibular molar [18-20], or from the sublingual space. Indirect involvement of the submandibular space commonly follows lymphatic spread. Submandibular space infection can extend directly into the parapharyngeal and the anterior visceral spaces. The parapharyngeal space communicates with the other deep spaces of the neck, whereas the anterior visceral space communicates with the superior mediastinum.

Estera has proposed 3 criteria for the diagnosis of mediastinal infection of odontogenic origin [21].

1. Clinical evidence of severe oropharyngeal infection
2. Characteristic radiologic features of mediastinitis (radiograph of chest will generally show gas in the tissues, or fluid levels and mediastinal widening
3. Establishment of the relationship of mediastinal infection and oropharyngeal infection

The first 2 criteria were present in our case report. However, bacteriologic examination of pleural fluid did not yield any organism; hence, comparison with known oral flora could not be made. This may have been due to the fact that the patient had already been on antibiotics for approximately 5 days in a local hospital before presentation. Moreover, the absence of anaerobic culture media in our center, at the time the patient was presented, may have contributed to the negative result.

Plain radiography, ultrasonography, computed tomography (CT), and magnetic resonance imaging techniques are useful in the management of odontogenic infection. They serve to confirm the suspected clinical diagnosis, define the precise extent of the disease, identify complications, distinguish between drainable abscesses and cellulitis, and monitor deep neck space infection progression [22]. Extraoral plain radiographs can be used in localizing the source of dental infection especially in patients with trismus. Other pathologies such as cyst and tumors can also be visualized. Lateral neck radiograph is useful for the assessment of retropharyngeal and prevertebral space involvement. Prevertebral soft tissues of width greater than 5 mm (children) or 7 mm (adults) at C2 and 14 mm (children) or 22 mm (adults) at C6 are suggestive of retropharyngeal space involvement until proven otherwise [23,24]. Plain radiographs are cheap and readily available in most medical centers. However, it has a lower sensitivity (83%) than CT (100%) in diagnosing deep neck fascial space involvement [24]. Ultrasound scan is useful in differentiating cellulitis from abscess and in image-guided aspiration or drainage of abscesses [22]. Contrast-enhanced CT scanning has 100% sensitivity in diagnosing facial and deep neck infections, with typical findings being a low-attenuation area of water-to-soft tissue density surrounded by varying degrees of rim enhancement after contrast administration and massive swelling of muscles with obliteration of the fat spaces between the neighboring muscles, indicating spreading infection [24,25]. It is also useful for assessing intracranial and mediastinal complications and drainage of abscesses under image guidance and for follow-up. Its disadvantages include high cost, high dose of ionizing radiation, difficulty in differentiating abscess from cellulitis, and use of potentially allergic contrast materials [26]. The patient in this case report was assessed using physical examination and plain radiographs only. Physical examination can detect the presence of drainable abscess in 63% of cases [26]. In resource-poor environment, a combination of physical examination and plain radiography by an experienced clinician can be used to improve the diagnostic accuracy.

Management of severe odontogenic infections involves early protection of the airway, surgical drainage, early removal of source(s) of infection where feasible, supportive medical care, and follow-up review. Flynn et al. [27] classified facial and deep neck infections based on the degree of threat to the airway. This can serve as a useful guide. Patient positioning is vital, and any position that displaces the tongue posteriorly should be avoided. Appropriate antibiotics should be administered, and this should initially be chosen empirically and subsequently reviewed when results of microbiology, culture, and sensitivity are obtained. Patients who are allergic to penicillin should be given alternatives such as clindamycin. However, resistances to clindamycin in severe odontogenic infection have been documented [8-10]. Crystalline penicillin in combination with metronidazole and gentamicin remains the most effective regimen in our environment. Despite being very cheap, crystalline penicillin is less abused in our environment, and this may account for the low infection resistance associated with its use. Surgical drainage could be undertaken via an intraoral or extraoral approach [28,29] depending on the fascial space involved, and this should be done in line with Hilton's method to avoid injury to vital structures. A combination of both extraoral and intraoral approaches is also possible. Surgical treatment of associated mediastinitis can be achieved using either a cervical incision or thoracotomy, although cervical incision is associated with a lower anesthetic complication and pleural contamination. It has been advocated that thoracotomy should be performed only when infection spread below the carina anteriorly or the fourth cervical vertebrae posteriorly, and when >1 mediastinal compartment is involved [30,31].

Fatal odontogenic infections occur more commonly in the Third World countries where the population is less economically empowered and where malnutrition remains a major problem. Poor accessibility to quality health care is also a significant burden in these societies, and hence, people resort to cheap and readily available alternative remedies such as traditional healers and herbal medications [32]. The patient in this case report gave a history of the use of traditional medications after toothache, albeit, with no improvement in his clinical condition. The shortage of skilled manpower in Nigeria (with a population of >170 million) for the management of odontogenic infections is a large problem and may contribute to the morbidity and mortality often associated with this infection in our environment. A mortality rate of 20%-28.5% has been reported in our local environment [33-35]. Poverty, shortage of skilled personnel, and a poorly implemented national health insurance scheme are the main contributory factors for the mortality recorded in this case report.

5. Conclusion

Although often underestimated, odontogenic infections can lead to life-threatening complications and death as seen in this case report. Despite advances in surgical and medical care, significant

morbidity and mortality from odontogenic infections are frequently encountered, especially in resource-depleted environments. This has economic implications both for the patient and the society in general. Therefore, there is the need for increased public health awareness campaign, so that people can place value on their oral health. There is also the need to make dental care easily accessible and affordable and for manpower development to manage these conditions.

Conflict of interest

The authors declare that there are no conflicts of interest.

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