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Review Article

Odontogenic Neck Infections

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Abstract

Involvement of the deep cervical spaces as a result of odontogenic infection is a life threatening event. Unfortunately this minor tooth related infections occasionally become serious and life threatening where aggressive medical and surgical care is necessary to prevent disastrous result.

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Introduction

Odontogenic infections are not uncommon in the community. In vast Majority of cases these infections are minor and resolve either by spontaneous drainage through the gingival tissues of the tooth or by extraction of the offending tooth. Unfortunately this minor tooth related infections occasionally become serious and life threatening where aggressive medical and surgical care is necessary to prevent disastrous result.

Microbiology of Odontogenic Infections

As with infections elsewhere in the body, odontogenic infections usually arise because of normal endogenous flora. Mouth harbours a large number of different bacteria, both aerobic and anaerobic (Table I). Previously it was thought that odotogenic infections are caused by Streptococcus and Staphylococcus organisms[1, 2]. However recent studies performed with careful microbiological techniques under strict anaerobic conditions have produced a different picture of the flora causing these infections [3, 4, 5]. Based on the results of these investigations several important conclusions can be drawn regarding the microbiology of odontogenic infections. First, aerobic bacteria alone are rarely the cause. When they are, Streptococcus species are usually the offending bacterium. Second, about one half of the infections are caused by anaerobic bacteria (Table II). Third, in most patients, multiple organisms grow from the infection. In these mixed infections there is preponderance of anaerobic bacteria. Table III lists the bacteria that cause odontogenic infections. These are the bacteria of normal flora. The most common organisms are streptococcus, Peptostreptococcus, Eubacterium, Porphyromonus, Prevotella and Fusobacterium.

Entry of bacteria into deep tissues to cause an infection results from invasive aerobic bacteria gaining access through a necrotic dental pulp. The aerobic bacteria serve as the initiator of the infection, preparing the local environment for anaerobic bacterial infection. The anaerobic becomes predominant since the reduction oxidation potential favours the anaerobic growth. The clinical picture evolves like this: Streptococcus organisms most commonly cause the early stage cellulitis. As the infection progresses, a mixed streptococcal and anaerobic infection occurs. As the local tissue condition changes to a more hypoxic state, the predominant bacteria become anaerobic species.

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Table I: Normal mouth flora

Aerobic bacteria	Anaerobic bacteria
Gram positive cocci	**Gram positive cocci**
Streptococcus species	Streptococcus species
	Peptococcus species
	Peptostreptococcus species
Gram negative cocci	**Gram negative cocci**
Neisseria species	Veillonella species
Gram positive bacilli	**Gram positive bacilli**
Corynebacterium species	Clostridium species
	Actinomyces species
	Eubacterium species
	Lactobacillus species
Gram negative bacilli	**Gram negative bacilli**
Haemophilus species	Bacteroides species
	Fusobacterium species

Table II: Etiology of infections

Type of bacteria	Total infection
Aerobic only	<05%
Anaerobic only	60%
Mixed	35%

Table III: Microbiology of odontogenic infections*

Aerobic bacteria	Anaerobic bacteria
Gram positive cocci	**Gram positive cocci**
Streptococcus species	Streptococcus species(C)
α haemolytic (VC)	Peptococcus species (VC)
β haemolytic (U)	Peptostreptococcus species (VC)
Group D(R)	
Staphylococcus species(R)	**Gram negative cocci**
Gram negative cocci	Veillonella species(C)
Neisseria species(R)	
Gram positive bacilli	**Gram positive bacilli**
Corynebacterium species(R)	Eubacterium species (VC)
Gram negative bacilli	Lactobacillus species (U)
Haemophilus species(R)	
Eikenella corrodens(R)	**Gram negative bacilli**
	Bacteroides species (VC)
	B melaninogenicus (VC)
	B fragilis(R)
	Fusobacterium species (VC)

* VC- Very common, C- Common, U- Uncommon, R- Rare.

Implication of Microbiology for Antibiotic Therapy

Antibiotics are necessary as a primary treatment at the very outset of the odontogenic infections or it should be used as an adjunctive therapy to surgery to hasten resolution. The choice of antibiotic should be made with a clear idea of the antibiotic susceptibility of the bacteria causing the infection. There are two microbiologic factors that should be kept in mind when choosing an antibiotic. First, the antibiotic must be effective against Streptococcus organisms since these bacteria are most commonly encountered. Second, the drug should be effective against a broad range of anaerobic bacteria. Fortunately the antibiotic susceptibility of the oral anaerobes is great. Penicillin is still the drug of choice for its good sensitivity against Streptococcus organisms, both aerobic and anaerobic, but unfortunately resistance is emerging against this antibiotic [4]. Metronidazole has become popular recently in the treatment of odontogenic infection. This drug has absolutely no activity against aerobic bacteria but is effective against anaerobes [6]. Since anaerobes alone or in combination with aerobes cause 95% of odontogenic infection (Table II), metronidazole may play a major role in such infections. Broader spectrum antibiotic should be kept reserve for serious life threatening infections.

Natural History of Odontogenic Infection

Deep dental caries initiates inflammation of the dental pulp. Vasodilatation and oedema cause pressure in the pulp chamber, which cause severe dental pain as the rigid walls of the tooth prevent swelling. If left untreated the pressure leads to strangulation of the blood supply to the tooth through the apex and consequent necrosis of the pulp. The necrotic pulp provides a perfect setting for bacterial invasion into the bone tissue.

Once the bacteria have invaded the bone, the infection spreads equally in all direction until a cortical plate is encountered. During the time of intraosseous spread, he patient usually experience sufficient pain to seek treatment. Extraction of the tooth or removal of the necrotic pulp by an endodontic procedure resolves the infection if timely intervention is done.

Direction of Spread of Infection

The direction of spread of infection from the tooth apex depends on the thickness of the overlying bone and relationship of the bone's perforation site to the muscle attachments of the jaws. If infection perforates the bone above the muscle attachment, fascial space involvement occurs. When fascial involvement occurs, the potential for more severe infection with rapid spread becomes greater.

Fascial Space Involvement

Once the dental infection erodes the bony boundary it spreads through fascial plane to different well-defined fascial spaces or compartments. These spaces are Maxillary, Mandibular and Cervical or deep neck spaces. Maxillary tooth infection may spread to the vestibule of the mouth causing vestibular abscess. Infection may erode from mandibular teeth into a variety of spaces. The three primary spaces are submental, sublingual and submandibular spaces, the three secondary spaces are the pterygomandibular, masseteric and temporal spaces. If all three of the primary mandibular spaces become involved with the infection, the infection is known as Ludwig's angina. Ludwig's angina described in 1936 was a relatively common occurrence until the antibiotic era. It is a rapid bilaterally spreading gangrenous cellulitis of the submandibular, sublingual and submental spaces. It usually spreads posteriorly to the secondary spaces causing trismus. It produces gross swelling, elevation and displacement of the tongue and tense brawny indurations of the submandibular region superior to the hyoid bone. There is usually minimal or no fluctuation[1, 7]. The patient experiences severe trismus, drooling of saliva, tachypnea and dyspnea. Impending compromise of the airway produces marked anxiety. The cellulitis can progress with alarming Speed, producing an upper airway obstruction that may lead to death. The usual cause of Ludwig's angina is an odontogenic infection, usually from the second or third mandibular molar.

Extension of odontogenic infection beyond the mandibular spaces is an unusual event. When it occurs, spread to the cervical or deep neck spaces from the submandibular or sublingual spaces may have serious life threatening sequelae[8]. These sequelae may be the result of locally induced complication, such as upper airway obstruction or distant problem, such as mediastinitis.

Management of Odontogenic Infections

The principles of treating odontogenic infections are same as treating infections elsewhere in the body. Timely intervention is of utmost importance in such kind of infection, because a trivial infection may become life threatening if not timely or properly handled, especially in a country like ours. The outline of treating such a case is as follows:

(A) Assessment and Support of Host Defenses

Odontogenic infections are usually minor and can be easily treated. They become serious in patients who have some defense compromise, such as diabetes or immunosuppression. Careful review of the patient's defense should be a routine part of patient's evaluation.

Patients with moderate or severe odontogenic infection usually have severe pain and odynophagia. This results in a poorly hydrated, exhausted patient. Thus the infection itself produces a compromised host. So care must be taken to provide proper analgesic, nutrition and hydration to these patients.

(B) Airway Establishment

Fascial space involvement that compromises the airway may be anterior, as in Ludwig's angina, or posterior, as in a retropharyngeal space infection. In either case, rapid severe compromise of the airway may occur. The clinician should be aware of this and carefully and frequently monitor the airway status to prevent fatal obstruction.

In the uncomplicated odontogenic infection that involve the spaces of the mandible unilaterally, airway problem are rarely seen. In patients with bilateral involvement of the fascial space as in Ludwig's angina, airway embarrassment is the primary cause of death. Once the Ludwig's angina

is diagnosed, it is imperative that the patient be monitored frequently and carefully for airway problems.

If the decision is made to establish an artificial airway early, an oro or nasotracheal intubations may be considered. This procedure should be performed on awake and unparalysed patient. The administration of neuromuscular blocking agent may cause airway loss that cannot be regained. If the decision to establish an artificial airway is delayed, a tracheostomy is the only option. Tracheostomy should also be considered in patient with trismus. Blind nasotracheal intubations should be avoided because of the risk of the rupturing the retropharyngeal collection of pus, which may be fatal.

(C) Isolation of Bacteria

Isolation of bacteria is not needed in minor odontogenic infection. Because these infections are usually caused by Streptococcus organisms and oral anaerobes. The data are so consistent among various reports and the clinical experience, it is unnecessary to perform culture for uncomplicated odotogenic infection in an uncompromised patient.

However, in compromised patients and in patients with severe fascial space infections it is wise to get a specimen of pus for culture and antibiotic sensitivity testing. The specimen must be taken in an anaerobic method so that both aerobic and anaerobic culture can be done.

(D) Choice of Antibiotic

The drug of choice for odontogenic infections continues to be perenteral Penicillin. Even for serious fascial space infections including Ludwig's angina penicillin is preferred[1, 7]. Large doses of up to 20 millions units daily of intravenous penicillin may be required for serious infection. Metronidazole alone or in combination with penicillin is also a useful drug. It has minimal toxicity problem and is effective against anaerobes. Perenteral Cephalosporins may be moderately useful. The first generation Cephalosporins have the same effect as penicillin on the microbial population causing odontogenic infections. The second generation drug cefuroxime is more active against the anaerobic bacteria but loses some of the antistreptococcal activity of the first generation drugs. The third generation Cephalosporins is generally effective against anaerobes but also have decrease effectiveness against streptococci. Further they are quite expensive and have no clear additional benefit. Thus the second and third generation drugs are not highly desirable especially in a developing country like ours. Quinolones and metronidazole in combination may be useful in the patient with a severe infection who has had an anaphylactoid reaction to penicillin.

(E) Surgical Drainage and Decompression

Whenever infection spreads to one of the fascial spaces surrounding the maxilla or mandible, treatment must be aggressive. The initial step in therapy is the decision whether hospitalization is necessary. This decision is based on the presence and the amount of swelling, the nature of swelling and the state of body defenses. Infection that appears as chronic abscesses without a major cellulites component can be surgically drained and the patient observed as an outpatient basis. Similarly, patients with early infections having a soft doughy swelling can be treated in outpatients with antibiotic and minor dental procedure e.g. extraction or root canal treatment. However, patients with moderately increased temperature with an odontogenic cellulitis that is diffuse and indurated should be treated in hospital. Support of the host with hydration, antibiotics and analgesics plays an important role in the overall therapy. Antibiotic should be given perenterally, preferably intravenously.

Surgical treatment should be considered early. If any fluctuation is noted on physical examination, the patient should be taken to the operating room and drainage procedure should be performed. Drainage can be done trans orally or extra orally, depending on the patient's situation and the preference of the surgeon. Surgery from the mouth side is more difficult, with maintenance of the drainage becoming less predictable. Drainage from the cutaneous side is more likely to leave a scar.

After the incision is made, blunt dissection is used to explore the involved spaces and to break the loculi.

Conclusion

Involvement of the deep cervical spaces as a result of odontogenic infection is an uncommon but life threatening event. A large proportion of deep neck infections are the result of odontogenic infection. Initial treatment of a patient with suspected deep neck infection requires immediate hospitalization, host support, maintenance of airway, intravenous antibiotic therapy and incision and exploration of the involved spaces. Early surgical exploration, even in the absence of palpable fluctuation is likely to produce more rapid and complete resolution of the infection with minimal mortality. An artificial airway in these patients should usually be established. There should be no hesitation in accomplishing the necessary maneuver whether it is intubation or tracheostomy. Large doses of perenteral antibiotic therapy should be started immediately. Penicillin with metronidazole is the preferred combination. If doubt exists concerning the bacterial cause of infection gentamycin or third generation cephalosporin may be added.

Medical treatment with antibiotic therapy and host defense support may be employed initially without surgery; however, a rapidly progressing infection of the neck should be explored. If the infection continue to progress in spite of antibiotic therapy, surgical drainage becomes more important. If fluctuation is noted, pus should be drained immediately. Loculations of pus are disrupted by blunt dissection with haemostat and by finger pressure. When surgical treatment was the only method of therapy (before the antibiotic era), early and aggressive surgery was essential to treat these infections. However it is important to realize that although aggressive antibiotic therapy may reduce the need for extensive surgical exploration in many patients, antibiotic rarely replaces the need for surgery completely.

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