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Spread of Odontogenic Infections to Neck and Chest Region: A Case Series

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Running Title: Spread of Odontogenic Infections

Abstract: ***Tooth remains one of the biggest sources of infection affecting soft tissue in head and neck region. Delayed treatment and poor systemic condition may contribute to the advancement of the infection to spread along facial planes to distant sites such as the neck or even chest region.Unfortunately, many patients seek for medical help after the infection has worsen that makes the treatment becomes more complicated. This case series followed 3 patients that were treated at Hasan Sadikin Hospital with different spreading stages of odontogenic infection. These patients presented with red, painful, edema in submandibular, neck, or chest region and all three had toothache prior to their visits to the hospital. The infections were all started from gangrene radix of the mandibular tooth. We treated the patients with intravenous antibiotic and surgical intervention by extraction of the causative tooth, incision and drainage to control the infections and also culture resistency test to find the specific pathogens.They were hospitalized until the infection has subsided and were later discharged. This report will discuss the cause and pattern of odontogenic infections and the management of these cases.***

Keywords: odontogenic infections, spread, incision and drainage

1. Introduction

Abscess is a formation of pus that clinical diagnosis made by evaluating clinical signal and symptoms and along with research of its etiopathology and complemented by imagiology of the affected region.[1]Odontogenic causes are the most common source for spreading maxillo-facial infection [2,3,4]Most orofacial odontogenic infections originate from necroticpulps, infected periodontal pockets, or partiallyerupted teeth.[4,5]

An infection from the tooth can spread to facial space above and also the soft tissue below, on the neck or even the chest region. Infections originating in the facial planes of the head and neck spread downward along the cervical fascia, facilitated by gravity, breathing, and negative intrathoracic pressure.[3]

Early detection and treatment is more effective in decreasing the incidences of big complications.[1,5]However, these more serious pathologies, which attack deep fascia and evolve rapidly, are still reality in the universe of oral cavities infectious processes, especially in underdeveloped countries that have a portion of low income population that had limited access to health care, and also for lack of self-care. [1]

These infections can develop into life threatening events.[2] Therefore a serious measure must be doneimmediately. The right timing for treatment is key in treating patient with infection.[1]Systemic condition of the patient can also worsen the patient's condition that may delay treatment time.

Treatment of odontogenic infection range from oral medication consist of administration of antibiotic to stop the progression of infection. A culture test was done as early as possible to specified the type of antibiotic given. Surgical incision and drainage is a treatment option that may be taken by the dentist or oral surgeon when necessary.[1,4]

In this review, writer want to discuss the cause and pattern of odontogenic infection and management of these cases.

2. Case report

Clinical Case 1

Male, 37 years old from Sumedang area. The patient was brought to Hasan Sadikin Hospital Emergency Department with pain and swelling at left lower jaw. He complained of having toothache on the posterior lower left tooth about one week prior to admission. A swelling appeared after 2 days and he seek treatment to doctor and was given medications but the patient forgot the drugs name. History of fever (+), spontaneus pus drainage (+).

Physical examination showed edema at left cheek that extend to left submandible with 10x8x5 cm in size, reddish, localized, soft consistency, with fluctuation and necrotic tissue (Fig. 1).Heart rate 85x/minute, respiratory rate 28 x/minute, WBC 24.500/mm3, and sodium level 133 mEq. From intra oral examination we found radices of 36 and pulp gangrene of partially impacted 38, with trismus.

Figure 1: (A-C) Clinical examination of the patient with swelling showing signs of abscess with necrotic tissue on the left buccal and submandible. **(D)** Mouth opening was limited, calculus and gingivitis was seen

On the emergency unit, we gave the patient broad spectrum antibiotic, Ceftriaxone and Metronidazole intravenously, and performed extraction of tooth 36, incision and drainage (Fig.2). Bandage was replaced twice daily. Culture resistency result showed *Pediococcus pentosaceus*but still sensitive to all antibiotics. The patient was hospitalized for four days until there was no more pus production but he rejected to performed odontectomy of the impacted tooth, and later discharged with no complication.

Figure 2: (A) Penrose drain was inserted in incision site to ensure drainage of pus. We avoid incision on the necrotic tissue to avoid delayed healing **(B)** Mouth opening was improved immediately after incision and drainage of pus.

Clinical Case 2

Male, 46 years old was referred from Majalaya Hospital with swelling on the neck. It started from a toothache of the right lower molar about 2 weeks before admission. A swelling appeared on the right mandible one week after. The patient was brought to local hospital and was given Dalacin, Amoxan, and Mefinal but the spread continued and extended to the neck and chest. History of systemic disease was denied.

Physical examination showed edema at right submandible,submentale region, anterior neck that extend to upper chest, reddish, localized, warm, soft consistency, with fluctuation and tenderness on palpation (Fig. 3a-c). Intra oral examination showed radices of lower right second premolar and trismus (Fig. 3d). Cervical soft tissue radiographic examination was done to eliminate the possibility of airway involvement (Fig. 4). This patient presented to the emergency unit with tachycardia, tachypneu, leucocytosis (WBC 35.800/m3), showing signs of sepsis, thrombocytosis, and hyponatremia and decreased in oxygen saturation.

Figure 3: (A,B,C) Clinical picture on admission showing edema from the submandibula, submental, neck, and upper chest region. **(D)** Mouth opening only 5 mm showing sign of trismus.

Figure 4: Soft tissue lateral and anteoposterior radiography showed no sign of airway obstruction

On the emergency unit, antibiotic therapy was done intravenously using Ceftriaxone (1 g q.12 h) and Metronidazole (500 mg q.8 h). For source control, we extracted the causative tooth and did incision and drainage at the submentale region (Fig. 5). After three days of hospitalization, necrotomy debridement on the neck region was performed. We found ±100 cc of pus collection and necrotic tissue with no relation to the thoracal region. Laboratory finding found *Klebsiella pneumonia* as the isolated bacteria from the pus sample. The antibiotic was changed into Ciprofloxacin after the culture resistency test result was obtained. Penrose drain was maintained until pus production minimum and replaced every 3 days. The patient was discharged 12 days after admission.

Figure 5: (A) Extraoral drainage with pen rose drain kept until pus production minimum. **(B)** Panoramic radiograph after extraction of tooth 45 as the causative tooth

On one week control to the outpatient clinic, this patient showed improvement without any complication.

Clinical Case 3

Male, 30 years old, went to the Hasan Sadikin Hospital emergency unit with swelling on the left lower jaw and open wound on neck region. The patient complained of having toothache on the left lower molar about 15 days prior to admission. A swelling appeared on the 7th day, with hoarseness and difficulty to swallow. Spontaneus drainage from the neck was reported 3 days after. The patient admit to be referred to go to Hasan Sadikin Hospital by the local doctor but decided not to go at first and went back home instead. After his condition got worse, the family then decided to take him to our hospital.

The patient presented to the emergency department with sepsis (high fever, tachypneu, and leucocytosis with WBC 32.500/mm3). From clinical examination we found swelling at left lower jaw spreading to neck and left chest region, redness, warm, soft consistency, with fluctuation,pain on palpation and ulcer size 2x1 cm on the neck based on subcutis (Fig.6) .Intra oral examination showed poor oral hygiene and multiple radices with gangrene radix tooth 38 as the causative tooth . Laboratory finding showed sign of hyponatremia, hyperuremia, hypercreatinine, and compensated respiratory alkalosis. Radiograhic examination showed radiolucency surrounded by radioopacity at lower left neck region that was suspected as abscess (Fig. 7).

Figure 6: Clinical appearance showing ulcer size 2x1 cm, irregular edge, based on subcutis, pus (+) on the neck, and swelling with necrotic skin on the left chest region

Figure 7: Soft tissue lateral and posteroanterior radiography showed no widening of the retropharyngeal and retrolaryngeal space. Air collumn within normal limit. But there was radiolucency surrounded by radioopacity at lower left neck region suspected as abscess

Tooth extraction and necrotomy debridement was performed under general anesthesia in emergency operation setting.For wound care dressing,we used prontosan solution and povidone iodine gauze. Due to the long hospital stay, we decided to perform culture resistency test twice, the first result found *Citrobacter freundii*from the pus sample, and 14 days later the new result showed *Stenotrophomonas maltophilia* with sensitivity towards Cotrimoxazole and Levofloxacin. The antibiotic regimen then was changed into Levofloxacin drip.

During hospitalization, 4 necrotomy debridement under general anasthesia to this patientwas performed (Fig. 8) due to the ongoing spread of necrotic tissue until no more infection was seen on the tissue and the raw surface deemed appropriate for grafting (Fig. 9a-b). On the 23rd day of hospitalization, split thickness skin graft procedure was performed to close the raw surface area (Fig. 9c). The result of the operation was good and the graft showed good progress so we discharged the patient after being hospitalized for 39 days.

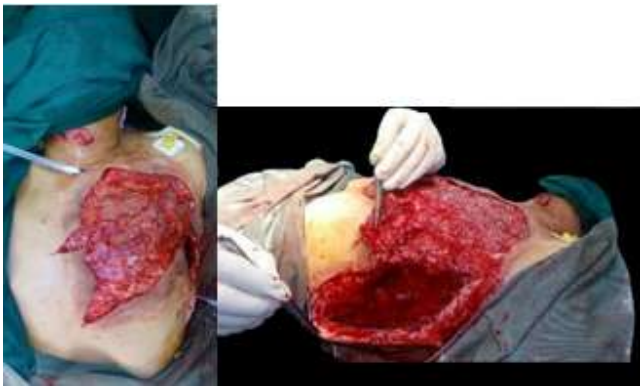

Figure 8: Pus collection in the thoracal wall was drainage during necrotomy debridement on this patient. The extent of the necrotic tissue was too wide that many healthy tissue was affected.

Figure 9: (A and B) After 23 day of hospitalization, signs of infection has diminished and reepithelization can be seen on the wound edges so we decide to do skin grafting to close the wound. (C) Clinical appearance post skingrafting with STSG

One week after, the patient came to the outpatient clinic for control follow up and woundcare treatment was performed.

3. Discussion

Sato et al., has shown that the main origin of maxillofacial infections were odontogenic (79.31%), followed by trauma (10.7%), immunosuppression (1.6%), pathologies (1.6%), and other causes (8%).[3]Flynn et al., presented in their prospective study with 37 consecutive hospitalized patients, a 68% prevalence rate of lower third molars as the most frequent tooth involved in odontogenic infections, followed by other lower posterior teeth (premolars, first and second molars), without anterior teeth involvement.[3]Bahl et al. in their retrospective study of 100 patients showed mandibular third molar as the most frequently involved offending tooth (60%), followed by mandibular 2nd molar, 1st molar, mandibular 2nd premolar and 1st premolar.[6]

In this case series, the cause of the infection was originate from dental infections. The patients complaint of having toothache prior to appearance of the swelling. We found similarity in our patients, from intra oral examination we found gangrene radix of the posterior mandibular teeth as the causative factor of the odontogenic infection. The teeth involved was the first molar (patient no 1), lower premolar (patient no 2),and third molar (patient no 3).

Odontogenic infections are usually locally confined, selflimiting processes.[3,7] However, under certain circumstances, like anatomical variations or suppression of the immune system of some patients, these infections may pass through the bony, muscular, and mucosal barriers and spread into contiguous and distant spaces, resulting in severe fulminating infections in the body cavities. [3] If the dental infection is surrounded by the alveolar bone, it will break down the bone in the thinnest portion (either the facial or lingual cortical plate), following the path of least resistance.[4,8,9]

In the later stages of infection, abscess formation can also lead to the formation of a passageway, or fistula, in the skin, oral mucosa, or even bone in order to drain the infection and suppurate at the surface. The infection process causes the

overlying tissue to undergo necrosis, forming a canal in the tissue, with a stoma.[8]In two of our patients, the infections has spread into adjacent area and suppurate the surface resulting in necrotizing fasciitis. Necrotizing fasciitis is an aggressive subcutaneous infection thattracks along the superficial fascia, which comprises all the tissuebetween the skin and underlying muscles.[10]

The spaces of the head and neck can allow the spread of infection from the teeth and associated oral tissues because the pathogens can travel within the fascial planes, from one space near the infected site to another distant space, by the spread of the related inflammatory exudate. When involved in infections, the space can undergo cellulitis, which can cause a change in the normal proportions of the face . If the mandibular teeth and associated tissues are infected, the infection can spread into the mandibular vestibular space, buccal space, submental space, sublingual space, submandibular space, or the space of the body of the mandible. From these spaces of the jaws and neck, possibly causing serious complications, such as Ludwig's angina.[8]

The masticator space is the mostprevalent site of spread from odontogenic infection. Involvement in masticator space can be seen by trismus in our patients. They have limited mouth opening that further worsen their condition because difficulty in nutritional intake. The spaces adjacent to the masticator space are theparotid space posteriorly, the parapharyngeal spacemedially, and the submandibular and sublingual spaces inferiorly. The parapharyngealspace occupies the central position among themasticator, parotid, and carotid vascular spaces.Therefore, infections in the parapharyngeal spacemay originate from any adjacent space.[9]

The retropharyngeal space connects the skull baseto the upper mediastinum and, in its infrahyoid portion,contains only loose fatty tissue. Thus, the retropharyngealspace is considered to be important becauseof its proximity to the airway and becauseinfection in this space may cause mediastinitis, bronchialerosion, and even septicemia.[9]

Most odontogenic infections are caused by more than 1 species of the bacteria normally found within the oral cavity. Roughly 50% of odontogenic infections are caused by anaerobic bacteria alone, 44% by a combination of aerobic and anaerobic bacteria and only 6% by aerobic bacteria alone.[11] The most common species of bacteria isolated in odontogenic infections are the anaerobic gram-positive cocci *Streptococcus milleri* group and *Peptostreptococcus*.[2] Anaerobic gramnegative rods, such as *Bacteroides (Prevotella)* also play an important role. Anaerobic gram-negative cocci and anaerobic gram-positive rods have little effect.[12]

Culture resistency results from the pus that was collected from our patients showed different result from other researchs. We found *Pediococcus pentosaceus* (patient no 1) sensitive to all antibiotic; *Klebsiella pneumonia* (patient no 2), sensitive only toward Amikacin, Meropenem, and Tigecyclin; and *Citrobacter freundii*(patient no 3), sensitive toward Amikacin, Cefepime, Ciprofloxacin, Cotrimoxazole, Gentamycin, Meropenem and Tigecyclin;and *Stenotrophomonas maltophilia*, sensitive towards Levofloxacin and Cotrimoxazole. After the result was obtained, the antibiotic regimen for our patient was changed according to the sensitivity. We can see there was differences among the bacteria involved in odontogenic infections.

*Pediococcus pentosaceus*is a gram positive bacterium belong to hormofermentative lactic acid bacteria.[10]*Klebsiella pneumonia*is a gram negative bacterium, considered as opportunistic pathogen that can cause range of infections in hospitalized patients, most commonly pneumonia, wound, soft tissue, or urinary tract infections. Now recognized as an urgent threat to human health because of the emergence of multidrug-resistant strains associated with hospital outbreaks and hypervirulent strains associated with severe community-acquired infections.[11,12]*Citrobacter freundii*is a gram negative bacteria that typically resistant to β-lactams.[13]*Stenotrophomonas maltophilia*is an emerging multidrug-resistant global opportunistic pathogen and associated with significant fatality/case ratio. *Stenotrophomonas maltophilia*is most commonly associated with respiratory infections in humans.[14]

Serious infections of face, head and neck are caused by lack of primary odontologic care and could be treated earlier. [1] Infection process evolve fastly due to several reasons such as inadequate antibiotic therapy in the first place that caused resistency to antibiotic, poor oral hygiene,self medication, lack of basic oral care, non removal of the etiology, and to delayed presentation at the hospital.[1, 4]Lack of oral health awareness was one of the main reason why our patients presented late to the hospital. The toothache was not managed soon enough and at the time of admission, the infection has progressed.

Sucessful management protocol for odontogenic infections consist of intravenous antibiotic therapy, modification of the antibiotic regimen according to the results of sensitivity tests, incision and evacuation of pus when indicated, and early treatment of causative tooth.[4]

Incases of necrotizing fasciitis, surgical intervention is the primary therapeutic modality and is indicated when this infectionis confirmed or suspected.[15]Surgical debridement under general anasthesia was performed on our patient no 2 and no 3 due to the extensive spread of infections. We drainage approximately 100 cc of pus from the neck region of patient no 2. Whilst from patient no 3, we drainage approximately 500 cc of pus from the chest and neck region.

In conclusion, odontogenic infection, in our cases because of gangrene radix of mandibular teeth, can spread into adjacent and distant spaces in orofacial, neck, and chest region if left untreated, although it is normally localized and self limiting.Delayed treatment may contribute in worse outcome and longer hospital stay. Antibiotic administration and removal of the focus infection is key in treating patient with this infection. Resistency of antibiotic have become very common that is why the antibiotic given must be specified based on the culture resistency test result.

4. Conflict of Interest

The authors have declared that there is no conflict of interest.

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