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ODONTOGENIC INFECTIONS MICROBIOLOGY AND MANAGEMENT

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ABSTRACT

Epidemiological triad of infection consists of a susceptible host, microbial organism and environment .Oral cavity encompasses a wide variety of microbial organism in which many of them possess virulent properties. Infection of oral and maxillofacial region are mostly odontogenic in origin. Infections occur because of the disturbance in the normal bacterial flora or from an external agent. Early recognition and management of these infections are essential to reduce the further complications. This article reviews the microbiology and management of odontogenic infections.

Keywords: *Odontogenic, Infection, Microbial, Antibiotics, surgical management.*

I. INTRODUCTION

Infection occurs in the maxillofacial region because of the co-existence of the susceptible host, microbial organism and environmental factors. Odontogenic infection is one of the most common infections of the orofacial region , it occurs as a sequele to a pulpal pathology. A wide array of microbial organism exist in the oral cavity and based on their metabolic demand it can be aerobic,facultative and anaerobic .Maxilofacial surgeons and dental practioners encounter dental infections in their clinical practice quite often. These infection may start as a pulpal necrosis and can even progress to severe sepsis ,endocarditis and deep neck space infectons which possess a major threat to patient. Until recently many researches are being carried for effective management of these infections. Most odontogenic resolve with out dreadful complication with simple incision and drainage, but it can be devastating in immunocompromised patients[2].The current article reviews the possible microbiology and management of odontogenic infections.

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II. ANATOMY AND SPREAD OF ODONTOGENIC INFECTION

The dentoalveolar complex consist of teeth, associated periodontal structures like gingival and bony tissue. Infection arising from dentition increase in the inoculum volume and propagate through the alveolar medullary bone ,which is the path of least resistence. Further the pus escapes from the bone to soft tissue labiobuccally or linguopalatally.The predictable route of extension of these infection is based on the anatomy and architecture of the surrounding muscle attachments .The natural barriers to the spread of pus in the tissue as layers of fascia muscle and jaw bone causing primary odontogenic space infections .A secondary odontogenic fascial space is in close proximity to a primary space and extend from it through anatomical boundaries. The most common location of odontogenic infection is the mandible or maxilla into the sublingual, submandibular, or masticatory spaces like temporal ,pterygomandibular, spreading into the parapharyngeal space, and extended spaces of neck.

III. MICROBIOLOGY OF ODONTOGENIC INFECTIONS

Bacterial colonization of the oral cavity right after birth mainly consist of S. mutans, S. epidermidis and S. salivarius) and Fusobacterium[3]. It is interesting to note that about 800-1000 bacterial taxa have been revealed in oral cavity through various culture methods and culture-independent molecular method in the past 50 years [4]. Studies have deciphered bacterial diversity of oral cavity,which emphasize the importance of unravelling the microbiota that cause odontogenic infections.

Although most of the dentoalveolar infections are polymicrobial ,anaerobic bacteria were isolated more common than aerobic in odontogenic infection cultures [5].The most common species that isolated is of anaerobic viridians Streptocooci . The cause of pathogenicity can be primarily attributed to bacterial biofilms . The evident suggest that , the potential of bacterial communities inhabit the oral cavity as primary niches in a symbiotic manner and form dental biofilm in a stepwise process initiated with surface contact and adhesion[6].In dentate patients ,most common route of spread of infection is through root apices and from periodontal pocket .It is speculated that edentulous patients harbour less organism than completely dentate patient[7].The microbial specificity of dental abscess is usually polymicrobial. The reported organisms from abscess cultures , were predominantly facultative anaerobes, such as the viridians group streptococci and the Streptococcus anginosus group, and strict anaerobes, especially anaerobic cocci, Prevotella and Fusobacterium species [8].More insight into the bacterial diversity were acquired with improved isolation and culture techniques .Bacteria belonging to treponema species were reported in a study by Siqueira JF in acute dento alveolar abscess [9].The microbial environment is more rich in Treponema denticola on the other hand lower numbers of Treponema socranskii, Treponema pectinovorum, Treponema amylovorum, and Treponema medium were also found.Another most prevalent colonization is Clostridium species causing dentoalveolar abscess in a range varying from 2% to 20%.In the clostridium group ,the common isolates were of Clostridium hastiforme, Clostridium histolyticum, Clostridium perfringens, Clostridium subterminale, and Clostridium clostridioforme[10].In a study done by Goldberg in the year 1970, the reported 93 cultures obtained from acute dentoalveolar infections are of peri- apical or periodontal origin. The reported microbiology of Seventy-three specimens produced pure cultures of only one pathogen, and 19 specimens revealed mixed growth of two or

more microorganisms. One specimen had no growth. Members of Staphylococci were found abundant in 73% of the cultures, and streptococci were present in 29%. No anaerobic species were reported[11].In a quest to identify changing microbial diversity of orofacial infections Sabiston and Gold initiated a study to understand the types of bacteria present in abscesses and identify their antibiotic-sensitivity patterns. In eight cases of acute dentoalveolar abscess ,they found that anaerobic microorganisms were indeed present in these abscesses in greater numbers. Fusobacterium nucleatum (F. fusifonne) was present in seven of the eight abscesses sampled and was a major constituent of five. Obligate anaerobic species Bacteroides were isolated from four of eight cases and were major isolants in three of these . Species of gram positive cocci - Peptostreptococcus, Lactobacillus, Actinomyces, and a gram-positive facultative rod occurred in two or fewer Cases. S. epidermidis occurred as a minor component in only one case of our series[12].Staphylococcus aureus is a gram positive cocci that can be visualized using gram stain is the second most common organism isolated from odontogenic infection cultures. In a retrospective study done at tertiary academic center in the University of Padua Otolaryngology Clinic at Treviso Regional Hospital with the diagnosis of submandibular space infection for the period 1998–2006 by Paulo et al.He reported the predominance of Coagulase-negative staphylococci(38.1%) and Staphylococcus aureus(31%) reflecting their abundance in mouth .On the other hand cultures also revealed Klebsiella pneumonia, Gemella morbillorum and Group F Streptococcus which is seem to be associated with orofacial infections[13].Rege et al in the year 2006 in his studies on antibiotic sensitivities stated streptococcus viridians is the most common pathogen in odontogenic infections.Significant improvement in diagnostic field helps the microbiologist to identify all the bacteria in the given sample.With the advance of deep sequencing DNA technology , we are now able to report diverse of microbial population .Genetic methods of identification have also helped in detection and speciation of fastidious organisms like Treponemes in samples from dental abscesses[14].

IV. MANAGEMENT OF ODONTOGENIC INFECTIONS

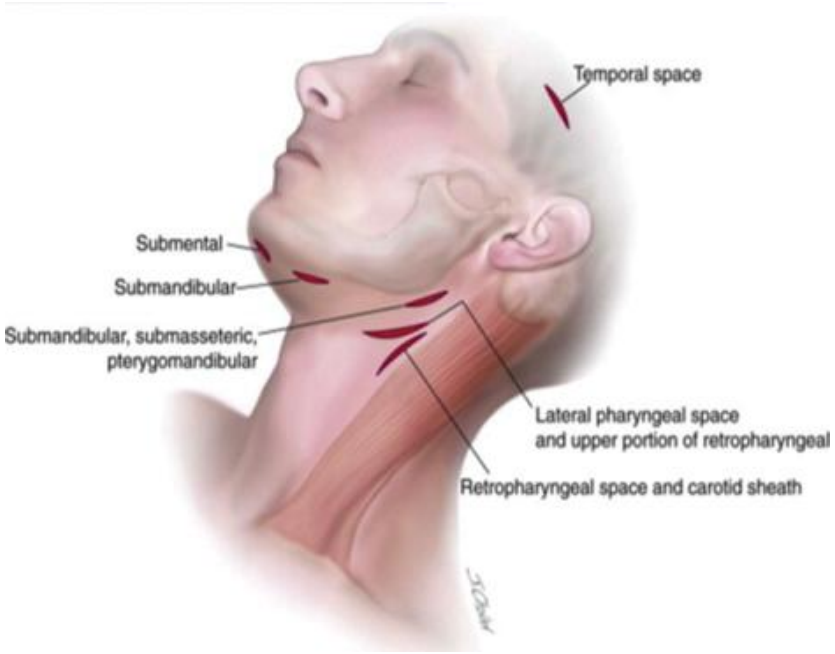
Odontogenic infection and its extensive spread can cause greater complication if it is not substantially managed at the right time. However, the prevention of odontogenic infection is the gold standard in dental care . A primary understanding of the initial source of infection and its potential extension should be evaluated with appropropriate clinical and radiological evaluation before establishing a proper treatment protocol[15].The management of these conditions can involve systemic antibiotic therapy, surgical or endodontic management or combination of thereof . Determination of the host factors and antibiotic resistence is also important. Infections from periapical and periodontal source are the most common cause of odontogenic infections,. Periapical infections begin with a carious lesion causing pulpal necrosis that introduces the pulp to microorganisms. The infection that was localized to root apex and periapical tissues may spread to other fascial spaces. Periapical infection can also spread through cortical bone causing cellulitis , localized and or deep-space abscess formation. If it is a confined infection to periapical and periodontal tissue ,the treatment involves root canal therapy or extraction of the involved tooth based on electrical pulp vitality test [16]. Non-vital pulp represents an infection of endodontic origin.Even in this modern era of antibiotic therapy, emergencies associated with odontogenic infections are still encountered in our dental office. The objective of definitive management is to

avoid life threatening complications and mortality. There are fundamental principles in order to manage the odontogenic infection appropriately [17].

V. PRINCIPLES

Determine the severity of infection, Evaluate host defences, Determine the setting of care, Support medically, Treat surgically, Choose and prescribe appropriate antibiotic, Administer antibiotic appropriately, Re-evaluate frequently. The initial step in the management is to determine the severity of infection based on assessment of airway patency,identification of involvement of vital anatomic locations and rate of progression of infection. The primary intention of antibiotic therapy is to reduce or eliminate the infection. The use of medical therapy should not be overlooked. Current trend is to start the systemic antibiotic therapy at the earliest to limit the spread of infection. Although there are controversy regarding the choice of antimicrobial therapy ,in the status of polymicrobial environment we should closely embrace the principles of antibiotic therapy for effeicient care[18]. Based on the clinical utility and minimal toxicity , penicillin remains as the first drug of choice in odontogenic infection.There are studies which shows the spectrum of activity of amoxicillin and ampicillin against certain gram-negative species, particularly Hemophilus injluenzae, Escherichia coli, and Proteus mirabilis. They are not quite as effective against gram-positive cocci as penicillin G or V and are also destroyed by most beta-lactamases. With the emergence of beta – lactamase producing organisms like bacteroides ,fusobacterium and some strains of veilonella thus eliminating other sensitive species. The combination of amoxicillin and clavulanic acid(875/125mg or 500/125mg) is indicated as first choice and in case of penicillin allergy clindamycin is the drug of choice[19]. Antibiotic coverage of Cefuroxime, a second generation Cephalosporin was less effective with just 46.66 % bacterial strains susceptible to it, whereas Cefotaxime (third generation Cephalosporin) was found to be highly effective (83 % sensitivity) [20].On a therapeutic point of view in order to get effective antimicrobial action, it is recommended to combine with surgical intervention that will control source of infection and halt its progression. It includes extraction of the offensive tooth and incision and drainage of involved anatomical sites{figure 1}.Once the anatomy of complex fascials spaces is understood,principles recommended by Topazian et al. is employed to explore the site and to open up all loculations of the abcess. This will also enable the clinician to obtain culture swabs for sampling the infective microbial organism,followed by copious irrigation.Soft drains can be placed in to the wound and can be sutured with a non resorbable suture to adjacent lip of skin.

Figure 1 : Typical incision sites for extraoral incision and drainage. From Lui DW and Abubaker AO: Odontogenic Infection. In Kademani D and Tiwana PS, editors: Atlas of Oral and Maxillofacial Surgery, St. Louis, 2016, Saunders



VI. COMPLICATIONS

Life threatening complications of these odontogenic infections can occur in patient with compromised host defence,associated comorbidities such as diabetes mellitus and primary immunodeficiency disorders . Criteria for hospital admission is determined by the airway patency,temperature, involvemnt of important anatomical spaces and systemic diseases of the patient .Complications of head and neck infections are invasive streptococcal infection , necrotising fasciitis, toxic shock syndrome mediastinitis and cavernous sinus thrombosis.

VII. CONCLUSION

The majority of infection in the head and neck region are odontogenic in origin.Successful management of these conditions demands identifying the pathogen with culture based or culture independent molecular techniques ,pathogen specific systemicantibiotic therapy and appropriate surgical intervention. Regardless of countless innovation in the medical field ,t he head and neck infection still carry significant risk , so definitive treatment should be given to ensure favourable patient outcome.

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