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A CROSS-SECTIONAL STUDY ON BACTERIOLOGICAL PROFILE AND ANTIBIOTIC SENSITIVITY PATTERNS OF MAXILLOFACIAL INFECTIONS

Dental Science

Dr Rishi Thukral (MDS), Assistant Professor, Dept of Dentistry, Atal Bihari Vajpayee Govt Medical College, Vidisha (M.P)

Dr Vidhi Mathur* Reader, Dept of Oral Pathology, College of Dental Sciences & Research Centre, Ahmedabad -380051 Gujarat, India. *Corresponding Author

Dr Dal Singh (MDS), Prof and head, KLR's Lenora institute of dental sciences. India.

Dr Animesh Barodiya (MDS), Private practitioner

Dr Akanksha Thukral Private practitioner

ABSTRACT

Introduction: Odontogenic infections are one of the most frequently occurring infectious processes. The current study was planned with the objective to determine the bacteriological profile and antibiotic sensitivity patterns of isolates from maxillofacial infections in patients without a history of empiric antibiotic therapy.

Materials and methods: Patients suffering from various infections of the maxillofacial region were contacted. Patients were interviewed using a questionnaire and a sample was taken from abscess. Various lab investigations were also done.

Results: A total of 82 patients with Maxillofacial infection were included. In this study, the most common clinical presentation was pain (90.24%) and swelling (70%). Mandibular teeth are involved in 71.95% of cases, and 28.05% of maxillary teeth are involved. The first molar tooth was most associated with infection. (n = 54). On analysing various organisms causing infection, 28 (34.15%) of the infections were caused by aerobes, 11 (13.41%) by anaerobes, and 30 (36.58%) were of mixed. No pathogens were isolated in 13 (15.85%) of the patients. The most sensitive antibiotic was amoxicillin/clavulanate combination (84.05% sensitive), followed by Clindamycin (81.16% sensitive).

Conclusion: Most of maxillofacial infection were caused by aerobes and most sensitive antibiotic was amoxicillin/clavulanate combination.

KEYWORDS

bacteriological profile, antibiotics sensitivity, maxillofacial infections

INTRODUCTION:

Human beings are subjected to various infections. Although dental health in India is improving, infections in the orofacial region commonly arise from the dental origin. Odontogenic infections are one of the most frequently occurring infectious processes, which are known from antiquity to present-day health care practice. Although there is very little data regarding the incidence of infections of the oral cavity, no one doubts its relevance. [1, 2] Infections of the maxillofacial area constitute a frequent entity in the daily practice of maxillofacial surgeons. [3]

Three contemporary problems confounding the clinical evaluation of patients with skin and soft tissue infection are, diagnosis, the severity of infection, and pathogen-specific antibiotic resistance patterns. Dozens of microbes may cause soft-tissue infections, and specific bacteria may cause a particular type of infection, considerable overlaps in clinical presentation exist. Early recognition of such infections and appropriate therapy are essential for management. Dental infections can occur in a number of ways. First, via the introduction of pathogens from the extra-oral origin. Second, through a change in the balance of indigenous flora. And third, with the entry of bacteria into the ordinarily sterile vital pulp of the tooth. [1]

The microbiology of dental infections has been the topic of many researches. Various bacteriology studies have shown variations in their conclusions. The difference between reports may be due to variation in bacteriological techniques employed for their isolation and variation in identification may be due to antimicrobials.

The microbial residents of oral cavity constitute one of the most varied and numerous floras in the human body. More than 500 bacterial taxa are found in the oral cavity, of which 22 predominant ones have been identified. Also, several fungal species, two or more protozoal genera, and many viruses are normal residents. [1]

Orofacial infections of odontogenic origin are usually polymicrobial. Usually, the primary microorganisms are aerobic in the early stages of dental infections. If not treated and controlled adequately, the populations of the microflora might be replaced by strict anaerobes. Recent clinical studies have emphasized the importance of anaerobic bacteria in orofacial infections. Anaerobes are isolated from virtually all dentoalveolar infections.

This ability has been demonstrated over the past decade in an array of infections not previously recognized in humans. The re-emergence of diseases in different forms caused by common microorganisms, such as Staphylococci, Streptococci, Escherichia coli, and Mycobacterium tuberculosis, further substantiates this observation. This re-emergence is caused partly by the acquisition of antibiotic resistance mechanisms, either through mutation or by transfer of genetic information from other bacteria; thus, there has been a rise in the antibiotic resistance of important pathogenic genera. [4]

Penicillin the drug of choice for the treatment of odontogenic infections. Recently, it has been shown that some anaerobic gram-negative rods such as Bacteroides corrodens, Bacteroides melaninogenicus, Bacteoides oralis, and Bacteoides ruminicola, isolated from orofacial infections, can produce beta-lactamases that cause clinical failures with penicillin therapy. [2]

To the general dentist, these factors and the therapeutic options now available may complicate the selection of an effective antimicrobial regimen for this patient suffering an odontogenic infection. Therefore, the current study was planned with the objective to determine the bacteriological profile and antibiotic sensitivity patterns of isolates from maxillofacial infections in patients without a history of empiric antibiotic therapy.

MATERIALS AND METHODS:

On a prospective basis, patients suffering from various infections of the maxillofacial region, who reported to the Department of Oral & Maxillofacial Surgery, People's College of Dental Sciences & Research Centre, were inducted into the study during the period of 1st January 2010 to 31st December 2010. Patients of all ages were considered for the study. A detailed history was noted for the patients, and a thorough clinical examination was done to diagnose the presence of an infection of the maxillofacial region. Radiological examination of the area of chief complaint was done if required to rule out the cause

of infection. History of drug administration was verified by reviewing the patient's previous medical, dental records, prescriptions and physical confirmation of the medication that the patient was taking. To be included in the study, the following inclusion criteria were considered:

1. Patients who suffered from infections of the maxillofacial region.
2. Patients with "closed", a non-draining abscess.
3. Patients who were not administered antibiotics during the immediate past 3-5 days.

The criteria for exclusion were:

1. A patient who did not fulfil the inclusion criteria
2. Patients with draining abscess (intraoral/extraoral) (As in draining abscess there is the communication of the abscess to the external environment which will lead to the change in the microbial flora due to exposure to environmental oxygen.
3. Patient with symptoms of toxicity, in whom antibiotics cannot be stopped for 48hrs

Once the inclusion criteria were verified, basic blood investigations were done (if indicated). An intravenous blood sample was collected and tested for:

1. Random Blood Sugar.
2. Haemoglobin percentage.
3. White blood cell count (Total and Differential)

Sample collection was done by aspiration technique using sterile 18/22 –gauge needle and 5/10ml disposable syringe. The site of aspiration, intraoral in case of a dentoalveolar abscess or extraoral in case of fascial space infection, was chosen after careful examination. The site of aspiration was disinfected, extra orally, with 5% betadine solution and 70% ethyl alcohol (for 2min.) and normal saline. Intraorally, the site was prepared using 0.2% chlorhexidine mouth rinse followed by a normal saline rinse. Finally, sterile dry gauze was used to wipe the area clean for any residual solution before aspiration. The maximum sample was aspirated with a single attempt to avoid contamination of aspirate. After aspiration air was expelled from the syringe without causing aerosol and needle was sealed with sterile rubber cork. The aspirated sample was labelled and transported to the microbiology lab within 30-45min. Cultures and smears for the detection of microbial agents were then carried out. Culture study is done in microbiology lab with standard inoculation method for aerobic, anaerobic and fungal growth. Antibiotic sensitivity is done in Sample with positive growth by standard Kirby Bauer disk diffusion technique.

RESULTS:

A total of 82 patients with Maxillofacial infection, in a one-year duration, were included in the study as per the inclusion and exclusion criteria. The age ranged from 5 years to 75 years, with the mean age of 33.21 years. Total 28.3% of the patients were in the 4th decade of life (maximum) and 1.21% in the 8th decade of life (minimum). There was a male predominance found in this study. Out of 82 patients, 61 patients (74.39%) were male, and 21 (25.61%) were female.

In this study, the most common clinical presentation was pain (90.24%) and swelling (70%) followed by trismus (53.66%), and only 15% of the patients had fever. Out of 82 patients, 58.54% of the patients had the foci and infection on the left side. Mandibular teeth are involved in 71.95% of cases, and 28.05% of maxillary teeth are involved. The first molar tooth was most associated with infection. (n = 54). The teeth involved in the infection were equally distributed in all the four quadrants of the dentition.

In 82 patients, 102 spaces were involved, with the majority of patients reporting with the involvement of multiple spaces. Sub-mandibular (30.49%) and buccal (21.95%) were predominantly involved, followed by submental (17.07%), dentoalveolar (18.29%) and sublingual space (12.19%). We did not find any case of temporal space and Ludwig's angina during the study period.

The conditions were managed by extraction of offending tooth alone or, extraction along with incision and drainage (by extraoral or intraoral approach). Extraction alone was performed in 21 cases (25.61%). Incision and drainages were done in 74.39% of cases, of which 73.77% were done intra-orally and 26.23% extra-orally. A drainage tube was placed in only 31.15%. Duration and frequency of changing drainage tube was dictated by the response of the patient A total of 158 isolates were obtained from 82 study samples. Total 35 different strains of microorganisms were isolated from the study group, with an average of 1.93 isolates per sample. Growth was found in 84.15 % cases (n = 69), and 15.85% of cases reported sterile (or no growth). More than one isolate was reported in 48 cases, with two isolates reported from 24.39 % cases (n= 20), three isolates reported from 24.39 % cases (n = 20), four isolates in 8.53% cases(n=7) and five isolates in one case. In the study samples totally, 15.85 % were reported as negative cultures (n = 18).

On analysing various organisms causing infection, 28 (34.15%) of the infections were caused by aerobes, 11 (13.41%) by anaerobes, and 30 (36.58%) were of mixed. No pathogens were isolated in 13 (15.85%) of the patients.

Out of 156 isolated organisms, Staphylococcus Aureus was the most common aerobic bacteria present (n=21) followed by streptococcus viridians, and among anaerobes, Fusobacterium nucleatum was the most common isolate (n=11) followed by prevotella (n=7). [Table 1 and 2]

The response of bacteria to a particular antibiotic is divided into three categories as sensitive, moderately sensitive and resistant as per the zone diameter. Among samples of 82 patients, growth was found in 69 (84.15 %) samples. The most sensitive antibiotic was amoxicillin/ clavulanate combination (84.05% sensitive), followed by Clindamycin (81.16% sensitive) and Ceftriaxone (76.81% sensitive). Full list of antibiotic sensitivity patterns is provided in Table 3.

Table 1: Aerobe Bacterial isolates (n=91)

Name of organism	No. (%)
Staphylococcus Aureus	21 (23.08)
E.coli	5 (5.49)
St. viridians	13 (14.29)
Pseudomonas	5 (5.49)
Stapphylo sp.	3 (3.3)
Actinomyces	3 (3.3)
St mutans	5 (5.49)
Streptococci Sp.	5 (5.49)
Enterococus faecalis	4 (0.044)
St. Miller	5 (5.49)
Klebsiella	5 (5.49)
Camphylobacter	2 (2.2)
Neisseria	5 (5.49)
Cornybactreium	3 (3.3)
Micrococcus	2 (2.2)
Hemophilus	1 (1.1)
Unidentified	4 (4.4)

Table 2: Anaerobe Bacterial isolates (n=65)

Name of organism	No. (%)
Fusobacterium nucleatum	11 (16.92)
Prevotella	7 (10.77)
Actinomyces Israelii	2 (3.07)
Peptococus	1 (1.54)
Bacteroides melaninogenicus	3 (4.62)
Bacteroids	6 (9.23)
Baccilus Sp.	3 (4.62)
Bacteroids fragilis	2 (3.07)
Peptostreptococus	5 (7.69)
Hemophilus influenza	2 (3.07)
Veillonella	2 (3.07)
Porphyromonas	4 (6.15)
Gemella	4 (6.15)
Eubacterium	4 (6.15)
Prpinobacterium	3 (4.62)
Capnocytophaga	3 (4.62)
Eikenella corridens	1 (1.54)

Table 3: Antibiotic sensitivity pattern of bacterial isolates (n=69)

Antibiotic	Sensitive	Moderately sensitive	Resistant
amoxicillin/clavulanate	58, 84.05%	6, 8.69%	5, 7.25%
Clindamycin	56, 81.16%	4, 5.78%	9, 13.04%
Ceftriaxone	53, 76.81%	3, 4.35%	12, 17.39%
Ampicillin	45, 65.22%	7, 10.14%	17, 24.64%
Vancomycin	43, 62.32%	7, 10.14%	18, 26.09%

*Metronidazole was tested only on anaerobes and for all of them, it was sensitive.

DISCUSSION

In our study, the age ranged from 5 years to 75 years, with the mean age of 33.21 years. This is in accordance with results of previous studies. HAUG et al. (1991) [5], in his study, found that the most common age range for all odontogenic infections was 25 to 30 years. Flynn T. (2006) [6, 7] claimed that the mean age of the patient with severe odontogenic infection was 34.9 years.

In our study, there was male predominance, out of 82 patients, 61 were male, and 21 were female.

Similar results were obtained by Kangara et al. (1980) [8], Haug et al. (1991) [5], Pinheiro et al. (2004) [9] and Haung T (2004) [10], in their studies they found that there is a male predominance in patients having maxillofacial infections,

In our study of 82 patients, the most frequent clinical presentation was pain (90%) and swelling (85%). Which is similar to a study conducted by *Bridgeman et al.* (1995) [11], in which at the Royal Melbourne Hospital they reported a prevalence of 100% for pain and 98% for swelling as a clinical presentation of the same disease.

In the current study, only 15.85% reported with fever. Whereas. *Bridgeman et al.* (1995) [11]claimed that 50% of patients with maxillofacial infection present with fever. Haug et al. (1991) [5]suggested that the rise in temperature is one of the prominent symptoms of maxillofacial infection. Generally, patients with acute bacterial infections may present with fever and elevation of body temperature above normal.

Trismus, a common clinical feature of odontogenic infection, was seen in 44 (53.66%) out of 82 patients which are in accordance with the study of *Bridgeman et al.* (1995) [11] where 46% of trismus patient was seen. Flynn T. (2006) [7] found dysphagia and trismus in 70% of the patients in his study.

The first molars, upper and lower, were involved in a maximum number of cases in this study population (n = 62). *Storoe et al. (2001) [12]* in their study, found that the most commonly involved tooth in odontogenic infection is mandibular third molar. Flynn T et al (2006) [6, 7] and Tozoglu et al (2009) [13] found the association of upper and lower molars more frequent. This might be because the permanent first molar is the first tooth to erupt in the oral cavity, thus has the maximum exposure to cariogenic food and bacteria, making it more prone for caries and periodontal diseases and hence directly responsible for a greater number of odontogenic infections.

Space involved

In our study, we found the most commonly involved space in odontogenic infection was Submandibular, followed by Buccal and Submental. This is similar to finding to other studies. Rega A (2006) [14] and Tozoglu et al (2009) [13] stated that the Buccal and Submandibular spaces are most frequently involved.

Anaerobic or anaerobic

In the present study, the microbiological isolates of bacterial ranged from aerobes, anaerobes and mixed aerobes and anaerobes. Of the total 156 isolates, 91(58.33%) were aerobes, and 65(41.67%) were anaerobe. There was a significant difference between the incidence of pure aerobes (n=28), pure anaerobes (n=11) and mixed isolates (n=30). A maximum number of infections were polymicrobial (n=57).

Barlett et al. (1979) [15] and Brook et al. (1981) [16], also stated that odontogenic infections are polymicrobial in nature with predominantly mixed aerobic and anaerobic microbial flora followed by pure anaerobes and pure aerobes.

Sklavounos et al [17] (9.5%) and Anuradha R et al [18](13.3%) also found of specimen with negative growth similar to our study. In the present study, we found a considerably high number of sterile isolate 15.85% (n=13). The probable reason of sterile culture was the suppression of growth of isolates, which might be attributed to bacterial inhibitory mechanisms which include residual antimicrobial agents, limitation of culture media used and atmospheric conditions provided to the sample and fastidious organism (delicate organism dying during transportation/transfer of the clinical sample from the patient to transport media). [19]

In the present study, the predominantly isolated microorganism was Staphylococcus Aureus which was isolated in 21 patients. The high rate of staphylococcus isolation may be due to contamination of aspirate from the skin as it is the most common commensal and most of the samples were taken extra orally. We also found considerable incidence of Streptococcus viridians also which is in agreement with other studies by Storoe et al (2001) [12], Li et al (2001) [20], Huang et al (2005) [21], Takai S (2005) [22].

In our study, we found that Amoxicillin / Clavulanic acid (84.05%) is the most effective antibiotic in these types of conditions. Sobottka I et al (2002) [23], Bascones et al (2004) [24], Gutirrez-Perez et al (2004) [25], Pinheiro et al (2004) [9], López-Píriz et al (2007) [26], Al-Selivany B (2010) [27] had also stated that the Amoxicillin / Clavulanic acid is the most sensitive antibiotic in such infections and recommended the use of Amoxicillin / Clavulanic acid as a first step in initial management of orofacial infections.

One of the theories proposed is that even if one organism in the mixed culture is susceptible to penicillin, it can lead to successful treatment of the condition due to its effect on disrupting the haemostasis in the mixed ecosystem [28]. But keep in mind, the reports of an increase in penicillin resistance some authors recommend the combination of Amoxicillin + Clavulanic acid as a drug of choice for empiric treatment of odontogenic infections. [29-31] In case of allergy to Penicillin, the best choice is Clindamycin. [32, 33] Ciprofloxacin had the most promising activity against the isolates from the study samples. It had good activity against (96.06 %) gram-positive isolates and a 100 % activity against the gram-negative isolates. An overall 24.27 % resistance was noted in the gram-positive isolates, mostly in *Staphylococcus aureus* (12.5 %). Ciprofloxacin is not a drug of choice for treatment of odontogenic.

We did not find any antibiotic which has 100% effective against all the types of bacteria we had isolated except Metronidazole which was tested against pure anaerobic isolates (n=11) and all these anaerobes were 100% sensitive to Metronidazole.

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