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RESEARCH ARTICLE

CULTURE SENSITIVITY OF ODONTOGENIC INFECTIONS IN THE HEAD AND NECK REGION.

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Abstract

A randomized prospective study was conducted on 30 patients to identify the predominant organism in the odontogenic infections of the head and neck region and also to find out the drugs to which they are sensitive and resistant. Inoculation of each sample was done using blood agar and nutrient broth cultures for aerobes while plain blood agar and McConkey agar cultures were used for anaerobes. Klebsiella (40%) and Proteus (23.3%) species were the predominant anaerobic species present. The sensitivity was shown higher to Ciprofloxacin (63.3%) and Amikacin (46.6%) while resistance was present against Ampicillin (60%) and Cefpodoxime (56.6%). Thus, it was concluded that Klebsiella and Proteus are the predominant micro-organisms present in the infections of the head and neck region and are sensitive to Ciprofloxacin and Amikacin.

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Introduction:-

Space infections in the head and neck region have affected mankind since recorded history and signs of dental abscesses have been found even in the remains of early Egyptians¹. The spread of infection is determined by the virulence of the micro-organisms and the host defense mechanism. Systemic illnesses suppress the immunity of an individual and increase their susceptibility to infection. The odontogenic infections of the head and neck region affect multiple spaces more often than a single space. The submandibular space is the most commonly affected followed by the buccal and submental spaces. Head and neck space infections have significantly been reduced when compared with the past. This is due to the advent of antibiotics and improved dental care as opposed to the pre antibiotic era. Head and neck infections are potentially lethal if they are not diagnosed early and treated promptly. Previously and even till today, antibiotics are prescribed when symptoms such as pain, swelling first appear without determining either the cause or even the chemotherapeutic susceptibility of the microbes². Among the commonly used antibiotics, penicillin still remains the drug of 1st choice because of their safe use, minimal side effects and broad spectrum especially in combination with beta lactamase inhibitors.

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The most common pathologic sequence is a necrotic pulpal inflammation extending into the periapical area in the form of a dentoalveolar abscess which if unattended may penetrate through the cortical bone to involve the potential spaces created by fascial insertions³. Although the incidence of severe head and neck infections requiring hospitalization has decreased, there is still the challenge of proper treatment i.e. effective medication. Since decades, penicillin has been the drug of choice for odontogenic infections of the head and neck region. But the microbes have become resistant over a period of time thus developing penicillin resistant strains which have led to the usage of another drug or multiple drug therapy for treatment⁴. We intend to study the patients with odontogenic infections in the head and neck region by analyzing the results of the pus culture and sensitivity tests and framing a conclusion as to the predominant organism present and the drug to which it is sensitive to, thus enabling the patient to receive effective medication in the first prescription avoiding waiting time and discomfort to the patient.

The microbes have adapted to every environmental niche and are now adjusting to a world laced with antibiotics. This can be explained by the re-emergence of the diseases. Re-emergence is partly a result of acquisition of antibiotic resistance mechanisms either through mutations or by transfer of genetic information from other bacteria. Antibiotics covering gram positive, anaerobic, gram negative and beta lactamase producing organisms should be selected for pending culture and sensitivity results. Antibiotic resistance is an important consideration in the management of orofacial odontogenic infections.

This study was done to identify the predominant micro-organisms causing odontogenic infections in the head and neck region and also the drug to which they are sensitive and resistant to, so as to provide effective medication for the patient thereby decreasing their recovery time.

Materials & Methods:-

This study was conducted on 30 patients who reported to the Department of Oral and Maxillofacial Surgery, GITAM Dental College and Hospital presenting with the Odontogenic infections of the head and neck region were randomly selected for the study(Figure 1) after Ethical committee approval. Patients with systemic disorders, pregnant females and those with prior antibiotic usage were excluded from the study. A detailed case history of all the patients was taken.

Method of specimen collection:-

Pus was collected by aspirating the infected region using a sterile wide bore(21G) disposable needle with 2ml disposable syringes either intraoral (mucosa) or extra oral (skin). The pus collected in the syringe is transferred into a vacutainer with the help of a sterile cotton swab. Thus, the pus containing swab is sent to the Department of Microbiology for culture and antibiotic susceptibility testing.

Procedure:-

The cotton swab was processed in the laboratory using gram staining and the report was made. For aerobic cultures, the samples were inoculated on blood agar and nutrient broth¹. For the anaerobic cultures, the samples were inoculated on plain blood agar, McConkey's agar and streaked. Supplements added were 5% sheep blood, 0.5mg% haeme and 0.05mg/dl menadione. All aerobic cultures were incubated at 37°C for 24 hours while the anaerobic cultures were incubated at 37°C for 5 to 7 days. The antimicrobial susceptibilities were determined using the disk diffusion method⁴.

Results:-

All the data was entered in Microsoft Excel worksheet and analysis was done by using SPSS 20.1 version (statistical package for social sciences) software by percentage analysis and the susceptibility testing was done using the disc diffusion technique by Kirby Bauer method.

The predominant organism in the odontogenic infections of the head and neck region was found to be Klebsiella (43.3%), followed by Proteus (23.3%) and Pseudomonas (20%) out of which Klebsiella and Proteus are gram -ve and Pseudomonas is gram +ve, thus suggesting that gram -ve anaerobes are predominant in the odontogenic infections (Table 1).

The drug sensitivity is highest to Ciprofloxacin (63.3%) followed by Amikacin (46.7%) and Moxifloxacin (30%) (Table 2 & Figure 2) while the drug resistance is highest for Cefpodoxime (63.3%) followed by Ampicillin (60%) and Amoxyclav (40%) (Table 3 & Figure 3).



Figure 1:- Patient with Right Submandibular Space infection.

Table 1:- Predominant Organism.

Predominant organism	Frequency	Percent
Klebsiella	13	43.3
Proteus	7	23.3
Pseudomonas	6	20.0
E. Coli	2	6.7
Proteus & Pseudomonas	1	3.3
E. Coli & Pseudomonas	1	3.3
Total	30	100.0

Table 2:- Drug Sensitivity.

Parameter	Frequency	Percent
Ciprofloxacin	19	63.3
Amikacin	14	46.7
Moxifloxacin	9	30.0
Azithromycin	7	23.3
Tobramycin	7	23.3
Doxycycline	7	23.3
Cefepime	6	20.0
Amoxyclav	6	20.0
Imipenem	5	16.7
Gentamycin	5	16.7
Tetracycline	5	16.7
Cefpodoxime	4	13.3
Cefperazone	4	13.3
Meropenem	4	13.3
Cefuroxime	3	10.0

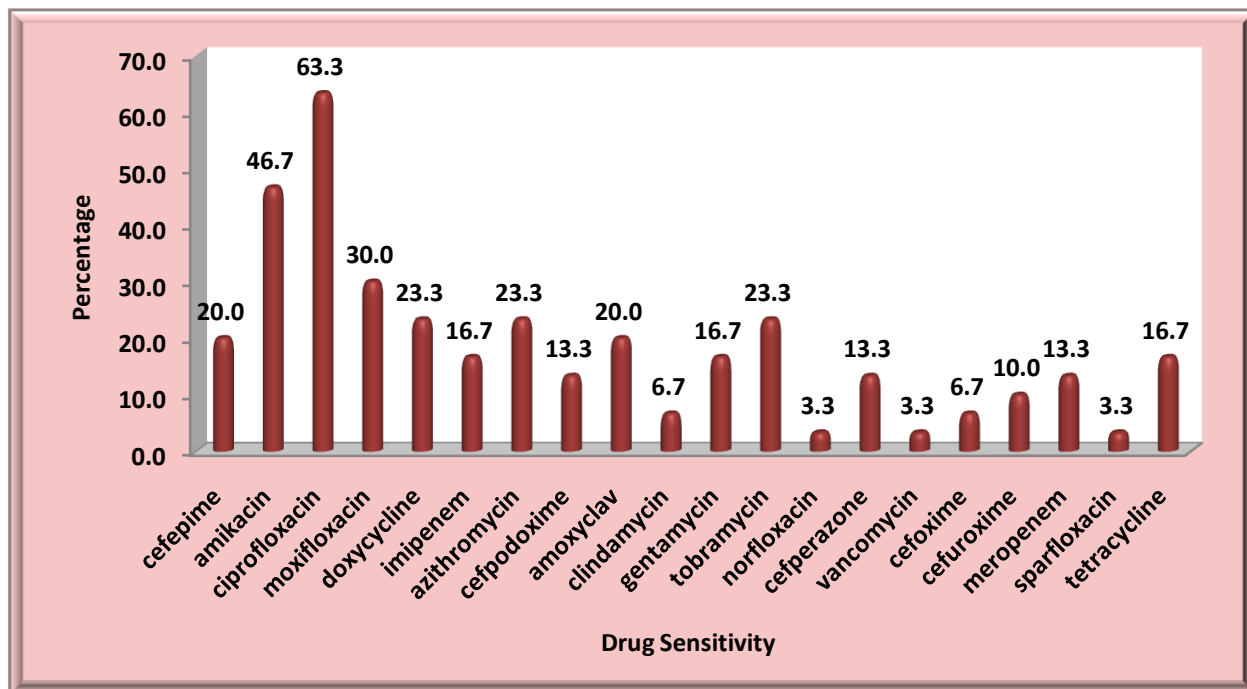


Figure 2:- Drug Sensitivity

Table 3:- Drug Resistance.

Parameter	Frequency	Percent
Cefepodoxime	19	63.3
Ampicillin	18	60.0
Amoxyclav	12	40.0
Doxycycline	9	30.0
Cefepime	9	30.0
Azithromycin	7	23.3
Amikacin	6	20.0
Clarithromycin	5	16.7
Cefuroxime	4	13.3
Cefotaxime	4	13.3
Vancomycin	4	13.3
Clindamycin	3	10.0
Tobramycin	3	10.0
Norfloxacin	1	3.3
Tetracycline	1	3.3

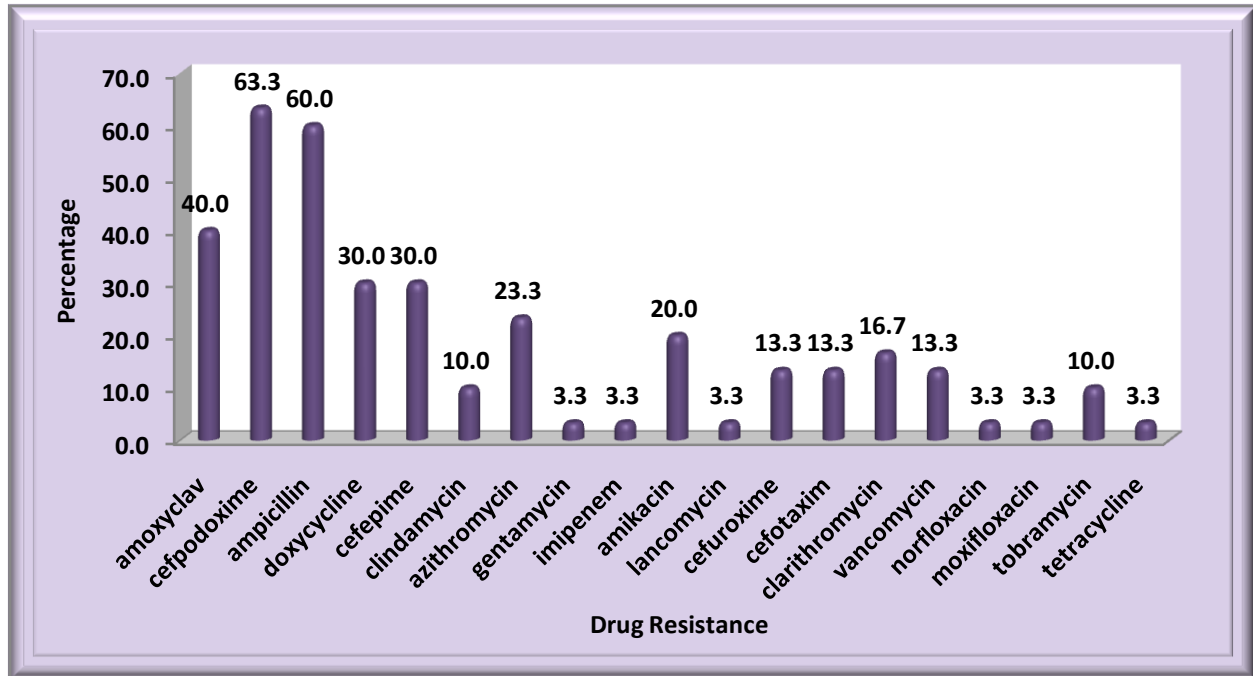


Figure 3:- Drug Resistance.

Discussion:-

Most orofacial infections are of odontogenic origin. Dental pulp infection, as a result of caries, is the leading cause of odontogenic infection. Once bacteria invade the dental pulp, an inflammatory reaction results in necrosis and a lower tissue oxidation-reduction potential. At this stage, the bacterial flora changes from predominantly aerobic to more anaerobic flora. Anaerobic gram-positive cocci and anaerobic gram-negative rods predominate. The infection progresses, forming an abscess at the apex of the root, resulting in bone destruction. Depending on host resistance and bacteria virulence, the infection may spread into the marrow, perforate the cortical plate and spread to the surrounding tissues.

Additionally, the anaerobic bacteria inhabiting the periodontal tissues may provide an additional source of odontogenic infection. Most odontogenic infections (70%) contain mixed aerobic and anaerobic bacteria. Pure aerobic infections have less than a 5% incidence. Pure anaerobic infections have a 25% incidence. The consensus by researchers is that in early odontogenic infections, bacteria are aerobic with gram-positive, alpha-hemolytic streptococci predominating. As the infection matures and increases in severity the microbial flora become a mix of aerobes and anaerobes. The anaerobes found are determined by the site of origin; pulpal or periodontal. As the host defenses begin to control the infection process, the flora becomes predominantly anaerobic. This study has been undertaken to identify the predominant organism present in the odontogenic infections of the head and neck region.

For centuries, the diagnosis and treatment of deep neck space infections have challenged physicians and surgeons. The complexity and the deep location of this region make diagnosis and treatment of infections in this area difficult. These infections remain an important health problem with significant risks of morbidity and mortality. In the past, odontogenic infections of the head and neck region were associated with high rates of morbidity and mortality. The overwhelming complication rate of the past has been reduced with the advent of modern microbiology and hematology, the development of sophisticated diagnostic tools (eg, CT, MRI), the effectiveness of modern antibiotics and the continued development of medical intensive care protocols and surgical techniques. Treatment of localized infection was probably the first primitive surgical procedure performed and it most likely involved the opening of bulging abscesses with sharp stones or pointed sticks. Today, the principle remains the same; fortunately technique has improved¹⁸. Although therapy has progressed; the scalpel, extraction forceps and the endodontic reamer remain the keystones of therapy for odontogenic infections, along with the judicious use of antibiotics. The surgical treatment involves the incision and drainage either by Hilton's method¹⁹ or by Vazirani technique²⁰.

Antibiotic resistance is the resistance of a bacterium to anti-bacterial medication that used to be effective in treating or preventing an infection caused by that bacterium. There are 4 main mechanisms by which resistance can occur:

1. The prevention of access to the target by reduced cell membrane permeability and/or increased efflux
2. Changes in antibiotic target by mutation
3. The modification/protection of the target and
4. Direct modification of antibiotic.

Bacteria that are resistant to multiple drugs are called Multiple Drug Resistant (MDR) bacteria. Present increase in the usage of antibiotics in a massive manner has led to the development of resistance by many bacteria, thus requiring newer drugs and combinations to combat the infections.

Antibiotic sensitivity or Antibiotic susceptibility is the susceptibility of bacteria to antibiotics. Because susceptibility can vary even within a species (with some strains being more resistant than others), antibiotic susceptibility testing (AST) is usually carried out to determine which antibiotic will be most successful in treating a bacterial infection in vivo. Testing for antibiotic sensitivity is often done by the Kirby-Bauer method. We have done a study to identify the drugs to which the microbes of the odontogenic infections of the head and neck region are sensitive to and also those drugs to which they are resistant so as to prescribe an effective medication for the early recovery of the patient. Ideal antibiotic therapy is based on determination of the etiological agent and its relevant antibiotic sensitivity. Empiric treatment is often started before laboratory microbiological reports are available as the treatment should not be delayed due to the seriousness of the disease. The effectiveness of individual antibiotics varies with the location of the infection, the ability of the antibiotic to reach the site of infection and the ability of the bacteria to resist or inactivate the antibiotic.

In this study, the cotton swab containing pus was processed in the laboratory using gram staining. For aerobic cultures, the samples were inoculated on blood agar and nutrient broth. For the anaerobic cultures, the samples were inoculated on plain blood agar, McConkey's agar and streaked. Supplements added were 5% sheep blood, 0.5mg% haeme and 0.05mg/dl menadione. All aerobic cultures were incubated at 37⁰C for 24 hours while the anaerobic cultures were incubated at 37⁰C for 5 to 7 days. The predominant organism isolated was Klebsiella followed by Proteus and Pseudomonas. The procedure included gram staining of the smear followed by inoculation onto Columbia blood agar and incubation in 5% carbon dioxide at 37⁰C for aerobic cultures. Fastidious anaerobe agar supplemented with 7.5% wt/vol defibrinated horse blood and incubation in an anaerobic chamber of atmosphere 85% nitrogen, 10% CO₂ and 5% hydrogen at 37⁰C for anaerobic cultures.

According to this study, the most common pathogen isolated from the odontogenic infections of the head and neck region was Klebsiella (43%) followed by Proteus (26%) and Pseudomonas (23%) respectively. The microorganisms were sensitive to Ciprofloxacin (63%), Amikacin (46%) and Moxifloxacin (30%) while resistance was shown for Ampicillin (60%), Cefpodoxime (56%) and Amoxycylav (40%). Thus, we can infer that the odontogenic infections of the head and neck region can be effectively treated by using Ciprofloxacin and Amikacin.

Conclusion:-

This study was done to identify the main organism responsible for the presence of pus in the odontogenic infections of the head and neck region. Also to know the drugs to which the organisms are sensitive and resistant so that effective medication can be prescribed to the patient. The predominant organism identified in a total of 30 patients (10 male and 20 female) was Klebsiella followed by Proteus and Pseudomonas. They were mostly sensitive to Ciprofloxacin followed by Amikacin and Moxifloxacin while resistance was shown to Ampicillin followed by Cefpodoxime and Amoxycylav. Hence it can be concluded that the effective medication for the management of odontogenic infections of the head and neck region is the usage of Ciprofloxacin or Amikacin or Moxifloxacin. Still considering the small sample size, extensive research has to be carried out on a large sample to bring out effective medication for the patients suffering from the odontogenic infections of the head and neck region.

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