ACTA SCIENTIFIC DENTAL SCIENCES
Volume 9 Issue 3 March 2025

Research Article

Microbial Flora in Odontogenic Infection - A Comparative Analysis in Diabetic and Non-Diabetic

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DOI: 10.31080/ASDS.2025.09.1991

Received: February 06, 2025
Published: February 26, 2025

Abstract

Head and neck space infections, often stemming from untreated dental issues like caries or periodontitis, can progress to abscesses penetrating facial planes, posing serious complications. Diabetes mellitus increases infection susceptibility due to immune system alterations, fostering a vicious cycle where hyperglycemia exacerbates infections and vice versa. This study compared 40 patients with head and neck space infections, dividing them into diabetic (Group 1) and non-diabetic (Group 2) groups. It aimed to evaluate the types and number of involved odontogenic spaces, Causative microorganisms and their antibiotic susceptibility, and Duration of hospital stay. Significant differences emerged be- tween groups, particularly in causative organisms and clinical outcomes. Non-diabetic patients generally recovered faster with minimal antibiotics, contrasting with diabetic patients who often required more extended hospital stays, likely due to more severe infections and slower healing. Variations in antibiotic sensitivity were also noted, underscoring the importance of tailored treatment strategies based on diabetic status. This research underscores the critical role of managing diabetes in the context of head and neck infections, highlighting the need for personalized care approaches to optimize outcomes in these patients.

Keywords: Comparative Analysis; Facial Planes; Hyperglycemia; Odontogenic; Diabetics; Infection

Introduction

Odontogenic infections are infections that originate within a tooth or in the closely surrounding tissues. The spread of infection is determined by factors such as impaired host defence, the virulence of microorganisms, functional abnormalities of the host, and delayed treatment.

Diabetes mellitus can make a patient more susceptible to bacterial infections, leading to significant morbidity and mortality, due to lower production of interleukins in response to infection, reduced chemotaxis and phagocytic activity, immobilization of polymorphonuclear leukocytes and dysfunction in neutrophil bactericidal function, cellular immunity, and complement activation. These dysfunctions are responsible for a higher incidence and severity of infections in diabetic patients compared with healthy individuals [9].

The association between diabetes and periodontal disorders has been very well recognized in the literature [6]. It was identified as the sixth complication of diabetes in 1993 [7,8]. The oral cavity comprises more than 500 bacterial species. Odontogenic infections are generally polymicrobial [11]. Generally, in the orofacial region, most bacterial infections involve either a disturbance of the normal flora or displacement of the normal organisms to the site, where they are usually not seen [12].

Approximately, 5% of odontogenic infections are caused by aerobic bacteria, 35% are due to anaerobic bacteria, and the remaining 60% are caused jointly by aerobes and anaerobes. The microbiology of odontogenic infections in diabetic and non-diabetic individuals is variable. Among diabetic patients, a high prevalence of oropharyngeal colonization by Gram-negative bacteria might be a critical factor contributing to their increased susceptibility to focal infections [13]. Most odontogenic infections are resolved by the removal of the source of infection and systemic antimicrobial agents. Appropriate and effective antibiotics against causative organisms are essential in managing head and neck space infections [12].

These antimicrobial agents are selected empirically, but the main factors behind the choice are susceptibility of the likely microorganisms, the pharmacological properties of the drugs, the best way to give them; and their potential toxicity and side effects. Although pus cultures obtained from needle aspiration or surgical drainage can be a guide in choosing the antibiotics; empirical antibiotics are important before culture results become available.

The purpose of this study was to compare the type and number of odontogenic spaces involved, microorganisms causing infection, Antibiotic susceptibility and duration of hospital stay in diabetic versus non-diabetic individuals. The outcome of this study will help the maxillofacial surgeon gain knowledge of common pathogens and their resistance status, which will guide them towards an appropriate selection of empirical antibiotics.

Materials and Methodology

The study was conducted on 40 patients with Head and Neck Space Infection with Diabetes mellitus and Nondiabetic Individuals. A written consent form was obtained from each candidate after the nature of the study had been fully explained. A thorough case history was taken, and all the patients were divided into two groups

- **Group 1 (Diabetic patients):** Patients who presented with maxillofacial infections of odontogenic origin and fasting sugar level higher than 130 mg/dl or with a known history of diabetes mellitus.
- **Group 2 (Nondiabetic patients):** Patients presenting with maxillofacial infections of odontogenic origin and fasting sugar level less than 130 mg/dl or with no previous history of medical management of hyperglycemia.

Procedure

Preoperative

- Patient's detailed Case History was taken.
- Intraoral periapical radiograph/Orthopantomography of involved tooth or region to assess spaces involved.
- Patient's blood sample of Group A and Group B was collected to evaluate the blood glucose level.

Intraoperative

Collection of (pus) specimens for the assessment of involved microorganisms.

The sample was aspirated in a sterile 20 cc disposable syringe.

Microbiology assessment

Culture sensitivity test

A culture is a test to find an organism that can cause an infection. A sensitivity test checks to see what kind of medicine will work best to treat infection.

Culture and sensitivity test is a method of multiplying microbial organ- isms in a predetermined culture media with favourable conditions and tests performed to check the sensitivity of organisms towards the drugs. The test was done on the pus sample to identify the presence of the pathogenic organism. The bacteria form colonies-large groups of bacteria that were exposed to different antibiotics. Identification of the bacteria was made with various techniques, including examination of growth characteristics colour, texture, growth pattern, etc. Gram staining, microscopic examination, metabolic requirements. Antibiotic sensitivity was done by the Kirbybaure disc diffusion method.

Kirby-Baure Disc-Diffusion Method

- The sample (microbial) was transferred to the growth media (Mueller- Hinton agar) with the help of a swab.
- A growth medium, usually Mueller-Hinton agar, is first even seeded through- out the plate with the isolate of interest that has been diluted at a standard concentration. (approximately 1 to 2 x 10 colony forming units per ml)
- Then, using a dispenser, antibiotic-impregnated disks are placed onto the agar surface.
- As the bacteria on the lawn grow, they are inhibited to varying degrees by the antibiotic diffusing from the disk.
- The test antibiotic immediately begins to diffuse outward from the discs, creating a gradient of antibiotic concentration.
- Place the metric ruler across the zone of inhibition, at the widest diameter, and measure from one edge of the zone to the other edge.
- The disc diameter will be part of that number.
- If there is NO zone at all, report it as 0-even though the disc itself is around 7 mm.

- Zone diameter is reported in millimetres, looked upon the chart, and the result reported as S (sensitive), R (resistant), or I (intermediate).

Parameters included were

- Type and number of spaces involved.
- Duration of hospital stay.
- Causative microorganisms.
- Antibiotic sensitivity of the organisms cultured to the following antibiotics: amoxicillin, amoxicillin with clavulanic acid, metronidazole, ornidazole, gentamycin, cefoperazone, cefadroxil, ampicillin, ofloxacin, ceftriaxone. These antibiotics were selected based on current usage in the hospital and based on a review of the literature.

Results and Discussion

An odontogenic infection spreads to fascial spaces because the anatomy of the fascial planes of the head and neck is such that it has an ineffective barrier to the spread of infection, and plays a vital role in the clinical localization of an abscess [25]. The area of least resistance usually governs the spread of infection with the host defence mechanism and virulence of the organism playing an important role as well [4].

Fascial spaces can be divided into Primary spaces and Secondary spaces.

In current study total 10 types of spaces involved; In primary spaces: Sub-mandibular space, Sublingual space, Submental space, Buccal space, Canine space, Infraorbital space and secondary spaces: Submassetric space, Temporal space, lateral pharyngeal space and pterygomandibular space. In this study the secondary spaces are more commonly seen in diabetic group as compared to the nondiabetic group.

Rega., *et al*. [16]. and Kamat., *et al*. [13]. noticed in their studies that the sub-mandibular space was the most frequently involved. Similarly in our study, the most commonly involved space in both the diabetic and nondiabetic groups was the submandibular space, followed by the buccal space infection and submasseteric space infection. Similar results were observed by Rao., *et al*. [1]. in 2010 and G. C. Mathew., *et al*. [1]. in 2012.

This study shows in diabetic group, submandibular space infections were highest in number with 15 patients (24.52%), followed by Submasseteric space infection 10 patients (16.34%). There were 9 patients (14.75%) who had Buccal space infection and 6 (9.83%) participants who had pterygomandibular space infection. Lateral pharyngeal space infection, Submental space infection and Sublingual space infection were seen in 4 patients (6.55%) individually. Ca- nine space infection, Infratemporal space infection and temporal space infection were seen with 3 patients (4.92%) each. Whereas in nondiabetic Group, after 17 (36.96%) submandibular space infection, buccal space infection was seen with 7 patients (15.21%), followed by Submental space infection 6 patients (13.04%). Submasseteric space and pterygomandibular space infection were seen in 5 patients (10.86%). Lateral pharyngeal space infection was seen only in 1 patient (2.17%) (Table 1).

Causative organism

Common odontogenic infections are usually associated with five or more types of bacterial strains - including both aerobic and anaerobic bacterial colonies rather than just a single strain. Aerobic Streptococcus is a predominant bacterial strain at the beginning of the infection, and anaerobic bacteria gradually increased as the infection become chronic [2] Warnke., *et al*. [39]. reported in their study that several bacterial strains formed colonies in 98% of patients with abscesses. Streptococcus Viridans was the most common strain noted in their study.

In this study, out of 40 patients of both the groups, 6 patients showed No growth, 4 patients (17.39%) in diabetic Group and 2 patients (9.52%) in the nondiabetic Group. This may be attributable to anaerobic infections, collection of a sample after antibiotic dose (inaccurate history from the patient), and occasionally loss of organisms during handling, transportation, and processing of the samples. Similarly no growth was noticed in the study conducted by Rao., *et al*. [4]. T.-T. Huang., *et al*. [17]. observed in their study that the most common organism in diabetic patients was Klebsiella pneumoniae versus viridans streptococcus in nondiabetic patients. Similarly organisms isolated in this study were Klebsiella species, Pseudomonas, Staphylococcus aureus and Streptococcus species in both the groups. Klebsiella pneumonia (34.78%,8 patients) was the most commonly isolated organism in diabetic group, followed by Pseudomonas species (26.08%,6 patients). Whereas in the non-diabetic group the most commonly isolated organism was staphylococcus aureus (47.61%, 10 patients) followed by Pseudomonas species (33.33%, 7 patients). Whereas in diabetic Group, staphylococcus aureus was seen in 4 patients (17.41%). The Streptococcus species isolated in 1 patient (4.34%) in the diabetic population and 2 patients (9.52%) in the non-diabetic population. (Figure 1).

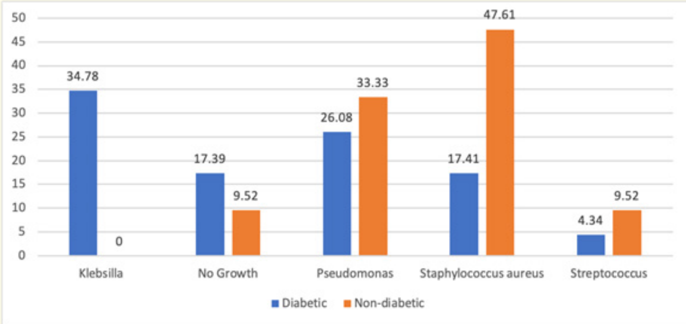

Figure 1: Distribution of participants based on causative organism.

Antibiotic sensitivity and resistance

Antibiotic sensitivity testing was performed on the pathogens that were isolated. Most commonly used antibiotics in the maxillofacial unit were Amoxicillin, metronidazole, ornidazole, Gentamycin, cefoperazone, cefadroxil, ofloxacin, ceftriaxone, cefotaxime, Ampicillin. Klebsiella pneumonia is a Gram-negative, non-motile, encapsulated, facultative anaerobic, rod-shaped bacterium. In a reviewed study conducted by C.M. Chang., *et al*. [15]. in 2003, uniformly resistant to ampicillin, and all but one strain were susceptible to all cephalosporins.

In this study, Klebsiella pneumoniae isolated in 8 patients in diabetic patients, it showed 100% sensitivity to Amoxicillin, 1st generation cephalosporin namely cefadroxil, 3rd generation cephalosporin namely cefotaxime, ceftriaxone; Nitroimidazole namely Ornidazole, Metronidazole and ofloxacin, individually. Whereas it showed 50% (4 patients) resistance to Ampicillin and Gentamycin individually and 37.5% (3 patients) resistance to Cefoperazone (Figure 2).

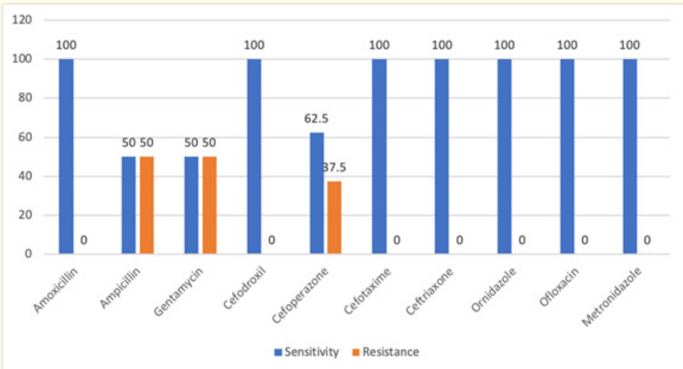

Figure 2: Distribution of antibiotic sensitivity and resistance for Klebsiella species in diabetic group.

Staphylococcus aureus, is a gram-positive coccus, a facultative anaerobe that grows by aerobic respiration or by fermentation that yields principally lac- tic acid. Because antibiotics are widely used in hospitals, hospital staff members commonly carry resistant strains. When people are infected in a healthcare facility, the bacteria are usually resistant to several types of antibiotics, including almost all antibiotics that are related to penicillin (called beta-lactam antibiotics).

Strains of bacteria that are resistant to almost all beta-lactam antibiotics are called methicillin-resistant Staphylococcus aureus (MRSA). In this study, it showed 100% sensitivity to cefadroxil, cefotaxime, Ornidazole, Metronidazole and ofloxacin in both the groups. In the diabetic group, it showed 100% sensitivity to Amoxicillin, ceftriaxone. It showed resistance to Ampicillin in 25% (1 patient) of the diabetic group and 30% (3 patients) of nondiabetic Group.

Resistance to Gentamicin in 50% (2 patients) of diabetic people and 60% (6 patients) of nondiabetic Group. 25% (1 patient) from diabetic Group showed resistance to Cefoperazone, whereas 50% (5 patients) of nondiabetic Group showed resistance to Cefoperazone. 20% (2 patients) from nondiabetic Group showed resistance to Amoxicillin and 40% (4 patients) resistance to ceftriaxone (Figure 3).

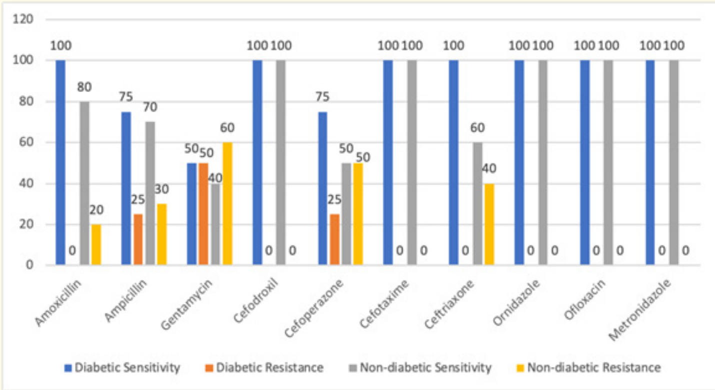

Figure 3: Distribution of antibiotic sensitivity and resistance for staphylococcus species in both groups.

Streptococcus viridans, aerobic gram-positive cocci were isolated in 1 patient in the diabetic group, and it showed 100% resistance to Ampicillin. Whereas in the nondiabetic Group, it was isolated in 2 patients and showed 50% resistance to 3rd generation cephalosporin. In a study conducted by Walia., *et al*. [25]. streptococcus viridans showed resistance in 25% and was susceptible in 75% to penicillin as well as to Erythromycin and Gentamicin [25].

Pseudomonas aeruginosa, is a gram-negative, facultative aerobe, rodshaped, a sporogenous and mono flagellated bacteria that has incredible nutritional versatility. It is an opportunistic pathogen.

Walia., *et al*. [25]. noted in their study that pseudomonas was 100% resistant to Amikacin, but was sensitive to Cephotaxime, Cefuroxime and Ciprofloxacin.

Whereas in our study, it isolated 26.08% of the diabetic group and 33.33% of the nondiabetic group. It showed 100% sensitivity to Amoxicillin, 3rd generation cephalosporin namely cefotaxime, ceftriaxone; Nitroimidazole namely Ornidazole, Metronidazole and ofloxacin in both the groups. Whereas it showed 16.66% resistance to Ampicillin and Gentamycin individually and 83.34% resistance to 1st generation cephalosporin namely cefadroxil, 3rd generation cephalosporin namely Cefoperazone, individually in diabetic patients. In nondiabetic patients, it showed resistance to Ampicillin and Gentamycin in 14.28%, individually and 71.42% resistance to cefadroxil and 85.71% to Cefoperazone (Figure 4).

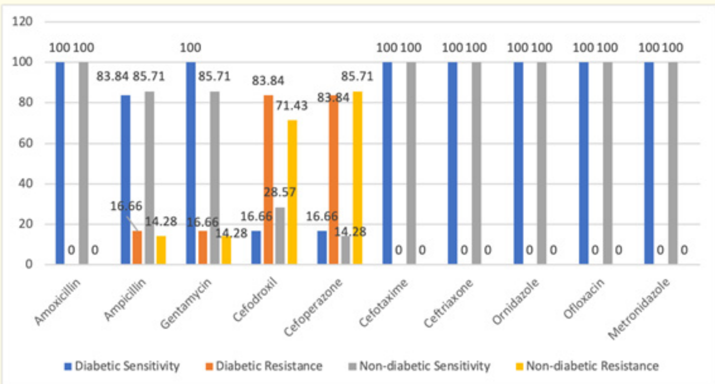

Figure 4: Distribution of antibiotic sensitivity and resistance for pseudomonas species in both groups.

In literature, studies have shown that the basic beta-lactam antibiotics are key antibiotics to be started for treating odontogenic infections as these infections are predominantly of gram-positive aerobes [25].

It was noted in the study that the response to intravenous antibiotics was more favourable, as the symptoms subsided faster with them when compared with oral antibiotics in less duration of time, thus reducing the requirement of hospital stay. In our study, the hospital stay of patients in the diabetic group was found to be relatively longer as compared to the non-diabetic group, 6.60 days and 5.50 days, respectively. the same results had been obtained in the previous studies conducted by Chen., *et al*. [14], Huang., *et al*. [8], Chang., *et al*. [2], and Kamat., *et al*. [13].

Conclusion

In conclusion, The foundation of management of odontogenic infections in the head and neck region remains the same in diabetic and nondiabetic patients that include controlling the source of infection, drainage, and adjunctive antimicrobial therapy.

The following conclusions can be formed from the findings of the present study

- The submandibular space was the most commonly involved in both groups, irrespective of glycemic level.
- The organism most commonly isolated in diabetic patients was Klebsiella pneumonia, whereas in nondiabetic patients was Staphylococcus aureus.
- The diabetic population most commonly presented with multiple spaces involved, whereas the nondiabetic population presented with single space infection and secondary spaces like Submassetric space, Temporal space, lateral pharyngeal space and pterygomandibular space were more commonly seen in diabetic group compared to non-diabetic group.

Antibiotic sensitivity results of the study surprisingly showed 100% sensi- tivity to Amoxicillin, metronidazole, ofloxacin and ornidazole. So as per the study, the empirical treatment line consisting of synergism of Amoxi- cillin and metronidazole is efficient in controlling the spread of infection.

The duration of hospital stay was longer in the diabetic group as compared to the non-diabetic group.

Statement and Declaration

- **Funding:** The authors did not receive any funds, grants or support from any organization for the submitted work.
- **Competing Interest:** The authors have no relevant financial or non-financial interests to disclose.
- Ethics Approval: Ethical appproval was obtained from the Institutional Ethics Committee (IEC)

Consent to participate Informed consent was obtained from all individual participants included in the study.

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