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Antibiotic sensitivities pattern in clinical management of maxillofacial odontogenic infection

Abstract

Background: Globally, greater than 90% of infections in the head and neck region are of odontogenic origin. Several species of bacteria present in the mouth that exploit the circumstances of human immunity and oral hygiene to cause infections which can spread to the facial region, neck and to the rest of the body leading to serious outcome. Various bacteriological studies show variations in their conclusion. Objective: The aim of this study was to provide evidence of the most prevalent organisms involved in orofacial space infections and the most effective antibiotics for maxillofacial odontogenic infection (OMI).

Material and methods: Sixty patients clinically diagnosed as OMI were enrolled in this study selected from different polyclinics from dental department at Jeddah area, Saudi Arabia. The mean age of patients was 31.4±17.26 year (35 males and 25 females). Inclusion criteria were patients with maxillofacial infections that assessed radio-graphically using periapical or panoramic views and patients had swelling intra-oral and/or extra-oral, fistula, redness, trismus, and lymphadenopathy. Exclusion criteria included patients already on antibiotics and medically compromised patients (diabetic, hepatitis, and HIV+).

Results: The most commonly involved facial space was the combination of buccal and submandibular space that was involved in 46.67% of patients. While, among the entire aerobically cultured bacteria, Ciprofloxacin and Amoxicillin/clavulanic acid were the most sensitive drug with 97% and 95% of sensitivity respectively, followed by Clindamycin 88% and Cefotaxime (80%). The least effective drug was amoxicillin 18% (Table 4). While, among the entire anaerobically cultured bacteria, Metronidazole was the most sensitive drug (93%) followed by Ciprofloxacin, Amoxicillin/clavulanic acid and Clindamycin with 90%, 87% and 85% of sensitivity respectively, where Cefotaxime was 78%. Conclusion: Maxillofacial odontogenic infection (OMI) is usually poly-microbial, consisting of a complex mixture of both anaerobes and aerobes. Ciprofloxacin, Amoxicillin/clavulanic acid and Clindamycin were the most effective drugs for all isolates of OMI and the least effective drug was amoxicillin of OMI. Early surgical intervention along with selective antibiotics can stop these infections spread to deeper spaces of face and neck and hence many untoward complications can be avoided.

Keywords: antibiotic sensitivity test, surgical management, maxillofacial odontogenic infection

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Introduction

Odontogenic Maxillofacial Infections (OMI) and majority of them arise from teeth but can spread to the alveolar process and deeper tissues of the max¬illofacial region.[1] Spreading OMI is a serious illness.[2] The facial spaces of head and neck represent major pathways for the spread of deep infections.[3] The human oral cavity as a biological system contains many species of microorganisms. When these microorganisms penetrate into deeper tissues or in case of compromised host resistance and bacterial infections they manifest as diseases.[4] The infections of orofacial region are commonly dental in origin and they are ranging from simple periapical abscess to severe infection involving the facial planes in head and neck region and may sometimes threaten the life of the patient.[5] The clinical course and spread of OMI depends on multiple factors including anatomy of teeth, muscle attachment and host defense mechanism.[6] Potential complications of these infections consist of orbital infections,[7] necrotizing fasciitis,[8] cavernous sinus thrombosis,[9] cerebral abscess[10] and mediastinitis.[11]

When bacteria get access to deeper tissues, they will cause odontogenic infections, in the state of sufficient pathogenic bacteria and a weak body condition, infections may spread to various spaces in the oral cavity.[12,13] Early diagnosis, identification of microorganisms through culture and antibiotic sensitivity, prompt antibiotic treatment together with early removal of cause should prevent most complications and resulting in early recovery, therefore management of these infections involves both surgical and supportive therapy.[14]

The study was carried out to find out the types of microbial flora and their antibiotic sensitivity in isolates of maxillofacial odontogenic cellulitis patients. The already published researches have provided great input but the local data is lacking. This study provides local evidence of the most prevalent organisms involved in orofacial space infections and the most effective antibiotics for maxillofacial odontogenic cellulitis patients. This will also improve our services of dental practice and will provide local guidelines to manage maxillofacial odontogenic cellulitis patients by dental practitioners.

Patients and methods

Subjects

Sixty patients clinically diagnosed as oral and maxillofacial infections of odontogenic origin enrolled in this study. They were

selected from different polyclinics dental department at Jeddah area, Saudi Arabia. The mean age of patients was 31.4±17.26 year, of both gender (35 males and 25 females). Inclusion criteria were patients with maxillofacial infections that assessed radio-graphically using periapical or panoramic views and patients had swelling intra-oral and/or extra-oral, fistula, redness, trismus, and lymphadenopathy. However, patients already on antibiotics and medically compromised patients (diabetic, hepatitis, and HIV+). Were excluded from the study as these patients could have a low immune system which will allow other microorganisms of low virulence to be cultured not commonly found in facial space infections and therefore interfere with the present study design. Informed consent was taken from all the patients prior to the study.

Procedures

The routine case history, clinical examination, and pre-anesthetic evaluations were carried out before these patients underwent surgical decompression/drainage either under local anesthesia or under general anesthesia. The surgical drainage/decompression was carried out under local anesthesia or general anesthesia, and drains were placed intra-orally/extra-orally as required.

Postoperatively all the patients were maintained on intravenous Cephataxime (1g tid) till culture report was obtained and after that the specific antibiotics were started if necessary.

Collection of the pus samples: The selected patients presenting with orofacial infections of odontogenic origin. The site of specimen collection was disinfected with povidone- iodine prior to specimen collection. For bacteriological examination, usual painting and draping was carried out in all the cases. The specimen (pus/exudates) was collected by aspiration with 18-gauge needle in a syringe with routine aseptic precautions before drainage. The needle was closed immediately with the plastic cap to avoid contamination.

Specimen culture: A part of this sample was immediately injected in two separate bottles with airtight corks, containing a nutrient broth and Thyoglycollate media for aerobic and anaerobic microflora isolation, respectively. The remaining part of the sample from the syringe was used to prepare slides to examine the microorganisms under the microscope. The samples were sent to laboratory within an hour for further processing.

Identification of microbes and antibiotic sensitivity: After incubation for 48–72 hours, all sets of plates were visualized for growth followed by biochemical tests were done to identify the genus and species of bacteria. In the laboratory following steps were done to confirm the microflora from the sample:

Identification of aerobic microorganisms: Assay time/turnaround time was 2 days. The pus sample was aseptically plated on blood agar plate and on MacConkey's agar plate to make a primary well. Subsequently spreading was done by a nichrome wire loop. Both the plates were streaked aseptically and Incubated under aerobic conditions at 37°C for 24 hours. The colonies on both the plates were recorded. Blood agar plate was used for all organisms and MacConkey's agar plate was for gram negative organisms. The morphology was confirmed with gram staining.

Identification of anaerobic microorganisms: Assay time/turnaround time was 5 days. The pus sample in Thioglycollate broth was inoculated in the same and incubated at 37°C overnight. Subculture was done on blood agar and it was immediately put in an anaerobic biobag with indicator. The bag was sealed with parafilm. Incubation was done at 37°C for 48 hours. The growth of colonies was observed and recorded by following Gram staining. Aerotolerance testing was done. If the colony grows on aerobic culture, it is unlikely to be an obligate anaerobe. If no growth occurs on aerobic culture, the organism is presumptively identified by means of gram reaction, colony characters, and available biochemical tests. If required antimicrobial susceptibility is done on blood agar with disc diffusion technique. Zone of inhibition is measured by the help of the WHO quality control chart to access the antibiotics sensitivity.[15]

Statistical analysis

All the data were collected and entered in IBM SPSS version 21 and analyzed through its statistical package. Frequency distributions and percentages for all the variables were worked out and results were analyzed and presented in tables. Quantitative variables were calculated in mean and standard deviation whereas the qualitative variables were assessed in frequency and percentage ($P<0.05$).

Results

Demographic and clinical data: In the present study 60 patients with maxillofacial odontogenic infection were considered. They were selected from different polyclinics from dental department at Jeddah area, Saudi Arabia, the mean age of patients was 31.4±17.26 year, 35 of them were males and 25 of them were females. Thirteen (21.67%) were smokers and forty-seven (78.33%) were non-smokers. Mean duration of presence of clinical symptoms was 3.2±0.97day. All patients (100%) presented with swelling of facial region while pain was of varying intensity among all patients based on visual analogue scale. Limited mouth opening was present in 41 (68.33%) patients at the time of first inspection. fever was a clinical symptom among 38 patients (63.34%). Regarding the Etiology of OMI, the periapical source, pericoronitis, deep periodontal pockets affected 76.65%, 18.33% and 5.02% of cases respectively (Table 1).

Distribution according to maxillofacial involved space: The Submandibular space was most frequently found in 28 patients (46.67%) followed by Buccal space in 17 patients (28.33%), submandibular in 7 patients (11.67%), Infraorbital space in 3 patients (5%), Vestibular space in 2 patients (3.34%), Palatal space in 2 patients (3.34%) and Submental space in 1 patient (1.59%) (Table 2).

Distribution of Bacterial isolates among studied patients: Mixed infection (31 patients representing 51.7%), aerobic organism only (23 patients representing 38.3%) and anaerobic organism only (6 patients representing 10%) respectively were the bacterial isolates distribution found in the selected samples (Table 3). The most commonly isolated micro-organisms were, Streptococcus spp (46.7%), Staphylococcus spp (28.4%) and Klebsiella spp (14.9%) respectively representing the aerobic bacterial results among studied patients. While, the most common isolated organism was Prevotella spp. (41.2%) and Peptostreptococcus spp. (20.5%) respectively representing the anaerobic bacterial results among studied patients.

Distribution according to antibiotic sensitivity pattern: Among the entire aerobically cultured bacteria, Ciprofloxacin and Amoxicillin/clavulanic acid were the most sensitive drug were 97% and 95% respectively, followed by Clindamycin 88% and Cefotaxime 80%. The least effective drug was amoxicillin (18%) (Table 4). While, among the entire anaerobically cultured bacteria, Metronidazole (93%) was the most sensitive drug followed by Ciprofloxacin, Amoxicillin/clavulanic acid and Clindamycin were 90%, 87% and 85% respectively, where Cefotaxime was 78% (Table 5).

Surgical drainage and removal of cause of infection: Extraction of involved tooth and intraoral incision & drainage of abscess was the surgical procedure done for 71.67%. While 13.34% of patients required endodontic treatment of involved tooth and intraoral incision & drainage of abscess. However, 11.67% of patients required extraoral incision and drainage of abscess. Finally, extraction of involved without incision & drainage of abscess required for 3.32% of patients (Table 5).

Table 1 Clinical data and etiology of odontogenic maxillofacial infections (OMI)

Parameter		Number	Percentage (%)
Clinical Data	Gender (male: female)	35:25	58.34% : 41.66%
	Smoking (smokers: nonsmokers)	13:47	21.67% : 78.33%
	Pain and swelling in facial region	60	100%
	Fever	38	63.34%
	Limited mouth opening	41	68.33%
Etiology	Periapical source (Carious tooth/Necrotic pulp)	46	76.65%
	Pericoronitis	11	18.33%
	Deep Periodontal Pockets	3	5.02%
	Total	60	100%

Table 2 Maxillofacial involved space in odontogenic infections

Maxillofacial involved space	Number	Percentage (%)
Submandibular and Buccal	28	46.67%
Buccal	17	28.33%
submandibular	7	11.67%
Infraorbital	3	5%
Vestibular	2	3.34%
Palatal	2	3.34%
Submental	1	1.59%
Total	60	100%

Table 3 Distribution of Bacterial isolates among studied patients

Bacterial Isolates	Number	Percentage (%)
Mixed infection	31	51.7%
Aerobic organism only	23	38.3%
anaerobic organism only	6	10%
Total	60	100%

Table 4 Antibiotic sensitivity pattern for aerobically cultured bacteria

Antibiotic	Sensitivity		Resistant	
	Number	Percentage (%)	Number	Percentage (%)
Ciprofloxacin	58	97%	2	3%
Amoxicillin/clavulanic acid	57	95%	3	5%
Clindamycin	53	88%	7	12%
Cefotaxime	48	80%	12	20%
Amoxicillin	11	18%	49	82%

Table 5 Antibiotic sensitivity pattern for anaerobically cultured bacteria

Antibiotic	Sensitivity		Resistant	
	Number	Percentage (%)	Number	Percentage (%)
Metronidazole	56	93%	4	7%
Amoxicillin/clavulanic acid	54	90%	6	10%
Clindamycin	52	87%	8	13%
Ciprofloxacin	51	85%	9	15%
Cefotaxime	47	78%	13	22%

Table 6 Surgical drainage and removal of cause of infection

Surgical Procedure	Number	Percentage (%)
Involved tooth Extraction and intraoral incision & abscess drainage	43	71.67%
Involved tooth endodontic treatment and intraoral incision & abscess drainage	8	13.34%
Extraoral incision & abscess drainage	7	11.67%
Involved tooth Extraction without incision & abscess drainage	2	3.32%
Total	60	100%

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Discussion

Studies show that the pyogenic infections are majority of odontogenic origin in head and neck region and their common causes are dental caries, pericoronitis, periodontitis, trauma or complications from dental procedures that require using broad spectrum antibiotics.[16–19] This study aimed to provide evidence of the most prevalent organisms involved in orofacial space infections and the most effective antibiotics for maxillofacial odontogenic infection.

The present study results proved that OMI is a frequent encountered problem in dental surgeries and often require referral to maxillofacial surgeons which agreed with previous studies.[20,21] Even the influence of tobacco smoking as a risk factor in development of OMI is not very clear in the literature, but the role of smoking in the pathogenesis of periodontal disease is evident.[22] In the present study 21.67% patients had history of tobacco smoking, while a previous study found that the prevalence of smokers among OMI patients was 80%.[23] However, pain and swelling were the two most common presenting complaints as 100% of patients presented with swelling that confirms the data of other studies where pain in the facial region as a presenting symptom was reported as 89.47%,[24] 97%[21] and 96%.[25] While 63.34% and 68.33% of patients in this study had fever and limited mouth opening due to OMI. In many other studies fevers of varying degrees were reported in patients of OMI which indicate that an increase in temperature is a sign of spreading OMI in facial spaces.[25,26] Moreover, regarding the etiology of OMI, carious teeth with periapical infection was the most common etiological factor in the development of OMI in the present study group that was present in 76.65% of patients followed by Pericoronitis in 18.33% of patients. These data agreed with Han et al., 2016 reported periapical origin in 60.3% cases followed by pericoronitis in 27.4% cases[25] and with Methew et al.[21] reported that the pulpal origin of OMI reported in 71% cases followed by periodontal 17% and pericoronitis in 5% cases.[21]

In the present study, the most commonly involved facial space was the combination of buccal and submandibular space that was involved in 46.67% of patients. This data is comparable with the data of other studies which reports involvement of submandibular space infection in 54.6%,[25] 47.2%[27] and 29.1%.[28] Submandibular space is in close proximity to mandibular molar and buccal space which is the reason for affected first with by the septic process, and spread to the facial level. Second most common space involvement in this study was the buccal space in 28.33% of patients. Zhang et al.,[29] in their study also reported similar results and in their patient's buccal space was involved in 26% cases [29]. The reason of common involvement of buccal space is that infection from both maxillary and mandibular posterior teeth can drain in buccal space. In the other hand, many studies reported that buccal spaces have the highest predominance.[30–32] Odontogenic maxillofacial infections, if untreated, may progress to involve deep neck space infection, which can spread upward to brain causing brain abscess, meningitis and cavernous sinus thrombosis.[28] Determining the exact anatomic location of infection is a key step in determining its severity and management.[33]

Concerning the frequency distribution of organisms isolated, the present study and Lewis et al., 1986 who isolated mixed micro-organisms in lower value 51.7% and 54% respectively.[34] However, Brook et al.[35] and Kohli et al.[36] reported even more lower values 44% and 38% respectively. However, only aerobic micro-organisms were isolated in 38.3% of the cases of the present study. This was similar to Kohli et al.[36] who reported that 35% of aerobic infections but it was high in comparison with Bahl et al.[15] who found aerobic infections in 25% and very high in comparison with Brook et al.[35] and Patankar et al.[37] who found aerobic infections in 6% and 8% respectively. In addition, only anaerobic micro-organisms were isolated in only 10% of the cases of the present study. This was not similar to studies reported pure anaerobic infections. It was low in comparison with Bahl et al.[37], Patankar et al.,[3] Bakathir et al.,[23] Kohli et al.,[36] found aerobic infections in 15%,14%,23% and 22.5% of cases respectively, while very low in comparison with Brook et al.,[35] and Lewis et al.,[34] who found aerobic infections in 50% and 40% of cases respectively.[15,34–38] While, Staphylococcus spp. was isolated in this study in 28.4% of total cases. Similar percentage was reported by other investigators.[15,36,37,39] In addition, Fating et al.[40]; Chunduri et al.[41] and Külekci et al.[42] reported very low percentage 3.4%, 5.2% and 7.1% respectively.[40–42] Moreover, in this study, Streptococci spp. was isolated in 49.2% of specimens. However, only Bahl et al.[37] was similar reported isolation in 45% of the specimens.[37] While, other investigators[34,40,41] reported lower percentages in addition to Walia et al.[39] and Kohli et al.,[36] 2009 reported 15% and 10% respectively.[36,39] However, the isolation of Klebsiella found in 12.4% in of cases this study, we agreed with Walia et al., 2014 reported that Klebsiella found in 10% of specimens.[39] However, Kohli et al.[36]; Patankar et al.[3] and Fating et al.[40] isolated Klebsiella in 2.67%, 3% and 5% of cases. Similarly, Prevotella spp. was isolated in 41.2% of the cases in this study.[15,36,40] However, Bahl et al.[37]; Chunduri et al.[41] Külekci et al.[42] reported 30%, 25.7% and 25% of Prevotella spp. in their studies which is similar to this study. In the other hand, Fating et al., 2014 and Walia et al.[39] isolated very low percentage 1.7% and 5% of Prevotella spp. in their studies respectively.[39,40]

Regarding the antibiotic sensitivity pattern, our results found among the entire aerobically cultured bacteria, Ciprofloxacin and Amoxicillin/clavulanic acid were the most sensitive drug 97% and 95% respectively followed by Clindamycin 88% and Cefotaxime 80%. The least effective drugs were amoxicillin 18%. However, Singh et al.[43] reported high sensitivity value for amoxicillin and Cefotaxime were78% and 83%, respectively, and Amoxicillin/ clavulanic acid were 100%; while lower value was for ciprofloxacin 83%.[43] While, Bahl et al.[37] reported lower sensitivity value for ciprofloxacin and Amoxicillin/clavulanic acid 70% and 90% respectively while almost similar value for Clindamycin 85%.[37] Similarly, Fating et al.[40] reported high sensitivity value for Cefotaxime and amoxicillin 95% and 80% respectively and similar value for ciprofloxacin and Clindamycin 95% each while lower value for Amoxicillin/clavulanic acid 80%.[40] In addition, among the entire anaerobically cultured bacteria, Metronidazole was the most sensitive drug 93% followed by Amoxicillin/clavulanic acid, Clindamycin, Ciprofloxacin and Cefotaxime were 90%, 87%, 85% and 78% respectively. While, Singh et al., 2014 reported high sensitivity values for amoxicillin and Amoxicillin/clavulanic acid 78% and 100%, respectively while lower value for ciprofloxacin 83% and nearly similar value for Cefotaxime.[43] Moreover, Bahl et al.[37] reported lower sensitivity value for ciprofloxacin and Metronidazole 70% and 85% respectively while similar value for Amoxicillin/clavulanic acid 90% and almost similar value for Clindamycin 85%.[37]

Concerning surgical drainage and removal of cause of infection which are the primary management of OMI that range from simple tooth extraction to treatment as complex as wide incision of soft tissue in the submandibular and neck region or even open drainage of mediastinum.[33] In the present study, 71.67% of patients were treated simply by extraction of involved tooth along with intra-oral incision and drainage, while 11.67% of patients required extra-oral incision and drainage in addition to 13.34% of patients required endodontic

treatment of involved tooth and intra-oral incision & abscess drainage. Data of the current study differ from the study of Methew et al.[21] as they reported extra-oral incision for the drainage of abscess in 45% cases, and 27% of their patients had only intra-oral incision and drainage made, while 28% had both intra-oral and extra-oral incisions. This difference may be because patients of this study reported early for the treatment which prevented them from developing more serious infections and a need for extra-oral incisions to drain abscess.

Conclusion

Maxillofacial odontogenic infection is usually polymicrobial, consisting of a complex mixture of both anaerobes and aerobes. Ciprofloxacin, Amoxicillin/clavulanic acid and Clindamycin were the most effective drugs for all isolates of OMI and the least effective drug was amoxicillin of OMI. Early surgical intervention along with selective antibiotics can stop these infections spread to deeper spaces of face and neck and hence many untoward complications can be avoided.

Recommendations

1. Similar studies in other areas of the Kingdom of Saudi Arabia are recommended in order to provide overall a treatment modality with one antibiotic regimen on the whole Saudi population with OMI.
2. Ciprofloxacin, Amoxicillin/clavulanic acid and Clindamycin are recommended in odontogenic infections for complete coverage of aerobic microorganisms of OMI.
3. Metronidazole, Ciprofloxacin, Amoxicillin/clavulanic acid and Clindamycin are recommended in odontogenic infections for complete coverage of anaerobic microorganisms of OMI.
4. Despite advanced dental treatment facilities, patients still present with OMI that in many cases require hospitalization for management.
5. There is a need for general oral hygiene. In addition, regular dental check-ups cannot only prevent infections from carious teeth, but also prevent progression of any infection to deep neck space infection. This prevention includes removal of any source causing caries, trauma, pulpal and periodontal diseases. This will help lower the burden on health care system.

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Conflicts of interest

The authors declare that there is no conflict of interest to declare.

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