Original Article

Clinical, CT scan, and laboratory changes of abscess patients with odontogenic origin admitted to Shiraz acute surgical care center, Iran

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Abstract

Introduction: Rapid diagnosis of maxillofacial abscess with the odontogenic origin is effective in the treatment of patients. This study aimed to check the clinical evaluation, head, and neck computed tomography (CT) scan, and microbial sensitivity of hospitalized patients diagnosed with maxillofacial abscess admitted to the Maxillofacial Surgery Ward Shaheed Rajaie Surgical Acute Care Center of Shiraz, Iran from 2019-2021. **Method:** A cross-sectional study was conducted. The sample included patients diagnosed with the abscess of odontogenic origin. Data collection tools included personal profile registration form, chief complainant and clinical evaluation, laboratory test results, pus culture, antibiogram results, and head and neck CT scan changes form. Data was reported with descriptive statistics by SPSS-16 software. **Results:** The majority of patients were male; infection duration was 10 days; maximum mouth opening size was less than 20 mm in more than half of patients.The scan revealed 41.8% abscess, 36.4% cellulite, and 21.8% mixed abscess and cellulitis. There was 29.1% involvement of salivary glands. The majority of abscesses were unifocal involved in the submandibular space, and the least involvement was in peri mandibular space and carotid sheath. The most common organism causing was staphylococcal abscess coagulase-negative. **Conclusion:** In patients with maxillofacial abscess requiring hospitalization, the most common clinical features were trismus, toxic appearance, and dysphagia, and the most common source of abscess in scanning patients with mandibular molars was the most involved submandibular space and pterygomandibular space. Vancomycin, cotrimoxazole, and cefazolin had the greatest effect in the treatment of odontogenic infections in terms of antibiogram results and microbial culture.

Keywords: Dentofacial infection, head and neck CT scan, maxillofacial absences, microbial antibiogram

Introduction

More than 90% of head and neck infections have an odontogenic origin.[1] These infections are among the most common cases under the control of maxillofacial surgeons and impose a significant burden on the health care system.[2] The odontogenic abscess is the most common cause of deep neck infections in adults, and mandibular molars are the most common source of odontogenic infections requiring hospitalization.[3] Periapical or periodontal abscess, pericoronitis, pulpitis, and osteoarthritis cause the inoculation of bacteria in deep tissues.[4] Fasciitis leads to cellulite or abscess. The first area involved in odontogenic infection is the submandibular space, which leads

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to severe symptoms of trismus, respiratory problems, dysphagia, sialorrhea, and pyrexia.[5] Severe complications of an abscess include airway obstruction, sepsis, tissue necrosis, endocarditis, mediastinitis, and deep neck infections.[6] The other complications of an abscess include jugular vein thrombosis, carotid artery, mediastinitis, pericarditis, epidural abscess, and sepsis.[7] Cardiac arrest, renal failure and sepsis, airway obstruction, fasciitis, tissue necrosis, acute respiratory distress syndrome (ARDS), thrombosis, mediastinitis, and multiple organ dysfunction syndromes (MODS), although rare, are complications of the advanced odontogenic abscess. The risk of developing odontogenic abscess is higher in people with diabetes mellitus, obesity, alcohol, nicotine abuse, rheumatism, and poor oral hygiene.[1] The abscess can be potentially life-threatening and requires immediate diagnosis and treatment.[7]

Rapid diagnosis and management are common challenges for emergency physicians, ENT surgeons, maxillofacial surgeons, and radiologists. The complex anatomy of this area and diagnostic limitations can sometimes delay correct diagnosis.[8] Paraclinical tests and imaging with CT and magnetic resonance imaging (MRI) contribute to the diagnosis and management of head and neck infections.[9] They are critical for accurate diagnosis.[10] A head and neck CT scan is a tool to diagnose and localize the site of infection and helps decide on surgical or pharmacological interventions.[8] In addition, it is one of the tools of pre-surgery evaluation.[11]

Different types of pathogens, especially streptococcus viridians, gram-positive aerobic bacteria, portello, and gram-negative anaerobic bacteria, are common pathogens in odontogenic infections.[12] A study by Rath *et al*.[13] entitled "Etiology and Clinical Signs of Cellulite" revealed that penicillin or penicillinase-resistant penicillin is administered alone or in combination to 68% of patients and clindamycin to 28% of patients for 1 to 3 days. Another study showed that in 66% of cases undergoing dental abscess treatment, antibiotics prescribed contradict the treatment guideline.[14] The study center is the Referral Center of Patients in the South of Iran and Neighboring Countries in the region. They accept and treat patients with extensive infections. Therefore, the researchers decided to conduct a study with the aim of clinical evaluation, head and neck CT scan, and laboratory tests of patients with maxillofacial abscess admitted to the maxillofacial surgery ward in Shaheed Rajaie Hospital of Shiraz.

Method

This cross-sectional study was conducted with the aim of clinical evaluation, head, and neck CT scan, and laboratory tests of patients with maxillofacial abscess admitted to the maxillofacial surgery ward of Shaheed Rajaie Hospital, Shiraz, from 2019 to 2021. Population and research sample included all patients with maxillofacial abscess needed to be hospitalized in the oral and maxillofacial surgery ward of Shaheed Rajaie Educational and Medical Center. The study was carried out after approval by the ethics committee of Shiraz University of Medical Sciences with the code of IR.SUMS.DENTAL.REC.1399.107 and permission from the officials of the maxillofacial surgery ward of Shaheed Rajaie Educational and Medical Center. Patients with a chief complaint of maxillofacial abscess admitted to the ward after examination by physicians and diagnosing maxillofacial abscess with odontogenic origin were included in the study. The data collection tool was a demographic information questionnaire including age, gender, duration of disease, and clinical symptoms, including the patients' maximum mouth opening, the registration form of clinical features, and patients' chief complaint and examination for signs of dyspnea, dysphagia, dehydration, fever, and toxic appearance in terms of the weak immune system. Blood tests, biochemical and culture tests, and antibiogram secretion of pus obtained from aspiration, and head and neck CT scan were requested according to the patient's condition and the physician's discretion. Head and neck CT scan of hospitalized patients were reviewed, and changes were recorded by a fellow radiologist and the first author. The duration of hospitalization was extracted from the patient's file and recorded in the information registration form. Data were extracted and reported using SPSS-16 software and descriptive statistics of frequency, percentage, mean, and standard deviation.

Findings

The age mean and standard deviation were 33.81 ± 14.67 years; the minimum age of abscess was six, and the maximum age was 73. The mean and standard deviation of abscess duration was 10.04 ± 07 9.07 days, and the period of disease was at least 1 day and at most 50 days; 52.6% of patients were male, and 47.4% were female. The maximum mouth opening of 33% of patients was 10-20 mm and for 26.8% was less than 10 mm; 20.6% opened their mouths 20-30 mm and 11.3% opened their mouths 30-40 mm, and 8.2% of patients more than 40 mm during the examination. The most common areas of infection were mandibular molars 63.9%, maxillary molars 11.3%, anterior maxilla 8.2%, and maxillary molars and mandibular premolars 6.2%. Anterior mandible, 4.1%, was the lowest source of infection in hospitalized patients. Table 1 shows the demographic variables and disease status of the sample.

The most common clinical features and the chief complaint of hospitalized patients diagnosed with abscess of odontogenic origin were 57.7% toxic appearance, 38.1% dysphagia, 18.6% dyspnea, 12.4% dehydration, and 10.3% fever, respectively. WBC was high in 55.7% of patients in terms of biochemical and blood parameters. ESR was 54.63% high, CRP 58.76% and, BS 43.3%; in other cases, the indices were in the normal or low range. Diagnostic appearance on the head and neck CT scan was 36.4% cellulite, 21.8% mixed abscess and cellulite, and 41.8% abscess. There was no salivary gland involvement up to 70.9%. It was involved 20% of submandibular glands, 7.3% of parotid glands, and 1.8% of submental glands; 63.6% were unifocal, and 34.4% were multifocal.

The most significant lesion in the head and neck CT scan was 22.32 ± 53.54 mm; the minor lesion was 11.99 ± 26.58 mm, and the middle side of the lesion was 18.05 ± 41.35 mm. The submandibular space was 63.6%, pterygomandibular space 29.1%, parotid 18.2%, pharyngeal space 16.4%, infra orbital space and sub periosteal 12.7%, sub masseteric space and sublingual space 10.9%, lateral pharyngeal 9.90%, and temporal and retro pharyngeal 5.5%. The lowest space involvement was in peri mandibular and carotid sheath 1.8%. Triangle posterior, sinus cavernous, mediastinum, and intracranial were not observed in these patients. Table 2 presents the frequency distribution of abscess spaces in patients' head and neck CT scans.

Table 1: Description of demographic variables and disease status

Variable		Frequency	Percent	
Sex	Men	51	52.6	
	Women	46	47.4	
	Total	97	100	
Maximum mouth opening size	10 mm<	26	26.8	
	10-20 mm	32	33	
	20.1-30 mm	20	20.6	
	30.1-40 mm	11	11.3	
	40 mm>	8	8.2	
	Total	97	100	
Infection source	Anterior maxilla	8	8.2	
	Maxillary premolars	11	11.3	
	maxillary molars	6	6.2	
	Anterior mandible	4	4.1	
	mandibular premolars	6	6.2	
	mandibular molars	62	63.9	
	Total	97	100	
	Mean±SD	**Min**	**Max**	**Total**
Age	33.81±14.67	6	73	97
Duration of infection	19.04±9.07	1	50	97

A total of 36.4% of bone marrow and 29.1% of air bubbles were observed in the head and neck CT scan, but there was no vascular involvement in any of the requested scans. Airway stenosis was observed in 16.4% of scans. 20% of patients had shift airway. Therefore, 56.7% (55 patients) were hospitalized with a diagnosis of microbial culture abscess. In 36.08% of positive culture cases, 20.62% of bacterial growth was not reported in the culture medium. Organisms responsible for an abscess with odontogenic origin were 25.71% staphylococcus DNase positive coagulase-negative, streptococcus non-hemolytic, and enterococcus 14.29%, staphylococcus, klebsiella, and streptococcus viridians 8.57%, vancomycin-resistant enterococcus and streptococcus group D 5.5%, and Citrobacter, Bacillus spp., Acinetobacter spp. 2.86% as the organisms' source of an abscess. Commonly prescribed antibiotics at the center were clindamycin, ampicillin/sulbactam, metronidazole, cefazolin, penicillin, co-amoxiclav, gentamicin, ciprofloxacin, amikacin, vancomycin, imipenem, and ampicillin, respectively. Antibiogram results showed that vancomycin 80%, cotrimoxazole 77.8%, cefazolin 79.16%, ceftazidime 62.5%, amikacin 60%, ciprofloxacin 55.55%, clindamycin gentamicin, meropenem, cefixime, and doxycycline 50%, and imipenem 28.57% were effective against organisms' source of the abscess.

Discussion and Conclusion

Odontogenic infections are common emergencies requiring hospitalization, which impose costs and time on health care

Table 2: Relative frequency distribution of abscess involvement areas in the head and neck CT scan of hospitalized patients diagnosed with maxillofacial abscess

Areas of abscess involvement in CT scans of patients	Not involve		Involve		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Infra orbital space	48	87.3	7	12.7	55	100
Periosteal sub	48	87.3	7	12.7	55	100
Pterygomandibular space	39	70.9	16	29.1	55	100
Masseteric space sub	49	89.1	6	10.9	55	100
Temporal superficial space	46	83.6	9	16.4	55	100
Temporal deep space	52	94.5	3	5.5	55	100
Mandibular pero	54	98.2	1	1.8	55	100
Submandibular space	20	36.4	35	63.6	55	100
Submental space	48	87.3	7	12.7	55	100
Sublingual space	49	89.1	6	10.9	55	100
Intracranial	55	100	0	0	55	100
Pharyngeal space lateral	50	90.9	5	9.1	55	100
Pharyngeal space retro	52	94.5	3	5.5	55	100
Pharyngeal space para	46	83.6	9	16.4	55	100
Mediastinum	55	100	0	0	55	100
Sinus cavernous	55	100	0	0	55	100
Sheath carotid	54	98.2	1	1.8	55	100
Space parotid	45	81.8	10	18.2	55	100
Triangle posterior	55	100	0	0	55	100

providers.[15] This study was conducted with the aim of clinical evaluation, head, and neck CT scans, and laboratory tests of patients with maxillofacial abscesses admitted to the Shaheed Rajaie Surgical Acute Care Center of Shiraz from 2019-2021. Patients with an odontogenic abscess had a mean age of 33.81 years old and a mean disease duration of 10.04 days. Infection was more common in men than women. In a study by Weise *et al*. 2019,[1] the mean duration of medical care of patients was 20.3 days in the time range of 8-33 days. Yuvaraj[16] evaluated the maxillofacial infections of odontogenic origin in 107 patients within the age range of 3-78 years and a mean age of 35.2 years old and confirmed that the majority of patients were male.[16] Thus, odontogenic infections are more common in men, which is consistent with the findings of other studies. However, the reason is not apparent; men are usually in worse health status than women and often neglect mild oral and facial infections. In addition, the rate of facial and neck injuries is higher in men.[4] The maximum mouth opening of 59.8% of patients was less than 20 mm. The most common areas of the source of abscess were mandibular molars, maxillary premolars, anterior maxilla, maxillary molars, mandibular premolars, and anterior mandibles, respectively.

The most common involvement was observed in the submandibular space, pterygomandibular space, parotid, pharyngeal para space, infra orbital space, and sub periosteal space, sub masseteric space, and sublingual, lateral pharyngeal, temporal, and retro pharyngeal. There was minimal space conflict in peri mandibular and carotid sheath areas and no involvement was observed in posterior triangle, cavernous sinus, mediastinum, and intracranial sites.

Brian *et al*.[15] prepared a guideline for the use of CT scan in the treatment of odontogenic infections. In 129 patients, the most common facial spaces involved were vestibular 58.2%, submandibular 18.6%, petri go-mandibular 6.2%, buccal 5.4%, and lateral pharyngeal 5.4%. mandibular lower border involvement was suggested as the best predictor of the need for a head and neck CT scan. Mouth opening less than 25 mm was identified as the second predictor of the need for the head and neck CT scan. The accuracy of these two predictors was 96.9% in need of a head and neck CT scan in a maxillofacial abscess.[15] In the present study, 55 patients (56.70%) had a head and neck CT scan request that met the predictive criteria for a CT scan in the study by Brian. In the study by,[16] performed on 42 patients admitted to an odontogenic abscess, 48% of the patients were reported to have 48% pterygomandibular space, 21% sub-mandibular space, 9% sub-master, 9% temporal space, 8.80% pharyngeal space, and 6% of other areas.[16] An 8-year retrospective study in Brazil demonstrated that 55.74% of odontogenic infections were more common in the mandible, 82% in the posterior teeth, and 18% in the anterior teeth. Tooth decay was the leading cause (90.90%); there was 42.85% submandibular space involvement, and 76% of patients required surgical treatment. Odontogenic infection was reported 13.63% in the left mandibular third molar, 11.3% in the left mandibular first molar, and 6.49% in the left mandibular second molar, respectively. The submandibular space was most affected by the third and first mandibular molars, and the canine space and vestibular were most involved in anterior tooth infections. Posterior teeth are responsible for 82% of odontogenic infections, and the most common cause of mandibular third molar infection is probably due to difficulty brushing and cleaning posterior teeth.[4]

Out of 56.7% of hospitalized patients for whom microbial culture was requested, 20.62% of bacterial growth was not reported in the culture medium. The organisms responsible for the abscess with odontogenic origin were staphylococcus DNase positive coagulase-negative, non-hemolytic streptococcus, and enterococcus spp, staphylococcus, klebsiella and streptococcus viridians, group d streptococcus, vancomycin-resistant enterococcus, citrobacter, bacillus spp, and acinetobacter spp. Commonly prescribed antibiotics in maxillofacial surgery for abscess patients were clindamycin, ampicillin/sulbactam, metronidazole, cefazolin, penicillin, co-amoxiclav, gentamicin, ciprofloxacin, amikacin, vancomycin, and ampicillin, respectively. According to the antibiogram and microbial culture of vancomycin, cotrimoxazole, cefazolin had the most significant effect in treating odontogenic infections. According to the results of the antibiogram and microbial culture, vancomycin, cotrimoxazole, and cefazolin had the greatest impact in treating odontogenic infections. Rath *et al*.[13] also showed that β-hemolytic streptococcus (BHS) is a major cause of cellulite, and patients complained of severe fever and chills before or during admission of erythema. Penicillin or penicillinase-resistant penicillin was prescribed alone or in combination with clindamycin.[13] In a study by,[1] streptococcus viridians, staphylococcus epidermidis, enterococcus faecalis, and prevotella oris were reported as the most common infectious organisms, respectively. In the antibiogram, clindamycin was more resistant to all infectious groups.[1] Yuvaraj[16] reported penicillin as a commonly prescribed drug for all patients except those with a history of allergies. In some cases, it was also prescribed in combination with metronidazole. In culture, 80% gram-positive cocci and 19% gram-negative bacilli were reported. Streptococcus was the most common aerobic species, and pepto streptococci and propionibacterium were the most common anaerobic species.

The results of a study by Sebastian *et al*.[17] entitled "Microbial Analysis of Odontogenic Infections and Susceptibility to Imperial Antibiotics" showed that the most common aerobic organism was streptococcus viridians 34.49% and the most common anaerobic organism was pepto streptococci 61.11%. The most common mixed organism in head and neck infections with odontogenic origin was streptococcus and pepto streptococci 30%. amoxicillin is the most common medicine with 96.55% microbial resistance, and metronidazole is 100% sensitive to anaerobic organisms. Identifying the organisms causing head and neck infection and examining the sensitivity and common resistance of the prescribed antibiotics help the physician to choose the appropriate antibiotic.[17] According to the findings, the most prevalent clinical symptoms of patients

with maxillofacial abscess needing hospitalization are trismus, toxic appearance, and dysphagia. The most common cause of infection in scanning patients with mandibular molars is the most involved submandibular space and pterygomandibular space. The most common cause of abscess in these patients was staphylococcus DNase positive coagulase-negative, and vancomycin, cotrimoxazole and cefazolin had the greatest effect in the treatment of odontogenic infections in terms of antibiogram results and microbial culture. The current results can aid assistants and oral and maxillofacial surgeons to optimally manage the treatment of patients with abscess of odontogenic origin and reduce their hospitalization time and associated costs.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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