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A six-year retrospective evaluation of odontogenic infections in pediatric patients requiring hospitalization

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ABSTRACT

Aims: Odontogenic infections in pediatric patients are common conditions which need to rapid treatment because of the progression of the infection into deep facial spaces. This study aimed to investigate the treatment modalities and clinical findings of hospitalized patients because of odontogenic infections.

Methods: The study sample was collected from patient's medical records. Demographic data, clinical findings, hospital length, source of the infection and laboratory findings were compared.

Results: 330 patients were included and the study competed with 111 girls (34%) and 219 boys (66%) with a mean age of 6.81±3.25 years (min:1-max:17). 173 (%52) patients were treated for buccal space infection. The average duration of hospital stay was 2.69±0.78 days (min: 1, max: 6) in all cases and hospital stay was statistically higher in boys than girls (p=0.019). The duration of hospitalization was statistically higher in patients with fossa canina infection (p<0.001). 267 patients (%81) received ampicillin/sulbactam combined with metronidazole. The average day of the extraction of the causative tooth was the second day of the hospital stay. There was a positive correlation between length of hospital duration and CRP levels (p<0.001).

Conclusion: Odontogenic infections with facial cellulitis are generally seen in boys under six years old. The upper face is the most affected side with a rate of 72%. Intravenous penicillin and metronidazole treatment and early dental extraction with surgical drainage are necessary for rapid resolution of the infection.

Keywords: Odontogenic infections, pediatric, hospitalization, hospital stay, abscess

INTRODUCTION

Odontogenic infections are caused by bacterial invasion of the tooth and its surrounding soft and hard tissues and they generally originate from pulpal necrosis with bacterial invasion of peri radicular tissue or from deep periodontal pockets and pericoronitis leading to the formation of purulent collections.[1] Depending on the location and severity of the infection, the symptoms might be moderate to severe. Pain, swelling, and redness of the affected area are the most typical symptoms. Odontogenic infections can worsen breathing and swallowing difficulties, face cellulitis, fever, and other symptoms.[2] However, the inflammation process can advance and expand into deep facial regions if the primary source is not eradicated.[3] Multiple serious complications, including airway obstruction, cavernous sinus thrombosis, mediastinitis, eye globe affections, brain abscess, sepsis, and organ failure have been reported.[1-3]

Maxillofacial infections require early diagnosis and treatment. It depends on the severity of the infection and its location. Controlling and removing the causative agent is the primary goal.[4] Mild infections can often be treated with antibiotics alone, while more severe infections may require surgical intervention with drainage and hospitalization. Hospital care is indicated for patients who spread the infection to the parapharyngeal, peritracheal, and deep facial spaces, airway compromises and rapidly progressing cases with a fever higher than 38°C.[3,4] Children with facial infections commonly respond to antibiotic therapy alone. Moreover, rapid dental extraction with antibiotic therapy helps to shorten the length of hospital stay. The main purpose of this study was to perform a retrospective assessment of odontogenic infections in pediatric patients requiring hospitalization and to compare the clinical differences and treatment modalities.

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METHODS

Sample Collection

This retrospective study was approved by Erciyes University Clinical Researches Ethics Committee (Date: 06.02.2019, Decision No: 2019/113). The study sample was collected from patient's medical records in the hospital database of the Oral and Maxillofacial Surgery Department. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Hospitalized patients between the ages of 0-18 diagnosed with facial cellulitis of odontogenic origin between 2013-2019 years were included in the study. Cases of infections from unreported sources or with insufficient information were disregarded. Demographic parameters such as age, gender, and medical compromises were recorded. Detailed clinical findings such as the source of infection, region(upper or lower jaw), and affected spaces, a month at the time of disease onset, antibiotic usage before hospital visit, fever, and required treatment including total antibiotic usage during hospital care, antibiotic regimen, length of stay was investigated. Surgical interventions such as extraction and additional drainage, and anesthetics methods during surgical procedures (local or sedation/general) were recorded. WBC, lymphocyte, neutrophil, platelet counts, hemoglobin, erythrocyte sedimentation rate (ESR), and C- reactive protein (CRP) levels during the hospital care were obtained from patient records.

Statistical Analysis

Shapiro-Wilk's test, q-q plots, and the histogram were all used to evaluate the data's normality. The Levene test was used to analyze the homogeneity of the variance. For quantitative data, one-way analysis of variance (ANOVA) or Kruskal-Wallis tests were used to assess group differences; for qualitative data, Fisher exact test was used. Data values were expressed using mean±standard deviation, median (1^{st}-3^{rd} quartiles), or frequencies(percentages). Analyses were conducted using TURCOSA (Turcosa Analytics Ltd. Co., Turkey, www.turcosa.com.tr). Statistical significance was defined as a p-value 5%.

RESULTS

The study sample consisted of 361 patients hospitalized due to odontogenic facial cellulitis. 31 patients were excluded from the study because of insufficient data in patient records and laboratory findings. The study competed with 111 girls (34%) and 219 boys (66%) with a mean age of 6.81±3.25 years (min: 1-max: 17). More than half of the patients (54%) were individuals under 6 years of age. 35 patients had additional systemic conditions including epilepsy, FMF, diabetes, and asthma. Facial cellulitis originated from upper teeth in 168 patients (51%) and lower teeth in 162 (49%) patients. 173 patients were treated for buccal lodge abscesses and these patients constituted approximately 52% of all cases. Besides, there were 87 patients with submandibular abscesses (26%) and 64 (19%) patients were treated because of fossa canina abscess. 6 patients were hospitalized because of vestibular/lingual abscess formation. (Table 1). Most cases were hospitalized at 9^{th} (n=40) and 12^{th} months (n=40). The distribution of patients by month is shown in Chart. 228 patients (69%) had no history of using any antibiotics before hospitalization and 95 patients(29%) had used oral antibiotics before admission to the hospital. The initial admission to the hospital was considered the 1st day of the hospitalization. The average duration of hospital stay was 2.69±0.78 days (min: 1, max: 6) in all cases and hospital stay was statistically higher in boys than girls (p=0.019). According to the type of infection, the duration of hospitalization was statistically higher in fossa canina patients (p<0.001). There was no statistical difference between hospital stay and causative agents (upper or lower teeth, p=0.068). Similarly, there was no statistical difference between patients according to the usage of antibiotics before hospitalization (p=0.701) (Table 2).

Table 1. Descriptive statistics of study variables

Variables	Statistics
Sex, n (%)	
Female	111 (34)
Male	219 (66)
Age, (years)	
mean±sd	6.81±3.25
M (min-max)	6 (1-17)
Origin of infection	
Upper teeth	168 (51)
Lower teeth	162 (49)
Space, n (%)	
Buccal	173 (52.0)
Submandibular	87 (26.0)
Fossa canina	64 (19.0)
Vestibular/lingual	6 (3.0)
Hospital stay (days)	
mean±sd	2.69±0.78
M (min-max)	3 (1-6)

The average day of the extraction of the causative teeth was the second day of the hospital stay. It was observed that patients received an average of 4 doses of parenteral antibiotics before tooth extraction and 3 doses after the extraction. 44 patients (13%) received parenteral ampicillin/sulbactam, 267 (81%) received ampicillin/sulbactam combined with metronidazole, and 17 patients (5%) were treated with clindamycin because of penicillin allergy.

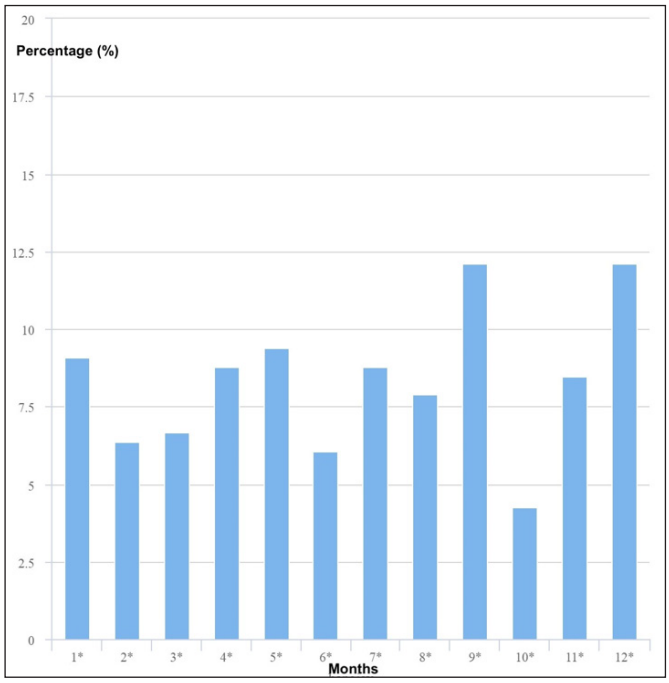

Chart. Incidence of infection by months

Tooth extraction was performed in 66 patients with local anesthesia and sedation was used in 264 patients. An average of 2 (1-3) teeth were extracted from each patient. There was no need for additional drainage of pus formation in 300 patients, while additional intraoral or extraoral drainage was performed in 30 patients, and a Penrose drain was inserted. The drain was removed on the second day after the tooth extraction. Fever over 380 was observed in 81 (25%) patients before tooth extraction and post-operative fever was seen in 40 patients (12%). When the relationship between the duration of hospital stay and the presence of preoperative fever was evaluated, it was determined that the duration of hospital stay was statistically higher in patients with preoperative fever than in those without (p<0.001). Similarly, the length of hospital stay was statistically higher in patients who had postoperative fever than in patients without postoperative fever (p= 0.004).

The average CRP, ESR, and WBC levels were 21.59 (10.9-52.2), 20 (13-29), and 10.5 (8.7-13.8) in all patients respectively and there were no statistical differences according to sex (p>0.05). When the levels of CRP, ESR, and WBC were compared to the causative agent, CRP levels were found statistically higher in infections associated with lower teeth (p=0.014). There were no statistical differences according to the type of infections (p>0.05). Besides, CRP, ESR, and WBC levels were statistically higher in patients who had a preoperative fever (p<0.05). CRP and ESR were statistically higher in patients who had postoperative fever after tooth extraction but WBC count was not different. (Table 2). Also, it was observed that there was a positive correlation between length of hospital duration and CRP levels (p<0.001). Other laboratory findings including lymphocyte, neutrophil, platelet counts, and hemoglobin, were compared according to the sex and type of infection and there were no statistical differences (Table 3).

Table 2. Comparisons of hospital stay and infection parameters with clinical findings

	Length of hospital stay (days)	CRP (mg/L)	ESR (mm/s)	WBC
Sex				
Girls	2.5±0.78	20.4 (9.4-45.0)	22 (13.5-29)	10.5 (8.6-13.8)
Boys	2.76±0.77	23.3 (12.7-55.2)	19.5 (12-29.25)	10.6 (8.7-13.7)
P value	0.019	0.228	0.455	0.773
Causative agents				
Upper teeth	2.76±0.78	20.4 (9.3- 45.4)	20 (13- 29)	10.5 (8.6- 13.9)
Lower teeth	2.61±0.76	23.3 (14.0- 55.6)	21 (12-30)	10.7 (8.8- 13.6)
P value	0.068	0.014	0.529	0.966
Type of infection				
Buccal space	2.5±0.78	19.8 (10.2- 45.6)	18 (13-26)	10.4 (8.3- 13.1)
Fossa canina	2.9 ±0.76	31.6 (11.3- 56.1)	22 (13-31)	10.5 (8.9- 15.1)
Others	2.77±0.72	22 (12.8-63.0)	21 (12-32)	10.9 (9.3- 13.6)
P value	<0.001	0.157	0.529	0.275
Antibiotic usage before hospitalization				
No (n=228)	2.67±0.79	17.9 (10.1- 50.2)	20 (13- 28)	10.6 (8.8- 13.7)
Yes (n=102)	2.74±0.74	30.3 (17.6-56.1)	20 (11- 35)	10.8 (8.6- 13.8)
P value	0.701	0.114	0.529	0.263
Pre-operative fever				
No (n=249)	2,5 ±0.71	19.7 (10.0- 42.3)	20 (12- 27)	10.2 (8.6- 12.6)
Yes (n=81)	3.1±0.80	46.2 (16.5-69.9)	21 (15- 35)	12.7 (9.2- 15.3)
P value	<0.001	<0.001	0.007	<0.001
Post-operative fever				
No (n=290)	2.6±0.74	21.3 (10.6- 49.9)	20 (12-28)	10.5 (8.7-13.8)
Yes (n=40)	3.0±0.91	37.1 (16.3-106. 0)	26 (15-36)	10.4 (9.2 -13.7)
P value	0.004	0.003	0.047	0.870

mean± standard deviation, Median(1st-3rd quartiles), Mann Whitney U, Kruskal Wallis, Student T test,

Table 3. Evaluation of laboratory findings in different study groups

	Lymphocyte count	Neutrophil count	Platelet count	Hemoglobin (mg/dl)
Total	2.48 (1.7-3.3)	6.9 (5.1- 9.5)	321.5 (267.5 -384.5)	12.8 (12.1-13.6)
Sex				
Girls	2.6 (1.9-3.3)	6.7 (5.1- 9.5)	321 (263-378)	12.8 (12.3- 13.6)
Boys	2.3 (1.6- 3.4)	7.1 (5.1-9.3)	322 (269- 387)	12.8 (12- 13.6)
P value	0.161	0.984	0.959	0.792
Type of infection				
Buccal space	2.5 (1.6- 3.1)	6.6 (5.0-8.6)	325 (264-387)	12.7 (11.9- 13.3)
Fossa canina	2.7 (2.1- 3.7)	6.5 (5.0- 10.4)	319 (270- 374)	12.7 (12.1- 13.8)
Others	2.1 (1.6 -3.4)	7.7 (5.5-10.1)	320 (268- 384)	13.3 (12.3- 13. 8)
P value	0.132	0.161	0.807	0.252

DISCUSSION

Pediatric patients frequently experience oral infections, especially those who are under the age of six. Odontogenic infections spread more quickly in children than in adults due to the presence of tooth germs, bone development centers, and more cancellous bone with wider medullary spaces.[4] It is challenging for clinicians to create a comprehensive management strategy for these individuals because of the anatomical heterogeneity.[5] The prevalence of odontogenic infections is more common in males sex than females with the range of 58%-65%.[6,7] In this study, most of the patients consisted of the male population (66%) and 54% of the patients were under 6 years similar to the literature. In addition, the length of hospital stay was statistically higher in boys.

Upper face infections are more common in pediatric patients and young children are more likely to have a maxillary buccal infection.[8,9] In our study, buccal space was the predominant site of the infection and 237 patients (72%) had upper face infection. The symptoms of upper-face infections are more severe include periorbital cellulitis, cavernous sinus thrombosis, systemic meningitis, and sepsis.[5] Lower face infections can spread to the deep neck and leading Ludwig angina which occurs because of dental origin with a rate of 75%-90%.[5,10] Cellulitis must be aggressively treated with intravenous antibiotics in order to clear up the infection quickly and with the least amount of morbidity as possible. The first choice of antibiotics for odontogenic infections is penicillin alone or in combination with metronidazole.[7,8] If the child is allergic to penicillin, clindamycin, cefazolin or ceftriaxone can be used.[1] A retrospective analysis of odontogenic infections treated with hospitalization showed that penicillin with metronidazole is mostly prescribed antibiotics but various can be used.[7] Odontogenic infections tend to be mixed with a variety of Gram-positive and Gram-negative organisms, with anaerobic organisms, and most infections respond well to empirical penicillin treatment.[11] It is generally accepted that ultimate antibiotic treatment should be started according to the results of sensitivity tests and cultures. The acquisition of cultures and sensitivity data, it was reported, does not appear to be therapeutically helpful and did not directly result in any antibiotic or other therapy adjustments.[6] In this study, we started the empiric antibiotic treatment with penicillin and metronidazole in 81% of the patients and repeat resolution was observed within 2 days and all patients in this study were discharged uneventfully.

Clinical signs can be various in patients with facial cellulitis and most of the patients admit to the hospital because of facial swelling and fever. The body temperature and WBC count of pediatric patients are higher than those of adults, according to an epidemiologic review comparing infections of the craniofacial region in children and adults.[12] Preoperative clinical signs and blood parameters reflect the patient's recovery status. It is accepted that higher CRP and the N/L ratio are related to the length of hospital stay, total antibiotic dosage, and recovery status.[13,14] According to Peters et al.[15] the location of the infection and the underlying medical condition are the best indicators of how long a patient will need to stay in the hospital. In this study, we observed that patients who had facial cellulitis of fossa canina lodge and preoperative high body temperature have more hospital stays than others. Additionally, it was observed that, as the CRP level increased, the length of hospital stay also increased. It is thought that the increase in the length of stay in the hospital is related to the high fever due to the high CRP level.

Intravenous antibiotic therapy with drainage is the most effective treatment modality in maxillofacial infections. Carter et al.[16] reported that surgical interventions under general anesthesia were required in 46% of patients with odontogenic infections. Previously, it was believed that the time of surgical drainage should be performed after the complete resolution of the swelling, and the extraction of the tooth generally be postponed to a later time in a subacute or chronic phase of the infection.[17,18] But recent studies focus on early surgical interventions for treatment. Treviño-Gonzalez et al.[19] showed that delay of tooth extraction of more than three days is

associated with an increased rate of mediastinitis, intensive care unit stay (ICU), and length of ICU stay. A delayed dental extraction was linked to a hospital stay of more than 7 days, according to findings from a different study.[20] Heim et al.[17] concluded to the removal of infection focus on surgical drainage in the early stage leads to the lowest length of hospital stay. In our clinic, we generally performed early extraction of the causative tooth and surgical drainage with intravenous antibiotic treatment and in this study, surgical interventions were performed within two days and 80% of the patients were treated under sedation or general anesthesia.

The limitations of this study are mostly due to its retrospective design. Data on complications follow-ups and blood culture and sensitivity are insufficient. Comparisons according to the different antibiotic treatment modalities are lacking due to the insufficient sample size. More clinical findings in different groups with more patients could contribute to the exact inferences.

CONCLUSION

Odontogenic infections with facial cellulitis are commonly seen in pediatric patients especially in boys under six years old. The upper face is the most affected side with a rate of 72%. Intravenous penicillin and metronidazole treatment and early dental extraction with surgical drainage are beneficial for rapid resolution of the infection with minimal morbidity.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Erciyes University Clinical Researches Ethics Committee (Date: 06.02.2019, Decision No: 2019/113).

Informed consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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