ASSESSMENT OF THE SEVERITY OF SPREADING ODONTOGENIC INFECTIONS AT KOMFO ANOKYE TEACHING HOSPITAL.

Olesu J. T.[1,2]*, Obiri-Yeboah S.[2,3], Gyimah N. T.[2,3], Atuwo-Ampoh S. Y. R.[2], Frimpong P.[2], Larmie R. N. L.[2,3], Oti Acheampong A.[2,3], Donkor P.[2,3]

[1] Cape Coast Teaching Hospital
[2] Komfo Anokye Teaching Hospital.
[3] Kwame Nkrumah University of Science and Technology.

Corresponding author: Olesu Jonathan Tettey, Cape Coast Teaching Hospital
Correspondence: jonolesu@yahoo.com

DOI: https://dx.doi.org/10.4314/gdj.v22i2.10

ABSTRACT

INTRODUCTION: Odontogenic infection is the major cause of sepsis in the orofacial region, leading to significant morbidity and mortality. It is, therefore, important for the clinician to determine the severity of the odontogenic infection and institute an aggressive treatment protocol when necessary to reduce the incidence of morbidity and mortality.

AIM: To assess the severity of odontogenic infection using clinical parameters at Komfo Anokye Teaching Hospital.

MATERIALS AND METHODS: This study employed a prospective cross-sectional design. The study was conducted over six months with selected participants in the Oral and Maxillofacial Surgery Department of the Oral Health Directorate at Komfo Anokye Teaching Hospital (KATH). The severity of odontogenic infections in each enrolled participant was determined using the Sainuddin et al. scoring criteria for odontogenic infections. Clinical parameters of dysphagia, SIRS, fascial space involvement, signs of dehydration, trismus, and comorbid conditions were used by Sainuddin et al. in scoring the patients. These parameters were used to clinically score the participant and thereby predict the severity of the odontogenic infection. The length of stay and treatment outcome were also determined. Data was captured and coded using Excel. It was then cleaned and analysed using Statistical Package for the Social Sciences (SPSS) version 25.0.

RESULTS: A total of 62 participants were enrolled in the study, comprising 31 males (50.0%) and 31 females (50.0%). Their ages ranged from 2 to 86 years, with mean, median, and modal ages of 44.8 years, 43 years, and 37 years, respectively. The clinical severity scores, using Sainuddin et al. (2017) criteria, were as follows: 27 (44.0%) moderate, 18 (29.0%) mild, and 17 (27.0%) severe.

CONCLUSION: Most patients with odontogenic infections presented with moderate severity, followed by mild and severe cases.

KEYWORDS: C-reactive protein, procalcitonin, odontogenic infection, severity.

INTRODUCTION

Odontogenic infections are infections that originate from the tooth and its surrounding structures. The most common aetiology worldwide is dental caries and periodontal disease. Whilst dental caries involves the tooth structure, periodontal disease involves the supporting structures of the tooth[1]. In a study by Amuasi et al. in Ghana, the common microorganisms associated with dental caries were Streptococcus, Bacillus, and Staphylococcus spp[2]. A complex interplay between bacteria, sugars, salivary, and genetic influences forms dental caries. Rapidly alternating phases of tooth demineralization and remineralization comprise the complex caries process. If net demineralization persists for an extended period, it may trigger specific caries lesions at anatomical predilection sites on the teeth. Periodontal disease is primarily caused by dental plaque; however, other local factors, such as calculus, overhang restorations, occlusal trauma, and systemic factors like immunosuppression, diabetes, alcoholism, stress, malnutrition, and age, are among the many variables that contribute to the complex course of periodontal disease, ranging from gingivitis to periodontitis.[5]

The enduring presence of dental plaque within the gingival crevices creates a low oxygen concentration, which facilitates the proliferation of anaerobic microorganisms[4]. Dental caries and periodontal diseases, when not treated, may progress from mild to severe odontogenic infections such as cellulitis, Ludwig's angina, and necrotizing cervical fasciitis, among others[5]. Severe odontogenic infections (SOIs) are a common cause of morbidity and mortality in dental practice[6,7]. In the pre-antibiotic era, global death rates due to sepsis were as high as 54.0%[8]. Even though antibiotics have significantly lowered this mortality rate to about 10.0% globally[9], currently, sepsis-related deaths have increased globally to 19.7%[10]. Hence, severe odontogenic infections still have a high risk of morbidity and mortality11. According to recent studies, severe odontogenic infections have increased, with a concomitant increase in hospitalization[12–17]. This increasingly severe presentation of odontogenic infections presents with a variable rate of mortality. According to studies conducted in Nigeria and Kenya, the mortality rates of severe odontogenic infections were 4.9%[18], 7.0%[19], 10.7%[20], and 33.3%[21]. However, in Ghana, a study conducted at Korle-Bu Teaching Hospital and Tamale Teaching Hospital reported mortality rates of 5.8%[22] and 12.6%[23], respectively, for severe odontogenic infections.

Moreover, in a retrospective study on Ludwig's angina done in Kumasi-KATH, mortality was 12.5%, and the duration of hospitalisation for most patients (44.6%) was 6-10 days[24]. The commonest complication was airway obstruction (46.0%), necrotising cervical fasciitis (12.5%), and septicaemia (7.1%)[24].

There are limited studies on SOIs in Ghana, particularly regarding their severity. A study assessing the severity of spreading odontogenic infections will significantly add to existing knowledge, thereby addressing the existing gap in the literature.

MATERIALS AND METHODS

A prospective cross-sectional study was conducted among 62 selected participants over six months (August 2023 - January 2024, inclusive). The study sample comprised all patients with spreading odontogenic infections presenting to the maxillofacial department through KATH's outpatient (OPD) and emergency departments. The study utilized laboratory data and clinical records from individuals who provided informed consent and met the inclusion criteria. Participants were assured of voluntary participation, and the data collected were kept confidential and used solely for research and publication purposes. No participant was identified by the name. Participants were informed about the study's details before giving their verbal and written consent. Verbal consent was obtained from participants whose conditions made it impossible for them to sign the consent form; however, the written consent was signed by a legally authorised representative (guardian or relative). Moreover, permission or assent was sought from children, whilst consent was sought from the parent or guardian. All patients who presented with spreading odontogenic infections were included. However, the study excluded patients who did not consent to the study.

A structured researcher-administered questionnaire was designed and administered to consenting participants. Data collection was done by the principal investigator and two research assistants. The three researchers were calibrated to ensure uniformity in the data collection. The demographic characteristics of participants were recorded. The severity of odontogenic infections of each enrolled participant was determined using Sainuddin et al. scoring criteria as illustrated in Table 1 below: These parameters were used to score the participant and thereby

Table 1: Sainuddin et al. severity scoring criteria of odontogenic infections25

Criteria		Score	Maximum score	Patient score
Systemic Inflammatory Response Syndrome (SIRS)	Temperature >38.3°C	1		
	Heart rate >90 bpm	1		
	Respiratory rate >20/min	1	4	
	WBC < 4 or > 12x10^9/L	1		
Trismus	Moderate < 2cm	3		
	Severe < 1cm	4	4	
Dysphagia	Mild – able to swallow most foods	2	5	
	Moderate – unable to swallow fluids	4		
	Severe – drooling saliva	5		
Collection in 1 fascial space	Low severity (canine, vestibular)	1		
	Moderate severity (buccal)	2	5	
	High severity (all other spaces)	4		
Collection in 2 or more fascial spaces		5		
Sign of dehydration (↓ BP/ ↑Urea/ ↓Skin turgor)		1	2	
Comorbidities: Diabetes mellitus/ immuno-compromised states/ known or suspected chronic alcohol misuser		1		
Total Score			20	

Note: 0 = Normal; 1-8 = Mild severity score; 9-16 = Moderate severity score; >16 = Severe severity score

Predict the severity score of the odontogenic infection, as described by Sainuddin et al. (2017). Participants' blood samples were collected for laboratory investigations, such as Full Blood Count (FBC), Liver Function Test (LFT), Kidney Function Test (KFT), Fasting Blood Sugar (FBS) or Random Blood Sugar (RBS), C-reactive protein (CRP), and procalcitonin (PCT) before antibiotic therapy was started. All patients were adequately managed.

Plasma concentrations of CRP and PCT were used as laboratory indices to determine the severity of odontogenic infection. Direct immunoturbidimetry using the recombinant CRP method and a Dimension Analyser were used to measure CRP. A fully automated chemiluminescence analyser and PCT reagents were used to measure PCT. The relationship between CRP levels and the odontogenic severity score, as well as PCT and the odontogenic severity score, was then determined. Data was captured and coded using Excel. It was then cleaned and analysed using version 25.0 of Statistical Package for the Social Sciences (SPSS). For all quantitative variables, the mean and standard deviation were computed. Summaries were presented as tables, pie charts, or graphs. Categorical data, such as gender and levels of education, were summarised with proportions and percentages. Chi-squared and p-values were used to determine any statistical differences between severity scores and demographics. Continuous variables were analyzed using measures of dispersion such as means and medians. Pearson correlation coefficient was used to determine any association between biomarkers of sepsis (C-reactive protein and procalcitonin) and severity scores. Ethical approval was sought from Komfo Anokye Teaching Hospital Institutional Review Board (KATH IRB/AP/148/22).

RESULTS

Demographic characteristics of patients presenting with odontogenic infections at KATH

SEX

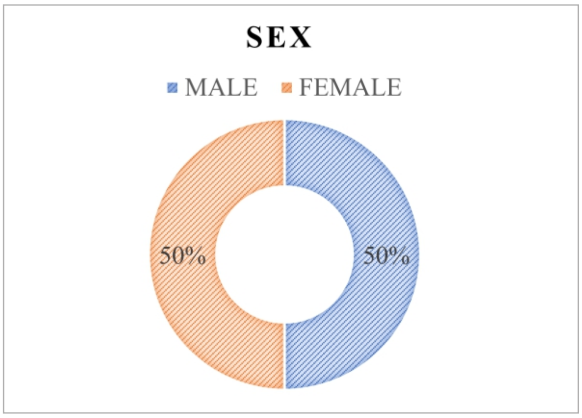

Figure 1: Sex distribution

The sample's gender/sex distribution consists of 31 males (50%) and 31 females (50%).

The male-to-female ratio, therefore, is 1:1

Age

The sample's age distribution ranged from the youngest person, at 2 years old, to the oldest person, at 86 years old, with a mean age of 44.8, a median age of 43, and the mode occurring at 37 years old.

Table 2: Age Distribution

Age Groups (Yrs)	Frequency [N=62]	Percentages
≤ 21	4	6.5
22 TO 41	26	41.9
42 TO 61	20	32.3
62 TO 81	10	16.1
≥ 82	2	3.2
TOTAL	**62**	**100.0**

Table 2 above shows the distribution of individuals across different age groups. The majority (41.9%) falls within the 22- to 41-year range, followed by 32.3% in the 42- to 61-year range.

Table 3: Educational Level

Educational Level	Frequency [N= 62]	Percentages
Junior High	26	42.0
Senior High	22	35.0
None	5	8.0
Tertiary	5	8.0
Primary	4	6.0
TOTAL	**62**	**100.0**

Table 3 illustrates the distribution of educational levels in a sample of 62 individuals. The highest frequency (42.0%) belongs to the Junior High category, followed by Senior High at 35.0%. Notably, 8.0% reported having no formal education, while the Tertiary and Primary education categories constitute 14.0% of the total sample.

Table 4: Distribution of diagnoses among patients

Diagnosis	Count Of Diagnosis	Percentages
Abscess	29	46.8
Cellulitis	18	29.0
Necrotising Cervical Fasciitis	13	21.0
Ludwig's Angina	2	3.2
Grand Total	**62**	**100.0**

Table 4 shows the distribution of diagnoses among 62 cases, with 29 individuals diagnosed with abscess, 18 with cellulitis, 2 with Ludwig's angina, and 13 with necrotising cervical fasciitis.

Ascertaining The Severity Of Odontogenic Infections And Determining The Relationship Between The Severity Score Of Odontogenic Infections And Biomarkers Of Sepsis.

Table 5: Clinical Severity Score

Severity	Frequency [n=62]	Percentages
Mild	18	29.0
Moderate	27	44.0
Severe	17	27.0
Total	**62**	**100.0**

Table 5 shows the distribution of severity levels among 62 cases of odontogenic infections, with 29.0% classified as mild, 44.0% as moderate, and 27.0% as severe.

The Pearson's correlation coefficient for severity scores and C-reactive protein(Crp) is 0.4, and for severity scores and procalcitonin (Pct), it is 0.5. These coefficients indicate a moderate positive correlation between severity scores and procalcitonin, as well as a low positive correlation between severity scores and C-reactive protein.

Using the Shapiro-Wilk test for normality of severity scores. The Shapiro-Wilk test for the overall severity score yielded a p-value of approximately 1.62×10^{-7}, indicating that the data significantly deviates from normality. Therefore, non-parametric tests were used for group comparisons.

Since the severity scores are not normally distributed, a non-parametric method (Kruskal-Wallis H test) was used to compare the mean severity scores between sexes. ($p=0.0014$). The p-value indicates a statistically significant difference in severity scores between sexes.

Comparing the differences in severity scores by sex, a t-test was used, and a statistically significant difference in mean severity scores was found between the sexes.($p=0.001$)

The Length Of Hospital Stay And The Mortality Rate Of Severe Odontogenic Infections.

Table 6: Duration of hospital stay

Duration of hospital stay		
Days Admitted	Frequency	Percentage
≤5	19	31
6 - 11	22	35
12 - 16	19	31
17≥	2	3
Total	62	100

The table illustrates the distribution of the number of days admitted for patients, with 31% admitted for ≤5 days, 35% for 6-11 days, 31% for 12-16 days, and 3% for 17 days or more. The average duration of hospital stay was 9 days.

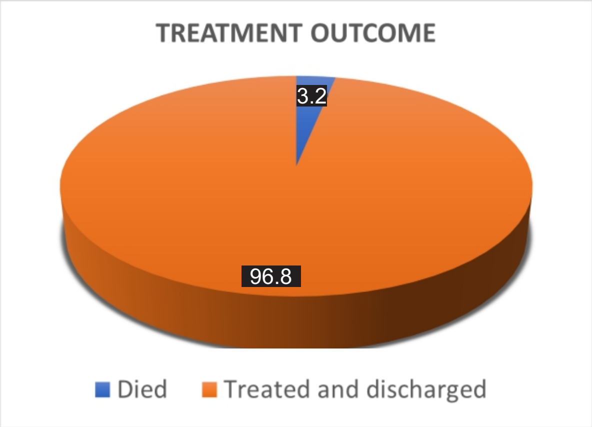

Figure 2: Treatment Outcome

The figure above provides the distribution of outcomes among 62 cases, with 3.2% resulting in death and 96.8% being treated and discharged.

DISCUSSION

In this current study, it is noteworthy that when examining the normality of severity scores, the distribution was found to be non-normal. However, when comparing the difference in severity scores by sex, a strong statistical significance was observed ($p < 0.05$), as shown in Table 8, suggesting that sex plays a role in determining the severity scores of odontogenic infections. This finding aligns with other studies, such as those by Braimah et al., Osunde et al., Adamson et al., and Yelibora et al., which also found that most participants were males[18,20,24,26].

In determining the clinical severity of odontogenic infections, nearly half (44.0%) of the participants in this study had moderate severity, followed by mild and severe cases. Although the mild presentations followed the moderate severity score, there were almost equal presentations in mild and severe clinical scores. This indicates that most participants in this study presented themselves quite late, although not excessively late, for healthcare. This may be due to them resorting to herbal preparations or self-medications or might have been kept on admission by a general practitioner. When the patient or general practitioner realizes the condition is deteriorating, they refer the patient to an oral and maxillofacial specialist. Moreover, there is an almost equal distribution between the mild and severe presentations of severe odontogenic infections. This represents nearly a third of the participants. This means that a third of the patients with severe odontogenic infections presented either with mild or severe symptoms; however, the majority presented with moderate severity.

In ascertaining the relationship between the clinical severity scores and biomarkers of sepsis (i.e., C-reactive protein and procalcitonin), as inferred from Table 5, the relationship between severity scores and biomarkers of sepsis indicates a positive correlation for both. This means the clinical severity score and biomarkers of sepsis have the same direction and strength. As the clinical severity score increases or decreases, biomarkers of sepsis (C-reactive protein and procalcitonin) move in the same direction with the same magnitude. However, there was a moderate positive correlation between severity score and procalcitonin and a low positive correlation between severity score and C-reactive protein. This suggests that procalcitonin exhibits better kinetics in response to sepsis than C-reactive protein, as it tends to rise earlier and provides a quicker detection of sepsis compared to C-reactive protein. This finding is consistent with a study by Magrini and her colleagues. In their study, procalcitonin and C-reactive protein did not show a significant correlation, and C-reactive protein has a slower kinetic profile than procalcitonin. However, procalcitonin has been demonstrated to identify infections and sepsis earlier[27].

In this current study, the mean duration of hospital stay was 9 days. Hence, the majority of participants in this study have lost an average of 9 days of working hours, which is the time they could have spent with family and friends and the comfort of being at home. Hence, economic growth is affected negatively. The duration of hospital stay in this study is similar to that reported in studies by Blankson et al. and Adjeso et al. in Ghana. According to Blankson and his colleagues, the mean duration of hospital stay was 9 days, and that of Adjeso and his colleagues was 10 days. However, Fomete et al. reported a hospital stay range of 4 to 42 days, with a mean of 15 days, in their study in Nigeria. This means that their patients stay longer on average during admission than those in the current study and those of Blanson et al. and Adjeso et al. Likely, their patients presented very late for treatment with severe odontogenic infection.

The mortality rate in this present study was 3.2%, with most participants being successfully treated and discharged. Nevertheless, the mortality rates in the Ghana study by Blankson et al. and Adjeso et al. were 5.8% and 12.6%, respectively. The high mortality rate in their studies, compared to the current study, may be a result of the severe presentation of odontogenic infections or a larger sample size in those studies compared to this present study. A limitation of the study is the small sample size, which reduces the study's power.

CONCLUSION

There was an equal gender distribution, with an age range of 2 to 86 years. However, the mean age was 44.8 years. Most participants' educational level and employment status were junior high and self-employment, respectively. Most participants (44.0%) presented with moderate severity of odontogenic infections. As the severity of odontogenic infections increases, the levels of biomarkers of sepsis (CRP and PCT) also increase, as they have a positive correlation with biomarkers of sepsis.

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