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Clinical characteristics and length of stay of patients with severe odontogenic infections

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Abstract

Background: Severe odontogenic infections (SOI) continue to persist in varying forms with associated morbidity.

Objective: This study aimed to describe the sociodemographic and laboratory characteristics of patients with SOI following admission, and to determine the factors influencing their length of stay.

Methods: This was a cross-sectional study involving patients with SOI who required hospital admission. Variables for this study included age, sex, employment category, educational level, Health Insurance status, previous dental visit, offending tooth, diagnosis, random blood glucose, laboratory parameters, and length of stay (LOS) as a measure of management outcome.

Results: Forty-six patients were included in this study, consisting of 18 females. The mean age of patients was 43.2 years (SD 18.4). The median LOS for patients over the study period was 7 days (IQR 6,10). Length of stay varied significantly with age category (p = 0.018). Middle-aged adults (36 – 65 years) and older adults (over 65 years) were more likely to remain hospitalised for more than a week compared to patients aged 18 – 35 years (OR = 13.3 and 12.0, respectively). The most consistently abnormal parameters in patients with SOI were elevated white blood cell count, deranged Gamma-glutamyl Transferase (GGT) and albumin tests. Albumin showed the highest correlation with LOS (r = 0.623, p = 0.198), and serum total protein showed a significant difference between participants with LOS of up to one week and patients who stayed longer (p = 0.035).

Conclusion: With the high success rate of our current management regime for SOI, age, serum albumin, and total protein were the most suggestive predictors of the length-of-stay of patients with Severe Odontogenic Infections.

Keywords: Odontogenic, Ghana, cellulitis, infection, length-of-stay

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INTRODUCTION

The aetiology of odontogenic infections includes factors related to host immune response, organism virulence, anatomy and environmental factors [1]. An imbalance in these conditions contributes to the development or spread of odontogenic infections. Odontogenic infections are severe when uncontrolled, rapidly progressive, and spatial and pose a threat to airway patency, systemic stability, or life [2]. Severe Odontogenic infections (SOI) are usually bacterial in nature, including aerobes and anaerobes, each consisting of rods and cocci. A SOI-study suggested that four species of bacteria made up as much as 94% of cultured organisms (Streptococcus viridans, 36.1%; Coagulase negative Staphylococcus aureus 23%; Staphylococcus aureus 14.0%; and Klebsiella pneumoniae 5.7%) [3], while another showed predominantly Streptococcus (39%), Enterococcus (20.6%), Corynebacterium (11.9%), Staphylococcus (9.3%) [4].

An odontogenic abscess may spread from a localised region around the tooth to distant anatomic spaces and with possible consequent systemic response [1]. Potential anatomic spaces are classified as mild, moderate, and

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severe, with the mediastinum, intracranial, and prevertebral spaces considered extreme [5]. The manifestations of SOI are therefore either related to the direct effects of the abscess or the initiated immune responses. The function of the immune system in reaction to SOI could consequently be compromised by conditions such as long-term use of corticosteroids, transplants, HIV, alcoholism, liver disease, and diabetes [6]. When unchecked, SOI may progress to Ludwig's angina, deep neck abscesses, necrotising cervicofacial fasciitis (NCF), airway obstruction and septicaemia, among others [7]. Management of SOI in any form requires meticulous, yet prompt care and organisation. The principles of care involve assessing the severity of infection, evaluating host defence, selecting the setting of care, performing surgical and medical interventions, and administering antibiotic therapy, as well as frequent patient evaluation [5]. Care, however, is tailored to individual patients and the operating protocols of institutions of care. Like many other geographic locations, SOIs unfortunately persist in various forms, with associated mortality rates of 0.3-5.6% [8,9].

In Ghana and many sub-Saharan African countries, however, few studies have characterised the sociodemographic and clinical laboratory features of patients with SOI alongside their management outcomes. This study addresses that gap by presenting these parameters among patients managed according to Korle-Bu Teaching Hospital's standard operating procedures (SOP). Understanding these patterns is essential for improving timely intervention, guiding resource allocation, and enhancing patient outcomes in the region.

MATERIALS AND METHODS

A cross-sectional study was conducted (from October 2019 to April 2022) among all patients who presented to the Oral and Maxillofacial Unit of the Korle-Bu Teaching Hospital with the clinical diagnosis of a Severe Odontogenic Infection requiring admission. Patients with orofacial infections with no definite history or association with dental infections were excluded from the study. Patients who met the inclusion criteria were consecutively recruited into the study. Severe Odontogenic Infections were defined as rapidly progressing bacterial infections of dental origin that extend beyond the alveolar process into deep fascial spaces. All patients were managed in accordance with the Oral and Maxillofacial Unit's standard operating procedure (SOP), as outlined in our data collection methods and comprising initial assessment, investigations, antimicrobial therapy, definitive source control and surgical drainage, as well as supportive care and follow-up.

Informed consent and assent were obtained from patients as soon as they were clinically stable. Patients were thoroughly assessed at presentation, admitted, and the required emergency, surgical, and medical care was provided. Routine Full Blood Count (FBC), Blood Urea, Electrolytes and Creatinine (BUE), Liver Function Tests (LFT), Random Blood Sugar (RBS), HIV test and aspirate culture and sensitivity (C/S) were performed for each patient. Prior to the outcome of C/S, all patients who had not received antibiotics before presenting were put on IV Co-Amoxiclav 1.2 g 8-hourly for 5 days, IV Metronidazole 500 mg 8-hourly for 5 days. Individualised adjunct medical therapy was provided for each participant, including fluid and electrolyte balance, pain control, dietherapy, management of comorbid conditions, and frequent evaluations and repeated surgical interventions when required. Patients were subsequently administered sensitive antibiotics based on C/S results. However, for patients whose clinical parameters did not show improvement after four days prior to C/S results, or whose C/S did not yield any growth, antibiotics were routinely changed to IV Clindamycin 300 mg 6 hourly for 1 week and IV Ciprofloxacin 400 mg 12 hourly for 1 week. Antibiotics were modified for patients who had an allergy to any of the routine medications used in standard management.

Primary surgical care involved incision and drainage under general or local anaesthesia with placement of drains, as well as the extraction of the offending tooth. The airway was also secured. Repeated dressings, explorations and debridement were also done, varying from twice daily to every other day. Patients were discharged based on their clinical assessment, supported by significant improvements in laboratory indicators. Variables for this study included age, sex, employment category, educational level, Health Insurance status, previous dental visit, offending tooth, diagnosis, RBS, laboratory parameters, C/S, and length of stay (LOS). Variables were analysed descriptively. This study categorised LOS into 'one week or less' and 'more than 1 week' [10]. Length of stay was then used as an outcome of interest for chi-square analyses with other study variables and to correlate with laboratory parameters. Analyses were done using Stata (16.1, StataCorp. LLC, College Station, TX, USA).

Patient confidentiality was strictly maintained throughout the study, with all identifiable information securely protected and excluded from analysis. The study was approved by the Institutional Review Board of Korle-Bu Teaching Hospital (KBTH-IRB 00019/2019), ensuring the highest level of ethical standards.

RESULTS

The study included 46 patients, 28 males and 18 females. The age range was 12 to 77 years, with a mean age of 43.2 (SD 18.4) years. Many of the patients with SOI were middle-aged adults (48%), while 39% had previously sought dental care for the offending tooth (Table 1). Ranging from 2 to 23 days, the median LOS for patients admitted over the period was 7 days (IQR: 6,10). Length of stay did not significantly vary with sex ($p = 0.559$), education ($p = 0.897$), employment category ($p = 0.082$), NHIS status ($p = 0.784$), or location (laterality) ($p = 0.140$). Length of stay, however, varied significantly with age

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Table 1. Characteristics of patients with severe odontogenic infections

Variable	Number	Percent
Sex		
Male	28	60.9
Female	18	39.1
Age		
<18	3	6.5
18-35	14	30.4
36-65	22	47.8
> 65	7	15.2
Education		
None	6	13
Primary	4	8.7
Secondary	13	28.3
Tertiary	23	50
Employment		
Formal sector	1	2.2
Informal sector	31	67.4
Unemployed	14	30.4
NHIS		
Yes	24	52.2
No	22	47.8
First visit		
Yes	28	60.9
No	18	39.1
Location		
Right	12	26.1
Left	15	32.6
Bilateral	19	41.3
Jaw		
Upper	4	8.7
Lower	42	91.3

category (p = 0.018). Middle-aged adults (36 - 65 yrs) were more likely to stay in the hospital for more than a week than patients 18 - 35 yrs (OR = 13.3). Similarly, the odds of older adults (> 65 years) staying for over a week were 12 times those of younger adults. About 28% (n = 13) of patients had other known medical conditions. These were hypertension (7), diabetes (2), hypertension and diabetes (1), Hepatitis B (1), Renal disease (1), Sickle Cell Disease (1), and Tuberculosis (1). The presence of a known comorbidity did not, however, influence the length of stay (p = 0.185). Also, only one patient among the participants was reactive for HIV testing. Furthermore, hyperglycaemia was present in 41.1% of the study population.

Ludwig's angina was the most common severe odontogenic infection diagnosis (Figure 1). One patient, who was diagnosed with sepsis, died on the same day of presentation, representing a mortality rate of 2.2%. Thirteen patients (28.3%) had alternative treatments or attempted self-medication before attending the clinic. No patient indicated being allergic to any of the medications used. Empirical antibiotics were changed to clindamycin among 14 patients (29%). Except for one patient who died, all other patients recovered uneventfully. The commonest offending tooth was the lower first molar (19), followed by the wisdom tooth (15). All maxillary offending teeth were premolars. In 22 patients (56.4%), there was the presence of gross caries on at least one other tooth aside from the offending one. The mean period from the onset of symptoms to presentation was 10.1 days (SD:15.4). Waiting period to presentation did not significantly vary among sex (p = 0.200), age category (P = 0.993), education (p = 0.553), employment (p = 0.486), NHIS status (p = 0.293), or previous visits (p = 0.581).

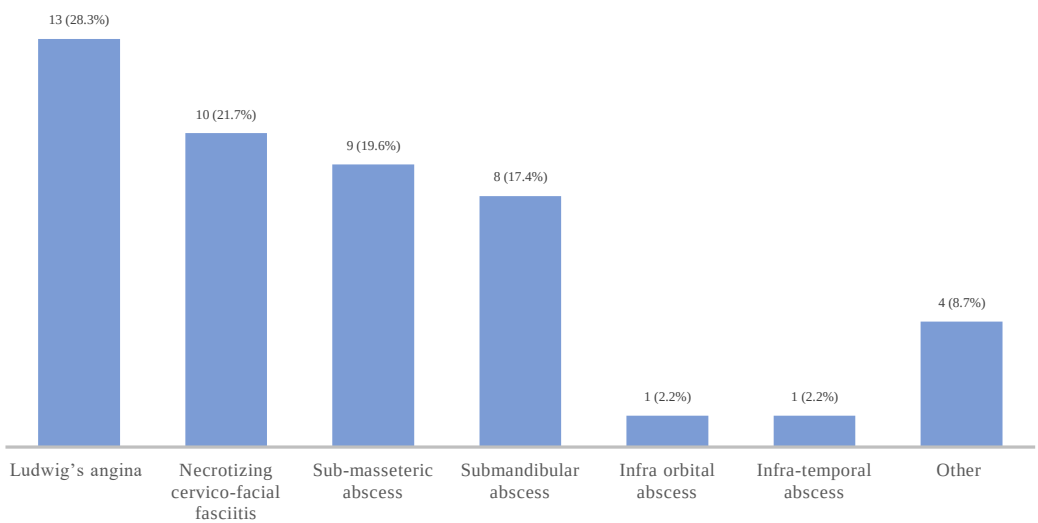

Figure 1. Distribution of severe odontogenic infection diagnoses

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Table 2. Associatiom of presenting laboratory indices with the length of stay

Laboratory Parameter	Mean	SD	Proportion with abnormal values (%)	Correlation with LOS (R)	P-value of X^2 test
Haemoglobin (g/dL)	11.1	2.6	38.1	-0.321	0.765
White Cell Count (x10^9/L)	17.4	7.6	92.7	-0.043	0.277
Platelet count (x10^9/L))	363.8	179.3	31.7	0.031	0.873
Sodium (mmol/L)	140.5	7.5	23.0	0.033	0.651
Potassium (mmol/L)	4.4	0.8	12.8	-0.016	0.598
Creatinine (mg/dL)	90.6	55.7	24.2	-0.061	0.769
AST (U/L)	47.0	36.2	40.7	0.348	0.864
ALP (U/L)	42.3	27.3	34.6	0.426	0.769
GGT (U/L)	83.5	50.7	70.4	0.172	0.183
Total protein (g/L)	6.5	1.6	25.9	-0.378	0.035*
Albumin (g/L)	3.5	1.9	46.2	0.623	0.198
RBS (mmol/L)	8.0	2.5	35.3	0.465	0.242

Laboratory indices of patients with SOI are shown in Table 2. The most consistently abnormal parameter was the White Blood Cell count. This was followed by Gamma-glutamyl Transferase (GGT) and Albumin levels. From the parameters used in this study, albumin showed the highest correlation with LOS. However, only the serum Total Protein showed a significant difference between participants with LOS of up to 1 week and those with longer LOS (Table 2).

DISCUSSION

We sought in this study to describe the sociodemographic characteristics, laboratory parameters, and outcomes of patients with SOI after management in accordance with the SOP of our institution. It was found, among other things, that the median LOS for patients seen over the study period was 7 days, with older patients being more likely to stay longer.

The choice of Co-Amoxiclav and Metronidazole as empirical antibiotics, OR Clindamycin for SOI, is supported by several previous publications with notably high rates of success [11,12]. Amoxicillin-Clavunate has similar activity against both gram-positive and gram-negative bacteria, and the combination has been shown to be effective against several bacteria cultured from odontogenic infections [2]. Based on our clinical assessment, a switch to clindamycin was necessary for 14 patients, suggesting a probable success rate of 68.8%. The use of clindamycin as a second-line choice of antibiotics for SOI was suggested by Jevon et al, while Tancawan showed that Amoxicillin/clavulanic acid was comparable to clindamycin in achieving clinical success (88.2% versus 89.7%) in acute odontogenic infections. The study also indicated that the safety profile was consistent with the known side effects of both drugs [13]. The effectiveness of Co-Amoxiclav and metronidazole corroborates the current notion that there is no need to change these as empirical drugs; however, our experience with clindamycin as a second-line, soon after noticing an unsatisfactory response, further reinforces the need for individualised care and frequent reviews when managing patients with SOI.

By comparing the independent variables of this study to LOS, this study examined these variables at presentation as possible predictors. Length of stay was categorised as ≤ 1 week versus > 1 week to reflect meaningful differences in clinical course and resource utilisation. Prolonged hospitalisation beyond seven days typically indicates complications such as multi-space involvement, systemic sepsis, or slow recovery, and thus was used as a marker in this study for undesirable outcome. Several sociodemographic and laboratory parameters have been known to be useful in monitoring the disease progression and management of SOI. For instance, Leucocytosis is a prevalent feature in many studies, while Uittamo et al. noted that patients with Odontogenic infections who had less formal education were more likely to be hospitalised than patients in other education groups [14].

Similarly, Furuholm et al. also reported that body temperature, pulse, C-Reactive protein levels, and WBC counts at hospital admission were significantly higher in patients with odontogenic infections who required admission [15]. The Laboratory risk indicator for necrotising fasciitis (LRINEC) score is a popular metric that is especially useful when the SOI has progressed to NCF. This tool is based on six common serum parameters at the time of presentation: C-reactive protein (CRP), total white cell count, haemoglobin, serum sodium, creatinine and glucose [16]. In this study, however, using LOS as the outcome variable, only serum Total Proteins showed a significant difference between participants with LOS of up to one week and patients who stayed longer. Leucocytosis was, however, a prevalent laboratory feature, followed by deranged Gamma-glutamyl Transferase (GGT) and Albumin levels. Similar observations were made by McGrowder et al. [17] and Pastrovic et al. [18].

Total serum protein, which includes albumin and globulins, reflects both nutritional status and systemic inflammatory

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responses. In severe infections, albumin levels often decrease due to increased capillary permeability, redistribution, and heightened metabolic demands during the acute-phase response. Also, hypoalbuminemia impairs wound healing, reduces drug-binding capacity, and weakens immunity. Derangement would therefore be frequently observed in patients with more extensive or severe infections and is associated with worse clinical outcomes, including longer hospital stays, greater risk of complications, and slower recovery [19]. Comorbidities would typically be expected to increase length of stay through several mechanisms, such as impairing the immune response by altering drug metabolism and antibiotic response, or predisposing patients to complications, such as delayed wound healing or systemic involvement. However, in this study, no observable difference in LOS was detected between patients with and without comorbid conditions.

A limitation of this study was the relatively small sample size and the use of a single centre, which may restrict the generalizability of the findings. In addition, the scope of variables examined was limited; for example, only a few inflammatory markers were assessed. Notably, C-reactive protein (CRP), identified in other studies as a potential predictor of the severity and progression of odontogenic infections, was among the limited variables measured. Incorporating a broader range of clinical and laboratory parameters, along with culture and sensitivity analyses, in future studies could provide a more robust understanding of the predictors and outcomes of severe odontogenic infections. Our study, however, provides some insight into SOI that would be useful for its management. To strengthen the evidence base, additional studies in the region are needed to evaluate a wider array of clinical, biochemical, and microbiological parameters that may function as early or reliable disease markers, thereby improving diagnostic accuracy and guiding timely intervention.

Conclusion

Despite the high overall treatment success rate, age, serum albumin, and total protein levels were suggestive indicators of prolonged hospital stay. Middle-aged and older adults were more likely to remain hospitalised for over a week. Multi-centre studies with larger cohorts and broader biomarker assessments are warranted to validate and expand on these findings.

DECLARATIONS

Ethical consideration

Ethical approval for the study was obtained from the Institutional Review Board of Korle-Bu Teaching Hospital (KBTH-IRB 00019/2019).

Consent to publish

All authors agreed on the content of the final paper.

Funding

None

Competing Interest

The authors declare no conflict of interest.

Author contribution

MOB and PKB conceptualised, designed, and collected the data. PKB and GEP analysed the data, and PKB and IA drafted the manuscript. All authors reviewed and approved the final version.

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Availability of data

Data is available upon request to the corresponding author.

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