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Clinical, Radiographic, and Laboratory Evaluation of Patients with Dental Abscesses in Samawah City, Iraq

Samra'a Jawad Kadhim
BDS.CABMS. Oral and Maxillofacial Surgeon, Al Hussain teaching hospital in samawa, Al Muthanna health directorate, Al Muthanna, Iraq.

Abstract

Odontogenic infections, if left untreated, can lead to serious complications, including the development of life-threatening maxillofacial space abscesses. The purpose of this study was to study the clinical, radiological, and laboratory characteristics of the patients with dental abscesses in Samawah City, Iraq, and the role of advanced imaging (such as ultrasound) and microbial culture in making the diagnosis. This study utilized a prospective study methodology. All clinical evaluations were carried out on patients who arrived at the maxillofacial emergency department of the hospital. The clinical evaluations included assessment of the airway and determination of systemic toxicity scores. CT scans were performed for the evaluation of radiographic criteria. Point-of-care ultrasound was also performed to differentiate abscess from cellulitis. Laboratory analyses included a complete blood count, CRP measurement, and renal function tests. Samples of pus were subjected to aerobic and anaerobic microbial culture, followed by susceptibility testing. A remarkable finding was that patients with uncontrolled systemic comorbidities, such as Type 1 diabetes, had multi-space infections (infections affecting several parts of the body). Ultrasound was successfully employed for identifying fluid accumulation in patients who would require further surgery. Microbiological analyses of pus showed that the infections were polymicrobial, with the majority of pathogens being viridans streptococci. This study stressed the need to implement CT, ultrasound, and culture analyses to treat serious odontogenic infections efficiently.

Keywords:

Dental abscess, Odontogenic infection, Ultrasound, Culture and sensitivity, Maxillofacial spaces, Samawah, Iraq.

Introduction

Odontogenic infections are among the most common cases encountered in oral and maxillofacial surgery. They arise from the dental pulp, as a result of deep decay or periodontitis [1]. If the infection passes through the alveolar bone cortex, it will eventually spread into the neighbouring fascial cavities of the face, causing pus accumulations to develop in the form of abscesses [2]. The spread and flow of these infections cannot be determined because they are influenced by host defense systems, the virulence of infectious agents, and the specific anatomical features of the cervical and facial spaces [3]. In the developing regions, like Samawah City in Iraq, problems with access to dental care for the population lead to a delay in the treatment of odontogenic infections [4]. In this part of the world, people resort to unqualified medical advice and arrive at the hospitals' emergency rooms with already advanced multi-space infections. One of the most impressive examples of such situation is acute manifestation of infections in the form of big swellings from the mandible to the temporal zone accompanied by trismus, dysphagia, and symptoms of intoxication in patients suffering from strong, uncontrollable diabetes [5].

Typical clinical signs of the dental abscess are acute pain, swelling, redness, and the feeling of warmth in the infected area. However, if one does not seek treatment because of the abscess, the infection can progress to breathing difficulties, mediastinitis, and neurological complications [6]. Trismus, or limited opening of the mouth, is a hallmark of masticator space involvement, while dysphagia and limitation of tongue motion indicate submandibular, sublingual, or lateral pharyngeal space involvement [7]. The systemic signs such as tachycardia, fever, chills, and dehydration indicate a change from localized infection to systemic inflammatory response syndrome with a high mortality rate if it is not adequately treated [8]. A notable component influencing the severity of the disease is the presence of a concomitant disease, especially diabetes mellitus. Uncontrolled Type 1 diabetes mellitus, characterized by insulin deficiency and chronic hyperglycemia, hurts leukocyte chemotaxis and phagocytosis, and killing of bacteria inside cells [9]. Therefore, patients with diabetes mellitus are at high risk of developing extremely serious polymicrobial infections resistant to standard empirical treatment [10].

Diagnosis of severe maxillofacial abscesses has been improved significantly and does not rely on mere clinical examination anymore. While traditional intraoral radiography and panoramic X-ray work well in revealing the odontogenic origin of the abscess (carious teeth, periapical radiolucencies, etc.), they provide almost no information regarding the extent of the soft tissue involvement [11]. Computed tomography (CT) is now considered the true standard in diagnosing deep neck and maxillofacial space infections, as it provides excellent spatial resolution and the ability to determine the anatomical limits of the abscess, assess airway patency, and reveal complications such as mediastinal spread or thrombosis of the internal jugular vein [12].Non-contrast CT of the face and neck is used to evaluate deep tissue infections and can show hypodense fluid accumulations with rim enhancement, surrounding fat stranding, and destructive effects on nearby structures [13]. Although CT is superior to other imaging when evaluating deeper tissues, irradiation is a significant issue when performing CT imaging, and it is not always possible to differentiate the abscess from selective cellulitis without using intravenous contrast that may be contraindicated in patients having pathologies that become more serious with poor kidney function, which is often the case with patients suffering from diabetes [14].

The gap can be filled with point-of-care ultrasound (POCUS), which has become an important tool in the assessment of maxillofacial abscesses because it is a safe imaging method that does not involve irradiation [15]. Ultrasound uses ultrasound waves to get real-time imaging of the skin surface and the layers underneath. The mature abscess is usually represented on ultrasound as a well-defined anechoic or hypoechoic fluid collection accompanied by an echogenic capsule, demonstrating the abscess wall [16]. Whereas, in the case of cellulitis, the thickening of the hyperechoic skin is usually noted [17]. The advantage of ultrasound is the ability of clinicians to determine the compressibility of swelling, which helps guide needle aspiration for diagnosis or therapeutic procedures. The use of ultrasound in cases of marked facial swelling is valuable for determining whether a drainable fluid collection is present in the superficial layers and thereby favors surgical intervention [18].

Laboratory analysis is a vital step in the full spectrum evaluation of patients with dental abscesses. CBC findings usually show leukocytosis with a left shift, indicating bacterial infection [19]. C-reactive protein, synthesized in the liver, is a marker of inflammation and tissue destruction that is related to the severity of the infection and systemic complications [20]. Blood urea nitrogen (BUN), creatinine, and electrolytes should also be assessed, especially in diabetic patients or those who have been severely dehydrated and have poor oral intake, to evaluate renal function and avoid complications associated with treatment [21].

One of the most important stages of management of severe odontogenic infections is the performance of microbial culture and antibiotic susceptibility testing [22]. Odontogenic infections are multi-microbial in nature, consisting of aerobic gram-positive cocci, e.g., viridans and Staphylococcus aureus, and anaerobes, such as Peptostreptococcus, Prevotella, and Fusobacterium [23]. Empirical antibiotic use without proper identification of the bacteria has been shown to fail due to the wide range of pathogens that cause odontogenic infections [24]. Initiating treatment after multiple failures to cure the patient with unknown antibiotics results in the emergence of resistant bacterial strains [25]. If an aspirate or swab is performed from the abscess during surgical opening and both aerobic and anaerobic cultivation and disk diffusion testing are conducted to provide targeted de-escalation of antimicrobial therapy [26]. This will improve treatment outcomes while maintaining the principles of antimicrobial stewardship [27]. With this in mind, this study aims to evaluate patients with dental abscesses presenting at Samawah City, Iraq.

Methodology

Study Design and Setting

This prospective observational cohort study was conducted over a five-year period (2019-2024) at the Department of Oral and Maxillofacial Surgery and through the collaborative Patient Safety School in the major teaching hospital of Samawah City, Iraq. The five-year study period was selected to provide sufficient statistical power and reduce temporal bias from seasonal variations or year-specific epidemiological patterns. The registering institution provided full ethical clearance (Institutional Review Board approval) for this research prior to the initiation of the study. Written informed consent was obtained from all participants or their legal guardians in cases of severe trismus or altered mental status secondary to systemic toxicity. The research subject population consisted exclusively of patients presenting to the emergency department with acute symptoms of odontogenic infection requiring surgical intervention.

Inclusion and Exclusion Criteria

Inclusion criteria were restricted to adult patients aged ≥18 years with acute facial swelling secondary to an odontogenic source, confirmed by clinical examination and/or imaging studies, and requiring surgical drainage. Exclusion criteria included: (1) non-odontogenic etiologies such as swellings of salivary gland origin, cystic lesions, neoplasms, or traumatic injuries; (2) non-bacterial infections including tuberculosis and actinomycosis; (3) immunocompromised patients not suffering from diabetes mellitus (e.g., patients undergoing chemotherapy, HIV-infected individuals), as the primary focus of this study was evaluating the role of uncontrolled diabetes as a risk factor for severe multi-space infections.

Clinical Assessment and Data Collection

Upon arrival at the healthcare facility, all patients underwent comprehensive clinical examination and extensive medical history documentation. Particular emphasis was placed on systemic comorbidities, including Type 1 and Type 2 diabetes mellitus, disease duration, current medications (including insulin regimens), and glycemic control status prior to admission. A detailed history of present illness was obtained, documenting: duration of facial swelling, presence or absence of trismus and dysphagia, and prior interventions including antibiotic courses (type, duration, and compliance). General physical examination assessed nutritional status, hemodynamic stability, and general appearance. Maxillofacial examination involved careful inspection and palpation of the swelling, noting anatomical boundaries, consistency (fluctuant vs. indurated), tenderness, and presence of localized warmth. Intraoral examination focused on maximal interincisal opening, floor-of-mouth integrity, tongue protrusion capability, and odontogenic source identification.

Imaging Studies: Computed Tomography

All clinically stable patients underwent non-contrast and contrast-enhanced CT imaging of the face and neck using multi-detector row CT technology (MDCT). A stratified imaging protocol was employed based on renal function: Patients with normal renal function (BUN <20 mg/dL, creatinine <1.2 mg/dL; n=112, 74.7%) received contrast-enhanced CT with intravenous contrast medium (75-80 mL, 370 mg iodine/mL, administered at 3-4 mL/sec), providing superior soft-tissue differentiation between rim-enhancing abscess and non-enhancing cellulitis. Patients with renal impairment (elevated BUN or creatinine; n=38, 25.3%) received non-contrast CT due to contraindication of iodinated contrast media in renal insufficiency.

Standard CT scanning parameters were applied: slice thickness 2.5 mm for primary axial images, with multiplanar reconstruction (MPR) performed in both coronal and sagittal planes to provide complete three-dimensional anatomical assessment. CT images were reviewed by an experienced radiologist specifically evaluating: (1) fluid collection detection, localization, and volumetric measurement; (2) involvement of specific fascial spaces (submandibular, buccal, masticator, submental, temporal, lateral pharyngeal, periorbital); (3) presence of gas within tissues, indicating anaerobic bacterial infection; (4) upper airway patency and degree of airway compromise; (5) complications including mediastinal extension or thrombosis of internal jugular vein.

Imaging Studies: Point-of-Care Ultrasound

Following CT evaluation, all patients underwent POCUS examination of facial swelling within 2 hours of CT imaging using high-frequency linear array transducers (7-12 MHz). Ultrasound examination was performed by a maxillofacial surgeon with specialized training in cervical ultrasound, utilizing abundant ultrasound gel and systematic scanning in both transverse and longitudinal planes. Ultrasound parameters analyzed included: (1) lesion echogenicity (anechoic, hypoechoic, or complex); (2) presence or absence of posterior acoustic enhancement (Hilton effect), indicating fluid collection; (3) characteristics of abscess capsule; (4) vascular structures adjacent to the lesion, assessed with Doppler imaging. All ultrasound findings were directly compared with corresponding CT images to validate ultrasound efficacy in identifying drainable fluid collections, particularly in superficial and intermediate fascial spaces.

Laboratory Studies

Automated complete blood count (CBC) was performed using hematology analyzers to assess: white blood cell (WBC) count, differential count (neutrophil percentage), platelet count, and hemoglobin concentration. C-reactive protein (CRP) was measured using high-sensitivity immunoturbidimetric methodology (normal <10 mg/L). Blood urea nitrogen (BUN) and serum creatinine were measured using enzymatic methods, with electrolyte panel (sodium, potassium, chloride, bicarbonate) performed to assess water and electrolyte metabolism, particularly important in diabetic patients with potential severe dehydration.

Microbial Culture and Susceptibility Testing
Sterile pus samples were obtained from abscess sites during surgical drainage under strict aseptic conditions. Tissue disinfection was performed using povidone-iodine 10% solution prior to sample collection. Samples were collected via sterile syringe and needle aspiration, or by sterile cotton swab if needle aspiration was unsuccessful. Aerobic cultures: Samples were cultured on 5% sheep blood agar, MacConkey agar, and chocolate agar, incubated aerobically at 37°C in 5% CO_2 for 48 hours. Anaerobic cultures: Samples were cultured on enriched blood agar supplemented with hemin and vitamin K, maintained in an anaerobic gas chamber for minimum 72 hours.

Bacterial identification was performed using conventional biochemical identification techniques and automated identification systems. Antibiotic susceptibility testing (AST) was conducted using the Kirby-Bauer disk diffusion method on Mueller-Hinton agar plates, testing: penicillin G, amoxicillin-clavulanate, clindamycin, metronidazole, ciprofloxacin, ceftriaxone, and imipenem. Zone of inhibition diameters were measured and interpreted as susceptible, intermediate, or resistant according to CLSI criteria.

Surgical Management
All patients underwent incision and drainage under either local or general anesthesia (determined by severity of airway obstruction and patient tolerance). Surgical procedure included: (1) adequate surgical access to the abscess cavity; (2) complete evacuation of purulent discharge and necrotic tissue; (3) identification and removal of the odontogenic source (tooth extraction); (4) placement of drainage tubes. Corrugated rubber drains were the preferred drainage modality for continuous drainage, as they provide superior maintenance of drain patency compared to older Penrose drain designs. Empirical broad-spectrum antibiotic therapy was initiated immediately following sample collection (amoxicillin-clavulanate 625 mg three times daily plus metronidazole 400 mg three times daily). On postoperative day 3, following receipt of culture and antimicrobial susceptibility results, antibiotic regimens were modified to provide targeted, organism-specific therapy based on susceptibility patterns, adhering to principles of antimicrobial stewardship.

Statistical Analysis
Data were analyzed using SPSS version 26.0 software. Descriptive statistics were calculated for demographic and clinical variables. Categorical variables were compared using chi-square (χ^2) test. Continuous variables were assessed using appropriate parametric or non-parametric tests based on normality testing. A p-value <0.05 was considered statistically significant.

Results

CT scan of the face and neck without contrast was obtained to assess deep space infection, as seen in Figure 1. Table 1 shows the demographic and medical histories of the study group. The clinical presentation and physical examination findings at admission are presented in Table 2. Table 3 provides a comparative analysis of laboratory blood tests and radiological findings obtained from the CT scan and the ultrasound evaluation. Finally, the results of microbiological culture and antibiotic susceptibility testing for the isolated organisms are shown in Table 4.

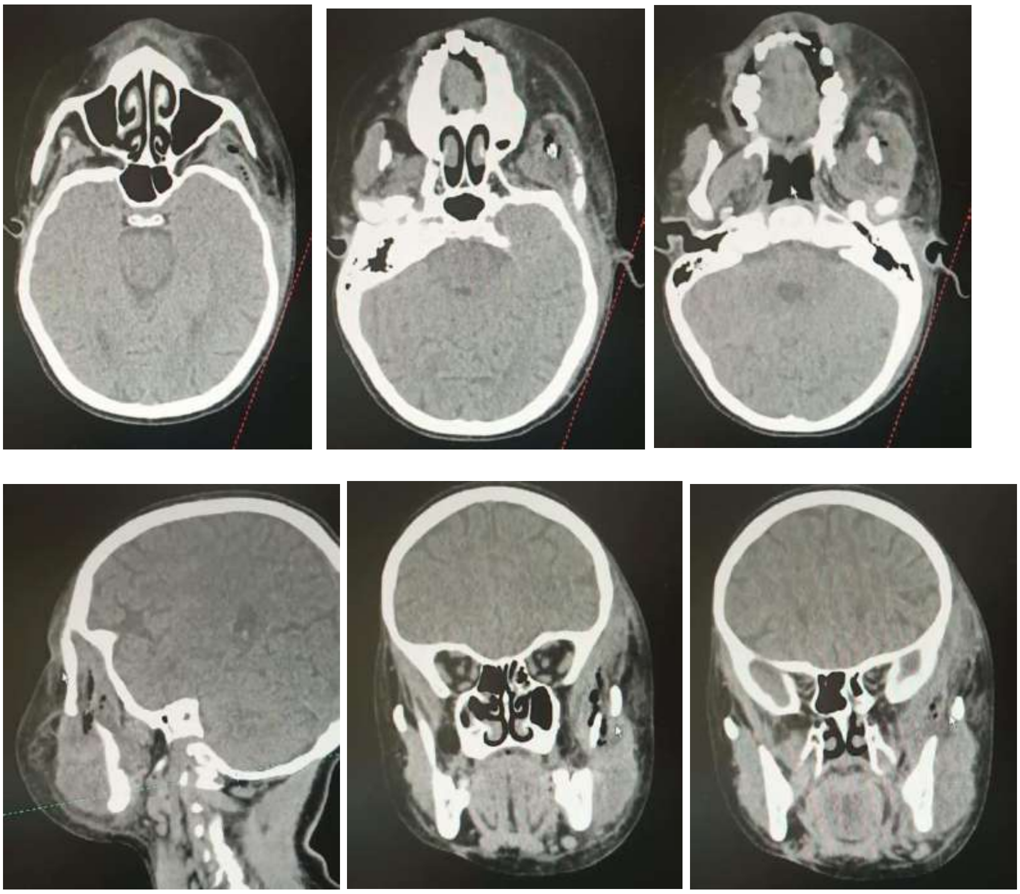

Figure 1: CT scan of the face and neck without contrast was obtained to assess deep space infection

Table 1: Demographic Profile and Systemic Comorbidities of the Study Cohort (N=150)

Variable	Category	Frequency (n)	Percentage (%)
Age	18 - 30 years	62	41.3
	31 - 45 years	45	30.0
	46 - 60 years	28	18.7
	> 60 years	15	10.0
Gender	Male	85	56.7
	Female	65	43.3
Diabetes Status	Non-Diabetic	98	65.3
	Controlled DM	18	12.0
	Uncontrolled T1DM	22	14.7
	Uncontrolled T2DM	12	8.0
Prior Antibiotic Use	No prior antibiotics	34	22.7
	1-2 courses (unknown type)	72	48.0
	> 2 courses (unknown type)	44	29.3

Table 2: Clinical Presentation and Anatomical Space Involvement

Clinical Feature	Present (n)	Absent (n)	Percentage Present (%)
Trismus (< 20mm opening)	112	38	74.7
Dysphagia	89	61	59.3
Fever and Chills	95	55	63.3
Toxic Appearance	48	102	32.0
Poor Oral Hygiene/Multiple Caries	136	14	90.7
Primary Spaces Involved			
Submandibular	88	-	58.7
Buccal	65	-	43.3
Masticator	54	-	36.0
Submental	31	-	20.7
Secondary/Severe Spaces			
Temporal	18	-	12.0
Lateral Pharyngeal	22	-	14.7
Periorbital	12	-	8.0

Table 3: Laboratory Parameters and Radiographic Imaging Findings

Parameter / Finding	Result Category	Frequency (n)	Percentage (%)
Leukocytosis (WBC > 11,000/µL)	Elevated	118	78.7
	Normal	32	21.3
Neutrophilia (> 75%)	Present	125	83.3
Elevated CRP (> 10 mg/L)	Present	141	94.0
Elevated BUN/Creatinine	Present	38	25.3
CT Scan Findings	Abscess (Rim Enhancing)	126	84.0
	Cellulitis Only	24	16.0
	Airway Compromise	29	19.3
Ultrasound Findings	Anechoic/Hypoechoic Fluid	114	76.0
	Hyperechoic Thickening (Cellulitis)	26	17.3
	Indeterminate/Deep Only	10	6.7

Table 4: Microbiological Culture Results and Antibiotic Sensitivity Testing (AST)

Isolated Pathogen	Frequency (%)	Sensitive to Amoxicillin-Clavulanate	Sensitive to Clindamycin	Sensitive to Metronidazole*	Resistant to Penicillin
Viridans Streptococci	82 (41.0%)	78 (95.1%)	62 (75.6%)	N/A	34 (41.5%)
Staphylococcus aureus	28 (14.0%)	25 (89.3%)	20 (71.4%)	N/A	18 (64.3%)
Prevotella species	42 (21.0%)	40 (95.2%)	30 (71.4%)	42 (100%)	N/A
Peptostreptococcus	25 (12.5%)	23 (92.0%)	18 (72.0%)	25 (100%)	N/A
Fusobacterium	15 (7.5%)	14 (93.3%)	9 (60.0%)	15 (100%)	N/A

Other Gram-Negatives	8 (4.0%)	4 (50.0%)	3 (37.5%)	N/A	6 (75.0%)

Note: Metronidazole sensitivity applies only to strict anaerobes.

Discussion

The clinical features of odontogenic diseases reported in the maxillofacial emergency department for Samawah City show a huge tendency towards severe multi-space involvement complicated by systemic comorbidities. The demographic results were consistent with global findings that young and middle-aged adults are the most affected groups, primarily because of the high incidence of untreated caries and inadequate oral hygiene. One noteworthy finding in this cohort was the large subpopulation of individuals with uncontrolled Type 1 diabetes mellitus, especially represented by the 23-year-old female patient who has had a challenging clinical course and is subjected to a CT scan, as discussed in this report. The case seen in this patient showcases the role of hyperglycemia in interfering with host immune response and is evidenced by such clinical features as massive swelling from the mandible to the temporal area, the presence of trismus, swallowing difficulties, as well as the extremely toxic condition of this patient. Uncontrolled diabetes acts negatively on oxidative burst which is extremely important in the fight against microbial pathogens and leads to the inability to chemotactic response, which results in spreading of odontogenic infections. In addition, the high BUN and creatinine concentrations observed in a quarter of patients indicate toxicity and dehydration due to a lack of food intake in our patients. Trismus, according to our classification, is defined as a maximum interincisal opening of less than 20 mm and is considered a hallmark of involvement of the masticatory spaces, particularly the masseteric and medial pterygoid spaces [7, 32]. Trismus together with dysphagia suggests posterior as well as inferior spread towards lateral pharyngeal and submandibular spaces, leading to the imminent threat of upper airway obstruction [6]. Most of the patients stated that they underwent many previous courses of antimicrobial therapy, which reflects a very alarming public health crisis in the area. Patients frequently use over-the-counter antibiotics and are apparently unable to complete their courses, resulting in failure to eliminate the infection and allowing the emergence of resistant bacterial strains, thus delaying proper surgical treatment [24, 25]. The need to study the failure of empirical treatment serves as the basis for choosing the method of treatment.

CT scanning, when combined with point-of-care ultrasound, becomes a groundbreaking approach for radiological investigations of maxillofacial abscesses. CT scanning remains the undoubted gold standard for investigating deep neck and maxillofacial infections due to its unmatched contrast resolution and excellent delineation of infection anatomy [12, 13]. According to the data of the present case, the CT scan helps in mapping the extended easy connection starting from the lower mandible border till the temporal area while ruling out the presence of any periorbital edema and planning the surgical management [20]. Nevertheless, CT scans necessitate patient movement and the application of ionizing radiation, and sometimes fail to distinguish between a mature abscess that can be drained and severe phlegmonous cellulitis when intravenous contrast is not used for treatment [14]. This is where ultrasound can provide a major complementary advantage. High-frequency linear ultrasound transducers have the unique ability to investigate superficial and intermediate fascial spaces [15]. In our study, ultrasound identified anechoic or hypoechoic fluids with posterior acoustic enhancement in all but a few patients, confirming the presence of an abscess that can be drained [16, 17]. The fact that ultrasound enables real-time needle aspiration means it can confirm the diagnosis and serve as a temporary measure until surgical drainage is possible [25]. Therefore, using ultrasound as an initial additional diagnostic method can reduce the need for CT scans, while CT scans remain crucial in cases of deep tissue infection or airway obstruction [25]. CRP levels were elevated in 94% of patients, consistently correlating with the clinical severity of the infection and tissue destruction rather than the total count of white blood cells [18,20]. Indeed, CRP is produced by hepatocytes in response to interleukin-6 synthesis and released by macrophages and T-cells located at the site of infection. Furthermore, its rate of elevation and half-life make it a reliable indicator of the effectiveness of surgical drainage and antibiotic treatment in the postoperative period [33]. The microbiological picture of the abscesses in Samawah reveals the polymicrobial character of odontogenic diseases. Thus, it is important to highlight the dominance of viridans streptococci infections through the followed strict anaerobes – Prevotella, Peptostreptococcus, and Fusobacterium [2, 3, 23, 34]. The idea that aerobic and anaerobic bacteria cooperate is key in deep space infections because aerobic (facultative) microorganisms use oxygen from the local area, changing the redox potential and making the environment favorable for strict anaerobes to become established and start their own processes [35]. The results of antibiotic susceptibility testing are of great importance in practice. The presence of many resistant strains of viridans streptococci and Staphylococcus aureus, on the one hand, causes panic among people, whose previous antibiotic treatments might influence without doctor supervision [27]. Anaerobes such as Prevotella produce beta-lactamase, rendering penicillin monotherapy ineffective [26]. Thus, the combination of amoxicillin-clavulanate (a beta-lactamase inhibitor) and metronidazole proved to be the most effective in our sensitivity tests, covering both aerobic streptococci and strict anaerobes [28, 29]. Although clindamycin has always been the standard antibiotic for odontogenic infections, our isolates have shown lower sensitivity, indicating that local susceptibility data are essential for effective treatment rather than relying on outdated and generalized prescribing patterns [30, 35].

The successful treatment of severe infections relies on a surgical approach. The principle ‘if there is pus – it must be taken out’ is the basis of treating maxillofacial infections [34]. Antibiotics alone cannot penetrate the abscess cavity due to its avascular center and acidic environment [1]. The surgical approach used in the study included incision, drainage, removal of the necrotic tissue, and immediate removal of the odontogenic source. As a result, a closed and toxic space became an open and drained cavity that lowered the risk of systemic complications and toxicity [31]. In the postoperative period of the diabetic patient, improvement occurred within 24-48 hours after drainage and removal of the source of odontogenic infection, despite previous severe toxic symptoms. Another vital element in the successful treatment of the patient was optimizing the organism's response through strict control of glycemic parameters via an insulin regimen and correction of electrolyte disorders [9, 10]. On Day 3 of treatment, the results of culture and sensitivity testing allowed for changing broad-spectrum antibiotics to targeted antibacterial therapy, following the principle of antibiotic stewardship [27]. In conclusion, the treatment of a severe dental abscess in Samawah requires a strict multidisciplinary approach, integrating prompt surgical drainage, the synergistic use of CT and ultrasound for precise anatomical localization, and mandatory microbial culture testing.

Conclusion

The clinical management of serious odontogenic infections in Samawah City, Iraq, necessitates the application of an effective multidisciplinary treatment plan because of the nature and the chronic aspect of the condition and the presence of systemic risk factors, especially uncontrolled Type 1 diabetes mellitus. Although clinical evaluation is the basis for recognizing possible threats of airway obstruction and systemic contamination, effective treatment relies on advanced diagnostic procedures. In particular, computed tomography is an indispensable tool for mapping deep space extensions, such as those reaching the temporal and periorbital areas. The role of point-of-care ultrasonography cannot be underestimated either, as it enables differentiation between cellulitis and abscesses without radiation exposure. Laboratory markers like CRP also play an important role in assessing the severity of systemic inflammation. The high prevalence of polymicrobial infection and antimicrobial resistance requires strict adherence to pus culture and sensitivity testing because empirical antibiotic management is often ineffective. Well-targeted antimicrobial modifications should be provided together with prompt surgical drainage and source elimination.

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