Patient Management With Severe Maxillofacial Infection in Tertiary Hospitals: a Multidisciplinary Treatment Algorithm

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Abstract

Background: The general objective of this study was to evaluate the management of patients with severe maxillofacial infections in a tertiary care hospital.

Methods: A study was performed whose methodology consisted of evaluating the epidemiological profile of 35 patients with serious maxillofacial infections, including age group, and gender. The patients were evaluated between December 2020 and November 2021**.** A total of 35 patients (18 male and 17 female) were recorded in this study.

Results: The most frequent etiological factor leading to infection was dental (91.4%), followed by infected fractures (5.7%). The teeth most frequently involved were the lower third and other lower molars (1^{st}, 2^{nd}, and premolars). The most performed treatment (14 patients) was drainage of the infected space, removal of the etiological agent and intravenous antibiotic therapy. 10 patients (8.6%) were treated with incision, drainage, and antibiotic IV therapy..

Conclusions: Multidisciplinary management can decrease morbidity and mortality in patients with severe maxillofacial infections.

Introduction

In oral and maxillofacial surgery, infections represent a frequent emergency, and management is an important part of treatment.[1]The etiopathogenesis of infections can be classified by: odontogenic route, related to the teeth and periodontium, as non-odontogenic infections, associated with glandular, sinus, and cutaneous pathologies, or as a result of trauma or neoplasms[2]. Bacterial cultures obtained from maxillofacial infections of odontogenic origin are predominantly from the oral flora[3]. The profile of these infections is poly-microbial, with a predominance of $Gram^{+}$ cocci, $Gram^{-}$ bacilli, and the presence of aerobic and anaerobic bacteria. Methods of surgical diagnosis and treatment have evolved satisfactorily to date despite having to overcome the high degree of mortality related to the pre-antibiotic period[4]. In contrast, the chronicity of disease has become more prevalent and therefore the infections have become more severe and complex [5]. Clinically, the initial signs and symptoms of odontogenic infection are characterized by: edema, erythema, suppuration, dyspnea, dysphagia, fever above 38.3ºC, moderate or advanced trismus, and fatigue [6]. The objective of this study was to evaluate the management of patients with severe maxillofacial infections in a tertiary care hospital.

Materials & Methods

The study was retrospectively observational, analytical, longitudinal, and was performed in a tertiary-level emergency hospital. It was conducted from December 2020 to November 2021, with 71 patients admitted to the hospital with odontogenic infections. Of these, (and fulfilling the inclusion criteria) 35 were enrolled in the study with: severe maxillofacial infections with trismus, airway compromise, affected deep fascial spaces, and risk of death. Excluded patients: were either unconscious or uncooperative during the

examination at the time of the interview, had suspended or changed medications at will, had abandoned the treatment, or did not return for evaluation. Medical, dental, and complementary information were recorded by questionnaire, and included: identification, clinical evaluation, signs and symptoms, origin of infection, anatomical location of infection, airway condition, treatment, opinion of the Hospital Infection Control Commission (HICC), culture and sensitivity testing, antibiogram, treatment in conjunction with other specialties, requested tests, patient's diet, antibiotic therapy, and complications. To prepare this questionnaire, two oral and maxillofacial surgeons, a general surgeon, a thoracic surgeon, and an oral-maxillofacial surgery resident were consulted. This study was guided by STROBE checklist for case-control, cross-sectional and cohort studies.

Results And Statistics Analysis

The data were exported from Google Forms to the *Statistica* Package for the Social Sciences (SPSS) v20.0 software for Windows, in which analyses were performed, adopting a confidence level of 95%. Absolute and percentage frequencies of each study variable associated with the hospital stay length were calculated using Fisher's exact test or Pearson's chi-square test. Data presenting significant associations were submitted to a multinomial logistic regression model (multivariate analysis).

MULTIDISCIPLINARY ASSESSMENTS

To construct an algorithm for conduct in the face of severe maxillofacial infections, the results of the quantitative analyses and a concise consolidation of meetings held with representatives of the general surgery and anesthesiology team at the institution where the study was performed were considered. The project was submitted to the National Research Ethics Committee and approved under registration number: CAAE: 39263720.6.0000.5047. All patients in the study were informed about its purpose and signed giving their informed consent.

RESULTS

Our study involved a prospective analysis of 35 patients admitted to a hospital with severe maxillofacial infections, and treated using surgical-incision, drainage and cause removal with IV administration of antibiotics. In relation to these infections, no deaths were recorded in the present study, the epidemiological profile shown in **Table 1** .

Table 1: Epidemiological profile.

		Length of stay		
	Total	**up to 10 days**	**>10 days**	**p-Value**
Age				***0.042***
up to 30 years	18 (51.4%)	**16 (61.5%) ***	2 (22.2%)	
>30 years	17 (48.6%)	10 (38.5%)	**7 (77.8%) ***	
Sex				0.289
Female	17 (48.6%)	14 (53.8%)	3 (33.3%)	
Male	18 (51.4%)	12 (46.2%)	6 (66.7%)	
Origin				
Inland-interior	13 (37.1%)	11 (42.3%)	2 (22.2%)	0.282
Inside the Fortaleza municipality	22 (62.9%)	15 (57.7%)	7 (77.8%)	
Smoker				
No	22 (84.6%)	18 (90.0%)	4 (66.7%)	0.165
Yes	4 (15.4%)	2 (10.0%)	2 (33.3%)	
Alcoholic				
No	23 (88.5%)	19 (95.0%)	4 (66.7%)	0.057
Yes	3 (11.5%)	1 (5.0%)	2 (33.3%)	
Allergies				
No	27 (84.4%)	19 (82.6%)	8 (88.9%)	0.660
Yes	5 (15.6%)	4 (17.4%)	1 (11.1%)	
Prior service				
No	6 (22.2%)	5 (25.0%)	1 (14.3%)	0.557
Yes	21 (77.8%)	15 (75.0%)	6 (85.7%)	
Antibiotics before admission				
No	8 (34.8%)	5 (29.4%)	3 (50.0%)	0.363
Yes	15 (65.2%)	12 (70.6%)	3 (50.0%)	

Source: Author. ***p<0.05, Fisher's exact test or Pearson's chi-square test (n, %).**

The etiology and initial symptoms are presented in **Table 2.** Despite the relevance of the description data, there was no statistical correlation between the etiological factors and length of hospital stay.

Table 2: Etiological factors and initial symptoms.

		Length of stay		
	Total	**Up to 10 days**	**>10 days**	**p-Value**
Dental etiology				
No	3(8.6%)	1 (3.8%)	2 (22.2%)	0.090
Yes	32 (91.4%)	25 (96.2%)	7 (77.8%)	
Etiological factor				
Caries	25 (71.4%)	19 (73.1%)	6 (66.7%)	0.149
Periodontitis	1 (2.9%)	1 (3.8%)	0 (0.0%)	
Post extraction	6 (17.1%)	5 (19.2%)	1 (11.1%)	
Infected fracture	2 (5.7%)	0 (0.0%)	2 (22.2%)	
Sinusitis	1 (2.9%)	1 (3.8%)	0 (0.0%)	
Topography of dental etiology				
3rd lower molars	16 (45.7%)	12 (46.2%)	4 (44.4%)	0.929
Other lower back teeth	17 (48.6%)	14 (53.8%)	3 (33.3%)	0.289
Other upper back teeth	4 (11.4%)	3 (11.5%)	1 (11.1%)	0.972
Other upper front teeth	2 (5.7%)	2 (7.7%)	0 (0.0%)	0.392
Other lower front teeth	1 (2.9%)	1 (3.8%)	0 (0.0%)	0.551
Initial symptoms				
Trismus	28 (80.0%)	21 (80.8%)	7 (77.8%)	0.847
Drainage	11 (31.4%)	8 (30.8%)	3 (33.3%)	0.886
Dysphagia	8 (22.9%)	7 (26.9%)	1 (11.1%)	0.330
Edema	34 (97.1%)	25 (96.2%)	9 (100.0%)	0.551
Pain	16 (45.7%)	14 (53.8%)	2 (22.2%)	0.101
Erythema	12 (34.3%)	10 (38.5%)	2 (22.2%)	0.376
Dyspnea	9 (25.7%)	7 (26.9%)	2 (22.2%)	0.781
Dyslalia	8 (22.9%)	7 (26.9%)	1 (11.1%)	0.330
Fever	6 (17.1%)	4 (15.4%)	2 (22.2%)	0.639
Lingual proptosis	1 (2.9%)	0 (0.0%)	1 (11.1%)	0.085
Ocular proptosis	1 (2.9%)	0 (0.0%)	1 (11.1%)	0.085

Rhinorrhea	1 (2.9%)	0 (0.0%)	1 (11.1%)	0.085
Tissue necrosis	1 (2.9%)	0 (0.0%)	1 (11.1%)	0.085
Myiasis	1 (2.9%)	0 (0.0%)	1 (11.1%)	0.085
Odynophagia	1 (2.9%)	1 (3.8%)	0 (0.0%)	0.551
Eyelid occlusion	1 (2.9%)	1 (3.8%)	0 (0.0%)	0.551

Source: Author ***p<0.05, Fisher's exact test or Pearson's chi-square (n, %).**

The affected fascial space locale was recorded **(Table 3),** noting that the submandibular space was most affected at 80% of the cases, this, followed by the submental space (28.6% of the cases), and sublingual space (25.7% of the cases). Infections invading the sublingual space were noted for their longer hospital stays. (p=0.017).

Table 3: Anatomical location.

		Length of stay		
	Total	**Up to 10 days**	**>10 days**	**p-Value**
Localization				
Submandibular	28 (80.0%)	21 (80.8%)	7 (77.8%)	0.847
Sublingual	9 (25.7%)	4 (15.4%)	**5 (55.6%) ***	***0.017***
Submental	10 (28.6%)	6 (23.1%)	4 (44.4%)	0.221
Cervical	6 (17.1%)	4 (15.4%)	2 (22.2%)	0.639
Oral	7 (20.0%)	5 (19.2%)	2 (22.2%)	0.847
Orbit	4 (11.4%)	3 (11.5%)	1 (11.1%)	0.972
Canine	4 (11.4%)	3 (11.5%)	1 (11.1%)	0.972
Paranasal sinuses	2 (5.7%)	1 (3.8%)	1 (11.1%)	0.418
Retropharyngeal	1 (2.9%)	1 (3.8%)	0 (0.0%)	0.551
Masseteric	1 (2.9%)	1 (3.8%)	0 (0.0%)	0.551
Pterygomandibular	1 (2.9%)	1 (3.8%)	0 (0.0%)	0.551
Chest	1 (2.9%)	1 (3.8%)	0 (0.0%)	0.551

Source: Author. ***p<0.05, Fisher's exact or Pearson's chi-square test (n, %).**

The treatment performed on most patients (40%) was incision and drainage of the infected locale, with removal of the etiologic agent and intravenous antibiotic therapy. 10 patients (28.6%) were treated with

incision, drainage, and IV antibiotic therapy. In 6 cases (17.1%) an HICC evaluation was requested, and there was a change in antibiotic therapy for 85.7% of these patients. Culture and sensitivity tests were requested for 8 (23.5%) patients. And an oral diet was accepted by the majority (94.3%), however, these remained hospitalized longer (p=0.013).

Table 4: Treatment.

		Length of stay		
	Total	**up to 10 days**	**>10 days**	**p-Value**
Need for airway access				
No	24 (68.6%)	**21 (80.8%) ***	3 (33.3%)	0.008
Yes	11 (31.4%)	5 (19.2%)	**6 (66.7%) ***	
Treatment				
ATB	6 (17.1%)	6 (23.1%)	0 (0.0%)	0.429
Removal of the cause + ATB	5 (14.3%)	3 (11.5%)	2 (22.2%)	
Incision and drainage + ATB	10 (28.6%)	7 (26.9%)	3 (33.3%)	
Incision and drainage + removal of the cause + ATB	14 (40.0%)	10 (38.5%)	4 (44.4%)	
HICC opinion				
No	29 (82.9%)	23 (88.5%)	6 (66.7%)	0.135
Yes	6 (17.1%)	3 (11.5%)	3 (33.3%)	
Antibiotic therapy change				
No	1 (14.3%)	1 (25.0%)	0 (0.0%)	0.350
Yes	6 (85.7%)	3 (75.0%)	3 (100.0%)	
Culture				
No	26 (76.5%)	21 (84.0%)	5 (55.6%)	0.085
Yes	8 (23.5%)	4 (16.0%)	4 (44.4%)	
Corticosteroid				
No	17 (48.6%)	12 (46.2%)	5 (55.6%)	0.627
Yes	18 (51.4%)	14 (53.8%)	4 (44.4%)	

Oral diet				
No	2 (5.7%)	0 (0.0%)	2 (22.2%)	
Yes	33 (94.3%)	**26 (100.0%) ***	**7 (77.8%)***	***0.013***

Source: Author ***p<0.05, Fisher's exact or Pearson's chi-square test (n, %).**

The laboratory tests requested were: blood count, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP), and computed tomography of the face without intravenous contrast for 24 (68.6%) of the patients, or computed tomography of the face with administration of contrast for 9 (22.9%) of the patients. Other exams such as cervical CT (17.1%), and chest CT (8.6%) were also requested and recorded. Antibiotic therapy was used, with ceftriaxone, amoxicillin, and clindamycin being the most prescribed (17.1% of patients). **(Table 5)**

Table 5: Antibiotic Therapy

		Length of stay		
	Total	**Up to 10 days**	**>10 days**	**p-Value**
Antibiotic administration				
Amoxicillin	6 (17.1%)	6 (23.1%)	0 (0.0%)	0.113
Clavulin	4 (11.4%)	4 (15.4%)	0 (0.0%)	0.211
Clindamycin	6 (17.1%)	4 (15.4%)	2 (22.2%)	0.639
Azithromycin	0 (0.0%)	0 (0.0%)	0 (0.0%)	1,000
Metronidazole	2 (5.9%)	1 (4.0%)	1 (11.1%)	0.437
Ceftriaxone	6 (17.1%)	4 (15.4%)	2 (22.2%)	0.639
Cephalothin	1 (2.9%)	1 (3.8%)	0 (0.0%)	0.551
Cefazolin	0 (0.0%)	0 (0.0%)	0 (0.0%)	1,000
Ampicillin	1 (2.9%)	1 (3.8%)	0 (0.0%)	0.551
Levofloxacin	3 (8.6%)	2 (7.7%)	1 (11.1%)	0.752
Oxacillin	2 (5.7%)	2 (7.7%)	0 (0.0%)	0.392
Piperacillin with tazobactam	0 (0.0%)	0 (0.0%)	0 (0.0%)	1,000
Other	1 (2.9%)	1 (3.8%)	0 (0.0%)	0.551

Source: Author ***p<0.05, Fisher's exact or Pearson's chi-square test (n, %).**

Complications were observed in one (1) patient (2.9%), who presented cavernous sinus thrombosis after sinusitis in the paranasal dental origin sinuses, with hospitalization for > 10 days (p=0.085), as well as an absence any infection involving the mediastinum, cranial cavity, or death. After corroborating the epidemiological profile, the correlation of the variables studied with the length of stay, patients who required access to the airways were 37.56% more likely to be hospitalized for more than 10 days, regardless of age, anatomical location of infection, or instituted diet.

Table 6: Influence of variables with OR

	p-Value	Adjusted OR (95%CI)
Hospitalization time >10 days		
Age	0.859	1.32 (0.06-28.80)
Sublingual Localization	0.154	10.74 (0.41-281.27)
Airway access necessitated	***0.018**	***37.56 (1.88-750.31)**
oral diet	1.000	0.42 (0.04-42.73)

***p<0.05, Multinomial logistic regression. OR = odds ratio; 95% CI = 95% confidence interval of the adjusted OR.**

Upon recording the relationship between fascial spaces and diminished airway access, significant results were obtained in Fischer's exact test (p<0.05) with the calculated OR (odds ratio). It was observed that the involvement of the sublingual space increases (by 30 times) the prevalence of tracheostomy (p=0.029). Involvement of the submental or submandibular spaces increases the need for tracheostomy by 17.2 times (p=0.034). Another important finding is that presenting 3 or more affected spaces increases the need for airway access by 11 times (p=0.038) and the need for tracheostomy by 19.3 times (p=0.047).

Table 7: Correlation between anatomical space and the need for tracheostomy.

		Tracheostomy			
	Total	**No**	**Yes**	**p-Value**	**OR (95%CI)**
Space					
Right sublingual	4 (11.4%)	2 (6.3%)	2 (66.7%)	***0.029**	***30.0 (1.83-490.79)***
Left sublingual	7 (20.0%)	5 (15.6%)	2 (66.7%)	0.095	ns
Submental	12 (34.3%)	9 (28.1%)	3 (100.0%)	***0.034**	***17.2 (1.1-368.7)***
Right submandibular	12 (34.3%)	9 (28.1%)	3 (100.0%)	***0.034**	***17.2 (1.1-368.7)***
Left submandibular	21 (60.0%)	18 (56.3%)	3 (100.0%)	0.259	ns
Cervical	6 (17.1%)	5 (15.6%)	1 (33.3%)	0.442	ns
Right orbit	3 (8.6%)	3 (9.4%)	0 (0.0%)	1,000	ns
Left orbit	1 (2.9%)	1 (3.1%)	0 (0.0%)	1,000	ns
Right maxillary sinus	2 (5.7%)	2 (6.3%)	0 (0.0%)	1,000	ns
Left maxillary sinus	1 (2.9%)	1 (3.1%)	0 (0.0%)	1,000	ns
Right ethmoid sinus	2 (5.7%)	2 (6.3%)	0 (0.0%)	1,000	ns
Left ethmoid sinus	1 (2.9%)	1 (3.1%)	0 (0.0%)	1,000	ns
Right mouthpiece	5 (14.3%)	5 (15.6%)	0 (0.0%)	1,000	ns
Left mouthpiece	4 (11.4%)	4 (12.5%)	0 (0.0%)	1,000	ns
Right canine	3 (8.6%)	3 (9.4%)	0 (0.0%)	1,000	ns
Left canine	1 (2.9%)	1 (3.1%)	0 (0.0%)	1,000	ns
Left retropharyngeal	1 (2.9%)	1 (3.1%)	0 (0.0%)	1,000	ns
Left masseteric	1 (2.9%)	1 (3.1%)	0 (0.0%)	1,000	ns
Left pterygomandibular	1 (2.9%)	1 (3.1%)	0 (0.0%)	1,000	ns
Left chest	1 (2.9%)	1 (3.1%)	0 (0.0%)	1,000	ns
>3 spaces	5 (11.4%)	3 (9.4%)	2 (66.7%)	***0.047**	***19.3 (1.33-281.60)***

***p<0.05, Fisher's exact test; OR = odds ratio; 95%CI = 95% confidence interval of OR; ns = non-significant OR**

Discussion

This research revealed a mean patient age of 31.2 years old, corroborating the current literature [8–12]. Our study also presents gender, where 18 patients were male and 17 were female, yet not allowing assertion that odontogenic infections are determined by the sex of the patient [13]. In relation to prior care, twenty-one patients had received care prior to hospital admission, and of these, 75% remained in the hospital for up to 10 days. 62.5% had undergone antibiotic therapy prior to admission, corroborating the literature [14], and 49% of the evaluated patients presented severe infection requiring antibiotic therapy. However, in the present study, a noted delay (between early stage perception and management of infection as severity increases), demonstrates that classical principles of odontogenic infection management are not generally followed. [14] The most common etiological factor of the infections was dental, mostly related to the lower molars, this is because most odontogenic infections are associated with caries and periodontal disease, resulting from unsatisfactory oral hygiene. [15] Trismus and edema were the principal clinical signs observed upon hospital admission. 97.1% (N = 33) of patients presented edema, 80% (N = 28) reported trismus, and when associated with dysphagia, dyspnea, and dyslalia, they become suggestive of serious infections [16]. In this study, the anatomic spaces presenting the highest incidence were: submandibular, submental, and sublingual. This confirms a relationship with principal causative agents, however, clinical studies reveal that the pterygomandibular, and submandibular spaces [17, 18]are affected in greater numbers. For airway management, 68.6% (n = 24) of the patients did not require access, data not compatible with the study by Flynn [5] where the most used technique for management was nasofibroscopic intubation. For patients requiring securing the airway, the technique to be used was first discussed between the anesthesiologist and the oral and maxillofacial surgeon. The 24 patients mentioned above were managed in an outpatient setting. The proposed treatment for these 24 patients consisted of incision and drainage, removal of the causative agent, and IV antibiotic therapy. [19] One of the limitations of this study was the limited availability of antibiotics in the public health system, which made it impossible to administer the antibiotics proposed by the HICC. That being said, clinical studies of maxillofacial infection treatment have concluded that with incision and drainage, followed by removal of the cause, all antibiotics present satisfactory results [5, 10, 19]. However, antibiotics remain recommended for systemic manifestations and should be used to complement treatments. Empirical antibiotic therapy should be performed until culture and sensitivity tests results are available[20]. Regarding the use of corticosteroids in patients with odontogenic infections; of the 35 patients studied, most (51.4%) received corticosteroid medications. However, certain authors believe that the use of corticosteroids may worsen outcomes due to their immunosuppressive nature [18, 21]. Yet, short-term use of corticosteroids has been shown to be safe and effective: corticosteroids decrease trismus, modulate body temperature, and reduce hospitalization time. Finally, of the outcomes observed, only one patient evolved cavernous sinus thrombosis, requiring empirical antibiotic therapy, anticoagulants and, in some cases, surgery. [22]

Conclusions

Patients with severe maxillofacial infection associated with airway compromise require coordinated multidisciplinary action with prolonged hospital stays, especially if the sublingual space is affected.

Declarations & Statments

Conflict of interest

We have no conflicts of interest.

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Competing interests

“The authors have no relevant financial or non-financial interests to disclose.

Availbility of data and materials:

All research procedures were informed about the purpose of the research and an informed consent was signed, in accordance with 1964 Helsinki Declaration

Ethics approval and consent to participate:

The project was recognized as Research Ethics by the National Ethics Commission and approved under registration number: CAAE20.6.000.547. All research procedures were informed about the purpose of the research and an informed consent was signed, in accordance with 1964 Helsinki Declaration

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Statystical analysis and data review of the study

The first draft of the manuscript was written by Francisco de Assis Crescêncio Vergetti and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript

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Figures

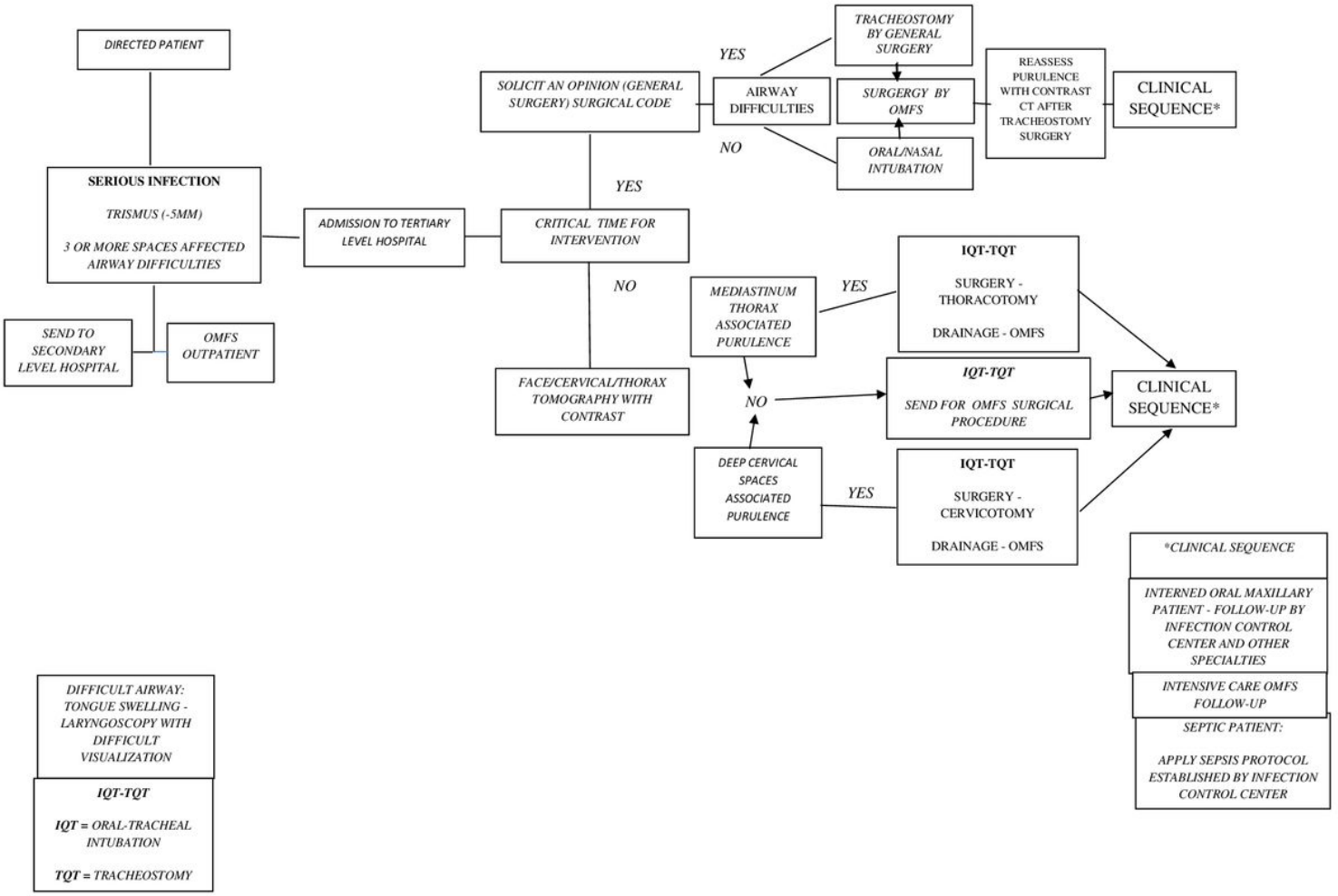

Figure 1

TREATMENT ALGORITHM