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Original Article

Treatment of odontogenic infections: An analysis of two antibiotic regimens

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ABSTRACT

Purpose: Retrospective analysis of the efficacy for two commonly used antibiotic regimens in the management of severe odontogenic infections.

Patients and Methods: Evaluation of records of patients admitted to the Oral and Maxillofacial Surgery service at Boston University Medical Center from 2009 to 2014 with severe infections of odontogenic origin (SOI). Patients were divided into two groups based on the administered intravenous antibiotic: 1) Group I: Clindamycin only and 2) Group II: Penicillin and Metronidazole. Variables evaluated included demographic characteristics, ASA status, and anatomic site of infection risk, length of hospital stay, antibiotic failure, and pharmaceutical treatment cost.

Results: 78 patients (46 males and 32 females) were included in the study. There were 57 patients in group I (average age 32.6 years) and 21 in Group II (average age 32.8 years). The average white cell count at time of admission count was higher in Group I (19.3) versus Group II (17.4). Antibiotic failure rate was 3.5% in Group I and 4.7% for group 2 patients.

Conclusion: Clindamycin alone and combination of Penicillin with Metronidazole are both effective pharmaceutical regimens for SOI. Clindamycin therapy resulted in shorter hospital stay and lower net treatment costs with a slightly higher success rate.

1. Introduction

Patients with severe head and neck infections of odontogenic origin (SOI) present a significant challenge to surgeons from both medical and surgical standpoint. Infections from teeth that are limited to the oral cavity or superficial anatomic spaces are primarily managed on an outpatient basis with control of the etiological factor, antibiotics, and surgical incision and drainage if necessary. However, infections involving deep head and neck fascial spaces usually require hospital admission and management as an inpatient since they have the potential to evolve into true medical and airway emergencies. Despite the odontogenic origin of the majority of these infections, the treatment of such infections can be led by various medical or surgical specialties, often subject to individual hospital policies and doctor availability.[1]

The aim of this study was to compare the efficacy of two antibiotic treatment regimens in the management of SOI. We hypothesized that results could help clinicians in their decision making process while managing SOI patients with the objectives of being cost-effective and decreasing the use of unnecessary antibiotics which has been shown to promote antimicrobial resistance.

2. Patients and methods

This study involving retrospective record analysis was approved by the institutional review board at Boston University. The inclusion criteria were as follows: 1) Patients with SOI managed by the Oral and Maxillofacial Surgery (OMS) service at Boston Medical Center between 2009 and 2014, 2) Surgery under general anesthesia which involved incision and drainage, removal of the source of infection and drain placement within 24 h of admission, 3) Procurement of culture and sensitivity samples, and 4) Antibiotic therapy with either 3 Clindamycin or Penicillin and Metronidazole. Patients who developed multi organ diseases due to non odontogenic causes were excluded from the study. Patients who were given antibiotics other than the study groups were also not included in the study. For study purposes, all patient records were divided into two groups based on the type of antibiotics administered: 1) Group I: patients treated with intravenous (IV) Clindamycin (600 mg every 8 h), and, Group II: IV Penicillin G (2 million units every four hours) and IV Metronidazole (500 mg every 8 h). Patients were discharged from the hospital when they were found afebrile for a period of 24 h, along with normalization of white blood cell count (WBC), and adequate oral intake (> 1500 calories). Once

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discharged from the hospital, all patients were prescribed oral antibiotic therapy for 7 days. Group I patients were prescribed Clindamycin - 600 mg to be taken every 8 h while patients in Group II received Penicillin VK – 500 mg to be taken every 6 h.

For all patents in either group, average age, gender, American Society of Anesthesiologists (ASA) classification, average WBC on presentation, and the fascial spaces involved were recorded. The degree or severity of risk from infection was classified according to the anatomical sites involved, utilizing the criteria which have been previously published[2]: 1) Low-risk: infections localized to the buccal or infraorbital spaces; 2) Moderate-risk: infections of the submandibular, submental, sublingual, submasseteric, and/or pterygomandibular spaces; 3) High-risk: infections involving the lateral pharyngeal, retropharyngeal and/or pretracheal spaces. If a patient had involvement of three or more areas of moderate-risk, they were considered to be in the high-risk group. Similarly antibiotic failure was determined by the failure of the patient to respond to the administered drug regimen based on clinical findings, CT scan imaging and culture and sensitivity testing.

3. Results

During the study period, 98 SOI patients were managed by the OMS service at Boston Medical Center. Of these, a total of 78 patients were included in the study. Five of the 98 patients were excluded from the study as their treatment regimen consisted of a Flouroquinolone which was prescribed due to documented allergy to the antibiotic regimens being evaluated in this study. 15 other patients were excluded due to prolonged inpatient stay secondary to complications arising from medical comorbidities (i.e. Deep Vein Thrombosis, Pulmonary Embolism, Chronic Heart Failure, and hospital acquired pneumonia) which were unrelated to the SOI.

Of the 78 patients included in the study, 46 were males and 32 were females. There were 57 patients in Group I (Clindamycin) and 21 patients in Group II (combination of Penicillin/Metronidazole). There were more male patients in Group I (63.2%) when compared with Group II (47.6%). There was no significant difference between the average ages of the patient sample in both groups. Group I had an average age of 32.6 years while Group II had an average age of 32.8 years. The findings were analyzed using the chi square t tests. The average WBC count at the time of initial presentation was higher in Group I (19.3) vs. Group II (17.4). These differences were not statistically significant (P *value* < 0.003). Relative to ASA status, 84.7% of the patients in Group I and 76.9% of patients in Group II belonged to either ASA Class I or II. Relative to the risk of infection, 84.7% patients in Group I and 76.1% in Group II reported with moderate risk having involvement of submandibular, sub lingual and submental spaces most commonly. Table 1 summarizes these results. Microbiological assessment of the culture samples revealed findings expected in SOI. Gram-positive microorganisms were found in 75.9% and 66.3% patients for Group I and II respectively. Gram-negative microorganisms were obtained in 21.4% and 42.9% for Group I and II respectively. Anaerobic cultures were seen in 5 21.1% of Group I patients and 37.3% of Group II patients; the remainder were aerobic infections. Table 2 summarizes these findings.

Table 3 was more descriptive in terms of the treatment all the patients received at the hospital. The average number of days of hospital inpatient stay for Group I patients was 5.87 days which was marginally lesser than the average number of days for Group II (6.57 days). Antibiotic failure reports ranged from 3.5% in Group I in comparison to 4.7% in Group II. The overall healthcare costs of treating SOI for our patient in tertiary care healthcare setting was lower in Group I ($6507.80) when compared to Group II ($7127.64).

Table 1
Group Characteristics.

Characteristics	Treatment Groups (n = 78)	
	Clindamycin Group 1 (n = 57)	Penicillin/Metronidazole Group 2 (n = 21)
Average Age (Years)	32.68	32.42
Gender		
Men	35 (63.2 %)	10 (47.6 %)
Women	21 (36.8 %)	11 (52.4 %)
ASA Class		
Class I	20 (35.3 %)	8 (38.2 %)
Class II	28 (49.4 %)	8 (38.7 %)
Class III	9 (15.3 %)	5 (23.1 %)
Anatomical Risk		
Low	3 (5.2 %)	1 (4.7 %)
Medium	48 (84.7 %)	16 (76.1 %)
High	6 (10.1 %)	4 (19.1 %)

Table 2
Microbiology.

Culture Results	Group 1	Group 2
Gram Positive	75.9 %	66.3 %
Gram Negative	21.4 %	42.9 %
Aerobic	75.1 %	66.1 %
Anaerobic	21.1 %	37.3 %

4. Discussion

Historically speaking, SOI of the head and neck region had significant morbidity and mortality associated with them. However, with progression of technology including CT scanning and advanced airway management techniques coupled with major changes in treatment strategies which has included appropriate antibiotic therapy and surgical care delivery in a timely manner, one cannot help but notice the large shift in mortality rate. Williams initially reported close to 50% mortality for treated cases of Ludwig's angina in 1940.[3] However, in a subsequent publication, he showed a significant reduction in mortality rate (10%) for similar infections, and this was primarily attributed to application of sound principles of airway management, timely surgical drainage and effective use of antibiotics.[4] It is understandable that during that era, treating surgeons, dentists, and physicians had minimal resources and limited antibiotic choices. Over the next few decades, scientific development led to a plethora of devices and medications which further led to individual preferences and biases, giving rise to wide controversies in the management of these infections appropriately as discussed in the beginning of this article. Our study shows that Penicillin and Metronidazole or Clindamycin still represent clinically effective and practical antibiotic regimens when used empirically as the first-line therapy.

Any antibiotic regimen used in the management of infection should be based on following basic principles of pharmaceutical therapy which include safety and efficacy of the drug. Rega et al found that greater growth of aerobes was commonly encountered in culture sampling as compared to anaerobes, and gram positive cocci had higher percentage than gram negative rods.[5] Viridans streptococci, Provetella, Staphylococci, and Peptostreptococcus were the bacterial strains isolated in most cultures. Similarly, some researchers have found that *Streptococcus anginosus* group and hemolytic streptococci were clearly associated with odontogenic abscesses, while others have shown that Viridans group streptococci (VGS) and Neisseria species may a decisive role in the etiology of SOI with VGS, staphylococci, *Prevotella*, *Peptostreptococcus*, and *Bacteroides* being the most common offending pathogens.[6,7] These findings are consistent with the microbiological spectrum obtained from the culture samples in our study population.

A combination of Penicillin G and Metronidazole has long been shown to be effective for management of SOI. Penicillin G has greatest