Journal of Cranio-Maxillo-Facial Surgery 47 (2019) 1292–1299

Contents lists available at ScienceDirect

Journal of Cranio-Maxillo-Facial Surgery

journal homepage: www.jcmfs.com

Epidemiological analysis of management of severe odontogenic infections before referral to the emergency department

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ARTICLE INFO

Article history:
Paper received 9 February 2019
Accepted 4 May 2019
Available online 10 May 2019

Keywords:
Odontogenic infections
Head and neck infections
Dental abscess
Management of odontogenic infections
Epidemiological analysis

ABSTRACT

Purpose: The aims of the present study are to present the epidemiology and management of patients hospitalized with odontogenic infections in a major Greek hospital from 2015 to 2016 and to find out whether the basic principles of management of odontogenic infections were followed before referral to the emergency department of the Oral and Maxillofacial Surgery Clinic (OMFSED).
Methods: A retrospective study of the patients hospitalized with odontogenic infections was performed, including management both prior and after referral to the OMFSED.
Results: During the two-year period from 2015 to 2016, 102 patients, 54 men (52.9%) and 48 women (47.1%) were hospitalized with severe odontogenic infections. The most common space involved in severe odontogenic infections was the submandibular (52.9%), and in 31.4% of the patients multiple spaces were involved. The lower third molars were the most common cause (36.5%). In 83 patients (81.4%) the tooth causing the infection had not received any treatment whatsoever and in all cases (100%) no decision for early incision and drainage prior to the referral to the OMFSED was made.
Conclusion: The data presented reveal that the basic principles of management of odontogenic infections are not followed before referral of the patients to the OMFSED.

1. Introduction

Odontogenic infections present one of the most common pathologies in the Oral and Maxillofacial region (Christensen et al., 2013) and their management often becomes a serious condition that Oral and Maxillofacial Surgeons (OMFS) have to treat (Roy et al., 2016). The severity of odontogenic infections may range from low-grade, well localized infections that require minimal treatment, to severe life-threatening infections (Flynn, 2014a; Ogle, 2017).

Basic principles of management of odontogenic infections include (Flynn, 2014a):

- determination of the severity of infection,
- evaluation of patient's host mechanisms,
- early determination whether the patient can be treated by a general dentist or should be referred to an OMFS,
- removal of the cause of the infection by endodontic treatment or extraction of the tooth causing the infection,
- incision and drainage in the case of abscess or cellulitis, with culture and antibiotic sensitivity testing when indicated
- medical support of the patient,
- prescription and proper administration of the appropriate antibiotic,
- frequent evaluation of the patient (lack of improvement within 72 h or deterioration consists failure of treatment and the patient should be referred to OMFS) (Flynn, 2014a).

Moreover, there are specific criteria for the immediate referral of a patient with an odontogenic infection to an OMFS (Flynn, 2014a; Ogle, 2017). Difficulty breathing (dyspnea), difficulty swallowing (dysphagia) as well as a rapidly spreading infection are the most alarming ones, necessitating immediate referral to a hospital emergency room since they may pose an immediate threat to the airway. Several other criteria demand referral to an OMFS, with the

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https://doi.org/10.1016/j.jcms.2019.05.002
1010-5182/

more objective ones being extension of the infection beyond the alveolar process, fever greater than 38.3 °C (101 °F), more than moderate trismus (interincisal opening less than 20 mm) and failure of previous treatment. Other criteria include systemic involvement of an odontogenic infection, patients that have malaise and toxic appearance or appear dehydrated, patients with compromised host defences, need for extraoral incision and drainage and need for treatment under general anesthesia (Flynn, 2014a; Ogle, 2017).

The aims of the present study are to present the epidemiology and management of patients hospitalized with odontogenic infections in a tertiary hospital in Athens, Greece during the years 2015–2016 and to evaluate whether the above-mentioned basic principles of management of odontogenic infections (Flynn, 2014a; Ogle, 2017) were followed prior to referral to the emergency department of the Oral and Maxillofacial Surgery Clinic (OMFSED).

2. Material and methods

A retrospective study of the patients hospitalized between 1st of January 2015 and 31st of December 2016 with severe odontogenic infection in the Department of Oral & Maxillofacial Surgery of the General Hospital of Athens "G. Gennimatas" in Athens, Greece was performed. The OMFSED records as well as the patients' records and files were retrospectively examined regarding age, gender, anatomic space involved, tooth responsible for the infection, management both prior and after referral to the OMFSED, including days of active odontogenic infection before referral to the OMFSED and days of hospitalization, as well as treatment outcome.

Patients treated in the OMFSED with minor odontogenic infections that did not require hospitalization, patients denying hospitalization, patients with head and neck infections of non odontogenic origin were excluded. Patients under 15 years of age were not included in the study, since they cannot be admitted in the General Hospital of Athens "G. Gennimatas" and are referred to a pediatric hospital.

Statistics were performed using SPSS Statistics 23, IBM for MAC. Data regarding mean values are presented as mean ± SD (Standard Deviation).

Due to the retrospective nature of this study, it was granted an exemption in writing by the General Hospital of Athens "G. Gennimatas" IRB. The Helsinki Declaration has been read and its guidelines followed.

3. Results

Between 2015 and 2016, 3509 patients were examined at the OMFSED. During that period, 102 patients, 54 men (52.9%) and 48 women (47.1%) were hospitalized with severe odontogenic infections. The patients' age ranged from 15 to 76 years, with an average of 41.6 (±15.4) years and a median of 40 years (Fig. 1). Seventy-five percent of the patients were younger than 55 years old. In 32 of the 102 patients hospitalized (31.4%) multiple spaces were involved. The most common space involved was the submandibular space which was involved in 54 patients (52.9%), followed by the pterygomandibular space which was involved in 22 patients (21.6%) (Fig. 2). The submental space was involved in 18 patients (17.6%), the submasseteric in 15 (14.7%), the sublingual in 12 (11.8%), the lateral pharyngeal and the buccal in 6 each (5.9%) and the infratemporal and infraorbital in 4 each (3.9%).

The lower third molars were the most common cause of the infection (36.5%), with the first lower molars being the second most common cause (23.5%) and the second lower molars the third most common (20%).

3.1. Management of the patients prior to OMFSED referral

Symptoms and signs of odontogenic infection before referral to the OMFSED ranged from 1 to 22 days with a mean of 5.3 (±4.4) days and a median of four days (Fig. 3). Twenty five percent of the patients had signs and symptoms for at least 7 days prior to referral. The 15.7% of the patients sought medical attention by a dentist within 24 h before their admission to the OMFSED in a stage when they had already developed a severe odontogenic infection necessitating immediate referral to the OMFSED.

In 11 patients (10.8%) the odontogenic infection occurred after an extraction of a tooth (in all cases the extracted teeth were in the mandible and in seven cases they were third molars with reported pericoronitis). In four patients (3.9%) root canal treatment preceded the odontogenic infection, another three patients (2.9%) were undergoing root canal treatment and one (1%) was about to have root canal treatment when the odontogenic infection developed. In 83 patients (81.4%) the tooth causing the infection had not received any treatment whatsoever before referral to the OMFSED. In all cases (100%) there had not been any incision and drainage in an early or any phase of the odontogenic infection prior to referral to the OMFSED.

Fifty patients (49%) were under antibiotic treatment upon referral to the OMFSED. Of those patients 16 (32%) were treated with Amoxicillin, 14 (28%) with Amoxicillin & Metronidazole, 6 (12%) with Amoxicillin/clavulanic acid, 4 (8%) with Amoxicillin/clavulanic acid in combination with Metronidazole, 2 (4%) with clindamycin, 2 (4%) with clarithromycin, 2 (4%) with cefuroxime, one (2%) with cefaclor and one (2%) with doxycycline. In two patients (4%) we were unable to retrieve the exact antibiotic treatment that has been administered before referral to the OMFSED. The days of antibiotic treatment ranged from 1 to 14 with a mean of 4.3 (±3.1) and a median of four days.

3.2. Patients management after admission in the OMFSED

In all 102 patients (100%) incision and drainage of the odontogenic infection was performed after admission to the OMFSED. In 37 patients (36.3%) incision and drainage was performed under general anesthesia, while in the remaining 65 patients (63.7%) incision and drainage was performed under local anestesia with or without the administration of oral sedation. In 34.3% of the patients incision and drainage of the odontogenic infection was performed through an extraoral incision, while in 6.8% of the patients an extraoral as well as an intraoral incision was used. In the remaining 58.9% of the patients incision and drainage of the odontogenic infection was performed intraorally. Drains were placed and all the compartments explored were lavaged with copious amounds of a solution made of povidone-iodine, H_2O_2 and normal saline and then once again lavaged with normal saline. With the exception of 11 patients where the teeth responsible for the infection had been extracted before the occurrence of the odontogenic infection, and of three patients that were undergoing root canal treatment as well as one who was about to have root canal treatment when the odontogenic infection developed, in 87 patients (85.3%) the responsible teeth were extracted after admission to the OMFSED. In the four patients that were having or were about to have root canal treatment the teeth were retained and an immediate endodontic consultation was advised. All hospitalized patients received intravenous antibiotic treatment.

Hospitalization ranged from 2 to 27 days with a mean of 5.9 (±3.4) and a median of 5 days (Fig. 4). All the compartments involved in the infection were lavaged daily in all patients through the drains and the surgical wounds with a solution made of povidone-iodine, H_2O_2 and normal saline and then lavage with

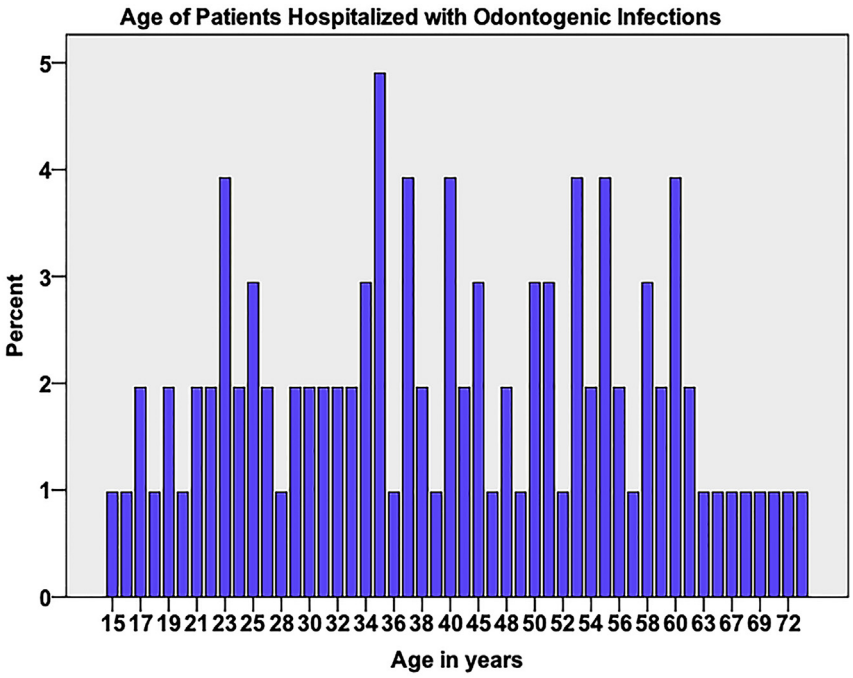

Fig. 1. Age of patients hospitalized with odontogenic infections.

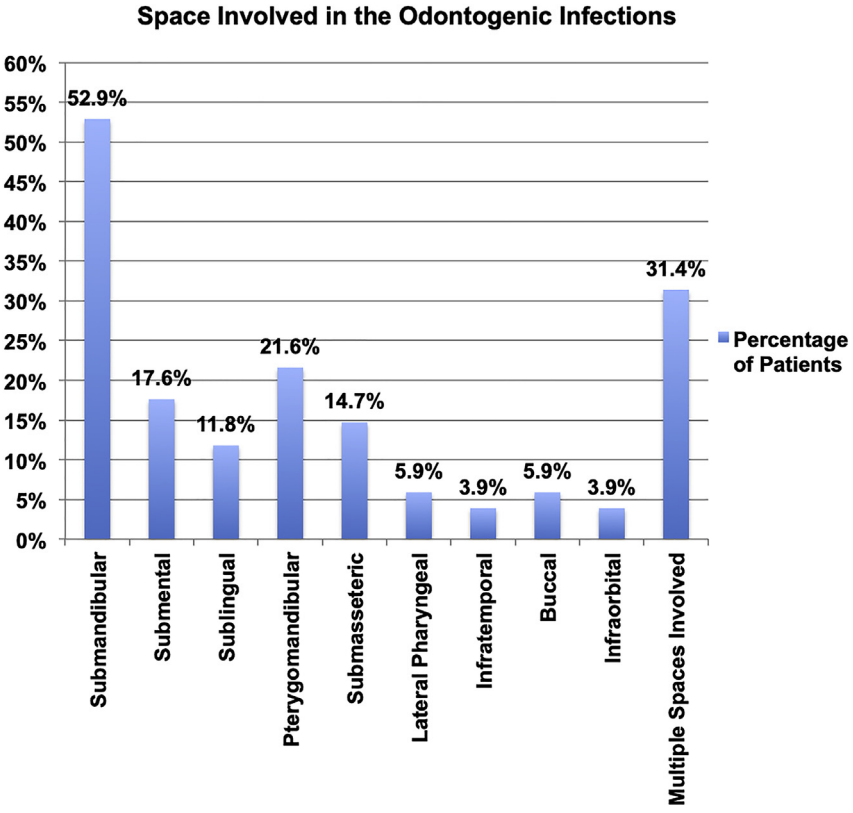

Fig. 2. Percentage of spaces involved in the odontogenic infections.

normal saline was performed. The antibiotic treatment of choice during hospitalization was intravenous sultamicillin (ampicillin+sulbactam) coupled with metronidazole for 67.5% of the patients and clindamycin for 14.3% of the patients.

Culture and antibiotic sensitivity testing was performed on a regular basis, however not all patients were tested. Culture specimens were obtained using culturette swabs. In some cases patients were treated at late hours where a swab was sometimes not readily

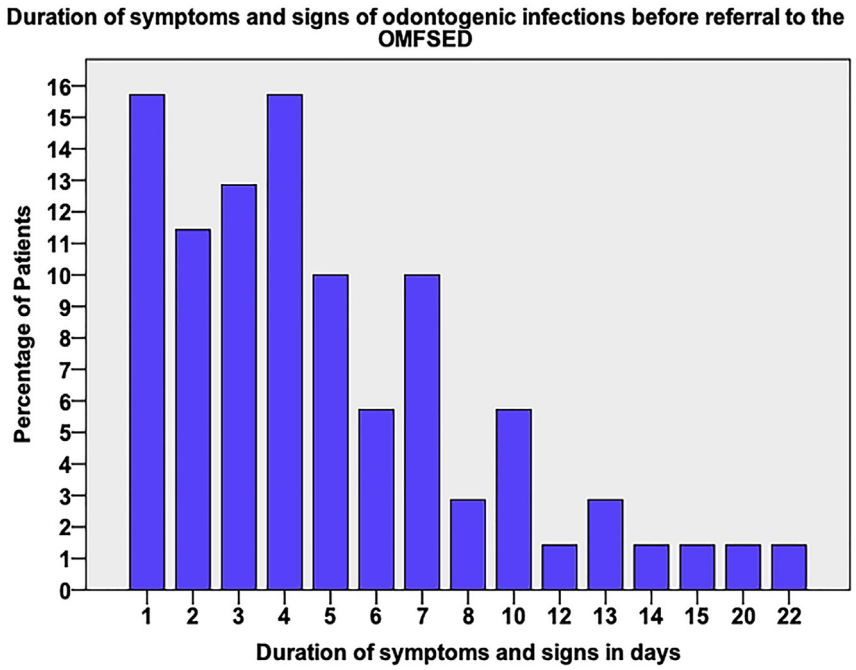

Fig. 3. Duration of symptoms and signs of odontogenic infections before referral to the OMFSED.

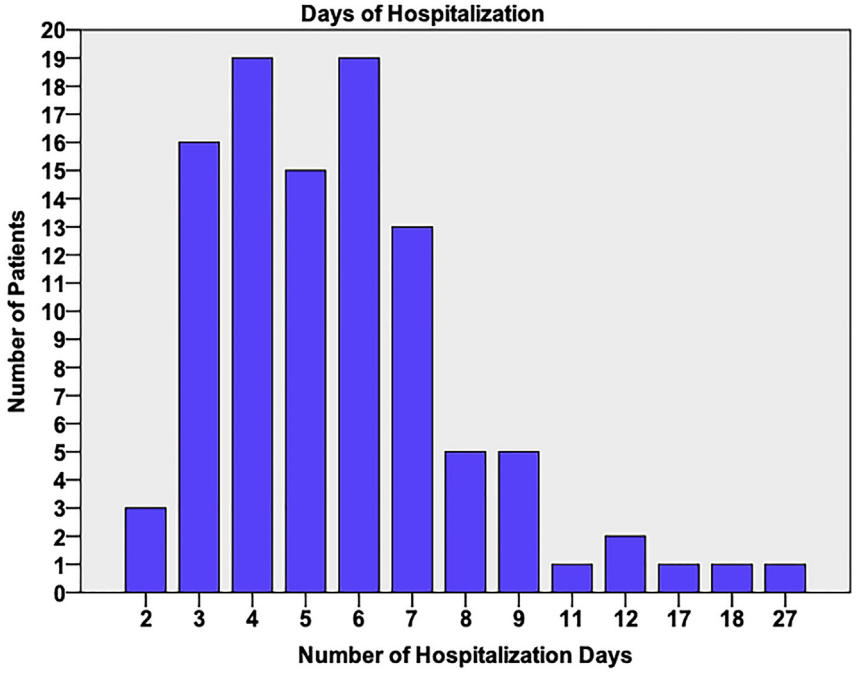

Fig. 4. Number of days that the patients were hospitalized.

available. As a matter of fact culture and antibiotic sensitivity testing has been omitted in some patients with odontogenic infections deemed less severe. Furthermore, in many instances patients were discharged before their culture and antibiotic sensitivity testing became available and as a result they were not included in the patient's records. We retrieved 33 culture and antibiotic sensitivity testing results, one of which (3%) did not show any growth. Bacteria were isolated in 32 cultures (97%). A total of 84 bacterial strains were isolated from 32 patients, accounting for 2.6 isolates per patient. Anaerobic bacteria were detected in 28 of these 32 cultures (87.5%) and aerobic bacteria were detected in 29 (90.6%) cultures. In four cases (12.5%) only aerobic bacteria were isolated and in three cases (9.4%) only anaerobic bacteria were isolated. Prevotella spp. were found in 27 (84.4%) cultures. Bacteria of the Streptococcus viridans group were found in 24 (75%) cases. Candida albicans was identified in 3 samples (9,4%), were anaerobic and aerobic bacteria were also isolated. In 56.3% of the cultures penicillin resistant bacteria were found and in 31.3% of the cultures

clindamycin resistant bacteria were found. Ten different bacterial species were resistant to penicillin. The percentage of Prevotella spp. resistance to penicillin was 50%, with Prevotella denticola and Prevotella melaninogenica showing the highest percentage of resistance with 83.3% and 55.5% respectively. Nine different species of bacteria were resistant to clindamycin. The percentage of Prevotella spp. resistance to clindamycin was 29.4%. Prevotella buccae, melaninogenica and denticola showed the highest percentage of clindamycin resistance with 50%, 33.3% and 33.3% respectively. The resistance of S. viridans group to clindamycin was 16.7%, while it was 100% susceptible to penicillin.

In two patients we were forced to perform a tracheostomy under local anesthesia due to an inability to secure the patients' airway. Two patients developed an allergic reaction in the antibiotic administered during hospitalization (piperacillin-tazobactam and meropenem respectively). One patient who presented with uncontrolled diabetes and untreated thrombophilia, developed severe metabolic acidosis and was admitted to the Intensive Care Unit (ICU) where he subsequently developed pulmonary embolism. Another patient with uncontrolled diabetes had severe electrolyte imbalances and renal impairment. One patient presented with a necrotizing fasciitis with skin necrosis in the submental area. With the exception of one patient with an infratemporal infection where a second incision and drainage was performed there was no need for additional incision and drainage in order to treat a residual infection in any other patient. There were no recurrences. No deaths occurred during that period.

4. Discussion

Deep space infections in the head and neck are probably the most common cause for admission to the OMFSED (Poeschl et al., 2010) and most commonly head and neck infections are of odontogenic origin (Huang et al., 2004). In the Department of Oral and Maxillofacial Surgery of the General Hospital of Athens “G. Gennimatas” in Athens, Greece, 3509 patients were examined at the OMFSED between 1st of January 2015 and 31st of December 2016. During that two-year period 102 patients were admitted with severe odontogenic infections and a slight male predominance [54 men (52.9%) versus 48 women (47.1%)] was noted. Male predominance is consistent with previous studies performed ranging from mild (Nadig and Taylor, 2018) to significant male predominance (Bertossi et al., 2017; Wang et al., 2005). However, in a previous study performed between 2009 and 2010, in an other tertiary hospital in Athens, Greece, women slightly outnumbered men (51.4% versus 48.6% respectively) (Igoumenakis et al., 2014). Nevertheless, in another study performed from 2010 to 2013 in the same hospital in Athens, significant male predominance was noted (60.9% versus 39.1%) (Igoumenakis et al., 2015). The majority of the patients admitted were relatively young [mean age was 41.6 ± (15.4) years] with 50% being younger than 40 years old and 75% of the patients being younger than 55 years old. In the abovementioned studies that were conducted in another tertiary General Hospital in Greece, where children could also not be admitted and were referred in pediatric hospitals as in our study, the mean age of patients admitted with odontogenic infections was comparable with 40.8 ± 16.4 (Igoumenakis et al., 2014) and 39.1 ± 15.4 years (Igoumenakis et al., 2015). In some studies where children were included, the mean age of the patients was even lower and mean age of 38.9 (Gams et al., 2017) and 36.17 years (Nadig and Taylor, 2018) have been reported. Young children may get odontogenic infections, but the majority occur in adults (Bertossi et al., 2017; Nadig and Taylor, 2018; Wang et al., 2005).

In patients with odontogenic infections needing admission deep head and neck spaces were involved. In almost one third of the patients (n = 32, 31.4%) multiple spaces were involved. The most commonly involved space was the submandibular, which was involved in more than half of the patients hospitalized (n = 54, 52.9%). The submental space was involved in 18 patients (17.6%). The submandibular space lies between the mylohyoid muscle and the overlying superficial layer of the deep cervical fascia and the submental space lies between the anterior bellies of the right and left digastric muscles and the overlying fascia (Flynn, 2014b), as a result involvement of the submandibular and submental spaces creates a significant swelling (Flynn, 2014b) that according to our clinical experience alarms most patients and is hard to overlook during clinical examination. The pterygomandibular, submasseteric and infratemporal spaces are compartments of the masticator space. Involvement of those spaces creates a moderate to severe trismus that should alarm the patient and the dentist (Flynn, 2014b). In our study the masticator space was involved in 41 patients (40.2%). In the literature the submandibular space is the most commonly infected space, followed by the buccal and submental spaces (Rega et al., 2006; Farmahan et al., 2014). Frequent masticator space involvement has been also reported (Flynn et al., 2006).

As in other reports (Indresano et al., 1992; Flynn et al., 2006; Farmahan et al., 2014) the lower third molars were the most common cause of the infection (36.5%) in our study, followed by first (23.5%) and the second lower molars (20%).

In the management of an odontogenic infection it is paramount to remove the cause of the infection, and to perform surgical drainage when the infection is in the stage of cellulitis or abscess (Flynn, 2014a; Ogle, 2017). Most commonly the cause of the infection is a necrotic pulp or a deep periodontal pocket (Flynn et al., 2006). The dentist can most of the times easily find the cause of an odontogenic infection which should be managed with endodontic treatment or extraction. When the odontogenic infection is in the stage of inoculation no further incision and drainage is needed. Incision and drainage, apart from appropriate dental therapy, is needed in odontogenic infections that are in the stage of cellulitis or abscess. However, in minor odontogenic infections that do not extend beyond the alveolar process, the extraction of a non restorable tooth may provide adequate drainage of the accumulated periapical pus and debris. Limited drainage can also be achieved through the apical foramen of a tooth that is endodontically treated. The incision and drainage of a vestibular abscess or cellulitis is a relatively simple and straightforward task. Basic patient medical support and prescription of the appropriate antibiotic can also easily be performed by the general dentist, when needed. As a matter of fact, the general dentist can safely manage an odontogenic infection in its early stages, following the basic principles of management of those infections or refer a patient without delay to an OMFS or OMFSED when needed (Flynn, 2014a; Ogle, 2017).

In our study, a significant delay in the referral of patients to the OMFSED was noticed, despite the presence of signs and symptoms that demanded immediate referral (Flynn, 2014a; Ogle, 2017). Half of the patients needed hospitalization, presented with signs and symptoms demanding immediate consultation by an Oral and Maxillofacial Surgeon such as dyspnea, dysphagia, significantly elevated temperature [fever over 38,3 °C (101 °F)], severe trismus (Flynn, 2014a; Ogle, 2017) that had persisted for at least four days, with 25% of the patients having those signs and symptoms for 7 days or more. Only 15.7% of the patients were referred in the OMFSED within a day. Delayed presentation of patients with odontogenic infections at OMFSED has also been reported in other studies (Flynn et al., 2006; Igoumenakis et al., 2014).

Furthermore, in 83 patients (81.4%) the tooth causing the infection had not received any treatment whatsoever before referral to the OMFSED. It is worth noticing that in 11 patients (10.8%) the odontogenic infection occurred after an extraction of a

tooth. In seven of these cases the extracted tooth was a mandibular third molar. According to our data it is most certain that in these patients there was an odontogenic infection present at the time of extraction that was poorly managed, since six out of seven patients reported episodes of pericoronitis with one of them being also under treatment with methotrexate for rheumatoid arthritis and one patient reported that the tooth had caries and was tender to pressure. Moreover in four patients (3.9%) root canal treatment preceded the odontogenic infection, another three patients (2.9%) were having root canal treatment and one (1%) was about to have root canal treatment when the odontogenic infection developed. These 29 cases highlight the importance of immediate referral to an OMFS in case of lack of improvement within 72 h, or deterioration when treating even an initially minor odontogenic infection (Flynn, 2014a).

In our study, in all cases (100%) no incision and drainage in an early phase of an odontogenic infection prior to the referral to the OMFSED was attempted. Incision and drainage in the case of abscess or cellulitis, is paramount in the management of odontogenic infections and consists a pillar of the basic principles of management of odontogenic infections (Flynn, 2014a; Ogle, 2017) that according to our study is consistently ignored prior to referral to the OMFSED.

When management of the tooth responsible for the odontogenic infection is not performed by extraction or endodontic treatment, and incision and drainage is not performed, the administration of antibiotics does not necessarily prevent the deterioration of the infection (Flynn, 2014a; Ogle, 2017). The antibiotic tissue penetration into the infected jaw bone and abscess cavity is low and low antibiotic concentration is achieved. In addition, the incision and drainage of the infection reduces the bacterial load and alters the anaerobic environment caused by anaerobic bacteria in the infected site (Japanese Association for Infectious Disease/Japanese Society of Chemotherapy, 2018).

Almost half of the patients hospitalized with severe odontogenic infections (50 patients, 49%) were under antibiotic treatment upon referral to the OMFSED, which corroborates with other studies (Igoumenakis et al., 2014; Nadig and Taylor, 2018). All of these patients had severe odontogenic infections and needed an antibiotic treatment. However, taking into account the small percentage of addressing the cause of the infection, the total absence of incision and drainage and the significant delay in the referral of patients to the OMFSED, it seems that the fact that antibiotic therapy plays an adjunctive role and is not the basic method of treatment was ignored (Flynn, 2014a; Ogle, 2017; Kumari et al., 2018).

The results indicate that the basic principles of the management of odontogenic infections were not followed before referring the patients to the OMFSED of the General Hospital of Athens “G. Gennimatas” in Athens, Greece. It appears that the referring dentists were reluctant to perform extractions and incision and drainage in patients with odontogenic infections. A widely held but false opinion is that extraction of a tooth in the presence of an acute infection promotes the spread of that infection, and many dental practitioners forget that antibiotic therapy plays an adjunctive role and is not the basic method of treatment for odontogenic infections (Jundt and Gutta, 2012; Shanti and Flynn, 2016; Flynn and Shanti, 2016; Kumari et al., 2018).

Nonetheless, although there are no specific data available in our study, some of the patients hospitalized with severe odontogenic infections were not followed regularly by a dentist and did not seek dental or medical attention on time. In addition, a high percentage of patients that practice self-medication for odontogenic infections by taking leftover antibiotics has been reported in Greece (Igoumenakis et al., 2014). Poor oral hygiene is associated with a higher risk of odontogenic infection (Igoumenakis et al., 2014). The socioeconomic status of the patients and oral hygiene has not been assessed in our study, however lower socioeconomic status is generally associated with poor oral health (Jundt and Gutta, 2012). In Greece dental care is mainly private in terms of both supply and financing and the average monthly expenditure of the richest 20% of the population is 18.23 times more than the corresponding expenditure of the poorest 20% (Kostas and Dimitris, 2017). The 15.7% of the patients sought medical attention by a dentist within 24 h before their admission to the OMFSED in a stage when they had already developed a severe odontogenic infection necessitating immediate referral to the OMFSED (Flynn, 2014a; Ogle, 2017).

After referral to the OMFSED the basic principles of management of odontogenic infections were followed in all patients (Flynn, 2014a; Shanti and Flynn, 2016; Flynn and Shanti, 2016; Wates et al., 2018). In all patients admitted with a severe odontogenic infection, a detailed medical and dental history was obtained, and a thorough examination was performed. Blood tests including complete blood count, electrolytes, liver and kidney tests, CRP as well as INR, aPTT and PT tests were made. The severity of the patients' infection as well as their host mechanisms and comorbidities were evaluated and any necessary medical support was provided. In all patients we prescribed adequate analgesics for pain relief and judiciously controlled highly elevated fever. Furthermore, we provided active hydration and supported patients nutritionally. Six out of the 102 patients (5.9%) hospitalized with odontogenic infections had poorly managed diabetes and endocrinological consultation was performed. Two out of 102 patients (1.9%) received immunosuppressive drugs, one received azathioprine for Crohn's disease and the other methotrexate for rheumatoid arthritis. The patients' treating physicians were conducted and their treatment was modified stopping the immunosuppressive medication.

Empirical antibiotic treatment was initiated in all patients without delay (Opitz et al., 2015). Our empiric intravenous antibiotic treatment of choice during hospitalization, sultamicillin (ampicillin+sulbactam) coupled with metronidazole for 67.5% of the patients and clindamycin for 14.3% of the patients are supported widely in the literature (Kuriyama et al., 2007; Rega et al., 2006). In the majority of the patients a Panoramic X-Ray and a Head and Neck Contrast-enhanced CT were performed and the involvement of the spaces of the head and neck was thoroughly evaluated. A decision of whether the patient was to be treated under general or local anesthesia was made and early surgical treatment without delay was provided. Occasionally urgent awake fibre-optic intubation was needed (Taub et al., 2017). In two patients a tracheostomy under local anesthesia due to an inability to secure the patients' airway was performed.

In all 102 patients (100%) incision and drainage of the odontogenic infection was performed. The percentage of patients treated under general anesthesia (36.3%) was justified by the severity of their infection (Flynn et al., 2006). In the remaining 65 patients (63.7%) incision and drainage was performed under local anesthesia, most often after the administration of oral sedation (Igoumenakis et al., 2014). When possible and according to the space involved and the severity of the infection the incision and drainage was performed intraorally (58.9% of the patients) for the avoidance of conspicuous scars, but in 34.3% of the patients it was performed extraorally and in 6.8% of the patients with a combination extraoral as well as an intraoral incision.

The responsible teeth were extracted without delay in 87 patients (85.3%) and only in four patients (3.9%) that were undergoing or were about to have root canal treatment the responsible teeth have been retained and an immediate endodontic consultation has been advised. In 11 patients the responsible tooth had been extracted prior to referral to the OMFSED.

The average duration of hospitalization was 5.9 (±3.4) days and 50% of the patients were hospitalized for more than 5 days (median was 5 days). The mean length of hospitalization was comparable with other studies in Greece and abroad (Igoumenakis et al., 2014, Kim et al., 2017). During hospitalization the patients were closely monitored and in some instances the antibiotic treatment was modified, according to the patients' post-operative response and the culture and antibiotic sensitivity results. Our study had an average of 2.6 isolate bacteria per sample compare to 0.86 to 1.4 isolates per sample in other studies where samples were also collected with swabs (Heim et al., 2017; Hunt and Meyer, 1983; Epstein and Scoop, 1977). The average isolates per sample are higher reaching up to 3.3 bacteria for samples obtained by aspiration (Lewis et al., 1985). S viridans group bacteria were the predominant aerobic bacteria and Prevotella spp. were the predominant anaerobic bacteria which correlates with findings in the literature (Farmahan et al., 2014; Heim et al., 2017). In severe odontogenic infections b-lactamase-producing anaerobic bacteria may be present and antibiotics potent against anaerobic bacteria that produce b-lactamase should be administered (Japanese Association for Infectious Disease/Japanese Society of Chemotherapy, 2018). In our study penicillin resistant bacteria were found in 56.3% of the cultures and clindamycin resistant bacteria were cultured in 31.3% of the cultures. The penicillin and clindamycin resistance reported in the literature varies significantly but the resistance in our study tended to be relatively high (Flynn et al., 2006; Kim et al., 2017). In our study the resistance of Prevotella spp. in penicillin (50%) was high but even higher resistance has been reported in other studies (Boyanova et al., 2010). The resistance rate to clindamycin in Prevotella species in our study was higher (29.4%) than that reported in the literature (Boyanova et al., 2010), but consistent with previous studies in the Greek population (Papaparaskevas et al., 2008). Streptococci viridans were 100% susceptible to penicillin and showed 16.7% resistance in clindamycin which correlates with findings in the literature (Heim et al., 2017; Kuriyama et al., 2002).

The post-operative course for all but eight patients (94 patients, 92.2%) was uneventful. As mentioned in the results we were forced to perform tracheostomy under local anesthesia in two patients (1.9%) due to an inability to secure the patients' airway. Another two patients (1.9%) developed an allergic reaction in the antibiotic administered during hospitalization. One patient was admitted to the ICU with severe metabolic acidosis and subsequently developed pulmonary embolism, one patient with uncontrolled diabetes had severe electrolyte imbalances and renal impairment and one patient presented with a necrotizing fasciitis. In one patient with an infratemporal infection a second incision and drainage was performed in order to treat a residual infection. No deaths occurred.

The large number of patient admitted with odontogenic infections, the potential severity and morbidity of the infections, the relatively young age of the patients, the frequent need of treatment under general anesthesia and the prolonged hospitalization render odontogenic infections a major healthcare problem (Jundt and Gutta, 2012).

5. Conclusion

Our study concludes that the basic principles of managing odontogenic infections were not followed before referral to the OMFSED of the General Hospital of Athens “G. Gennimatas” in Athens, Greece.

Continuous education of the dentists in the management of odontogenic infections and the development of healthcare programs for the education and awareness of patients regarding odontogenic infections may lead to the reduction of severe odontogenic infections needing hospitalization.

Financial disclosure

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of interest

There are no conflicts of interest.

Acknowledgements

There are no acknowledgements to be made.

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