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Significant rise in neck infections progressing to descending necrotizing mediastinitis during the COVID-19 pandemic quarantine

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ABSTRACT

To present five patients with DNM, who were treated during the first quarantine for Coronavirus disease 2019 (Covid-19).

Five patients with DNM were treated in our department during the first lockdown. The mean age of the patients was 42,2 years and four were male. Two patients were immunocompromised. Repeated surgical drainage was performed in all patients, whereas four were also subjected to elective tracheostomy during their first operation. The mean hospitalization duration was 55,4 days and mortality was 40%.

During the first lockdown for the Covid-19, a rise in the ratio of DNM cases to the overall incidence of cervicofacial infections was observed in our department. All patients with DNM were operated on an emergency basis and were subsequently admitted to the ICU. We consider the effect of the quarantine as a decisive factor for this escalation, because according to the department archives, there had not been any cases of DNM originating from a dental infection, for the past 5 years. Additionally, past studies from the same department reported no more than 6 cases over a 10 year period.

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic has significantly altered the practice of oral and maxillofacial surgery (OMFS) since its emergence (*Zimmermann and Nkenke*, 2020). Due to their proximity to the oral and nasal cavity of the patient during clinical examination and surgical procedures, oral and maxillofacial surgeons, as well as dentists and ear-nose-throat specialists, were inclined to defer cases that were not acute. Simultaneously, the public were informed that they should protect the National Health System by seeking medical and dental consultation strictly for major emergencies (*Fouda* et al., 2020). This was especially the case during the first pandemic wave at the beginning of 2020 (*Al-Izzi* et al., 2020). In the midst of deprivation of primary dental care, Politi et al. (2020) highlighted the unexpected reduction in the number of admissions with cervicofacial infections of dental origin during the lockdown in London. Concurrently, the same authors reported that a higher proportion of patients with infections required invasive treatment. It was also the opinion of Yakubov et al. (2020), that more severe cases of cervicofacial infection emerged during the quarantine.

Our observations were similar. Indeed, during the first lockdown, trauma cases were reduced, which was to be expected because travelling and social interaction were prohibited (Fouda et al., 2020). Oncology cases were managed as before — as reported by other authors (Barca et al., 2020). Therefore, in our department, emergency procedures during the pandemic's first wave were mostly severe cervicofacial infections of dental origin. As an OMFS department of a tertiary referral hospital serving a population of 4 000 000, the maximum number of patients admitted yearly for a face or neck infection originating from the oral cavity is about 100 (Igoumenakis et al., 2014, 2015; *Katoumas* et al., 2019). Critical complications of these infections, such as cavernous sinus thrombosis, deep-neck infection, fasciitis or descending necrotizing mediastinitis (DNM) are exceptionally rare, considering the population being referenced (Zachariades et al., 1988; *Rallis* et al., 2006; *Igoumenakis* et al., 2014; *Katoumas* et al., 2019). Nevertheless, during the first lockdown, our department treated four patients, and consulted on one more, with cervical infections

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of dental origin, which had already progressed to DNM by the time of initial assessment. According to the hospital records, there had not been any cases of DNM originating from a dental infection over the previous 5 years. Past references for the same hospital also reported no more than six cases over a 10-year period (Mihos et al., 2004). Furthermore, it must be emphasized that during the lockdown there were no state-organized offices that patients could call to seek over-the-phone medical or dental advice. This was also unavailable in our institution, so patients had to visit the emergency department for medical consultation.

The aim of this paper is to present five cases of DNM during the first wave of the COVID-19 pandemic in a tertiary hospital in Athens, Greece.

2. Case series presentation

During the first lockdown due to COVID-19, between March 13 and June 1, 2020, four patients with DNM were treated by our OMFS department. For one more, who had been admitted to a nearby hospital ICU, urgent consultation was sought from our department.

All the patient details are shown in Table 1. Four patients were male and one female, with a mean age of 42.2 years. Patients 1, 2, and 3 presented signs and symptoms of DNM on arrival at the hospital. Patients 1 and 2 presented to the Emergency Department (ED) of the hospital with symptoms of a generalized infection: pyrexia, bilateral neck swelling, tachypnea, tachycardia, shortness of breath, and difficulty in swallowing. They both had a history of odontalgia 1–3 days before the generalized symptoms began, without previous dental or medical intervention. Patient number 3 was transferred to our department due to left-side neck swelling, redness, and stiffness of sudden onset, during his hospitalization for uveitis of the right eye in another hospital. Other signs and symptoms included dysphagia, general fatigue, and shortness of breath, whereas he reported no dental treatment or odontalgia previously. The patient was immunocompromized with diabetes mellitus (type II). Patients 4 and 5 were already in the intensive care unit (ICU) when OMFS consultation was sought.

After clinical examination and blood drawn for laboratory tests, patients 1, 2, and 3 underwent a CT scan, with intravenous contrast medium, of the facial, cervical, and thoracic region. This decision was based on previous experience and the need to examine the upper and lower airway. Main radiological findings included air and fluid collection within the soft tissues of the neck and the mediastinum. Blood tests also confirmed the infectious nature of the acute condition, with elevation of C-reactive protein (CRP) and white blood cell (WBC) values. Following initial evaluation, these patients were taken to the operating room (OR), where they underwent cervicotomy (No 1, 2, 3), elective tracheostomy (Nos 2, 3), and thoracotomy for drainage and debridement (No 2, 3). Patient 4 had been transferred from another ICU, which became designated for COVID-19 patients, during their treatment for DNM. According to the history notes, the patient had undergone dental extractions, cervicotomy, and chest tube insertion for thoracic cavity drainage, and remained under constant re-evaluation. This patient underwent more dental extractions and tracheostomy, but no more drainage. Unfortunately, there were no notes regarding previous dental treatment in their hospital records. Finally, patient 5 was also treated in another hospital ICU for DNM, and was offered urgent OMFS consultation and treatment. This comprised cervical incisions, drainage, and dental extractions because transthoracic surgical debridement and tracheostomy had already been undertaken by thoracic surgeons. According to this patient's history notes, they had presented with neck swelling, pyrexia, dysphagia, and dyspnea following endodontic treatment of the lower-right second molar tooth.

All patients underwent cervicotomy and thoracotomy as a standardized initial approach. Initial operations were followed by new visits to the OR for surgical drainage, according to the clinical course and radiological findings. Cervical and thoracic CT was performed every 48–72 hours, until a stable, improving state was reached. The mean hospitalization duration was 55.4 days. According to the hospital notes, four patients had dental infections originally, which were diagnosed clinically and radiographically and properly addressed thereafter, with tooth extractions. The initial source of infection was not possible to identify in one patient (No. 3), despite repeated clinical and radiological examinations, so it was deduced that their immunocompromized state facilitated the spread of a subclinical dental infection to the neck. The

Table 1
Data regarding patients with DNM.

Patient No.	1	2	3	4	5
Age (years)	47	37	58	40	29
Gender	F	M	M	M	M
Previous treatment[a]	No	No	Yes (uveitis)	Yes (DNM)	Yes (dental)
Comorbidities	No	No	DM (type II)	No	HIV infection
CRP/WBCC	Elevated	Elevated	Elevated	Elevated	Elevated
Initial site of infection	Mandibular 1st molars bilaterally	Left lower 3rd molar	Unknown	Mandibular molars bilaterally	Mandibular right 2nd molar
Diffusion	Anterior and posterior mediastinum	Posterior mediastinum	Anterior mediastinum	Posterior mediastinum	Posterior mediastinum
Surgical drainage	Cervicotomy Thoracotomy Intercostal drain	Cervicotomy Thoracotomy Intercostal drain	Cervicotomy Thoracotomy Intercostal drain	Cervicotomy Intercostal drain	Cervicotomy Intercostal drain
No of OR visits[b]	3	4	3	1	1
Pathogens	*Streptococcus salivarious*	*Prevotella melaninogenicus* *Peptostreptococcus anaerobius*	MSSA	*Acinetobacter baumannii*	Unknown
Hospitalization (days)	14	54	57	65	87
Tracheostomy	No	Yes	Yes	Yes	Yes
Outcome	Death	Discharged	Discharged	Discharged	Death

M: male, F: female, CRP: C-reactive protein, WBCC: white blood cell count, OR: operating room, MSSA: methicillin-susceptible *Staphylococcus aureus*.
[a] Prior to oral and maxillofacial consultation.
[b] Following admission to our institution or operations performed by our department in another institution.

pathogens were anerobic or facultative anerobic bacteria in three of the five patients. The fourth patient (No. 4) had *Acinetobacter baumannii* in tracheal cultures, but this was attributed to the ICU hospitalization.

A review of the hospital records for the same period, i.e. March–June 2020, for detection of patients admitted to our department with cervicofacial infections of dental origin, yielded 16 patients. The number of admissions with the same diagnosis for the same period in 2019 (March–June) was 22. As a general rule, hospitalization criteria for dental infections in our department include pyrexia, malaise, dysphagia, hoarseness of voice, and trismus (Igoumenakis et al., 2015).

3. Discussion

Severe infections of the orofacial and cervical regions are associated with poor oral health, absence of dental care and compromised general health (*Wang* et al., 2005; *Roccia* et al., 2007; Jundt and Gutta, 2012; Juncar et al., 2014; *Igoumenakis* et al., 2015; *Zirk* et al., 2016; *Heim* et al., 2018; *Qu* et al., 2018; *Pham Dang* et al., 2020; *Uittamo* et al., 2020). In the limited series presented here, one patient (No. 3) had diabetes mellitus type II and another (No. 5) was diagnosed with HIV infection during their hospitalization.

DNM is a serious complication of a cervical abscess or cervical fasciitis, and signifies pus effusion towards the thoracic cavity (*Wang* et al., 2005; *Heim* et al., 2018). As the infection spreads in between the fascial planes of the neck, pus may reach the thoracic cavity via different paths: a) the skin and subdermal tissues, b) the large vessels of the neck, and c) the prevertebral space. The first two paths usually lead to the anterior mediastinum, and the last to the posterior mediastinum (Zachariades et al., 1988; *Mihos* et al., 2004; *Malis* et al., 2008; *Júnior* et al., 2011). The prevertebral space is also called the 'danger space', mainly because its involvement practically renders the infection thoracic, as the lower border of this space is the diaphragm. DNM is a rare critical condition and requires immediate drainage via thoracotomy (Mihos et al., 2004; *Wang* et al., 2005; *Malis* et al., 2008; *Escobedo* et al., 2020). Importantly, DNM may be indefinable in a patient with cervical cellulitis or abscess. Therefore, clinical suspicion is often the main criterion for emergency imaging, with a computerized tomography (CT) scan followed by extensive drainage of the neck and thoracotomy (*Ruiz* et al., 1993; *González-García* et al., 2011). DNM may be fatal if left untreated, or even with a delay in treatment, at a rate ranging from 5% to 40% (*Ruiz* et al., 1993; *Mihos* et al., 2004; *Roccia* et al., 2007; *Qu* et al., 2018).

The diagnosis of DNM was established with clinical examination and CT of the face, neck, and thoracic cavity. All patients presented were diagnosed according to the Estrera's diagnostic criteria of for DNM: 1) clinical manifestations of severe infection (pyrexia, tachycardia, tachypnea); 2) characteristic radiological features of mediastinitis on CT scan; 3) identification of necrotizing infection at surgery; 4) preexisting oral or cervical infection (*Wang* et al., 2005; *Escobedo* et al., 2020). For patients 1, 2, and 3, OMFS consultation was the initial step. It has been shown that the spread of an infection into multiple spaces of the neck is associated with a significant rise in CRP and WBC values (*Heim* et al., 2018). However, patients No 1, 2, and 3 were in major respiratory distress upon entrance to the ED. Therefore, elevated CRP and WBC counts mainly supported our diagnosis, instead of establishing it.

Other authors argue that DNM is under-reported and that there has been a rise in the occurrence of this condition (Cai et al., 2006; *Escobedo* et al., 2020). Indeed, large series of patients with DNM have been reported over the last 5 years, compared with limited numbers in the previous decades (*Ruiz* et al., 1993; *Freeman* et al., 2000; *Roccia* et al., 2007; Huang et al., 2015; Qu et al., 2018, 2020; Pucci et al., 2020). However, the populations in the countries with large series reports are incomparably larger than the Greek population. Hence, we consider this to be a very rare cohort for our establishment.

Tracheostomy was performed in four patients, either during the initial drainage and debridement, or following a prolonged intubation period in the ICU. Indeed, the current evidence does not justify the application of a single treatment algorithm regarding tracheostomy in the management of DNM (*Ruiz* et al., 1993; *Freeman* et al., 2000; *Roccia* et al., 2007; *González-García* et al., 2011; *Escobedo* et al., 2020). The surgical drainage undertaken for each patient was dictated by the type of DNM and the effusion pattern in the thoracic cavity. Qiu et al. have advocated vacuum-sealing drainage for deep, multiple-space neck infections, but this has not yet been a common practice in our institution (Qiu et al., 2019). Surgical drainage with cervicotomy, thoracotomy, and extractions of the causative teeth, with perioperative and postoperative antibiotic administration, has been the baseline of management for all patients with DNM, and is widely accepted in the literature (Zirk et al., 2016; *Heim* et al., 2018).

The mean hospitalization duration for our patients with DNM was similar to that found by other studies (*Qu* et al., 2018; *Escobedo* et al., 2020). All the patients were re-operated an average of three times, which was in agreement with the general clinical practice (*Freeman* et al., 2000; *González-García* et al., 2011; *Escobedo* et al., 2020). In their systematic classification of the factors affecting the duration of hospitalization in cases of head-and-neck odontogenic infection, Heim et al. found that a) age, b) inability to detect the exact causative focus, and c) spread of the suppuration in many spaces of the neck, significantly prolonged the length of hospital stay (*Heim* et al., 2019). Our observations regarding patients with DNM support the above conclusions.

The reported mortality for DNM varies between 5% and 40% (*Freeman* et al., 2000; *Cai* et al., *2006*; *Malis* et al., *2008*; Qu et al., 2018, 2020; *Escobedo* et al., *2020*). This wide range may be attributed to the rarity of DNM, which may lead to delayed diagnosis and treatment (*Ruiz* et al., 1993; *Cai* et al., 2006; *Rallis* et al., 2006). Well-timed clinical suspicion of this condition is essential, in order to subject the patient to the appropriate investigation — especially a cervicothoracic CT with contrast medium (Freeman et al., 2000).

DNM is a polymicrobial infection, as are all neck infections of dental origin (Zirk et al., 2016; *Heim* et al., 2017; *Kim* et al., *2017*; *Escobedo* et al., 2020). The pathogens identified in our patients were mainly anerobes, but not specific, resistant strains. Microbiological culture of the purulent discharge for identification of the causative microorganism is necessary in cervicofacial infections (*Heim* et al., 2017). However, empirical antibiotic administration remains the rule (Zirk et al., 2016; *Kim* et al., 2017). Importantly, as other authors have emphasized, the management of cervicofacial suppuration is primarily surgical, with perioperative antibiotic treatment. Further antibiotic administration does not optimize the curative outcome, and should be reserved for immunocompromised patients or sepsis (Böttger et al., 2020).

During the first confinement period due to the COVID-19 pandemic in Athens, private dental practices were operating only for emergencies, much as in other European capitals. Because dental care in Greece is primarily based on the private sector, a rise in cervicofacial infections of dental origin, which would need OMFS management, was expected. In our department, the number of patients admitted with this condition remained unaltered, although there was an increase in the seriously ill among those. Politi et al. (2020) and *Long and Corsar (2020)* demonstrated an increased proportion of severe infections to overall infections needing admission during the quarantine period. These authors explained the lower overall infection rate, which made the

incidence of severe infections more prominent, as follows: a) Patients with mild symptoms stayed away from hospital care because of fear of COVID-19. b) The availability of over-the-phone dental consultations and antibiotic prescriptions early in the course of the disease was higher compared with before lockdown (*Long and Corsar*, 2020; *Politi* et al., 2020). On the other hand, Puglia et al., in their study on the management of cervicofacial infections during the pandemic first wave, reported mainly changes in the choice of treatment — making it more radical — rather than a shift in the number of patients (*Puglia* et al., *2021*).

Pham Dang et al. (*Pham Dang* et al., 2020) also found that the total number of patients requiring consultation for dental infections corresponded with the number before the quarantine. Nevertheless, they reported a decrease in the severity of infections treated, with no life-threatening complications. This was attributed to a reduction in the consumption of non-steroidal anti-inflammatory drugs (NSAIDs) by the public. These medications reduce the immune response, thereby inhibiting it from controlling an infection. Additionally, NSAIDs may also conceal the symptoms of an acute infection and hinder timely diagnosis of a possible exacerbation or complication. It was therefore the conclusion of Pham Dang et al. that the avoidance of NSAIDs during the confinement period, on the grounds that they may worsen the clinical course of COVID-19, reduced the rate of grave infection (*Pham Dang* et al., 2020).

Our study reports a rise in the number of patients with severe infections, managing five cases of DNM during the first confinement period, although the overall number of patients with infections was unchanged. This could be attributed to the lockdown effect, as Politi et al. and Long and Corsar indicated, which probably led to further increases in self-medication, including both antibiotics and NSAIDs. The occurrence of self-medication had already been relatively high in Greece, and over-the-counter antibiotic dispensation had been banned only recently. Therefore, aside from the effects of NSAIDs highlighted by Pham Dang et al., an overall rise in resistant microorganisms, due to antibiotic abuse, should be considered (Igoumenakis et al., 2015; *Karakonstantis and Kalemaki*, 2019).

4. Conclusion

Our limited case series indicated a rise in the incidence of DNM during the first lockdown, which possibly reflected the effect of patients' abstention from hospital visits and dental care, as well as self-medication during this time. Further research is required on the number of antibiotic or NSAID prescriptions dispensed without in-person consultation, during the quarantine, as this is another important aspect of public health influenced by the COVID-19 pandemic.

Ethical approval

Due to the fact that explicitly anonymous data were retrospectively analyzed, approval was not necessary.

Declaration of competing interest

The authors declare no conflicts of interest. The authors also wish to declare no funding during the writing of this paper.

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