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Research Article

Diagnosis and Management of Severe Deep Neck Infections

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Abstract

Purpose: Report the clinical, paraclinical, therapeutic and evolutive characteristics of severe deep neck infection (DNI).

Methods: It was a descreptive, retrospective study about 15 patients managed for a severe DNI, in the ENT department of «Taheur Maamouri Universitary Hospital» in Tunisia, over a period of 15 years [2019-2021].

Results: A male predominance was noted with a sex-ratio of 2. The mean age was 42 years old. The most frequent risk factors were diabetes mellitus (6 cases), chronic renal failure (2 cases) and an inappropriate initial treatment (anti inflammatory drugs: 10 cases). The most common complaints were a cervico-facial swelling, dysphagia and fever. Clinical features often include neck pain and swelling (12 cases), torticollis (3 cases), subcutaneous emphysema (5 cases) and trismus (9 cases). Contrast enhanced computed tomography confirmed severe DNI in all cases. An abscess was found in all cases. Etiologies were dominated by dental causes (8 cases). Complications were frequently encountered. Eleven patients had upper airway compromise, six had mediastinitis, three had internal jugular vein thrombosis and three necrotizing fasciitis. One patient died during his hospital stay due to septic shock. The therapeutic management was medico-surgical and urgent. Seven patients (46,6%) required emergency tracheotomy for initial airway management. One patient needed hyperbaric oxygen therapy.

The average hospital stay was of 23 days. The outcome was favorable in 93% of cases.

Conclusion: DNI is a serious life-threatening disease. Early diagnosis and immediate medico-surgical treatment are essentiel.

Keywords: Deep Neck Infection; Mediastinitis; Mortality; Surgical Drainage; Tracheostomy

Abbreviations

DNI: Deep Neck Infection; CECT: Contrast Enhanced Computed Tomography; NSAIDs: Non-Steroidal Anti-Inflammatory Drugs; AI drugs: Anti-Inflammatory Drugs; CRP: Mean C-Reactive Protein; WBC: White Blood Cell Count; ICU: Intensive Care Unit

Introduction

Cervico-facial cellulitis are bacterial infections, usually originating from the upper aerodigestive tract (pharyngeal or dental origin) [1]. The infection can spread rapidly along head and neck spaces. Most often, several risk factors of severe deep neck infection (DNI) are identified such as diabetes mellitus,

immunosuppression and inappropriate initial treatment [2,3]. The extension as well as the severity of the infection are often underestimated by clinical examination. The value of imagery is to specify the locoregional extent and to detect complications.

These infections pose a serious therapeutic management problem. They can compromise the vital prognosis.

The purpose of this work is to report the clinical, paraclinical, therapeutic and evolutive characteristics of DNI.

Materials and Methods

A retrospective analysis was conducted on patients with DNI in Oto-Rhino-Laryngology department of « Taher Maâmouri Universitary Hospital »in Tunisia. The study period was from January 2019 to December 2021.

Were considered as severity criteria: the presence of necrosis or emphysema due to anaerobic bacteria, extensive involvement of deep spaces, compression of upper aero-digestive tract and the presence of complications.

All patients with superficial infections and infections associated with neck's trauma or tumours were not included.

The diagnosis was suspected on clinical examination and confirmed by a contrast enhanced computed tomography (CECT).

We reviewed clinical status, etiology, associated systemic diseases, airway status, duration of hospitalization, tracheostomy, drainage methods, bacterial cultures, complications and outcomes of severe DNIs. SPSS 25.0 software was used for statistical analysis.

Results and Discussion

Demography

In total, 15 patients met the criteria. Mean age was 42 years (range,8 to 72 years). Male predominance was noted with sex-ratio = 2(10 male versus 5 female). The duration of the symptoms before hospitalization varied between 4and 10 days (mean 6 days).

Comorbidities

The most frequent risk factors of DNI were diabetes mellitus (6 cases: with degenerative complications in 4 cases and decompensated in all cases), chronic renal failure (2 cases) and inappropriate initial treatment by self-medication or following a prescription (corticotherapy or non-steroidal anti-inflammatory drugs (NSAIDs) : 10 cases, inadequate antibiotic: 10 cases).

Etiology

A dental origin was the most common etiology (n = 8; 53,3%). A tonsillopharyngeal origin was found in 5 cases (33,3%) (peritonsillar phlegmon/ foreign body); and adenophlegmonin 2 cases (13,4%).

Clinical features (Figure 1, 2, 3 and 4)

The most common presenting symptoms were neck swelling (n = 12; 80%), dysphagia (n = 15; 100%) and fever (n = 13; 86,6%). Three patients (20%) had dyspnea.

On physical examination, we found painful neck swelling (12 cases), torticollis (3 cases), subcutaneous emphysema (5 cases), trismus (9 cases), swelling of the floor of the mouth (3 cases) and bulging of the lateral pharyngeal wall (5 cases).

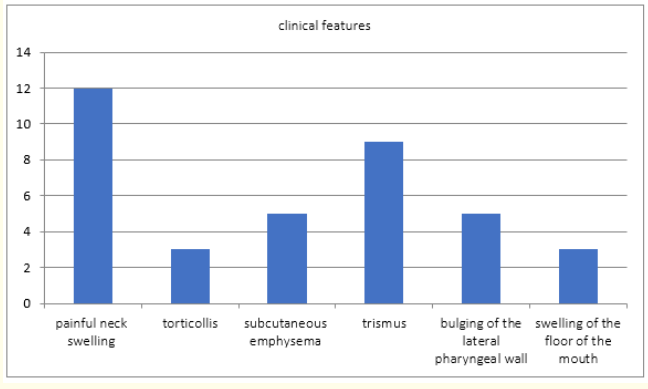

Figure 1: Most frequent clinical features.

Figure 2: Inflammatory right submandibular swelling with latero basi cervical extension related to a dental origin.al features.

Figure 3: Inflammatory left laterocervical and upper thoracic swelling: peritonsillar phlegmon complicated by DNI and mediastinitis.

Figure 4: Torticollis and left laterocervical swelling extended in upper chest region: emphysematous cellulitis complicated by mediastinitis.

Diagnosis

CECT confirmed severe DNI in all cases.An abscess was found in all cases (Figure 5). The mean size of the abscesses was 4.2 cm, varying between 2.5 and 7 cm. A bilateral form was found in two cases.

Prestyloid parapharyngeal location was the most common for the infection (n = 9;60%). Retrostyloid (n = 3;20%) and retropharyngeal (n = 3; 20%) spaces were the other frequently involved loci (Figure 5,6).

Complications were frequently encountered (Figure 7,8). Eleven patients had upper airway compromise, 6 had mediastinitis, 3 had internal jugular vein thrombosis and 3 necrotizing fasciitis.

Mean C-reactive protein (CRP) was 150 mg/L (range 78-481 mg/L). The mean white blood cell count (WBC) was 19.4 El/L (range 14000-33000 mg/L).

Microbiology results were available in 6 cases: *Klebsiella pneumoniae* (n = 2), *Pseudomonas aeruginosa* (n = 1;) and a negative culture (n = 3). Mycological test found mucormycosis in one patient presenting black lesions and necrosis.

Figure 5: CECT of the neck: axial (A,B) and sagittal (C) images showing right submandibular(yellow star) and parapharyngeal collections (red stars)with compression of the upper areodigestive tract (blue arrow).

Figure 6: CECT of the neck and chest: coronal (A) and sagittal images (B) showing left peritonsillar collection(yellow star) bulging into the oropharyngeal lumen and left submandibular (yellow arrow) spaces, arriving at the superior orifice of the mediastinum (blue star).

Treatment

All the patients received intravenous probabilistic antibiotherapy initially at admission. Cefotaxime combined with metronidazole (n = 7; 46,6%) was most often used for empiric antimicrobial treatment, although amoxicillin/clavulanic-acid (n = 3; 20%) was also frequently utilized (Table 1). Antimicrobial therapy was later specified according to the microbiological findings and the drug sensitivity tests. The mean duration of antibiotic therapy was 25 days (range 15-75 days).

Antibiotic n°1	Antibiotic n°2	Antibiotic n°3	Antifungal treatement	Cases
Cefotaxime (100 mg/kg/day)	Metronidazole (30 mg/kg/day)			7
Cefotaxime	Metronidazole	Targocid		1
Cefotaxime	Metronidazole	Pristinamycin		1
Cefotaxime	Metronidazole	Vancomycin		1
Cefotaxime	Metronidazole	Ofloxacine	Amphotericin B (1 mg/kg/day	1
Amoxicillin–clavulanic acid (100 mg/kg/day)	Metronidazole (30 mg/kg/day)			3
Cefotaxime	Vancomycin			1

Table 1: Intravenous antibiotherapy.

Five patients were admitted to the intensive care unit (ICU) for monitoring or because of respiratory distress. The mean of ICU stays was 5 days (range 1-20).

As for surgical treatment, eight patients (53.3%) required an external approach for incision and drainage (Figure 9). Six patients (40%) needed intra-oral drainage, while one patient required both approaches. Surgical revisions were done in all patients. Seven patients (46,6%) required emergency tracheotomy in local anesthesia for initial airway management. An eight year-old patient with mediastinal involvement needed transthoracic surgery. One patient received hyperbaric oxygen therapy (ten sessions every other day for 20 days). Patients with internal jugular vein thrombosis received curative anticoagulants.

One case of death was noted following septic shock in a patient with cervical and mediastinal mucormycosis.

The mean hospital stay was 23 days, with a minimum of 7 days and a maximum of 60 days.

The median follow-up time was 45 days (range 30-67). No neural or vascular complications were detected. Sequelae were detected in four cases: esophageal cutaneous fistula (1 case), unsighty sequelae (2cases), paralysis of marginal mandibular branch (1 case).

Figure 7: CECT of the neck and chest axial (A, B) and sagittal (C)images showing a descending necrotizing mediastinitis with Lemierre's syndrome:

- Thrombosis of right jugular vein (blue arrow)
- Retroesophageal mediastinal collection site of emphysema (red arrow)
- Retro-pharyngeal aerial collection , compressing the upper airways with posterior mediastinal extension (yellow star).

Figure 8: CECT of the neck and chest: coronal (A) and axial (B) sections showing extension of cellulitis to the anterior mediastinum (red arrows) with pericardial thickening and effusion (blue arrow).

Figure 9: Laterocervical incision along the anterior border of the sternocleidomastoid muscle in a patient with cervical and mediastinal mucormycosis: Black necrotic appearance (red arrow) of subcutaneous tissue and sternocleidomastoid muscle/white pus collection (red star).

Discussion

According to the literature, DNI is seen mainly in adults with a male predominance [1,5]. Similarly in our study, the average age was 42 years. There was an 8-year-old child, with no significant pathological history except for taking AI drugs at the onset of symptoms, admitted for cervicofacial cellulitis of dental origin complicated by mediastinitis.

It occurs especially in patients with immunodepression in all its forms: diabetes mellitus, chronic renal failure [3,5,6]. Anti-inflammatory (AI) drugs (Corticosteroids and NSAIDs) are also an essential factor in the transformation of a circumscribed cellulitis into severe DNI [7,8].

In our series, 66,6% of patients had taken AI drugs at the onset of symptoms. A review of the literature shows that taking AI drugs is found in all DNI series. Their use is not recommended, even dangerous [1,5-8]. This is explained by the fact that taking AI drugs, especially NSAIDs, in the absence of an effective antibiotic, promotes infection spread. In fact, they have a depressing effect on the humoral mechanisms of immune defense against infection [5,8,9].

The main etiology in our study was dental infection. Several authors reported on predominantly dental infections in severe cases with mediastinal infections or necrotizing fasciitis [1,8]. This high incidence is due to poor oral hygiene.

We distinguish two forms of severe cellulitis [1,2,10]:

- The pseudo-phlegmonous or phlegmonous form, of the floor of the mouth or of the parotido-masseter compartment, which results in a painful inflammatory process, trismus and compressive signs of the upper aero-digestive tract.
- The gangrenous form with subcutaneous snowy crepitus, necrosis and rapid cervico-mediastinal extension.

The most frequent symptoms are neck pain, neck swelling, odynophagia and dysphagia. Dysphonia and dyspnoea are more frequent in patients with basal and laterocervical extension with laryngeal and/or tracheal compression [1,2,11].

Biologically, there is moderate hyperleukocytosis with a predominance of polymorphonuclear neutrophils and marked

elevation of CRP levels. Biology helps to evaluate response to treatment. In addition, initial CRP is a good predictor for severe cases [12].

The infection is mixed polymicrobial. The predominance of anaerobic germs (*Prevotella species, Fusobacterium* species...) is unanimous among the authors [1,13]. In most of the literature, in severe cases with mediastinal involvement or necrotizing fasciitis, higher percentages of gram-negative and/or anaerobic bacteria have been described [10,11]. The microbial virulence is characteristic of severe DNI with at least the presence of one germ multi-resistant in antibiogram. The high proportion of patients with no bacterial growth in culture could be related to prior antibiotherapy [13]. In our series, microbiological results were available in 6 cases: *Klebsiella pneumoniae* (n = 2), *Pseudomonas aeruginosa* (n = 1;) and a negative culture (n = 3). Mycological test found mucormycosis in one patient presenting black lesions and necrosis.

Ultrasonography plays a role in the detection of abscess formation but cannot identify deep abscesses. CECT is the best radiological tool in evaluation of severe DNIs [14]. It defines the origin, location, extension and DNI's complications. It is also essential to distinguish abscess from cellulitis. A typical presence of air in soft tissues of the neck and mediastinum may be observed in anaerobic DNIs. Therefore, Lemierre's sd is more frequently observed with anerobic germs.

A CECT also helps to decide whether a surgical intervention is indicated [1,5,14]. In addition, it allows the study the relationship of the collections with the vascular axes, and helps to guide the choice of the surgical approach.

The treatment of severe DNI consists of airway management, antibiotherapy and surgical drainage of the abscesses [4,10,15].

Paraclinical investigations should in no way delay treatment. Antibiotic therapy must be effective and targeted, it is primarily probabilistic aimed at streptococcus and anaerobes. Then, antibiotics are adapted to the microbiological findings and antibiogram [1,11,13]. The antibiotherapy duration is variable according to the severity and the evolution. Currently, it is recommended to combine a b-lactamase resistant antibiotic (such as cefotaxime or imipinem) with an antibiotic highly effective against anaerobic species (such as clindamycin or metronidazole). Vancomycin should be used at risk of Methicillin-resistant Staphylococcus aureus (MRSA) infection and in patients with profound immune dysfunction.

In our study, all patients received intravenous antibiotics initially at admission. Cefotaxime combined with metronidazole (46,6%) was most often used for empiric antimicrobial treatment, although amoxicillin/clavulanic-acid(20%) was also frequently utilized.

The majority of studies favor drainage and/or surgical debridement on the day of admission. Delayed surgical therapy may increase morbidity and mortality [11].

Transoral approach is indicated in retropharyngeal space abscesses without involvement of other deep neck abscesses. Other deep neck abscesses are usually treated by external cervicotomy [10]. In several cases of mediastinitis, transthoracic approaches may bean optimal mediastinal drainage [2,10,11]. In our study, eight patients (53.3%) required an external approach for incision and drainage. Six patients (40%) needed intra-oral drainage, while one patients required both approaches. One patient with mediastinal involvement needed transthoracic surgery.

In severe cases, surgical revisions with drainage, as was done in the present study, are necessary. Regular lavage with antiseptic fluids is also recommended by several authors [8,15].

Airway management is challenging in patients with severe DNIs. Tracheotomy must be performed whenever there is breathing difficulty secondary to airways compression [12]. An early tracheotomy, facilitates surgical revisions and reduce sedation time for the patients. In several studies, an early tracheostomy is correlated to a shorter overall morbidity, mortality and duration of ICU stay [12,13]. Tracheal intubation is most often difficult in patients presenting severe cellulitis, because of limited access to the mouth, tissue rigidity and possible distorted airway anatomy [12].

In our study, initial tracheotomy for airway management was performed in 46,6% of cases.

Hyperbaric oxygen therapy should be considered as an adjunct to medical and surgical treatment [8]. It can significantly reduce

bacterial growth due to its bacteriostatic effect and its power of tissue regeneration [1,8,15]. However its contraindications and its availability limit its use.

Serious life threatening complications can occur in severe DNIs, such as airway compromise, mediastinitis, jugular vein thrombosis and septic shock [2,4].

Infection can spread from the neck to mediastinum by several routes. In the literature, the most important route reported is the retropharyngeal space, followed by the carotid space [10,11]. In our series, involvement of the mediastinum was shown in 40% of cases.

The prognosis of severe cellulitis is essentially linked to the terrain, the earliness and effectiveness of the initial treatment. In literature, the mortality rate in severe cellulitis varies between 7 and 50% [2,6]. In our series only one patient died due to septic shock (7%).

Conclusion

Severe DNI is rare but remains a challenging disease. Analysis of the risk factors and assessment of the severity criteria may reduce life-threatening complications. Immediate diagnosis and therapy are essential. Thus, intravenous empiric antibiotherapy, surgical drainage, an early tracheotomy in patients with respiratory difficulty, regular surgical revisions and antiseptic lavage are recommended.

Conflict of Interest

All authors have no financial interest or conflicts of interest to declare.

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