ORIGINAL ARTICLE

DESCENDING NECROTIZING MEDIASTINITIS: A 7-YEAR SINGLE-CENTRE EXPERIENCE

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Abstract

Introduction: *Descending necrotizing mediastinitis (DNM) is a life-threatening condition that originates from head and neck infections, subsequently extending into the mediastinum. Prompt diagnosis and emergent surgical intervention are critical for patient survival. This study aims to present our experience in managing DNM.*

Methods: *The present study retrospectively analyzed patients with DNM who underwent surgical treatment in our center, between 2017 and 2023.*

Results: *We identified 14 adult patients treated in our center in the 7-year period, with male predominance and a mean age of 45 years. The primary infection sites were pharyngeal in 7, cervical in 5 and odontogenic in 2 patients.*

At diagnosis, 4 patients had type I DNM, 3 had type IIA and 7 had type IIB. Disease progression to stage III occurred in the majority of patients (n=12). A total of 34 cervical procedures and 20 thoracic surgeries were performed, with a median of 2 cervical [1-7] and 1 thoracic [0-3] interventions per patient. Combined cervicotomy and thoracotomy was the preferred surgical approach. There was a low rate of long-term morbidity and no mortality.

Conclusion: *Successful management of DNM relies on early diagnosis trough computed tomography scan, appropriate antibiotic therapy, and urgent surgical drainage of the affected cervical and mediastinal planes. Our experience highlights favorable outcomes, underscoring the value of a well-coordinated multidisciplinary approach.*

Keywords: *Descending Necrotizing Mediastinitis; Surgical Drainage; Transcervical Drainage; Transthoracic Drainage; Thoracic Surgery*

INTRODUCTION

Descending necrotizing mediastinitis (DNM) constitutes a severe and potentially fatal condition that results from the downward spread of oropharyngeal and cervical infections into the mediastinum. [1,2]

First established by Estrera et al in 1983, the diagnostic criteria for DNM, remains in use today, encompassing 4 criteria: (1) clinical signs of severe infection; (2) characteristic radiographic findings; (3) documentation of necrotizing mediastinal infection during surgery or post-mortem; and (4) establishment of a connection between the oropharyngeal or cervical infection and the necrotizing mediastinal process.[1,3–5]

Infections of odontogenic, pharyngeal, or cervical origin can lead to necrotizing fasciitis, rapidly extending along deep fascial planes into the mediastinal compartments.[1,3,6–8] Three main anatomic pathways serve as potential infection routes: the pretracheal space; the vascular visceral space and, most importantly, the retrovisceral space, involved in 70% of cases of DNM. This aggressive process may cause, within hours, abscess formation, tissue necrosis, sepsis, and eventually, organ failure. [4,6,7,9]

Endo et al[10] proposed a classification based on the degree of mediastinal involvement. Type I DNM is confined to the upper mediastinum, above the tracheal bifurcation, while type II extends into the lower mediastinum. Type II was further subdivided in type IIA, with the infection extending to the lower anterior space and type IIB, involving both the anterior and posterior mediastinum.[1,3,6,11]

More recent modifications to this classification have emerged. In 2015, the European Society of Thoracic Surgery introduced a type III category, comprising involvement of the pleural space.

Meanwhile, a joint study by the Japan Broncho-Esophagological Society and the Japanese Association for Chest Surgery, in 2021, proposed a type IIC subtype, characterized by infection confined to the posterior lower mediastinum.[1,6]

DNM is a rapidly progressing, life-threatening condition that demands early diagnosis and classification, typically ascertained by cervicothoracic computed tomography (CT) scan.[4,5,12] Effective management entails a timely approach with broad-spectrum antibiotics and surgical drainage and debridement of the affected anatomic planes.[3,11] This often involves the collaboration of specialties such as Thoracic Surgery, Maxillofacial Surgery, and Otorhinolaryngology.

The present study focuses on the clinical features, surgical treatment and outcomes of patients with DNM referred to our center over the past 7 years.

MATERIAL AND METHODS

A single-center retrospective observational study was conducted of all patients with DNM who underwent thoracic surgical treatment in our institution, during the period of 2017 to 2023. Survival was accounted until December of 2024.

The diagnosis of DNM rested on medical history, clinical examination and CT scan, based on the criteria proposed by Estrera et al. The extent of DNM was evaluated by CT scan preoperatively and defined with the classification of Endo et al, modified by ESTS.

Data was obtained through review of medical records. The information collected included demographic characteristics and medical background, symptoms at presentation, preoperative imaging; number of procedures, surgical approach and intraoperative findings; microbial agents, antibiotic regimen, duration of invasive mechanical ventilation, need for tracheostomy; imaging progression, duration of neck and chest drainage and hospital stay, evidence of complications, treatment outcomes and survival. No patient was lost during follow-up.

The institutional ethics review board approved the study protocol with a waiver of informed patient consent.

The categorical variables were presented in absolute value and percentage format and the continuous variables with mean value and standard deviation.

RESULTS

This study included 14 patients treated at our center over a 7-year period, from 2017 to 2023. There was a predominance of male patients (79%, n=11), with a mean age at diagnosis of 45.0 ±12.1 years. 3 patients (21%) had a relevant medical history. The demographic features are compiled in table 1.

The most frequently presenting symptom was pain - odontalgia, neck, or chest pain (100%), followed by neck swelling and redness (57%, n=8) and fever (50%, n=7). Infection sources were pharyngeal (50%), cervical (36%), and odontogenic (14%).

At diagnosis, 4 patients had type I DNM, 3 had type IIA, and 7 had type IIB (50%). The majority of patients (86%, n=12) progressed to stage III, with pleural involvement. However, in 2 cases (one with type I and the other with type IIB), timely intervention prevented further spread of infection.

Preoperative assessment consisted of clinical history, physical examination, blood tests, chest X-ray, and, most importantly, contrast-enhanced cervical and thoracic CT scan to accurately determine the extent of the infection. The vascular visceral space was the most frequently affected anatomical route (86%, n=12), followed by the retrovisceral space (57%, n=8) and the pretracheal space (36%, n=5). Overall, in 93% of cases (n=13), the infection spread through multiple anatomic routes.

The median time from diagnosis to surgical treatment was 1 day. There were 72% (n=10) of patients who underwent surgery on the day or following day of the established diagnosis.

The majority of patients (86%, n=12) required combined cervicotomy and thoracotomy for effective drainage of purulent collections and debridement of necrotic tissue. One patient with type I DNM was successfully treated with transcervical approach alone (figure 1). One other patient with type III DNM, with posterior mediastinal and pleural involvement, underwent a combination of cervicotomy and video-assisted thoracoscopic surgery (VATS), with a favorable outcome. A description of the surgical procedures is provided in table 2.

In total, 34 cervical interventions were performed, either through cervicotomy or transoral local incision, alongside 20 thoracic surgeries (19 via thoracotomy and 1 via VATS). 86% of patients (n=12) required re-operation, ranging from a minimum of 2 and maximum of 7 surgeries. Each patient had a median of 2 cervical [1–7] and 1 thoracic [0–3] procedures.

Two patients required only a single surgical intervention: one with type I DNM and the other with type III. Both infections had a pharyngeal origin. The type I case underwent surgery on the first day after diagnosis, and the type III case on the third day. Both were operated on by the thoracic surgery team as the initial approach, which included cervical debridement in both cases and additional intrathoracic drainage and debridement in the type III patient.

Unilateral intervention was performed in 64% of cases (n=9), predominantly on the right mediastinum and pleura (n=7) whereas 4 patients required bilateral thoracic surgery. Pericardial drainage was required in 1 case, and 5 patients (36%) had dental extraction performed simultaneously. Moreover, 2 patients also underwent hyperbaric oxygen therapy.

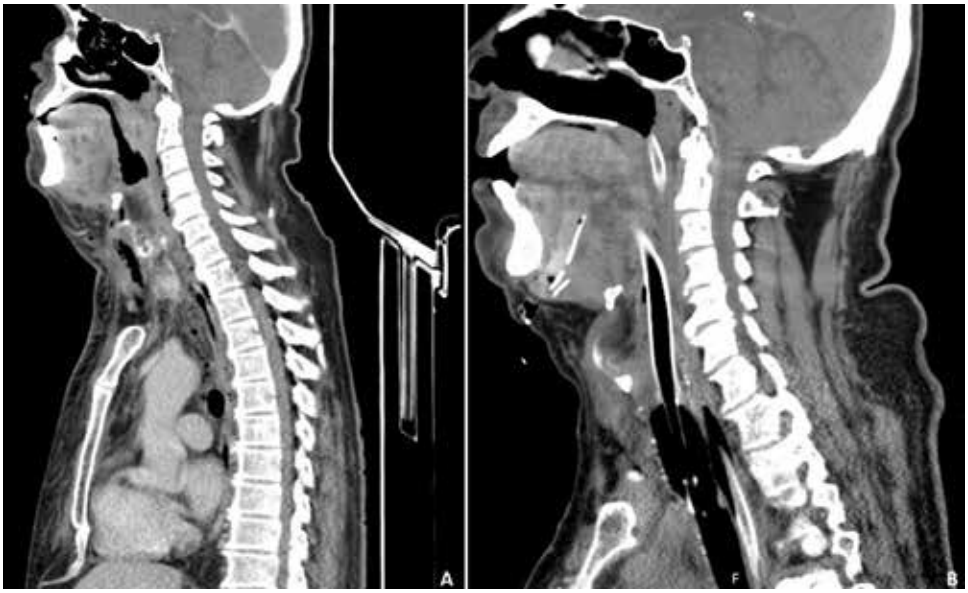

Figure 1 *DNM Endo type I: A) Preoperative CT scan; B) Postoperative CT scan (transcervical drainage).*

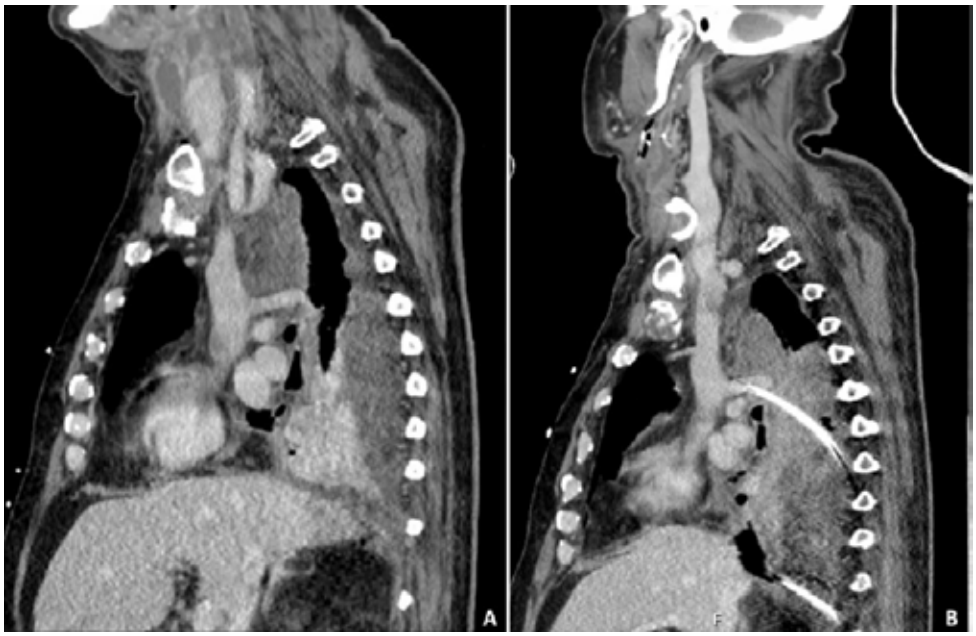

Figure 2 *DNM Endo type IIB: A) Preoperative CT scan; B) Postoperative CT scan (transcervical and transthoracic drainage via thoracotomy).*

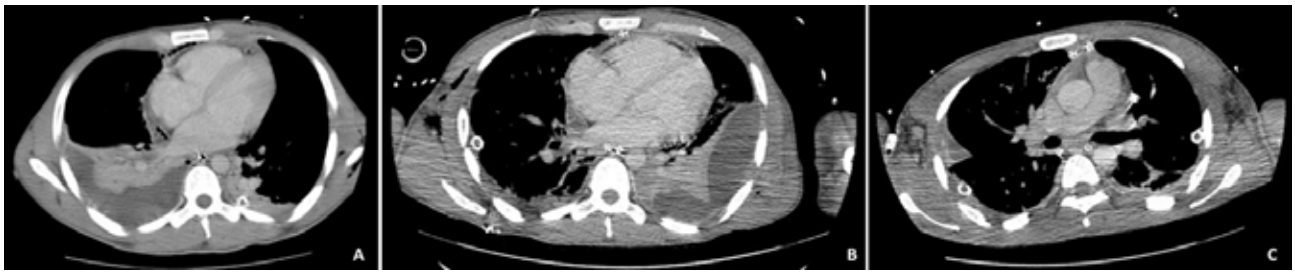

Figure 3 *DNM Endo type III – Radiologic Assessment: A) Preoperative CT scan; B) Postoperative CT scan, after the first surgery of transcervical and transthoracic drainage via thoracotomy; C) Postoperative CT scan, after the second and final surgery with dual approach.*

Table 1 **Demographic Features**

Characteristics	
Patients	14
Age (years)	45 ± 12,1 [29-67]
Gender	
Male	
Smoking Habits	4 (29%)
Comorbidities	
Diabetes	5 (36%)
Hypertension	2 (14%)
Malignant Neoplasm	1 (7%)
Autoimmune Disease (Psoriasis)	1 (7%)
Etiopathogenesis	
Pharyngeal	7 (50%)
Cervical	5 (36%)
Odontogenic	2 (14%)
Symptoms	
Pain	14 (100%)
Neck swelling and redness	8 (57%)
Fever	7 (50%)
Dysphagia	5 (36%)
Dyspnea	2 (14%)
Trismus	2 (14%)

Table 2 **Surgical Features**

Characteristics	
DNM Classification at Presentation	
Type I	4 (29%)
Type IIA	3 (21%)
Type IIB	7 (50%)
Route of Infection	
Vascular Visceral Space	12 (86%)
Retrovisceral Space	8 (57%)
Pretracheal Space	5 (36%)
Infection spread - Multiple spaces (≥2)	13 (93%)
DNM Final Classification	
Type I	1 (7%)
Type IIB	1 (7%)
Type III	12 (86%)
Surgical Approach	
Type I	
Transcervical approach	1 (100%)
Type IIB	
Transcervical + Thoracotomy approach	1 (100%)
Type III	
Transcervical + VATS approach	1 (8%)
Transcervical + Thoracotomy approach	11 (92%)

Thoracic Surgery evaluated all cases at diagnosis and was involved in the initial surgery for 36% of patients (n=5), in the second for 43% (n=6) and in the third surgery for 21% of patients (n=3). The surgical procedures were performed in conjunction with Maxillofacial Surgery and Otorhinolaryngology, underlining the multidisciplinary nature of treatment.

DNM is primordially a polymicrobial infection, reflecting the indigenous microflora of the oral cavity. In our study, 36% of patients (n=5) showed a polymicrobial infection, while 43% (n=6) had a single isolated pathogen. In 3 cases, microbiologic cultures were negative. Streptococcus spp was the most commonly identified agent, in 43% of cases (n=6), with Streptococcus constellatus (n=4) being the predominant strain, followed by Streptococcus anginosus (n=2). The genus Staphylococcus presented in 4 cases, primarily Staphylococcus aureus (n=3) and, Staphylococcus epidermidis (n=1). Other bacteria included Pseudomonas aeruginosa (n=2), Klebsiella Pneumoniae, Acinetobacter baumannii, Provetella oris, Prevotella denticola, Kocuria kristinae or Corynebacterium amycolatum. There were 2 patients who presented with single fungal infection, namely Candida albicans. Finally, 1 patient had mixed fungal (Candida krusei, Candida parapsilosis, Candida dubliniensis) and bacterial infection.

In all cases, broad-spectrum antimicrobial therapy was initiated empirically and subsequently adjusted according to culture and antibiogram results. The most frequently used antibiotics included ceftriaxone, piperacillin–tazobactam, metronidazole, and clindamycin. The mean duration of antibiotherapy was approximately 37 ± 11.6 [21-55] days. Antifungal therapy, mainly with fluconazole, was administered to two patients for 45 and 36 days, respectively. No significant iatrogenic adverse effects were observed that required premature discontinuation of medical therapy.

All patients were admitted to the intensive care unit (ICU), requiring a mean ICU stay of 24.6 ±18.4 [4-63] days. Furthermore, 86% of patients (n=12) required mechanical ventilation support for a mean of 20.6 ±15.8 [2-46] days. Tracheostomy was performed in 21% of patients (n=3). The remaining two patients were extubated immediately after the surgical procedures.

Complications comprised septic shock in 14% of patients (n=2), bronchopneumonia in 21% (n=3), and necrotizing fasciitis in 7% (n=1).

The mean duration of cervical drainage was 23.4 ± 13.9 [6–58] days, and thoracic drainage lasted a mean of

Table 3 **Clinical Progression Features**

Characteristics	
Surgery	
Cervical Approach	34
Median (number of procedures)	2 [1-7]
Thoracic Approach	20
Median (number of procedures)	1 [0-3]
Surgical Intervention	
Once	2 (14%)
Twice	6 (43%)
Multiple Times (≥3)	6 (43%)
Unilateral Surgical Intervention	9 (64%)
Dental Extraction	5 (36%)
ICU Stay (days)	24,6 ±18,4 [4-63]
Tracheostomy	3 (21%)
Intubation Period (days)	20,6 ±15,8 [2-46]
Morbidity	
Pneumonia	3 (21%)
Septic shock	2 (14%)
Necrotizing fasciitis	1 (7%)
Cervical Drainage Period (days)	23,4±13,9 [6-58]
Thoracic Drainage Period (days)	26,8 ±15,7 [4-53]
Hospital Stay (days)	48,2±24,0 [6-79]

26.8 ± 15.7 [4–53] days. The average length of hospital stay was 48.2 ± 24.0 [6–79] days, as summarized in table 3.

All patients achieved infection control and benefited from intensive physical rehabilitation post-hospitalization. The great majority of patients showed no long-term complications (93%, n=13) with only 1 patient experiencing dysphagia at the 1 year follow-up. There was no evidence of mortality.

This study excluded alternative causes of acute mediastinitis (such as trauma, esophageal perforation or post-sternotomy complications), as well as patients with localized cervical involvement. Pediatric patients (under 18 years old) were also excluded, as a separate study is planned for these cases.

DISCUSSION

DNM is a rare but deadly condition, constituting a surgical emergency. Mortality rates have improved with advances in diagnostic imaging and early treatment, today ranging from 10% to 20%.[1,6,7,11,13,14] The key to successful DNM management lies in the early institution of a comprehensive treatment.14–16 In our center, broad-spectrum antibiotics were initiated and subsequently adjusted according to microbiological findings, and surgical debridement was performed repeatedly as needed to control the infection. The surgical treatment strategy was determined through multidisciplinary decision, involving combined procedures of Thoracic Surgery, Maxillofacial Surgery and Otorhinolaryngology, in order to achieve optimal outcomes. Patients underwent regular CT scan reevaluations every 1–2 weeks and in case of clinical deterioration.

The severity of DNM directly correlates with mortality,[15] emphasizing the importance of timely and extensive surgical drainage. Most of our patients presented with type IIB DNM, possibly due to late clinical presentation or delayed search for medical care, and rapidly evolved into stage III. A meta-analysis by Prado-Calleros et al disclosed a difference in survival, in terms of limited disease (type I), showing 9.8% mortality, when compared to advanced cases (type II) with 31.5% mortality[5]. More recently, Sugio et al corroborated these findings, demonstrating a higher 90-day mortality associated with type II DNM as opposed to type I.1 Other identified poor prognostic factors included age over 70 years and septic shock.[1,2,4,5,11,17]

Open cervicothoracic surgery remains the preferred approach for DNM because it permits ample mediastinal exposure for thorough debridement and drainage; compared with video-assisted thoracoscopic surgery (VATS), several series report lower reoperation rates with open procedures, alongside favorable survival.[11–13,16,18,19] A 2023 multi-center Japanese analysis reported lower reoperation (15.5% vs 37.9%) and lower postoperative complication rates (24.1% vs 53.0%) with open surgery, compared to VATS[20].

In type I DNM, a transcervical approach may suffice to promote infection control. Type IIA cases require a combined cervicotomy and subxiphoidal or VATS mediastinal debridement. Finally, in type IIB (figure 2) and III (figure 3), complete drainage entails combined cervicotomy and (unilateral or bilateral) thoracotomy.[1–3,6,8,11,14] Misthos et al showed that dual drainage significantly improved survival in type II DNM compared to transcervical drainage alone, demonstrating a mortality rate of 9-19% with dual approach versus 47-50% mortality with isolated transcervical drainage.[18] Corsten et al performed a meta-analysis of 69 patients and reported better survival outcomes with additional thoracotomy (81%) compared to transcervical-only approaches (53%).[9,11]

In our institution, we favor a transcervical approach with cervicotomy for type I DNM. For type IIB and III, cervicotomy allied to a transthoracic approach, primarily via thoracotomy, is preferred, providing better access to the infected anatomical spaces and allowing for more effective adhesiolysis and drainage.

VATS may be an option in initial stages of DNM (type IIA),[15,16] as it minimizes musculoskeletal injury and reduces morbidity, compared to open procedures.[3,15] However, the demand for achieving complete debridement of the mediastinal and pleural spaces in the hostile inflammatory environment has limited its application.[8,18] In this sense, recent studies have shown good results. Zhao et al described 29 patients treated effectively with VATS, and

Table 3 **Clinical Progression Features**

Study	Patient Group	Outcomes	Key Results
Misthos P et al (2007) Journal of Oral and Maxillofacial Surgery Observational Study	27 Patients 17 Years (1985-2002)	Overall Mortality	9% in Cervical + Mediastinal Drainage vs 80% in Cervical Drainage
Lara CI et al (2013) Cir Esp Observational Study	29 Patients 21 Years (1988-2009)	Complication Rate Overall Mortality	45% 17%
Prado-Calleros HM et al (2020) Head Neck Systemic Review	145 Reports 963 Patients 75 Years (1938-2014)	Complication Rate Overall Mortality	65% 20%
Yano M et al (2020) J Thorac Dis Observational Study	7 Patients 8 Years (2011-2019)	Overall Mortality	No mortality
Sugio K et al (2021) JTCVS Open Observational Study	225 Patients 4 Years (2012-2016)	Operative Mortality Overall Mortality	4% (30-day) 5% (90-day) 85% (3-year) 69% (5-year)
Wu P et al (2021) Ear Nose Throat J. Observational Study	9 Patients 13 Years (2006-2019)	Overall Mortality	No mortality
De Palma A al (2022) Antibiotics Observational Study	15 Patients 18 Years (2002-2020)	Complication Rate	40%
Lucenic M et al (2022) Bratislava Medical Journal Observational Study	20 Patients 18 Years (2001-2019)	Complication Rate In-Hospital Mortality	85% 5%
Ho CY et al (2022) Ear Nose Throat Journal Observational Study	21 Patients 5 Years (2016-2021)	Overall Mortality	10%
Waldo-Hernández LI et al (2022) Neumologia y Cirugia de Torax (Mexico) Observational Study	51 Patients 12 Years (2006-2022)	Overall Mortality	28%
Reuter TC et al (2023) Eur Arch Otorhinolaryngol Observational Study	225 Patients 21 Years (1997-2018)	Complication Rate Long-Term Morbidity Overall Mortality	73% Dysphagia – 67% 9%
Nhat LX et al (2023) J Cardiothorac Surg Observational Study	95 Patients 10 Years (2010-2020)	Overall Mortality	9% (2010-2016) 10% (2016-2020)
Zhao Z et al (2024) Front Med Observational Study	31 Patients 10 Years (2012-2022)	Operative Mortality	26% (30-day)

guided percutaneous drainage directed at small residual collections[3] and, Yano et al has also presented 7 patients who achieved complete resolution through VATS drainage.[13] In 2023, a type III DNM case at our center, successfully underwent VATS, with satisfactory infection resolution. VATS can be effective for carefully selected, more focalized disease and in experienced centers, but evidence remains heterogeneous and largely retrospective.

In our study, pharyngeal and cervical infections were the more prevalent sources of DNM. Others such as Prado-Calleros et al and De Palma et al have also reported a decline in odontogenic infections,[3,5,12] historically the primary cause of DNM, possibly explained by improved dental care and oral hygiene.

The median time from DNM diagnosis to surgical treatment in our cohort was 1 day, slightly lower than the experience of other centers such as De Palma et al and Sugio et al.[1,12,17]

All patients required intensive care postoperatively, with the majority needing mechanical ventilation (86%), although only 21% required tracheostomy. Tracheostomy remains controversial in DNM due to the increased risk of contamination of the pretracheal space and spreading of infection.[4,8,14,18] We considered every case and chose to perform tracheostomy in select cases to secure the airway when prolonged mechanical ventilation was necessary.

In 43% of cases, Streptococcus spp was the prevailing agent, a trend consistent with other reviews.[5] 21% also showed positivity for Candida fungi. However, only 36% exhibited polymicrobial infection, which contrasts with the typical etiopathogenesis of DNM, possibly due to the early initiation of broad-spectrum antimicrobial therapy.

Two patients underwent hyperbaric oxygen therapy sessions. Recently published case reports demonstrated promising results with hyperbaric oxygen treatment, particularly in enhancing tissue angiogenesis and regeneration. While this therapy holds potential as an adjunctive treatment, more controlled studies are required to confirm its therapeutic value in DNM.[21–23]

DNM results in prolonged hospitalizations and a lengthy rehabilitation process. In our center, patients showed an average period of thoracic drainage of 27 days and a hospital stay of 48 days. Our results show lengthier drainage (15-20 days) and hospitalization (20-25 days) times compared to the literature.[7,11,18] Nevertheless, we observed no readmissions, including those related to recurrent mediastinitis or pleural effusion, reflecting the need of drainage until complete resolution of infectious collections.

Complications were present in 43% of patients, lower than reported in other reviews, as illustrated in table 4.[12,17] Only 2 patients progressed into septic shock, a factor associated with a higher morbidity and an independent predictor of mortality.[11,12] On the other hand, we accounted only one patient experiencing long-term morbidity, namely dysphagia. Dysphagia is a common late complication, can significantly impact quality of life and often requires long-term physiotherapy[1,14].

Surgical treatment led to positive outcomes, with significant symptomatic improvement and no mortality.

Nevertheless, inherent limitations include the small number of patients and retrospective observational design.

CONCLUSION

Due to the emergency nature of DNM, establishing prospective studies is challenging. The current understanding relies heavily on the collective experience shared by surgical centers worldwide. Successful treatment of DNM hinges on prompt diagnosis and immediate, high-quality surgical drainage of the affected cervical and mediastinal planes. We hope future large-scale investigations will further outline risk factors and help optimize multidisciplinary care for DNM patients

Conflicts of Interest

The authors have no conflicts of interest to declare concerning this work.

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