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Retrospective analysis of the positive effect of emergency room national early warning score 2 on descending necrotizing mediastinitis patients

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Abstract

Objective A retrospective analysis of patients with descending necrotizing mediastinum (DNM) admitted to the emergency department was performed to improve emergency physicians' knowledge of DNM, so as to achieve early judgment and timely resuscitation of DNM and to avoid delays in the diagnosis and treatment of patients. We explored the use of the NEWS2 to assess the condition of DNM patients, hoping to enable timely treatment and prevent adverse events.

Methods A retrospective review was conducted on the clinical data of 30 patients who were admitted to our hospital and ultimately diagnosed with DNM between 2014 and 2023. NEWS2 were calculated based on the clinical data of DNM patients at the time of emergency admission. Patients were then grouped according to their scores to explore the relationship between the score and adverse events during hospitalization as well as prognosis.

Results A total of 30 DNM patients were included, 22 of whom were male (73.3%). The median age was 53 years (range: 47.75 to 62.50 years). Seven patients were diagnosed upon emergency admission, while 23 had an undetermined diagnosis, yielding an emergency department misdiagnosis rate of 76.7%. According to the NEWS2, 19 patients were classified into the low-risk group, 6 into the medium-risk group, and 5 into the high-risk group. During hospitalization, 14 patients (46.7%) experienced critical events, including 2 cases of cardiac arrest. Thirteen patients (43.3%) developed secondary sepsis, with incidence rates of 31.6%, 66.7%, and 60.0% in the low-risk, medium-risk, and high-risk groups, respectively. Eleven patients died: 5 in the low-risk group (26.3%), 2 in the medium-risk group (33.3%), and 4 in the high-risk group (80.0%).

Keywords Emergency room management, Descending necrotizing mediastinitis, NEWS2 , Multidisciplinary combination therapy

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Introduction

Descending necrotizing mediastinitis (DNM) is a severe and life-threatening condition resulting from infections in the maxillofacial, oropharyngeal, or cervical regions that spread downward to the mediastinum. First described by Pearse in 1938, DNM caused by infection of the cervical lacunae has historically carried a high mortality rate, reported to be as high as 49% [1]. Given the rarity and high mortality rate of DNM, emergency physicians often have limited knowledge and low awareness of the condition, leading to missed diagnoses and misdiagnoses in the emergency room, which can delay timely diagnosis and treatment. Therefore, we believe it is crucial to raise awareness of DNM among emergency physicians and to identify simple, reliable methods for identifying patients at risk of DNM during emergency visits. The National Early Warning Score 2 (NEWS2) is a tool used to assess changes in a patient's condition and identify those at potential risk. It has gained widespread recognition both domestically and internationally for its effectiveness in rapidly evaluating patient status and predicting prognosis [2]. It includes respiratory rate, oxygen saturation, oxygen support, body temperature, systolic blood pressure, pulse, and level of consciousness [3]. It enables rapid assessment of emergency patients' conditions, helping to shorten the warning time and facilitate the early detection and management of critically ill cases. Continuous monitoring of the NEWS2 also provides valuable guidance in tracking changes in the patient's condition [4]. This study combines data on the general condition of DNM patients upon arrival at the emergency department, as well as their condition changes after admission, to explore early warning methods and emergency measures for DNM in the emergency room, with the aim of improving patient outcomes.

Data and methods

The study was approved by the Biomedical Research Ethics Committee of the Affiliated Hospital of Zunyi Medical University (KLL-2024-488).

Inclusion and exclusion criteria

Inclusion criteria patients diagnosed with DNM according to the definition proposed by Estrera et al. had (1) clinical evidence of severe oropharyngeal infection; (2) characteristic imaging features of mediastinitis; (3) documentation of necrotizing mediastinal infections during surgery or necropsy; and (4) establishment of a relationship between DNM and oropharynx [5].

Exclusion criteria patients with acute mediastinitis caused by non-descent causes were excluded; those younger than 16 years of age according to the NEWS2 were also excluded.

Clinical data

A total of 30 patients discharged with a diagnosis of DNM who met the inclusion criteria from 2014 to 2023 at our institution were 22 (73.3%) male patients and 8 (26.7%) female patients with a median age of 53 years (IQR: 47.75–62.50).

Methods

We conducted a statistical analysis of DNM patients in our hospital's emergency department, focusing on their general condition, clinical manifestations, imaging

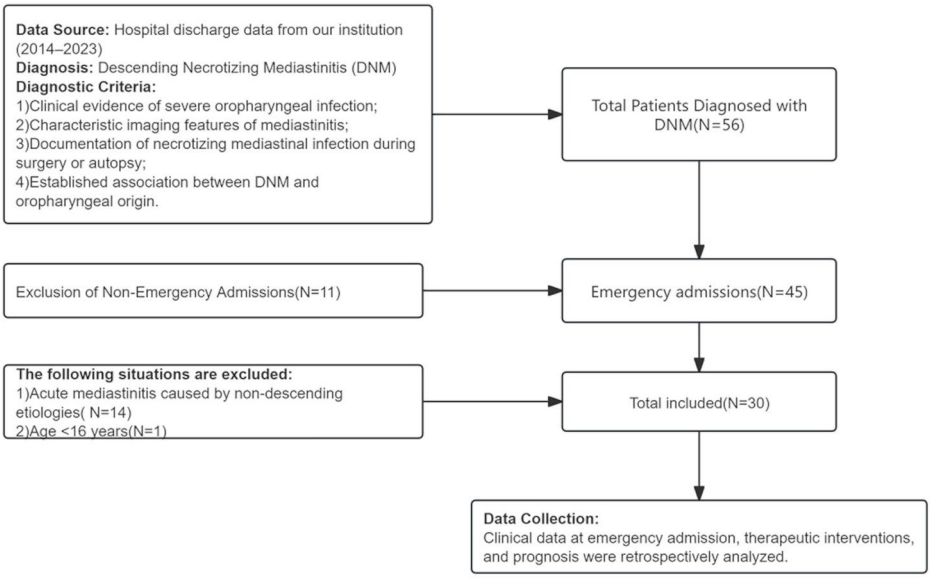

Fig. 1 Flowchart for patient selection in descending necrotizing mediastinitis (DNM)

results, and the emergency first aid measures taken during their visit. This analysis also included the department of admission, diagnosis, surgical treatment status, and prognosis. We identified common clinical presentations, factors contributing to delayed diagnosis, and the timely and effective application of emergency measures, along with factors influencing prognosis. A retrospective NEWS2 was assigned based on each patient's condition at the time of their emergency visit, and its correlation with in-hospital adverse events and prognosis was evaluated.

Table 1 List of clinical data of DNM patients

No	30
General information	
Age, years; M (P25–P75)	53(47.75, 62.50)
Male, No (%)	22(73.3%)
Emergency diagnosis, No (%)	7(23.3%)
Confirmed after admission, No(%)	23(76.7%)
Symptom, No(%)	
Maxillofacial swelling and pain	13(43.3%)
Swelling and pain in the neck	13(43.3%)
Fever	13(43.3%)
Sore throat	12(40.0%)
Dysphagia	11(36.7%)
Dyspnea	7(23.3%)
Chest pain	7(23.3%)
Coughing up sputum	7(23.3%)
Shortness of breath	6(20.0%)
Chest tightness	chest tightness
Difficulty opening the mouth	2(6.7%)
Hoarseness	2(6.7%)
Vital signs, Mean ± SD	
Breathe	21.67 ± 3.51
Body temperature	37.09 ± 0.96
Sphygmus	102.9 ± 19.85
Systolic pressure	124.2 ± 18.2
Airway management	
Invasive respiratory support	23(76.3%)
Non-invasive respiratory support	7(23.3%)
In-hospital adverse event	
Emergency	14(46.7%)
sudden cardiac arrest	2(6.7%)
Source of infection; No (%)	
Neck	14(46.7%)
Pharyngeal	9(30.0%)
Odontogenic	7(23.3%)
Onset of illness; M (P25–P75)	6.5(4.00, 10.50)
Length of hospitalization; M (P25–P75))	21(7.75, 34.50)
Comorbidity, No (%)	
Diabetes	6(20.0%)
Hypertention	7(23.3%)
Complication, No (%)	
Sepsis	13(43.3%)
Sepsis with MODS	4(13.3%)
Prognosis, No (%)	
Death	11(36.7%)
Cure	19(63.3%)

Statistical methods

In this study, numerical data were expressed as mean with standard deviation or median with range, and categorical data were expressed as percentages. Statistical significance of factors was assessed using the Pearson chi-square test or Fisher exact test. $p < 0.05$ was the threshold of significance. Statistical analysis was performed using SPSS (version 29.0, SPSS software, Munich, Germany).

Results

Among the 30 patients with DNM, 22 (73.3%) were male, and 8 (26.7%) were female, with a median age of 53 years (IQR: 47.75 to 62.50). Of these, 7 patients were diagnosed in the Emergency Department (ED), while the remaining 23 were diagnosed after hospital admission, resulting in a missed diagnosis rate in the ED of 76.7%. The median time from symptom onset to diagnosis was 6.5 days (IQR: 4.00 to 10.50), and 6 patients had diabetes mellitus as a comorbidity. (Table 1)

The most common clinical signs at presentation included neck swelling and pain (43.3%), maxillofacial swelling and pain (43.3%), fever (43.3%), sore throat (40%), and dysphagia (36.7%). Less frequent symptoms were dyspnea (23.3%), coughing up sputum (23.3%), chest pain (23.3%), shortness of breath (20%), chest tightness (10%), difficulty opening the mouth (6.7%), and hoarseness (6.7%). Most patients presented with a combination of these symptoms, contributing to the complexity of diagnosis. (Table 1)

In the ED, one patient required tracheal intubation, one underwent deep venous catheterization, and eight received oxygen via nasal cannula. Upon hospital admission, patients were distributed across thoracic surgery (12), ENT (10), intensive care (4), general medicine (2), and respiratory medicine (2). A total of 29 patients (96.7%) underwent surgical treatment, and 23 patients (76.7%) required intensive care with invasive respiratory support during hospitalization. The median duration of intensive care treatment was 8 days (IQR: 3.00 to 10.00), while the median hospital stay for all patients was 21 days (IQR: 7.75 to 34.50). (Table 1)

A retrospective review of the NEWS2 at the time of ED admission showed that 3 patients had a score of 0, 18 had scores between 1 and 4 (with 2 patients scoring above 3), 3 had scores between 5 and 6, and 5 had scores of 7 or higher. This resulted in 19 patients being classified into the low-risk group, 6 into the intermediate-risk group, and 5 into the high-risk group. (Table 2)

Table 2 Table of NEWS2 of DNM patients

Description	Low-risk group, *n* = 19(%)	Middle-risk group, *n* = 6(%)	High-risk group, *n* = 5(%)	Total, *n* = 30(%)
Emergency	7(36.8)	3(50.0)	4(80.0)	14(46.6)
Sepsis	6(31.6)	4(66.7)	3(60.0)	13(43.3)
Death	5(26.3)	2(33.3)	4(80.0)	11(36.7)

During hospitalization, 14 patients (46.7%) experienced life-threatening events, including 2 cardiac arrests. Of these, 7 events (36.8%) occurred in the low-risk group, 3 (50.0%) in the intermediate-risk group, and 4 (80.0%) in the high-risk group. Secondary sepsis developed in 13 patients (43.3%), including 6 cases (31.6%) in the low-risk group, 4 (66.7%) in the intermediate-risk group, and 3 (60.0%) in the high-risk group. Overall, 11 patients died, while the remaining 19 had a favorable prognosis. Among the death, 5 were from the low-risk group, 2 from the intermediate-risk group, and 4 from the high-risk group. (Table 2)

Discussion

Descending necrotizing mediastinitis, while rare, remains the most severe type of mediastinal infection [6]. Despite advances in antibiotic therapy that have decreased the overall incidence of DNM [7], the current study's mortality rate of 36.7% highlights the ongoing challenges in managing this condition. While previous research has primarily focused on refining surgical techniques [8–10], optimal treatment protocols for DNM are still debated [11, 12]. However, insufficient attention has been paid to early prevention and awareness, and the high rates of misdiagnosis and delayed diagnosis remain concerning. Early identification and intervention are critical to improving patient survival, as noted by Estrera et al., who emphasized that a high level of clinical suspicion in patients with persistent oropharyngeal or deep neck infections is essential for early DNM diagnosis [5]. Our study's retrospective analysis of the NEWS2 in 30 patients with DNM demonstrated that patients classified into intermediate- and high-risk groups had a significantly higher likelihood of in-hospital adverse events and death compared to those in the low-risk group. These findings suggest that the NEWS2 can serve as an effective early warning tool for predicting adverse outcomes and poor prognosis in DNM patients.

In this cohort of 30 patients, the ED underdiagnosed DNM in 76.7% of cases. This high rate of misdiagnosis may be attributed to the rarity of DNM and the nonspecific nature of its early clinical features, which often resemble common upper respiratory tract infections [13]. Symptoms such as neck and maxillofacial swelling, pain, fever, sore throat, and dysphagia are common but not unique to DNM, complicating early identification. Additionally, many emergency physicians lack familiarity with DNM, which increases the difficulty of early diagnosis and timely treatment. While CT imaging remains a critical diagnostic tool for DNM [14], its effectiveness can be limited in the early stages of the disease. Initially, imaging changes may be confined to the neck and jaw, while mediastinal changes often appear later. This delayed presentation may explain the low rate of confirmed diagnoses in the ED.

Regarding respiratory support, only one patient required tracheal intubation, one required deep venous catheterization, and eight patients received nasal cannula oxygenation in the ED. In contrast, 23 patients (76.7%) required invasive respiratory support during hospitalization, with 9 undergoing tracheostomy. Moreover, 14 patients (46.7%) experienced life-threatening events during their stay, including two cardiac arrests. Given that over three-quarters of patients required postoperative respiratory support and nearly half experienced sudden deterioration, the low rate of invasive respiratory support in the ED (4%) raises concerns. As maxillofacial and cervical infections often lead to respiratory distress, we recommend that patients with suspected DNM receive early tracheal intubation and be promptly transferred to intensive care units for continuous monitoring and sepsis management. Timely referral to institutions with appropriate critical care capabilities may prevent further complications and improve patient outcomes.

Additionally, diabetes appears to significantly impact DNM prognosis. In this study, 6 patients had comorbid diabetes, and 4 of these patients died, resulting in a mortality rate of 66.7% among diabetic patients. This aligns with previous findings by Hirai S et al., which identified diabetes as a predisposing factor for DNM [15]. In our cohort, the mortality rate for diabetic patients was approximately double that of the overall patient population, further underscoring the importance of vigilant monitoring and early intervention in this high-risk group. Studies have shown that hyperglycemia can impair neutrophil extracellular traps (NETs) formation, leading to compromised immune defense mechanisms. This diabetes-induced immune dysfunction reduces the body's ability to combat infections [16]. However, given that this was a single-center study with a small sample size, it is premature to conclude that diabetes is an independent risk factor for mortality in DNM patients. Further research involving larger cohorts is necessary to draw more definitive conclusions.

The NEWS2 is widely used in clinical practice and has significant value in assessing changes in the emergency room. Corfield et al. further confirmed that it is positively correlated with the extent of disease deterioration [17]. The review of patients' conditions upon emergency admission revealed that the incidence of emergency

events, sepsis, and death was significantly higher in the low-risk group compared to the intermediate-risk and high-risk groups. (Table 2)

This suggests that the NEWS2 may play a crucial role in early warning of adverse events and poor outcomes during hospitalization. The score could also assist emergency physicians in identifying high-risk DNM patients, ensuring that they are seen by appropriately skilled clinical staff at the right time. Therefore, the authors recommend continuous monitoring of the NEWS2 in patients with a high suspicion of DNM, and early intervention and treatment based on the score to reduce mortality from DNM. Based on our research data, this score can serve as an effective tool for assessing the progression of DNM patients and guiding clinical treatment. However, larger sample sizes are needed to confirm its statistical significance.

Conclusion

In conclusion, DNM is a rare but serious condition, often lacking specificity in clinical presentation or laboratory findings, making it prone to misdiagnosis or delayed diagnosis by emergency physicians. Diabet.s appears to increase the risk of adverse events and mortality, possibly due to immune deficiencies related to hyperglycemia. The NEWS2 may have a positive role in predicting disease progression and prognosis in DNM patients. We recommend dynamically using it in cases where there is a high suspicion of the patient's condition. This approach could help in early detection of deterioration and guide timely interventions, potentially improving patient outcomes. However, the small sample size and single-center nature of this study are limitations, and further large-scale studies are necessary to confirm the findings and enhance the statistical significance of the NEWS2 predictive power.

Study limitations

Firstly, as a single-center retrospective study with a small sample size ($n = 30$), there may be insufficient statistical power. Secondly, the data were collected from emergency inpatients at a single medical center, which could introduce two types of selection bias: (1) the exclusion of outpatient mild cases, resulting in a study cohort that is skewed toward moderate to severe cases; and (2) patients who were transferred to other hospitals but not included in the study. Future research should expand the sample size through prospective multi-center studies, especially those that include patients of varying severity levels and regionally transferred cases, in order to enhance the generalizability of the conclusions.

Abbreviations

DNM	Descending necrotizing mediastinitis
NEWS2	National Early Warning Score 2
ED	Emergency Department

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Author contributions
TXZ conceived the study and designed the method and supervised the completion of the data collection. All authors worked in the data collection. AY Y provided the funding source. FFD drafted the manuscript, and all authors contributed substantially to its revision. TXZ and FFD takes responsibility for the paper as a whole.

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Data availability
Data is provided within the manuscript or supplementary information files.

Declarations

Ethics approval and consent to participate
The study was approved by the Biomedical Research Ethics Committee of the Affiliated Hospital of Zunyi Medical University (KLL-2024-488). And obtained the patient's verbal informed consent.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Conclusion
DNM is the most severe form of mediastinal infection, and its early clinical manifestations are often nonspecific, making it prone to misdiagnosis and missed diagnosis by emergency physicians. Early NEWS2 can be considered as a helpful method in evaluating the progression and prognosis of patients with DNM.

Clinical trial number
Not applicable.

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