

## INVESTIGATION OF SEVERE PROGNOSTIC FACTORS IN PATIENTS WITH DEEP NECK INFECTIONS AT CHO RAY HOSPITAL

Ngo Van Cong<sup>1</sup>, Vo Nguyen Thuy Uyen<sup>2</sup>

<sup>1</sup> Cho Ray Hospital

<sup>2</sup> University of Medicine and Pharmacy, Ho Chi Minh City

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### Abstract

**Background:** Deep neck infection (DNI) is a severe otorhinolaryngological emergency with a high risk of rapid spread to critical structures, leading to complications and high mortality rates.

**Objective:** This study aims to identify severe prognostic factors in patients with DNI at Cho Ray Hospital (2023–2024).

**Methods:** A cross-sectional study was conducted with multivariate regression analysis to identify factors associated with severe progression and mortality. Data were collected from 151 patients medical records.

**Results:** Prognostic factors for ICU admission included dyspnea, NLR  $\geq 20$ , necrotizing fasciitis, pneumonia, and mediastinitis. Prognostic factors for mortality included dyspnea, chest pain, NLR  $\geq 20$ , necrotizing fasciitis, and septic shock.

**Conclusion:** Identifying severe prognostic factors can help clinicians recognize high-risk patients early for timely intervention, reducing complications and mortality.

**Keywords:** Deep neck infection, DNI

### 1. Introduction

Deep neck infection (DNI) is one of the most common emergencies in otorhinolaryngology. Infections originating from deep neck spaces can rapidly spread to adjacent spaces and critical structures such as the carotid sheath and mediastinum.

Without timely and appropriate evaluation and treatment, patients may quickly deteriorate, leading to severe complications and death [1-4].

Severe DNI refers to cases with complications posing a high risk of mortality, such as pneumonia requiring

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<sup>1</sup> First author: Ngo Van Cong; Phone number: 0918890806; Email: [congtmh@gmail.com](mailto:congtmh@gmail.com)

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invasive mechanical ventilation or septic shock [5-7]. Given the rapid progression of DNI when left untreated, early identification of patients at risk of severe outcomes is crucial. Recognizing early signs of severe progression or high mortality risk allows clinicians to develop timely and appropriate treatment plans.

Developing a prognostic tool to predict severe complications and mortality in DNI patients is essential. Prognostic factors help clinicians identify high-risk patients early, enabling timely interventions to reduce complications and mortality rates while optimizing healthcare resources. In Vietnam, the incidence of DNI remains relatively high, especially at Cho Ray Hospital, where numerous DNI cases are frequently admitted and treated. However, there is a lack of research on early prognostic models, such as scoring systems or predictive models for severe progression and mortality in DNI patients.

Therefore, we conducted this study titled "Investigation of Severe Prognostic Factors in Patients with Deep Neck Infections at Cho Ray Hospital from 2023 to 2024."

## **2. Subjects and methods**

### **2.1 Study Population**

All patients diagnosed and treated for deep neck infections (DNI) at Cho Ray Hospital from August 2023 to October 2024.

### **2.2 Inclusion Criteria**

Patients who visited and received

treatment at Cho Ray Hospital between August 2023 and October 2024 were included in the study if they met the following criteria:

- Aged 18 years or older
- Diagnosed with deep neck infection (cervical abscess, necrotizing fasciitis of the neck) based on:
  - Clinical signs: neck swelling, pain, fever, dysphagia, etc.
  - Laboratory findings: elevated white blood cell count, pus aspiration, characteristic imaging features.
  - Surgical findings (if applicable): presence of pus, necrosis of cervical fascia, etc.

### **2.3 Exclusion Criteria**

- DNI secondary to trauma or abscess-forming malignancies.
- Cases with insufficient study data, such as missing blood biochemistry or imaging results.
- Patients with uncontrolled underlying medical conditions.
- Patients who declined to participate in the study.

### **2.4 Study Design**

A cross-sectional study with statistical analysis.

## **3. Results**

The study included 151 cases.

Demographic Characteristics

- Gender distribution: Male patients accounted for 57% of the study population.
- Mean age: 56.9 years.
- Nutritional status: 6.6% of patients were malnourished (BMI <18.5), while 43% were overweight (BMI >23).
- Comorbidities: 71.5% of cases had at least one underlying disease, with diabetes mellitus being the most common (50.3%).

**Table 1. Demographic Characteristics of the Study Population**

Characteristics	N = 151
Gender	
Male	<b>86 (57%)</b>
Female	65 (43%)
Age (Median)	<b>56,9 ± 17,5</b>
BMI	
<18,5 (kg/m <sup>2</sup> )	10 (6,6%)
18,5 – 22,9 (kg/m <sup>2</sup> )	<b>76 (50,4%)</b>
≥ 23 (kg/m <sup>2</sup> )	65 (43%)
Comorbidities	108 (71,5%)
Diabetes	<b>76 (50,3%)</b>
Cardiovascular Disease	68 (45%)
Time of Onset (Median)	7 (TPV: 5 - 9,5) days
Length of Hospital Stay (Median)	8 (TPV: 6-12) days
<10 days	58,9%
≥10 days	<b>41,1%</b>

**Complications :**

- 93 cases (61.6%) had no complications.
- The most common complications were:
  - Pneumonia: 40 cases (26.5%)
  - Airway obstruction: 38 cases (25.2%)
  - Mediastinitis/mediastinal abscess: 28 cases (18.5%)

**Table 2. Complications of Deep Neck Infections**

Complications	Total (n=151)	Ratio (%)
Airway obstruction	38	25,2
Pneumonia	40	26,5
Mediastinitis/mediastinal abscess	28	18,5
Sepsis	8	5,3
Septic shock	22	14,6
Pleural effusion	14	9,3
Vascular complications	6	4,0
Pleural empyema	2	1,3
Uncomplicated	93	61,6

**Severe DNI Cases and Mortality Rate**

- The proportion of severe DNI cases (requiring mechanical ventilation, septic shock, or ICU admission) was 19.9%.
- Mortality rate: 14.6% (22/151 patients). Most fatalities were associated with septic shock and respiratory failure, often in patients with necrotizing fasciitis.

**Prognostic Value of NLR (Neutrophil-to-Lymphocyte Ratio)**

**Table 3. Relationship Between NLR, Length of Hospital Stay, Necrotizing Fasciitis, and Septic Shock**

(\*Mann–Whitney U test applied\*)

Characteristics	NLR	p
Length of stay		
<10 days	11,1 (6,7 – 11,8)	p = 0,103 <sup>a</sup>
≥10 days	11,8 (9,2 – 24,8)	
Type DNI		
Abscess	10,9 (7,5 – 20,1)	p = 0,024 <sup>a</sup>
NECROTIZIN G FASCIITIS	17,9 (11,1 – 26,8)	
Septic shock		
uninfected	11 (7,0 – 21,7)	p = 0,043 <sup>a</sup>
infected	16,2 (10,8 – 24,0)	

a: Mann – Whitney U test

#### Types of Deep Neck Infections

- Cervical abscesses were the most common, accounting for 83.4% (126/151 cases).

- Necrotizing fasciitis was observed in 16.6% (25/151 cases).

#### Prognostic Factors for Severe Progression

**Table 4. Severe Prognostic Factors in DNI Identified by Multivariate Logistic Regression Analysis**

Factor	Unit	Coefficient $\beta$	OR	KTC 95%	p*
Shortness of breath	Có/không	1,901	6,67	0,76 – 3,04	0,001
NLR $\geq$ 20	Có/không	0,373	1,45	0,71 – 1,46	0,048
NECROTIZING FASCIITIS	Có/không	0,661	1,94	0,58 – 1,91	0,03
Pneumonia	Có/không	0,902	2,46	0,56 – 2,36	0,02
Mediastinitis	Có/không	1,528	4,61	0,08 – 2,97	0,004

#### Multivariate Logistic Regression Analysis

#### 4. Discussion

In our study population, the median age was 59 years (IQR: 44–70 years), with the youngest being 18 years and the oldest 95 years. Patients over 30 years accounted for 90.1% (136/151 cases), while those over 60 years made up 49.7% (75/151 cases), a higher proportion than the 41.2% (106/257 cases) reported by Truong Minh Thinh in a study of 257 patients with deep neck infections [4]. This finding aligns with studies by Brittany R. Barber et al., which reported 50% of cases in patients over 55 years [8], and Huan T. T., where 52.4% of cases were in patients over 50 years [9]. The higher prevalence in older patients may be attributed to the increased presence of comorbidities such as diabetes mellitus, hypertension, and chronic kidney disease, which compromise the immune system and increase susceptibility to infections compared to younger individuals.

Overweight and obesity were observed in 43.0% of cases, similar to findings by Truong Minh Thinh (44.0%) and Le Thi Hoai Anh (46.3%) [4,10]. Several studies have linked obesity to an increased risk of comorbidities, including diabetes, which predisposes individuals to infections [11-13]. Additionally, malnutrition (BMI  $<18.5$  kg/m<sup>2</sup>) was noted in 6.6% of patients, consistent with Le Thi Hoai Anh's study (7.4%) [10] but lower than Park M. J.'s findings (12.6%) [13]. Malnutrition is a common cause of secondary immunodeficiency, increasing infection risk.

Comorbidities were present in 71.5% (108/151) of cases, with 31.8% of patients having at least one underlying disease. Diabetes mellitus was the most common comorbidity, affecting 50.6% of patients, similar to the prevalence reported by Truong Minh Thinh (51.0%) [4] and Dang Dieu

Linh (60.5%) [14]. Other conditions, including rheumatic diseases, chronic liver and kidney diseases, HIV, hematologic disorders, and chronic respiratory diseases, were also identified, all of which weaken immune function and increase the risk of severe infections.

The overall complication rate was 38.4% (58/151 cases), with pneumonia being the most common (26.5%). There were notable variations in complication rates and types across different studies, which may be attributed to epidemiological differences, socioeconomic factors, and variations in diagnostic and treatment approaches in different countries. However, despite these variations, the most frequently reported complications remain airway obstruction, pneumonia, and mediastinitis. Airway obstruction was highly prevalent in studies such as Suehara's (33.8%) [7] and Boscolo-Rizzo's (8.5%) [18]. Mediastinitis, a severe complication, was reported in 2.6% of cases in Mejzlik's study [19] and 10.5% in Suehara's study [7]. These discrepancies may reflect differences in early diagnosis rates, healthcare quality, access to surgical intervention, and antibiotic treatment approaches.

The proportion of severe DNI cases (requiring mechanical ventilation, septic shock management, or ICU admission) in our study was 19.9% (30/151 cases), primarily due to progressive septic shock and respiratory failure requiring mechanical ventilation. This finding is consistent with Suehara A. B.'s study, which reported an

ICU admission rate of 20.9% [7]. Similarly, Boscolo-Rizzo's study of 365 patients found an ICU admission rate of 18.4%, primarily due to severe complications such as airway obstruction and mediastinitis, aligning with our findings [18].

The mortality rate in our study was 14.6% (22/151 cases), with most deaths attributed to septic shock and respiratory failure, frequently observed in patients with necrotizing fasciitis. This is comparable to the 13.36% mortality rate reported in Gunaratne's meta-analysis of 1,235 cases [5]. In contrast, a study by Ncogoza in Rwanda on patients with necrotizing fasciitis-related DNI reported a higher mortality rate of 21.2% [6]. The high mortality rate in our study underscores the severity of DNI cases and highlights the critical need for early prognostic assessment and aggressive treatment to mitigate life-threatening complications such as septic shock and ultimately reduce mortality risk.

#### Multivariate Logistic Regression Analysis

Multivariate analysis is a critical statistical tool for identifying independent factors contributing to disease severity and outcomes [20]. This approach allows for the detection of clinically significant variables associated with severe prognosis, facilitating more effective diagnostic and treatment planning for DNI [21].

Our multivariate analysis identified five independent prognostic factors associated with severe disease progression:

- Dyspnea at admission (OR = 6.67; 95% CI: 0.76–3.04; p = 0.001)

- NLR  $\geq 20$  (OR = 1.45; 95% CI: 0.71–1.46; p = 0.048)

- Necrotizing fasciitis (OR = 1.94; 95% CI: 0.58–1.91; p = 0.03)

- Pneumonia (OR = 2.46; 95% CI: 0.56–2.36; p = 0.02)

- Mediastinitis (OR = 4.61; 95% CI: 0.08–2.97; p = 0.004)

In Boscolo-Rizzo's 2012 study, diabetes mellitus (OR = 5.43; p < 0.001) and multispace neck infections (OR = 4.92; p < 0.001) were also identified as independent prognostic factors for severe complications, including septic shock and pneumonia requiring mechanical ventilation [18] .

Similarly, Brittany R. Barber's 2014 study reported significant prognostic factors for severe complications, including respiratory failure at admission (p = 0.03), smoking history (p = 0.02), and diabetes (p = 0.02). These factors were associated with an increased likelihood of ICU admission and prolonged hospitalization [8] .

Differences in prognostic risk factors across global studies may be due to the complex interplay of clinical variables, which significantly influence disease progression and severity. Additionally, variability in diagnostic and therapeutic strategies for DNI further contributes to the differing outcomes reported across studies.

### Conclusion

Deep neck infections (DNI) remain a critical emergency in otorhinolaryngology,

with high complication rates, severe progression, and significant mortality risks. Key prognostic factors for ICU admission and mortality include dyspnea, chest pain, NLR >20, necrotizing fasciitis, pneumonia, mediastinitis, and septic shock.

This study provides valuable insights to help clinicians identify high-risk patients early, enabling timely intervention to reduce complications and mortality. However, due to the limited sample size, further validation studies with larger populations are necessary. Future prospective, multicenter studies are recommended to enhance the predictive accuracy of prognostic models for DNI.

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