

Clinical and laboratory characteristics and factors associated with mortality in meningococcal infection at Military Hospital 175, Vietnam: a retrospective case series

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Research Article

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Abstract

Background

Meningococcal infection is a rapidly progressive and potentially fatal disease, characterized by meningitis and/or septicemia. Data from Vietnam remain limited. This study aimed to describe the clinical and laboratory characteristics and explore factors associated with in-hospital mortality in patients with meningococcal infection.

Methods

We conducted a retrospective case series of patients diagnosed with meningococcal infection treated at Military Hospital 175, Vietnam, between January 2016 and December 2025. Clinical features, laboratory findings, cerebrospinal fluid (CSF) parameters, and treatment data were collected from medical records. Patients were divided into survivors and non-survivors. Continuous variables were expressed as median (IQR) and compared using the Mann–Whitney U test; categorical variables were compared using Fisher's exact test.

Results

Seventeen patients were included, of whom three (17.6%) died. Non-survivors had lower Glasgow Coma Scale scores (median 5 vs. 10, $p = 0.04$) and more frequent shock (100% vs. 21.4%, $p = 0.02$) and respiratory failure requiring mechanical ventilation (100% vs. 28.6%, $p = 0.03$). Laboratory findings suggested more severe systemic illness, including thrombocytopenia, elevated lactate, metabolic acidosis, coagulopathy, and renal dysfunction. The CSF-to-blood glucose ratio was significantly lower in non-survivors (0.11 vs. 0.32, $p = 0.03$).

Conclusions

Mortality in meningococcal infection is associated with markers of severe systemic disease, including impaired consciousness, shock, metabolic derangement, coagulopathy, and organ dysfunction. The CSF-to-blood glucose ratio may provide additional prognostic information. Early recognition of these features may help guide timely intensive management.

INTRODUCTION

Meningococcal infection, caused by *Neisseria meningitidis*, remains a serious public health concern worldwide due to its rapid and high mortality. The disease commonly presents as meningitis and/or septicemia and may lead to fulminant sepsis and multi-organ failure [2, 9]. Despite advances in antimicrobial therapy and intensive care, case fatality rates remain substantial, particularly in severe forms of the disease [8].

The clinical course of meningococcal infection is highly variable, ranging from mild illness to rapidly fatal disease within hours. Early identification of patients at risk of poor outcomes is therefore critical. Previous studies have identified several prognostic factors, including impaired consciousness, shock, and laboratory markers of organ dysfunction [1, 6]. However, the relative contribution of these factors may vary depending on the population and healthcare setting.

In Vietnam, published data remain limited. The disease often occurs sporadically, with scattered cases rather than large outbreaks, which contributes to the scarcity of comprehensive clinical studies. However, certain populations may be at higher risk. In military settings, close-contact living conditions facilitate transmission of *N. meningitidis* and may increase the risk of invasive disease [3].

Military Hospital 175 is a major tertiary referral center for the southern region of the Vietnam People's Army. Patients with suspected or confirmed meningococcal infection from military units in this region are typically referred to this hospital for diagnosis and management. As a result, the hospital serves as a key center for the care of meningococcal disease within the southern military healthcare system, providing a valuable opportunity to characterize clinical features and outcomes in this population.

Therefore, this study aimed to describe the clinical and laboratory characteristics of patients with meningococcal infection treated at Military Hospital 175 and explore factors associated with in-hospital mortality.

METHODS

Study design and setting

This retrospective case series was conducted at Military Hospital 175, Ho Chi Minh City, Vietnam.

Study period

Patients were enrolled between January 2016 and December 2025.

Study population

Inclusion criteria

- Compatible clinical presentation
- Microbiological confirmation of *Neisseria meningitidis* (culture and/or polymerase chain reaction [PCR])
- Availability of sufficient clinical and laboratory data

Exclusion criteria

- Incomplete medical records

- Unconfirmed diagnosis

Data collection

Clinical, laboratory, cerebrospinal fluid (CSF), and treatment data were extracted from medical records.

Definitions

- Shock: circulatory failure requiring vasopressors
 - Respiratory failure: need for invasive mechanical ventilation
 - Severe neurological impairment: GCS < 8
 - Outcome: survivors and non-survivors

Statistical analysis

Continuous variables were expressed as median (interquartile range, IQR) and compared using the Mann–Whitney U test. Categorical variables were compared using Fisher’s exact test. A two-sided p-value < 0.05 was considered statistically significant.

Given the number of variables tested and the small sample size, there is a potential risk of type I error due to multiple comparisons.

Variables with substantial missing data (e.g., D-dimer > 40% missing) were excluded from comparative analysis.

RESULTS

1. Patient characteristics and clinical presentation

A total of 17 patients with confirmed meningococcal infection were included in this study, of whom 3 (17.6%) died during hospitalization.

Patients who did not survive tended to present later than survivors, although this difference did not reach statistical significance. In contrast, the severity of neurological impairment on admission differed markedly between the two groups. The median Glasgow Coma Scale (GCS) score was significantly lower in non-survivors compared with survivors (5 [3–7] vs. 10 [10–14], $p = 0.04$). Notably, all non-survivors (100%) had severe neurological impairment (GCS < 8), whereas this was observed in only 21.4% of survivors ($p = 0.01$).

Severe systemic manifestations were significantly more frequent among non-survivors. Shock was present in all fatal cases (100%) compared with 21.4% of survivors ($p = 0.02$). Similarly, respiratory failure

requiring mechanical ventilation occurred in all non-survivors, whereas it was observed in 28.6% of survivors (p = 0.03).

Other clinical features, including vomiting, neck stiffness, petechial rash, and upper respiratory symptoms, did not differ significantly between the two groups.

Clinical characteristics are summarized in Table 1:

Table 1 Clinical characteristics				
Variable	Total (n = 17)	Survivors (n = 14)	Non-survivors (n = 3)	p-value
Day of illness at admission	2 (2–4)	2 (2–3)	4 (2–7)	0.18
Glasgow Coma Scale	10 (8–14)	10 (10–14)	5 (3–7)	0.04
GCS < 8	6 (35.3%)	3 (21.4%)	3 (100%)	0.01
Vomiting	10 (58.8%)	8 (57.1%)	2 (66.7%)	1.00
Neck stiffness	13 (76.5%)	12 (85.7%)	1 (33.3%)	0.09
Petechiae	7 (41.2%)	5 (35.7%)	2 (66.7%)	0.30
Shock	6 (35.3%)	3 (21.4%)	3 (100%)	0.02
Respiratory failure	7 (41.2%)	4 (28.6%)	3 (100%)	0.03

Data are presented as median (interquartile range, IQR) or number (%).

Comparisons between groups were performed using the Mann–Whitney U test for continuous variables and Fisher’s exact test for categorical variables.

Two-sided p-values < 0.05 were considered statistically significant.

GCS: Glasgow Coma Scale.

2. Laboratory findings

2.1 Hematological and biochemical parameters

Laboratory findings reflected more severe systemic involvement in non-survivors.

Platelet counts were significantly lower in non-survivors compared with survivors (60 [23–87] G/L vs. 155 [86–182] G/L, p = 0.028), indicating pronounced thrombocytopenia.

Markers of tissue hypoperfusion and metabolic derangement showed clear differences. Lactate levels were markedly elevated in non-survivors (23 [10–24] mmol/L vs. 4.1 [2.7–11.3] mmol/L, p = 0.01), while

arterial pH was significantly lower (7.11 [7.10–7.15] vs. 7.36 [7.30–7.45], $p = 0.02$), reflecting severe metabolic acidosis.

Coagulation abnormalities were also more pronounced in fatal cases. Prothrombin levels were significantly reduced in non-survivors (22% [21–55] vs. 56% [42–65], $p = 0.03$), suggesting impaired coagulation function.

Evidence of organ dysfunction was observed. Serum creatinine was significantly higher in non-survivors (236.7 [85–281] $\mu\text{mol/L}$ vs. 83 [75–93] $\mu\text{mol/L}$, $p = 0.041$), indicating renal impairment. Serum urea levels were also higher in non-survivors (11.1 [10.56–11.67] mmol/L vs. 5.5 [4.7–6.6] mmol/L , $p = 0.04$); however, this result should be interpreted with caution due to the limited number of observations in the non-survivor group ($n = 2$).

Aspartate aminotransferase (AST) levels were significantly elevated in non-survivors (106.8 [36–556] U/L vs. 33.5 [18–57] U/L, $p = 0.047$), whereas alanine aminotransferase (ALT) and total bilirubin showed a trend toward higher values without reaching statistical significance.

D-dimer levels appeared markedly elevated in non-survivors; however, statistical comparison was not performed due to limited available data.

Blood laboratory results are shown in Table 2:

Table 2
Blood laboratory findings

Variable	Survivors	Non-survivors	p-value
White blood cells (G/L)	22.4 (14–32)	48 (26–65)	0.09
Platelets (G/L)	155 (86–182)	60 (23–87)	0.028
AST (U/L)	33.5 (18–57)	106.8 (36–556)	0.047
ALT (U/L)	28 (22–59.6)	66 (45.5–588)	0.11
Bilirubin ($\mu\text{mol/L}$)	13.65 (10.9–24)	24 (3.91–39)	0.09
Creatinine ($\mu\text{mol/L}$)	83 (75–93)	236.7 (85–281)	0.041
Urea (mmol/L)	5.5 (4.7–6.6), $n = 13$	11.1 (10.56–11.67), $n = 2$	0.04*
Lactate (mmol/L)	4.1 (2.7–11.3)	23 (10–24)	0.01
pH	7.36 (7.30–7.45)	7.11 (7.10–7.15)	0.02
Prothrombin (%)	56 (42–65)	22 (21–55)	0.03
D-dimer	3707 (1115–24056), $n = 9$	17200 (16796–17604), $n = 2$	—
Fibrinogen (g/L)	3.93 (3.84–5.22)	2.30 (2.28–5.09)	0.07

Data are presented as median (interquartile range, IQR) or number (%).

Comparisons were performed using the Mann–Whitney U test.

Variables with missing data are indicated by the number of available observations (n).

D-dimer values were not statistically compared due to limited sample size.

*Results for urea should be interpreted with caution due to the small number of observations in the non-survivor group.

Two-sided p-values < 0.05 were considered statistically significant.

AST: aspartate aminotransferase; ALT: alanine aminotransferase.

3. Cerebrospinal fluid findings

Cerebrospinal fluid (CSF) data were available for 14 patients.

Among CSF parameters, the CSF-to-blood glucose ratio was significantly lower in non-survivors (0.11 [0.06–0.12]) compared with survivors (0.32 [0.27–0.39], p = 0.03).

Other CSF indices, including protein concentration, absolute glucose level, lactate, white blood cell count, and neutrophil percentage, did not differ significantly between the two groups, although CSF lactate tended to be higher in non-survivors.

Cerebrospinal fluid findings are presented in Table 3:

Table 3 Cerebrospinal fluid findings			
Variable	Survivors (n = 11)	Non-survivors (n = 3)	p-value
Protein (g/L)	0.73 (0.61–0.84)	0.64 (0.44–0.84)	0.62
Glucose (mmol/L)	2.5 (1.75–3.2)	0.4 (0.4–1.11)	0.07
Lactate	10.3 (6.8–13.5)	17.7 (10–19.6)	0.08
CSF/blood glucose ratio	0.32 (0.27–0.39)	0.11 (0.06–0.12)	0.03
WBC (/mm ³)	9300 (1617–14400)	1317 (640–4677)	0.18
Neutrophils (%)	80 (65–85)	95 (57–95)	0.28

Data are presented as median (interquartile range, IQR).

Comparisons were performed using the Mann–Whitney U test.

Cerebrospinal fluid data were available for 14 patients.

Two-sided p-values < 0.05 were considered statistically significant.

CSF: cerebrospinal fluid; WBC: white blood cell count.

4. Treatment and outcomes

All non-survivors required invasive mechanical ventilation, compared with 28.6% of survivors (p = 0.03).

The duration of hospitalization differed significantly between groups. Survivors had a longer hospital stay (20 [14–25] days), whereas non-survivors experienced early mortality, reflected by a markedly shorter duration of treatment (1 [1–10] days, p = 0.001).

The use of continuous renal replacement therapy (CRRT) and therapeutic plasma exchange (TPE) did not differ significantly between groups.

Time to defervescence was available in 14 patients and showed no significant difference.

Treatment and outcomes are summarized in Table 4:

Table 4 Treatment and outcomes			
Variable	Survivors (n = 14)	Non-survivors (n = 3)	p-value
Mechanical ventilation	4 (28.6%)	3 (100%)	0.03
CRRT	2 (14.3%)	1 (33.3%)	0.45
TPE	2 (14.3%)	0 (0%)	1.00
Length of stay (days)	20 (14–25)	1 (1–10)	0.001
Defervescence (days, n = 14)	2 (1–3)	—	—

Data are presented as median (interquartile range, IQR) or number (%).

Comparisons were performed using the Mann–Whitney U test or Fisher’s exact test, as appropriate.

Defervescence time was available in 14 patients.

Two-sided p-values < 0.05 were considered statistically significant.

CRRT: continuous renal replacement therapy; TPE: therapeutic plasma exchange.

DISCUSSION

1. Principal findings

In this study, several clinical and laboratory factors were found to be associated with in-hospital mortality in patients with meningococcal infection. These findings consistently reflect a pattern of severe systemic disease characterized by impaired consciousness, circulatory collapse, metabolic derangement, coagulopathy, and multi-organ dysfunction.

2. Clinical severity and early predictors

The association between impaired consciousness and mortality observed in this study is consistent with previous reports. A low GCS score reflects both central nervous system involvement and overall disease severity, and has been identified as an important prognostic factor in meningococcal infection [1].

Similarly, the presence of shock and respiratory failure in all non-survivors highlights the fulminant nature of invasive meningococcal disease. These findings are in line with earlier studies demonstrating that rapid progression to circulatory collapse and organ failure is a major determinant of mortality [6, 9].

3. Metabolic derangement and tissue hypoperfusion

Lactate elevation and metabolic acidosis were among the most prominent differences between survivors and non-survivors. These findings reflect profound tissue hypoperfusion and impaired oxygen utilization, which are well-established predictors of poor outcomes in septic conditions.

The degree of hyperlactatemia observed in fatal cases in this cohort is comparable to that reported in severe meningococcal sepsis and supports its role as a marker of disease severity [1, 8].

4. Coagulation abnormalities and pathophysiology

Coagulopathy was a key feature in non-survivors, as indicated by reduced prothrombin levels and markedly elevated D-dimer levels (descriptively observed). These findings are consistent with the pathophysiology of meningococcal sepsis, in which endothelial injury and inflammatory activation lead to disseminated intravascular coagulation (DIC) [7, 9].

Although D-dimer levels appeared substantially higher in non-survivors, this observation should be interpreted cautiously due to missing data and the small number of available measurements.

5. Organ dysfunction

Renal dysfunction was significantly associated with mortality, as reflected by elevated creatinine and urea levels. Acute kidney injury is a common complication in septic shock and contributes to poor outcomes.

Liver involvement was also observed, particularly through elevated AST levels, which may reflect hypoxic liver injury (“shock liver”). However, ALT and bilirubin did not differ significantly, suggesting that hepatic dysfunction may be less consistent or occur later in the disease course.

6. Cerebrospinal fluid findings

Among CSF parameters, only the CSF-to-blood glucose ratio was significantly associated with mortality. This ratio reflects increased metabolic activity within the CSF and impaired glucose transport across the blood–brain barrier.

Previous studies have reported inconsistent associations between CSF parameters and outcomes [1, 6]. The present findings suggest that the CSF-to-blood glucose ratio may provide additional prognostic information beyond conventional CSF indices.

7. Context and comparison with existing literature

Overall, our findings are consistent with previous studies describing the clinical spectrum and prognostic factors of meningococcal disease [1, 6, 8]. The observed associations with shock, metabolic derangement, and organ dysfunction align with global data [8].

In Vietnam, meningococcal infection is relatively uncommon and often occurs sporadically, resulting in limited published data. However, military settings may represent a higher-risk environment due to close-contact living conditions [3]. Military Hospital 175 serves as a major referral center for the southern military healthcare system, where patients with suspected or confirmed meningococcal infection are commonly managed. This context provides a valuable opportunity to characterize the disease in a specific high-risk population.

8. Limitations

The small sample size, particularly the limited number of fatal cases, reduces statistical power. Given the number of variables tested, there is a potential risk of type I error due to multiple comparisons. Missing data affected some analyses; for example, D-dimer was excluded from comparative analysis due to substantial missing data (> 40%), and urea values in non-survivors were available in only two patients and should be interpreted with extreme caution. Findings from this single-center military population may not be generalizable to broader civilian settings.

Conclusions

Mortality in meningococcal infection is associated with markers of severe systemic disease, including impaired consciousness, shock, metabolic acidosis, coagulopathy, and organ dysfunction. The CSF-to-

blood glucose ratio may provide additional prognostic value. Early recognition of these features is essential for identifying high-risk patients and guiding timely intervention.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki.

The study was approved by the Institutional Review Board of Military Hospital 175, Vietnam.

Informed consent was waived due to the retrospective nature of the study.

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