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Prognostic value of neutrophil-to-lymphocyte ratio in patients with sepsis at the emergency department

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Abstract

Introduction: Sepsis represents a diagnostic and therapeutic emergency, responsible for significant morbidity and mortality. The prognostic value of the neutrophil-to-lymphocyte ratio has been studied in different pathologies, particularly in septic patients. This study aimed to evaluate the prognostic value of the neutrophil-to-lymphocyte ratio in septic patients admitted to the emergency department.

Methods: This was a prospective, observational, descriptive, and analytical study. We included all patients with sepsis admitted to the emergency department. We collected epidemiological, clinical, biological, therapeutic, and evolutionary data and calculated the neutrophil-to-lymphocyte ratio at admission. To determine the prognostic value of the neutrophil-to-lymphocyte ratio, we established and analyzed the ROC curve.

Results: We included 106 patients. The average age was 65 ± 15 years. The sex ratio (F/M) was 1.4. The main medical histories were diabetes (52.8%), hypertension (46.2%), coronary artery disease (16%), and chronic renal failure (12.3%). The main reasons for consultation were general deterioration (84.9%), digestive signs (43.4%), and respiratory signs (43.4%). The most frequently selected infectious entry points were respiratory (37.7%), urinary (30.2%), and cutaneous (20.8%). Septic shock was diagnosed on admission in 26 patients (24.5%). The median neutrophil-to-lymphocyte ratio at admission was 9 [5-23]. After 72 hours of hospitalization, the intra-hospital mortality rate was 25.5%. In univariate analysis, the neutrophil-to-lymphocyte ratio appeared as a predictive factor for early intra-hospital mortality (p=0,003, OR= 2.96, CI95% = [3.23-14.97]). The area under the ROC curve of the neutrophil-to-lymphocyte ratio according to mortality was 0.75 (p<0.001, CI95%=0.66-0.85). A neutrophil-to-lymphocyte ratio cut-off of 6 was predictive of early mortality (p=0.003, Se=92%, Sp=68%, PPV=42%, NPV=97%) and outcomes in septic shock (p=0.04).

Conclusion: The neutrophil-to-lymphocyte ratio has prognostic value in septic patients, mainly for the identification of patients at high risk of poor outcomes.

Keywords: Biomarkers, Lymphocytes, Mortality, Neutrophils, Prognosis, Sepsis, Septic shock

Introduction

Sepsis represents a major public health problem, as it can lead to organ failure and rapidly become life-threatening. The identification and management of patients with sepsis remain a daily challenge for frontline physicians in emergency departments. In 2021, 166 million cases of sepsis and 21.4 million sepsis-related deaths from all causes were recorded worldwide, accounting for 31.5% of total global deaths (1).

Several biomarkers have been studied to assess the prognosis of patients with sepsis. According to Paskaline et al. (2), the persistence of elevated biological marker levels in septic patients admitted to intensive care units is correlated with an increased risk of clinical deterioration and mortality. In 2001, Zahorec et al. (3) reported a correlation between neutrophil and lymphocyte counts and prognosis in critically ill patients admitted to intensive care units.

Since the 1990s, the neutrophil-to-lymphocyte ratio (NLR) has attracted increasing scientific interest due to its pathophysiological relevance, wide availability, and low cost. This parameter has been explored in numerous studies across various medical specialties and has demonstrated its usefulness as both a diagnostic and prognostic marker. Thus, NLR represents a novel approach derived from the complete blood count that, according to some studies, can predict mortality in septic patients.

To date, few Tunisian studies have focused on the prognostic performance of the neutrophil-to-lymphocyte ratio in patients with sepsis.

This study aimed to evaluate the prognostic value of the neutrophil-to-lymphocyte ratio in patients admitted to the emergency department with sepsis.

Methods

This was a prospective, observational, descriptive, and analytical study conducted in the emergency department over 10 months (April 2022–January 2023).

Inclusion criteria: Patients aged 18 years and older, admitted to the emergency department for the management of sepsis, defined by a Sequential Organ Failure Assessment (SOFA) score ≥ 2.

Non-inclusion criteria: Patients younger than 18 years, and patients who did not meet the diagnostic criteria for sepsis or septic shock.

Exclusion criteria: Patients transferred to another healthcare facility for further management.

This study was based on the definitions of sepsis and septic shock established by the Third International Consensus (Sepsis-3) published in 2016 (4).

The primary outcome of the study was **early mortality**, defined as death occurring within the first 72 hours of management.

Study protocol: After enrollment, all included patients were admitted to the emergency room. Following initial stabilization, blood samples were collected at admission, including a complete blood count.

The management protocol for septic patients in the emergency department was based on the Surviving Sepsis Campaign guidelines (2021 update) (5). All patients received fluid resuscitation, with or without vasoactive agents, and empirical antibiotic therapy. Adjunctive treatments were administered according to the patient's clinical presentation and subsequent outcomes (low-dose systemic corticosteroids, oxygen therapy, etc.).

The neutrophil-to-lymphocyte ratio (NLR) was calculated from the baseline biological assessment at admission for all included patients.

For statistical analysis and to assess the prognostic value of the neutrophil-to-lymphocyte ratio, patients were divided into two groups: **Survivors and non-survivors**

Absolute and relative frequencies (percentages) were calculated for qualitative variables. Quantitative variables were expressed as means, medians, standard deviations, and ranges (minimum and maximum values).

Comparisons of proportions were performed using the Pearson chi-square test or Fisher's exact test when appropriate. Comparisons of means between independent groups were performed using Student's T test or the non-parametric Mann–Whitney test when required. A *p*-value < 0.05 was considered statistically significant.

To determine the prognostic value of the NLR, a receiver operating characteristic (ROC) curve was constructed. After confirming that the area under the ROC curve was greater than 0.5, the optimal cut-off value for the NLR was determined as the point corresponding to the best sensitivity–specificity balance.

Oral informed consent was obtained from all patients to allow the use of their medical data and follow-up of their clinical outcomes.

Results

A total of 106 patients were included in the study. The mean age was 65 ± 15 years, and the male-to-female ratio was 1.4. The main clinical presenting features at admission were general deterioration (84.9%), abdominal signs (43.4%), respiratory signs (43.4%), fever (34%), and urinary signs (20%)

The main sources of infection were respiratory (37.7%), urinary (30.2%), abdominal (18.9%), and cutaneous (20.8%). The mean SOFA score was 4 ± 2, with values ranging from 2 to 11.

Septic shock was diagnosed at admission in 26 patients (24.5%). An additional nine patients (8.5%) developed septic shock during their stay in the emergency department.

The median neutrophil-to-lymphocyte ratio (NLR) at admission was 9 [5–23]. Early in-hospital mortality was 25.5%.

The epidemiological, clinical, and biological characteristics of patients according to mortality status are presented in Table 1.

The area under the ROC curve (AUC) for the NLR in predicting mortality was 0.75 (95% CI: 0.66–0.85; p < 0.001), with a cut-off value of 6 (sensitivity 92%, specificity 68%, positive predictive value 42%, negative predictive value 97%) (Figure 1).

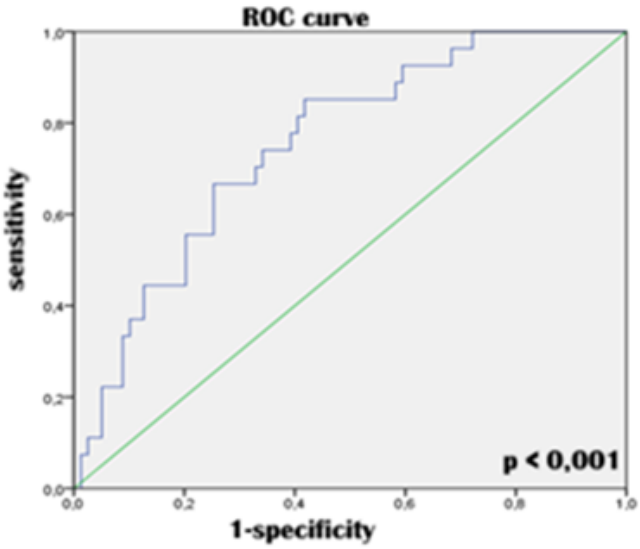

Figure 1: ROC curve of the neutrophil-to-lymphocyte ratio according to early mortality

The NLR was identified as a significant predictor of early in-hospital mortality (OR 2.96, 95% CI: 3.23–14.97; p = 0.003) in univariate analysis.

The clinical course of included patients according to the NLR cut-off is shown in Table 2.

Discussion

The neutrophil-to-lymphocyte ratio (NLR), calculated as the simple ratio of neutrophil to lymphocyte counts measured in peripheral blood, is readily available in the emergency setting.

Table 1: Epidemiological characteristics of patients with sepsis

Parameters	All patients n =106	Non-survivors n =27	survivors n=79	p-value
Age, years; mean± SD	65 ± 15	68 ± 10	64 ± 16	**0.03**
Female, n (%)	62 (59)	14 (52)	48 (61)	NS
Medical, n (%)	56 (53)	15 (53)	41 (52)	NS
Diabetes	49 (46)	9 (33)	40 (51)	NS
Hypertension	13 (12)	4 (15)	9 (12)	NS
Chronic	12 (11)	4 (15)	8 (10)	NS
kidney	17 (16)	10 (37)	7 (9)	**0.002**
disease	10 (9)	6 (22)	4 (5)	**0.02**
Heart failure				
Coronary heart disease				
Stroke				
Clinical parameters				
SpO2, %	90 ± 8	88 ± 10	92 ± 8	**0.02**
Respiratory rate, cycles/min	22 ± 5	25 ± 7	21 ± 5	**0.02**
Systolic blood pressure, mmHg	112 ± 28	108 ± 31	113 ± 27	NS
Diastolic blood pressure, mmHg	61 ± 17	57 ± 18	60± 17	NS
Heart rate, beats/min	97 ± 28	101 ± 27	87 ± 29	**0.04**
Glasgow Coma Scale	13 ± 2	12 ± 3	14 ± 2	**<0.001**
Septic shock, n (%)	26 (25)	14 (52)	2 (3)	**<0.016**
Sepsis scores at admission	4 ± 2	6 ± 2	4 ± 1	**0.001**
SOFA	1 [1-2]	2 [1-3]	1 [1-2]	**0.04**
qSOFA				
Laboratory data				
White blood cells (10^9 /L)	12830 [8515-19400]	12830 [8515-19400]	12540 [8500-16300]	NS
Neutrophils (10^9 /L)	10585 [6315-16520]	12928 [6315-10585]	9800 [6200-13880]	NS
Lymphocytes (10^9/L)	1000 [677-1692]	1000 [677-1692]	1570 [700-1880]	**0.009**
NLR	**9 [5-23]**	**20 [10-28]**	**8 [5-17]**	**0.004**

SpO2: peripheral oxygen saturation, *SOFA*: sequential organ failure assessment, q*SOFA*: quick sequential organ failure assessment, *NLR*: neutrophil to lymphocyte ratio

It is a biomarker that integrates two major components of the immune system: innate immunity, primarily mediated by neutrophils, and adaptive immunity, mediated by lymphocytes (6).

Table 2: Clinical outcomes of included patients according to the NLR cut-off.

Outcomes	NLR ≥ 6 n=74	NLR < 6 n=32	p-value
Development of septic shock, n (%)	26 (35)	5 (15,6)	**0.04**
Use of mechanical ventilation, n (%)	8 (11)	6 (19)	NS
Length of stay in the ED, hours	94 ± 10	84 ± 8	NS
Early mortality, n (%)	20 (27)	5 (16)	**0.003**

NLR: neutrophil to lymphocyte ratio, NS: non-significant, ED: emergency department

Indeed, neutrophils are the first immune cells mobilized by the host in response to invading pathogens. Their activity relies on several mechanisms, including chemotaxis, phagocytosis, the release of reactive oxygen species (ROS), exocytosis of granular proteins, and cytokine secretion. Regarding lymphocytes, the decrease in their circulating levels is explained by their marginalization and redistribution to the lymphatic system.

Thus, the NLR reflects the balance between neutrophil and lymphocyte levels in the body and serves as an indicator of systemic inflammation. This biomarker, which is easily accessible, non-invasive, and cost-effective, has attracted considerable interest in scientific literature. The NLR has been extensively studied in various fields, including surgery (as a predictor of postoperative complications and mortality), oncology (for monitoring patients undergoing treatment), and cardiology (to predict prognosis in patients with acute coronary syndromes, heart failure, and infective endocarditis) (7–10).

In this study, we investigated the prognostic value of the NLR in patients with sepsis. According to previous studies, an elevated NLR has been reported as an early indicator of complications and short-term mortality, thereby enabling the

identification of septic patients at higher risk of adverse outcomes and facilitating the optimization of initial therapeutic management.

Compared with the biological results of our study, Riché et al. (11) reported mean white blood cell and neutrophil counts that were very similar to ours, whereas lymphocyte counts and NLR values were lower. The median lymphocyte count and NLR were 770 [510–1030] cells/µL and 2.5 [6.5–21.2], respectively. Regarding the NLR, our study found a lower mean value than that reported by Liu X. et al. (12), who observed a mean NLR of 17.85 [9.61–28.19].

In an observational cohort study conducted in the emergency department of a university hospital in Turkey and including 373 patients with sepsis, Nazire B.A. et al. (13) demonstrated that the area under the receiver operating characteristic (ROC) curve of the NLR for predicting mortality was 0.61 (p = 0.01), with an optimal NLR cut-off value of 11.9, yielding a sensitivity of 37% and a specificity of 81.8%. In the same study, the NLR emerged as an independent predictor of mortality (OR = 1.63, p = 0.01, 95% CI= [1.11–2.41]).

In a 2020 meta-analysis including 14 studies (11,564 patients with sepsis), Huang Z. et al. (14) demonstrated that NLR values were significantly higher in non-survivors than in survivors (p=0.002). Furthermore, they showed that an elevated NLR was significantly associated with poor prognosis in patients with sepsis. Similarly, a 2024 meta-analysis including 10,811 patients reported a significant association between elevated NLR values and unfavorable clinical outcomes (15).

However, in contrast to these findings, other studies did not observe a significant association between NLR and in-hospital mortality among patients with sepsis (16,17).

The areas under the ROC curves of the NLR, reported in different comparable studies, according to mortality outcomes, are summarized in Table 3.

The results of our study demonstrate that the neutrophil-to-lymphocyte ratio (NLR) shows a satisfactory prognostic performance for predicting early mortality in patients with sepsis, with an area under the ROC curve (AUC) of 0.75.

Table 3: Performance of the NLR in predicting early mortality in patients with sepsis

Studies	AUC	p-value	Cut-off	Sensitivity	Specificity
X. Liu et al. (12)	0.69	<0.001	23.8	81	54
Riché et al. (11)	0.70	<0.001	5.3	78	55
Mandal and al.(18)	0.77	<0.001	10	98	93
Stoian and al *(19)*	0.76	<0.001	17.1	53	93
Our study	0.75	<0.001	6	92	68

AUC: Area under the curve

This finding is consistent with previously published studies and supports the potential utility of NLR as a prognostic biomarker in this clinical setting. Indeed, the AUC values reported in the literature range from 0.69 to 0.77 (11,12,18,19). These results indicate a moderate to good discriminative ability of NLR for mortality prediction in sepsis, although some variability exists across studies.

Considerable heterogeneity is also observed in the optimal NLR cut-off values, which range from 5.3 to 23.8. This variability may be explained by differences in study design, patient populations, sepsis definitions, timing of blood sampling, and outcome measures.

Nevertheless, the overall performance of NLR observed in our study, combined with its rapid availability, low cost, and non-invasive nature, supports its role as a valuable adjunct in the early prognostic assessment of patients with sepsis. Future research should focus on integrating NLR into multimodal prognostic models alongside clinical scores and other biomarkers to enhance its predictive accuracy and clinical applicability.

Conclusion

The neutrophil-to-lymphocyte ratio was associated with early mortality in patients with sepsis admitted to the emergency department. It may therefore help optimize initial clinical management to prevent unfavorable outcomes.

However, further evaluation of the optimal cut-off and target values of this ratio, as well as its dynamic changes during hospitalization, is necessary to enable more effective use of this biological parameter in routine clinical practice.

Conflict of interest: All the authors declare no conflicts of interest related to this study.

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Intentional Chloralose Poisoning in a Low-Resource Setting: Epidemiology and Short-Term Outcomes from a Tunisian Emergency Department

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Abstract

Background: Intentional self-poisoning with chloralose remains an issue in low- and middle-income countries, where α-chloralose rodenticides are easily accessible. Data from frontline emergency departments are limited.

Objective: To describe the epidemiological, clinical, management, and short-term outcome profile of intentional chloralose poisoning in a polyvalent emergency department.

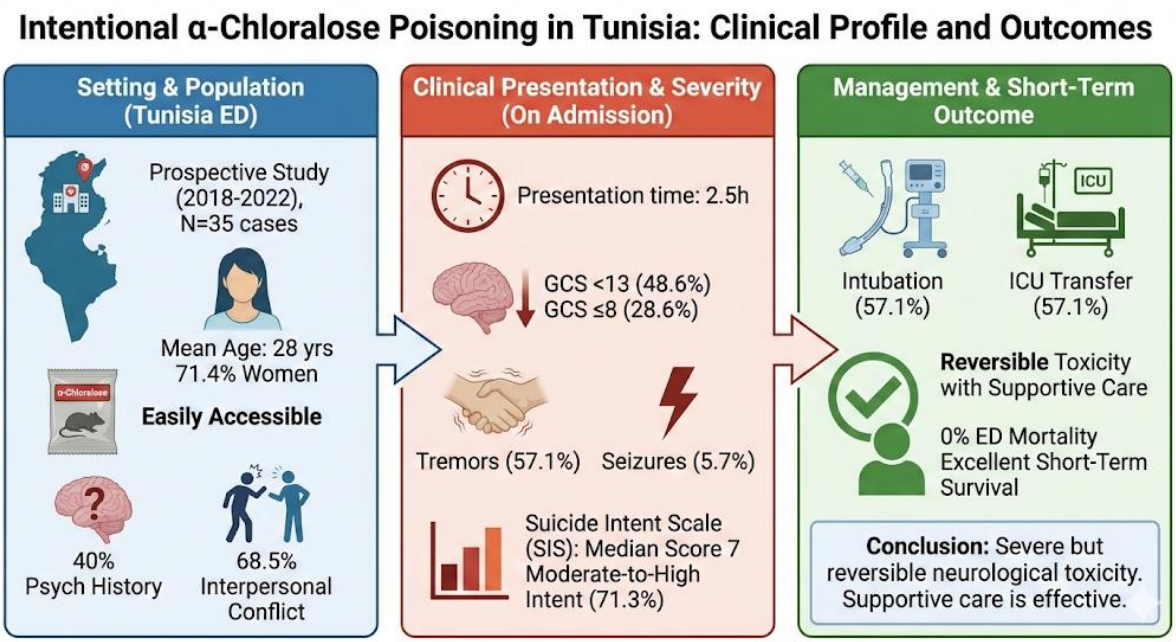
Methods: We conducted a prospective descriptive study in the emergency department of a regional hospital in Tunisia from January 2018 to December 2022. All patients aged ≥18 years with intentional ingestion of an α-chloralose, confirmed by history and/or toxicological analysis, were included. Sociodemographic data, clinical features, investigations, treatment, disposition, and outcomes were collected, and suicidal intent was assessed using the Suicide Intent Scale (SIS).

Results: Inclusion of 35 patients, among 1812 poisoning cases over the study period. The mean age was 28 ± 11 years, and 71.4% were women. Forty percent had a psychiatric history, and interpersonal conflict was the most frequent precipitating factor (68.5%). The median time to presentation was 2.5 hours. On admission, 48.6% had a Glasgow Coma Scale score <13, and 28.6% had a score ≤8; tremors and seizures occurred in 57.1% and 5.7% of patients, respectively. Orotracheal intubation was required in 57.1% of cases, 57,1% were transferred to intensive care, and no deaths occurred during emergency department stay. The median SIS score was 7 (range 0–22), with 71.3% of patients exhibiting moderate-to-high suicidal intent.

Conclusion: Intentional chloralose poisoning in this setting predominantly affects young women with psychiatric vulnerability and presents with severe but reversible neurological toxicity, frequently requiring organ support but associated with excellent short-term survival under supportive care.

Keywords: Acute poisoning, ICU admission, Clinical Predictors, Toxicological Predictors, Scoring Systems, Biomarkers, Poisoning, Outcomes

Graphical abstract



Introduction

Acute poisoning is a pathological condition of the organism resulting from exposure to a toxic substance that is exogenous to the body. It is a dynamic process that is often of short duration but can rapidly deteriorate, leading to life-threatening complications, justifying the need for a standardized and adapted emergency management approach (1).

Intentional acute poisoning has become a major public health challenge, with an increasing incidence, particularly among young females. According to statistics from the World Health Organization (WHO), more than 800,000 people die by suicide every year worldwide (1).

Currently, drugs, mainly psychotropic agents, are the most frequently used substances in intentional self-poisoning, especially among people treated with those molecules (2). The use of pesticides, and particularly chloralose, remains common in rural areas and in low and middle-income countries (3).

Chloralose is a chlorinated organic compound first described by Arthur Heffter in 1889. It was initially used in the medical field as a general anesthetic and subsequently as a hypnotic and sedative; however, these indications were later abandoned because of its adverse effects. At present, chloralose is used mainly for its rodenticidal and avicidal properties.

Although chloralose poisoning has declined in most developed countries, it remains relatively frequent in developing countries, including Tunisia. In Tunisia, particularly in the intensive care unit of the Emergency Medical Assistance Center of Tunis, which is the main toxicology reference center for the Greater Tunis area, the incidence of acute chloralose poisoning is considerable, with an estimated 100 hospitalizations per year and a mortality rate of 0.4% (4).

In literature, the incidence and prognosis of chloralose poisoning have been studied mainly in intensive care units or specialized toxicology centers. The present study aimed to describe the

epidemiological profile of chloralose poisoning in a polyvalent emergency department (ED).

Methods

We conducted a prospective, descriptive, single-center study in a polyvalent ED in a regional hospital in Tunisia over 5 years, from January 2018 to December 2022.
We included all patients aged 18 years or more admitted for acute intentional chloralose poisoning, defined as voluntary ingestion of an α-chloralose–containing preparation, confirmed by history and/or urine toxicological analysis. Patients who left the ED before completion of their management were excluded.

Data collection

Data were prospectively collected using a standardized form and included: sociodemographic characteristics, medical and psychiatric history, circumstances of poisoning, type of product, clinical presentation, and results of laboratory tests, electrocardiogram, arterial blood gases, and toxicological analyses. Suicidal intent was assessed using the 15-item Suicide Intent Scale (SIS), with scores categorized as low (0–3), moderate (4–10), or high (11–28). The SIS score was calculated by the physician upon admission or at discharge for comatose patients. Therapeutic management (including symptomatic treatment and organ support), ED course disposition, and in-hospital outcomes were also recorded.

Statistical analysis

Data were analyzed using SPSS version 25. Quantitative variables were described as means with standard deviations or medians with interquartile ranges, depending on their distribution (assessed by the Kolmogorov–Smirnov test). Qualitative variables were expressed as counts and percentages. A p-value <0.05 was considered statistically significant.

Ethical considerations

The study was approved by the Hospital ethics committee.

Results

During the study period, 35 patients were admitted to the ED for intentional chloralose poisoning. Figure 1 represents the flowchart of inclusion.

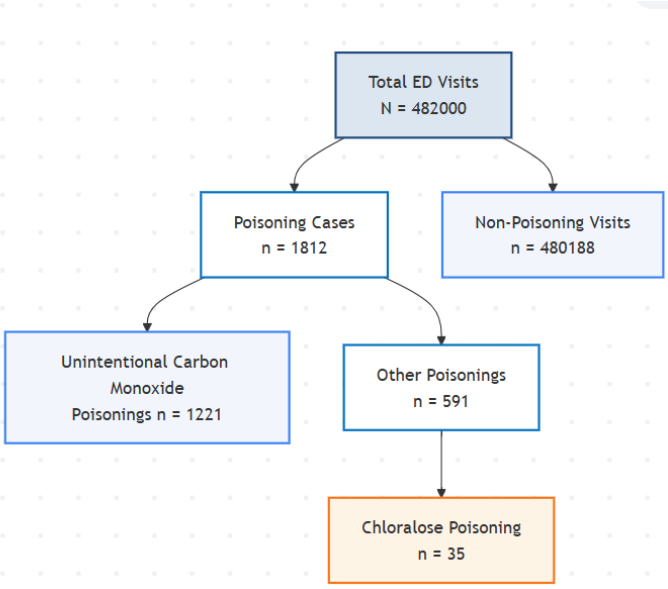


Figure 1: Flowchart of inclusion

The mean age of patients with chloralose poisoning was 28 ± 11 years (range 18–58). Women were younger than men, with a mean age of 25 ± 9 versus 34 ± 14 years. The male-to-female ratio was 0.4. Most patients were admitted from home (94.3%), with the remainder coming from the workplace or public areas. Thirty-two patients arrived by their own means three patients were transported by firefighters.

Most patients presented from their primary residence (94.3%), while the remaining 5.7% originated from an undetermined location, either an occupational setting or a public space.

For past medical history, only one patient had a history of diabetes. No other medical

comorbidities were reported. Fourteen patients had a documented psychiatric history, and seven had a prior suicide attempt.

The mean time from ingestion to ED presentation was 2.5 hours (range 1–6 hours); ten patients consulted within the first hour. The main reported precipitating factor was illustrated in Figure 2

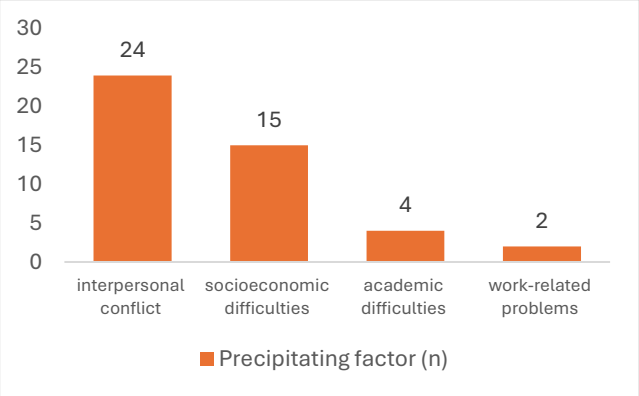


Figure 2: Precipitating factors leading to poisoning

Anamnestic data were contributory in 60% of cases, while in 40% of cases, the diagnosis was based on clinical presumption.

On admission, 18 patients (51.4%) had a Glasgow Coma Scale (GCS) score ≥13, whereas 10 patients (28.6%) had a GCS score ≤8. Tremors were observed in 20 patients (57.1%) and generalized seizures in 2 patients (5.7%). Hypersecretion was observed for 76% of patients.

The mean respiratory rate was 19 ± 3 cycles/min (range 8–28. The mean heart rate was 91 ± 20 beats/min (range 50–140). The mean systolic blood pressure was 117 ± 16 mmHg. All patients were afebrile, with a mean body temperature of 37.0 ± 0.09°C. Table 1 represents physiological abnormalities at admission.

Arterial blood gas analysis was performed in 18 patients. Hypercapnia ($PaCO_2$ >42 mmHg) was found in 7 patients, and hypocapnia ($PaCO_2$ <38 mmHg), consistent with hyperventilation, in 5 patients (14.2%). Hypoxemia (PaO_2 <60 mmHg) was documented in 2 patients (5.7%).

Routine biochemical parameters were within normal ranges for blood glucose (5.2 ± 1 mmol/L), creatinine (62.9 ± 6.7 µmol/L), and serum sodium (140 ± 2.1 mmol/L). Six patients presented with hypokalemia. Prothrombin time was reduced (<50%) in one patient without any comorbidity or co-ingestion of any other toxic. Urine screening was conducted for all patients, and it was positive for chloralose.

Table 1: Physiological abnormalities at admissions

Physiological abnormalities	N
Polypnea (≥20 cycles/min)	20
Bradypnea (≤12 cycles/min)	1
Tachycardia (>100 beats/min)	9
hypotension (systolic blood pressure <90 mmHg)	1

An electrocardiogram was obtained in 32 patients (91.4%). It was normal in 22 cases (68.7%). Sinus tachycardia was observed in 7 patients (21.8%) and sinus bradycardia in 3 patients (9.3%). No atrioventricular conduction disturbances or signs of membrane-stabilizing effects were observed.

Twenty-eight patients (80%) were initially managed in the emergency room, and seven (20%) in the short-stay unit. Orotracheal intubation with mechanical ventilation was required in 20 patients (57.1%). All patients received intravenous isotonic saline, and none required vasoactive drugs.

Gastrointestinal decontamination by gastric lavage was performed in 12 patients.

Overall, 23 patients (65.7%) were transferred to the intensive care unit, and the remaining patients were managed entirely in the ED.

All patients benefit from a psychological assessment at discharge, then referred to psychiatric consultation. Two patients were subsequently referred to psychiatric ED because of high suicidal risk. No deaths related to

chloralose poisoning occurred during ED hospitalization.

The median Suicide Intent Scale (SIS) score was 7 (range 0–22). Table 2 represents the distribution of suicidal intent according to the SIS score

Table 2: Distribution of suicidal intent according to SIS score

SIS Score	n	%	ICU admission n (%)
Low (≤3)	10	28.7	6 (17.1)
Moderate (4-10)	17	48.5	9 (25.7)
High (≥11)	8	22.8	8 (22.8)

SIS=suicidal intent scale; ICU=intensive care unit

Discussion

This study was a prospective single-center study from a Tunisian ED. Intentional chloralose poisoning represented a small proportion of all poisoning cases, predominantly affected young adults, and frequently required intensive care management. Within 5 years, 35 cases were identified, corresponding to approximately 2% of all poisonings. This pattern is in line with data from North African poison centers, where chloralose intoxication is reported far more frequently than in Western Europe, particularly France, where the annual incidence is estimated at around 10 cases per year (5). The higher burden in low- and middle-income countries is likely related to the easy, poorly regulated access to α-chloralose–containing rodenticides through hardware shops, pharmacies, and large retail stores, in contrast to Europe, where distribution is tightly controlled by biocide and pesticide regulations (6).

The demographic profile of our cohort is consistent with previously published series. The mean age was 28 years, and there was a clear female predominance with a sex ratio of 0.4. A Tunisian study conducted in the national toxicology center and including 752 cases of acute chloralose poisoning reported the same marked predominance of women, with a sex ratio of 3/7 (7). Those findings mirror the broader epidemiology of intentional self-poisoning in adults, where deliberate ingestion of toxic substances, often in a suicidal context, constitutes the most common precipitating factor (2).

In our series, most poisonings occurred at home and were triggered mainly by interpersonal conflict and socioeconomic difficulties, with a higher incidence among patients already followed in psychiatry. These circumstances are like those described in other studies from developing countries, where pesticides and rodenticides, including chloralose, are among the main agents implicated in acute intentional poisonings owing to their wide availability and the lack of strict sales regulation (8).

Clinically, our results confirm the predominant neurological toxicity of chloralose. Almost half of the patients presented with impaired consciousness (GCS <13), and nearly one-third had deep coma (GCS ≤8). Tremors were observed in more than half of the cohort, and generalized seizures were documented in only 2 cases. These findings are consistent with the known pharmacodynamic profile of chloralose, which combines sedative effects with paradoxical motor hyperexcitability, leading to a spectrum of manifestations ranging from somnolence and vertigo to coma, myoclonus, hyperreflexia, and seizures (7). Respiratory and hemodynamic involvement was generally secondary to central nervous system depression, with overall good hemodynamic tolerance and rare hypotension, in agreement with previous descriptions of chloralose intoxication (5,9). Although chloralose is known to inhibit thermoregulatory centers and can induce toxic hypothermia, no clinically significant hypothermia was observed in our cohort, possibly due to early presentation, environmental conditions, or early supportive measures.

Management in our study was predominantly supportive and non-specific, in line with current recommendations (9). Gastrointestinal decontamination by gastric lavage was performed in approximately one-third of patients who presented early after ingestion, to reduce gastrointestinal absorption of the toxicant(10). When gastric lavage was indicated, airway protection via orotracheal intubation was ensured in patients with altered consciousness to prevent aspiration. More than half of the patients required orotracheal intubation and mechanical ventilation, reflecting the severity of neurological impairment. Conversely, no patient required vasoactive drugs, which further supports the notion that chloralose toxicity in this context is mainly neurotoxic rather than cardiocirculatory (11).

The short-term outcome was favorable in all cases, with no deaths recorded during ED management. This is consistent with previous reports indicating that, in the absence of delayed consultation or major complications, chloralose-induced coma is usually rapidly reversible within 24 to 48 hours under appropriate supportive care. A Tunisian series of 752 cases reported a low mortality rate of 0.4%, primarily related to prolonged anoxic brain injury in patients managed late (7), underscoring the importance of early medical intervention.

Beyond the somatic prognosis, our data also highlight the psychiatric burden associated with intentional chloralose poisoning. The median Suicide Intent Scale score was 7, with a substantial proportion of patients classified as having moderate to high suicidal intent.

All patients in our cohort benefit from psychological assessment and are then referred to either psychiatric consultation or emergency. Among patients referred to psychiatric consultation, the adherence to the consultation was unknown. This discrepancy suggests that the psychiatric dimension of care may still be under-recognized and emphasizes the need for systematic psychiatric assessment and structured follow-up in all cases of intentional poisoning, regardless of the apparent somatic severity.

This study has several limitations, especially the loss of the long-term psychiatric trajectory of patients. The monocentric nature and relatively small sample size also limit the generalizability of the results...

From a public health perspective, intentional chloralose poisoning illustrates the broader issue of access to highly toxic substances in vulnerable populations. Even when medical prognosis is usually favorable, the impact on the health system is considerable: frequent intensive care admissions, the need for mechanical ventilation in young, otherwise healthy patients, and subsequent psychiatric care all contribute to increased costs and resource use. These findings argue in favor of stricter regulation of the distribution and sale of α-chloralose–containing products, combined with prevention strategies targeting psychosocial risk factors and improved coordination between emergency medicine, psychiatry, and community-based mental health services.

Conclusion

Intentional chloralose poisoning predominantly affects young adults, especially women, and is characterized by severe but reversible neurological impairment, often requiring airway protection and ICU admission, but with no short-term mortality. These findings highlight the importance of early supportive management combined with systematic psychiatric assessment to address underlying suicidal intent. Strict regulations of chloralose-containing products and targeted preventive strategies may help reduce the prevalence of this poison in the vulnerable population.

Competing interests: The authors declare no competing interests

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Heat Stroke in the Prehospital Setting: Clinical Characteristics, Management, and Factors Associated with Mortality in Central-Eastern Tunisia

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Abstract

Background: Heat stroke is a life-threatening medical emergency characterized by a rapid elevation of core body temperature (>40 °C) associated with neurological and cardiovascular disturbances, potentially leading to multiple organ dysfunction syndrome.

Objective: To describe the clinical, therapeutic, and prognostic characteristics of heat stroke in the prehospital setting and to identify factors associated with mortality.

Methods: A descriptive cross-sectional study was conducted by Emergency Medical Service EMS 03 in central-eastern Tunisia (Mahdia, Monastir, Sousse, and Kairouan) over three months (June–August 2023). Twenty-seven adult patients presenting with non-exertional heat stroke were included. Data were collected using a standardized form and analyzed using SPSS version 25.0. Descriptive and univariate analyses were performed to identify factors associated with mortality.

Results: The mean age was 75 ± 17.5 years, with a female predominance (55.6%). Most patients had comorbidities (85.2%). Hyperthermia and neurological impairment were constant findings; 51.9% of patients were comatose. Multiorgan involvement included acute kidney injury (33.3%), rhabdomyolysis (14.8%), metabolic acidosis (14.8%), and coagulation disorders (18.5%). Prehospital management included physical cooling (92.6%), pharmacological cooling (70.3%), oral hydration (48.1%), intravenous fluid resuscitation (85.1%), oxygen therapy (48.1%), and mechanical ventilation (22.2%). Mortality was 33.3%. Univariate analysis identified the following predictors of mortality: core temperature, confusion, coma, visceral involvement, hemodynamic instability, acute kidney injury, metabolic acidosis, coagulation disorders, rhabdomyolysis, use of mechanical ventilation, vasoactive drugs, and oral hydration. The type of cooling method was not significantly associated with the outcome.

Conclusion: Heat stroke remains a severe condition with high mortality. Early identification of high-risk patients and prompt prehospital intervention are essential to improve outcomes. Despite rapid management, multiorgan failure remains a major contributor to mortality, highlighting the need for further studies to optimize therapeutic strategies.

Keywords: Heat Stroke, Prehospital Care, Management, Mortality

Introduction

Heat stroke is a life-threatening medical emergency (1). Clinically, it is defined by the association of a rapid rise in core body temperature above 40 °C with neurological disturbances (delirium, seizures, or coma) and cardiovascular dysfunction (2.3). An alternative definition based on pathophysiology considers heat stroke as a form of hyperthermia associated with a systemic inflammatory response leading to multiple organ dysfunction syndrome, primarily encephalopathy (2). Despite improvements in cooling techniques and therapeutic management, the risk of progression to multi-organ failure and mortality remains high (2).

The objectives of this study were to describe the clinical, therapeutic, and prognostic characteristics of 27 cases of heat stroke managed in the prehospital setting and to identify predictors of mortality through univariate analysis.

Methods

This was a descriptive cross-sectional study conducted by EMS 03 in central-eastern Tunisia (four governorates: Mahdia, Monastir, Sousse, and Kairouan) over three months (June–August 2023). The study population included victims of heat stroke managed by EMS 03 teams during the summer heat wave.

Inclusion criteria: Patients aged 18 years or older who were managed for heat stroke (2) occurring at rest.

Exclusion criteria: Patients younger than 18 years and those presenting with exertional heat stroke.

Data Collection and Statistical Analysis: Data were collected using a specific form completed by EMS teams, including epidemiological, clinical, therapeutic, and prognostic information.

Statistical analysis was performed using SPSS version 25.0.

Continuous variables were expressed as mean ± standard deviation with minimum and maximum values; qualitative variables as frequencies and percentages.

Univariate analysis: Univariate analysis was performed to compare deceased and surviving patients. The chi-square test was used for comparisons.

Results

We enrolled 27 patients. Most patients were female (15/27; 56%), with a sex ratio of 1.27. The mean age was 75 years (range: 27–97 years). Most calls to EMS 03 originated from Sousse (55%), followed by Monastir (26%), Kairouan (11%), and Mahdia (7%) (Table 1).

Table 1: Distribution of patients according to the Mobile Emergency Medical Service (MEMS) unit involved

MEMS unit	Value
MEMS Hached Sousse	8 (30)
MEMS Sahloul Sousse	7 (26)
MEMS Monastir	7 (26)
MEMS Kairouan	3 (11)
MEMS Mahdia	1 (4)
MEMS Jem	1 (4)
Total	**27 (100)**

Most patients had a history of comorbidities (86%). Core temperature was elevated in all patients, with a mean of 40.6 ± 1.6 °C (range: 38.5–43 °C) (Table 2).

Neurological disorders were present in most cases (89%). Fourteen patients (52%) were comatose, with a mean Glasgow Coma Scale score of 9 ± 4.2. Cardiovascular disturbances were observed in 81% of cases, with arterial hypotension (systolic blood pressure ≤ 90 mmHg) in 6 patients (22%). Signs of dehydration were noted in 44% of cases. Respiratory distress was observed in more than half of the patients (55%).

From a biological standpoint, rhabdomyolysis was identified in 4 cases (14.8%), acute kidney injury in 9 cases (33%), metabolic acidosis in 4 cases (15%), and coagulation disorders in 5 cases (18%).

Table 2: Clinical symptoms at admission

Clinical parameter	n
Confusion	17 (63)
Headache	13 (48)
Fatigue	13 (48)
Coma	10 (37)
Dizziness	10 (37)
Dehydration	12 (44)
Dry, erythematous skin	12 (44)
Thirst	5 (18)
Syncope	6 (22)
Nausea and vomiting	3 (11)
Muscle cramps	3 (11)
Seizures	0 (0)

Regarding therapeutic management, 25 patients (93%) received physical cooling, and 19 patients (70%) had pharmacological cooling. Oral hydration was administered in 13 cases (48%), and 23 patients (85%) received intravenous infusion of cooled fluids. Three patients (11%) required vasoactive drugs. Oxygen therapy was provided to 13 patients (48.1%), with mechanical ventilation required in 6 cases (22%).

In terms of outcomes, 9 of 27 patients (33%) died, while 18 patients (67%) improved. Recovery was without sequelae in 9 cases and with sequelae in 9 cases. Most sequelae were neurological (8/9). Cardiac sequelae were observed in 2 cases, renal sequelae in 2 cases, and hematological sequelae in 1 case.

According to univariate analysis, factors associated with mortality were core temperature, confusion, coma, visceral involvement, hemodynamic instability, acute kidney injury, metabolic acidosis, coagulation disorders, rhabdomyolysis, use of mechanical ventilation, vasoactive drugs, and oral hydration. No significant difference was observed with respect to cooling methods (Table 3).

Table 3: Factors Associated with Mortality

	Number of cases n (%)	Deceased patients n (%)	P
Clinical factors			
Core temperature			
< 40°C	10 (37)	2(7)	0.001
≥ 40°C	17 (63)	7(26)	
Confusion			
Yes	17(63)	2 (7)	0.002
No	10(37)	7(26)	
Visceral involvement			
yes	20(74)	9(33)	0.030
no	7(30)	0(0)	
Glasgow Coma Scale			
(GCS)	14 (52)	8(30)	0.001
≤8	13(48)	1(4)	
>8-15			
Hemodynamic			
instability	6(22)	6(22)	0.001
yes	21(78)	3(11)	
No			
Rhabdomyolysis			
Yes	4(15)	4(15)	0.001
No	23(85)	5(18)	
Acute kidney injury			
Yes	9(33)	5(18)	0.026
No	18(67)	4(15)	
Metabolic acidosis			
yes	4(15)	4(15)	0.001
No	23(85)	5(18)	
Coagulation disorders			
yes	5(18)	4(15)	0.014
No	22(81)	5(18)	
Therapeutic factors			
Use of mechanical			
ventilation (MV)	6(22)	5(18)	0.003
yes	21(78)	4(15)	
No			
Use of			
catechola	3(11)	3(11)	0.009
mines,	24(89)	6(22)	
Yes			
No			
Oral			
hydration			
yes	13(48)	1(4)	
No	14(52)	8(30)	0.006

Discussion

Our results confirm that heat stroke remains a severe condition associated with high mortality, particularly among elderly patients with comorbidities. The 333% mortality rate observed in our series is consistent with data reported in recent international literature. Bouchama et al., in a comprehensive 2022 Nature Reviews Disease Primers article, reported intensive-care mortality rates of 63.2% for classic heat stroke and 26.5% for exertional heat stroke, highlighting the particularly poor prognosis of the non-exertional form that predominated in our cohort (1). A multicenter study conducted in southwestern China during the 2022 heat wave similarly reported high ICU mortality among classic heat stroke patients, with initial neurological symptoms identified as an independent predictor of poor outcome (2). These findings underscore the ongoing and increasingly urgent public health relevance of heat stroke in the context of accelerating climate change.

The epidemiological profile of our patients is consistent with the recent literature. The predominance of elderly individuals with multiple comorbidities aligns with findings from Yezli et al., whose 2023 systematic review of 2,632 classic heat stroke cases confirmed that older age, cardiovascular disease, and neurological impairment are hallmarks of the non-exertional form of the disease (3). Similarly, a large Japanese nationwide cohort study demonstrated that the presence of symptomatic comorbidities, particularly cardiovascular and renal disorders, significantly worsened prognosis in heat stroke patients (4). In our study, the mean age of 75 years and the 85.2% prevalence of comorbidities reflect a highly vulnerable population, consistent with the recognized risk profile for classic heat stroke during heat waves. The female predominance observed (56%) may reflect the higher proportion of elderly women in the general population and their increased physiological vulnerability to thermal stress.

The neurological impairment observed in our series, with 52% of patients in coma (GCS $\leq$8) and 89% presenting neurological dysfunction, confirms the severity of the classic form of heat stroke. Coma and a low GCS score were among the strongest predictors of mortality in our univariate analysis (p=0.001), which is in line with recent studies. A retrospective cohort study including 203 heat stroke patients found the APACHE II score and core temperature at 30 minutes after admission to be independent risk factors for 30-day mortality, with a 28.08% mortality rate (5). A study from Eastern India in 2024 similarly identified a GCS below 9 and hemodynamic instability as significant predictors of death (6). These convergent findings reinforce the importance of systematic neurological assessment as an early triage tool in prehospital settings.

The biological abnormalities observed in our cohort reflect multiorgan dysfunction and were strongly associated with poor outcomes. Acute kidney injury (p=0.026), metabolic acidosis (p=0.001), rhabdomyolysis (p=0.001), and coagulation disorders (p=0.014) were each significantly associated with mortality. These findings are consistent with the pathophysiological framework described by Bouchama et al. (2022), who emphasized that systemic inflammation, endothelial injury, and disseminated intravascular coagulation are central mechanisms driving organ failure in heat stroke (1). Yezli et al. (2023) similarly demonstrated that laboratory markers of coagulation dysfunction and end-organ damage are among the most reliable early indicators of fatal outcome in classic heat stroke (3). The prehospital identification of these markers, while challenging, should guide the prioritization of rapid transport and aggressive resuscitation.

Regarding therapeutic management, rapid cooling remains the cornerstone of treatment. In our series, no significant difference in mortality was observed according to cooling modality (physical

versus pharmacological cooling), suggesting that early intervention and baseline clinical severity are more decisive than the specific technique employed. This observation is consistent with the conclusions of a 2020 systematic review and meta-analysis by Douma et al., which found that water immersion techniques were superior to passive cooling in terms of cooling rate but that no single modality was unequivocally associated with improved survival outcomes in classic heat stroke (7). A recent study focusing on prehospital cooling strategies in community-acquired heat stroke similarly highlighted the predominant use of evaporative cooling in field settings. Authors found that delays in cooling initiation, rather than the choice of method, were the primary determinant of prognosis (8). The 2021 ACSM Expert Consensus Statement on exertional heat illness further emphasizes that the time from collapse to starting cooling is the critical variable in determining patient outcomes (9). In our cohort, the use of mechanical ventilation (p=0.003) and vasoactive drugs (p=0.009) was significantly associated with mortality, likely reflecting the greater severity of illness in patients requiring these interventions rather than any adverse effect of the treatments themselves. Interestingly, oral hydration was inversely associated with mortality (p=0.006), which may be explained by the fact that patients safely receiving oral fluids were less severely impaired at presentation.

The limitations of this study include its relatively small sample size (n=27), its retrospective single-service design, and the absence of multivariate analysis, which precludes the identification of independent predictors of mortality. The study period (June–August 2023) covers a single heat season, and findings may not be fully generalizable across all climatic contexts. Future multicenter prospective studies with larger cohorts are needed to validate the prognostic factors identified here and to evaluate the impact of structured prehospital cooling protocols on patient outcomes in the Tunisian context.

Conclusion

Heat stroke is a major public health issue associated with high morbidity and mortality. Prehospital management by emergency medical teams is crucial to limit complications. In this EMS 03 study conducted during the 2023 heat wave in Tunisia, mortality reached 33.3%, with several clinical, biological, and therapeutic factors identified as predictors of death. Despite rapid management, mortality remains high, underscoring the need for further studies to optimize treatment strategies.

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Challenges in Implementing Evidence-Based Guidelines for Acute Pediatric Dyspnea: The Experience of a District Hospital

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Abstract

Background: Acute dyspnea is a leading cause of pediatric emergency consultations. This study aims to describe the epidemiological, clinical, and therapeutic aspects of acute dyspnea in a Tunisian district hospital.

Methods: A descriptive cross-sectional study was conducted at El Alaa District Hospital in Kairouan, Tunisia, from January to June 2025, including 52 children under 15 years presenting with acute dyspnea.

Results: The mean age was 3.8 years, with a male predominance (75%). Asthma (50.9%), bronchiolitis (29.4%), and laryngitis (19.6%) were the primary diagnoses. Management included bronchodilators for all asthma cases and nebulized adrenaline for all laryngitis cases. Regarding bronchiolitis, management showed significant variations from national guidelines: while nasopharyngeal suctioning was performed only to 66.6% of cases, corticosteroids were administered to 46.7% of infants, and antibiotic therapy was initiated in 33.3%, despite the absence of documented bacterial coinfection. Bronchodilators were also used in 40% of bronchiolitis cases. Overall, clinical improvement was achieved in 73.1% of the total cohort, while 26.9% required transfer to a specialized pediatric ward. No deaths were recorded.

Conclusion: Acute dyspnea in this setting is mainly due to asthma and bronchiolitis. While most cases are managed successfully at the district level, standardized protocols and caregiver education remain essential.

Keywords: Acute Dyspnea; Pediatric emergency care; Management

Introduction

Acute dyspnea is defined as a subjective sensation of breathing discomfort resulting from complex respiratory and cardiovascular interactions (1). In the pediatric population, it represents one of the most frequent reasons for Emergency visits, accounting for up to one-third of all consultations (2). The etiologies are diverse and age-dependent, ranging from viral bronchiolitis in infants to asthma in older children (3,4). In district hospitals, the role of the primary care physician is vital for early recognition,

stabilization, and deciding on the need for referral to a specialized department. This study aims to evaluate the management and outcomes of acute dyspnea at El Alaa District Hospital in Kairouan, Tunisia, to optimize local pediatric care.

Methods

We conducted a descriptive cross-sectional study over six months (January–June 2025) at El Alaa District Hospital, Kairouan. The study included children presenting with acute dyspnea. Inclusion criteria were: any child under 15 presenting with respiratory distress, and Exclusion criteria included: Children presenting with dyspnea of psychogenic origin, or children with incomplete medical records or whose parents or legal guardians refused to allow participation in the study. The sample size was not calculated; we gathered all children in the study period.

Data were collected by multiple investigators using an anonymous physician-administered questionnaire covering sociodemographic data, clinical severity (using the Modified Wood Score: mild [1-3], moderate [4-7], severe [8-14]), therapeutic interventions, and patient outcomes. Statistical analysis was performed using SPSS software, with quantitative variables expressed as means and qualitative variables as frequencies.

To assess the appropriateness of medical care at El Alaa District Hospital, the therapeutic management of acute pediatric dyspnea was systematically compared with established evidence-based clinical guidelines. Specifically, the management of asthma exacerbations was evaluated according to the Global Initiative for Asthma (GINA) 2023 update(4), bronchiolitis care was reviewed based on the 2020 good practice recommendations of the Tunisian Society of Pediatrics (5), and laryngitis/croup management was evaluated against international emergency department consensus and Cochrane guidelines (6,7).

Management success was defined as patients who were safely discharged home without requiring a referral to a specialized department.

Results

Socio-demographic Characteristics

We enrolled 52 children responding to the defined criteria. The study population was characterized by a marked male predominance with a sex ratio of 3.0 and a mean age of 3.8 years. The 13-month to 5-year age group was the most represented (42.3%). Although all children were up to date with the national immunization program, significant environmental risk factors were identified, notably passive exposure to smoking in nearly half of the cases (46.2%). Regarding medical history, a family history of atopy was reported in 23.1% of patients, while a personal history of asthma was known in only 11.5% of the cohort (Table 1)

Table 1: Socio-demographic Characteristics

	Variable	Findings (n, %)
Age	Mean Age; years (mean± SD)	3.8 ± 3.1
	< 12 months; n(%)	11 (21)
	13 months – 5 years; n(%)	22 (42)
	> 5 years; n (%)	19 (36)
Sex	Male; n (%)	39 (75)
	Female; n (%)	13 (25)
	Sex ratio (M/F)	3
Medical History	Personal History of Asthma; n (%)	6 (11)
	Family History of Atopy; n (%)	12 (23)
	Recurrent Bronchiolitis; n (%)	5 (10)
Vaccination Status	Up to date (National Program); n (%)	52 (100)
Environmental Exposure	Passive Smoking; n (%)	24 (46)

Clinical Presentation, Diagnostic Distribution, and Severity

Regarding the clinical presentation, cough (78.8%) and wheezing (65.4%) were the most frequent symptoms, while more than half of the patients (59.6%) exhibited chest retractions. Most children maintained an initial oxygen saturation of 94% or higher (73.1%), although severe respiratory distress with SpO2 below 90% was observed in 5.8% of cases. Asthma was the leading etiology, accounting for 50.9% of diagnoses, followed by acute bronchiolitis (29.4%) and laryngitis (19.6%). According to the Modified Wood Score, most of the children were classified as moderate (59.6%), whereas 34.6% were mild and 5.8% required intensive stabilization for severe distress. (Table 2)

Table 2: Clinical Presentation, Diagnostic Distribution, and Severity

Variable		Findings (n, %)
Main Clinical Signs	Cough; n (%)	41 (79)
	Wheezing; n (%)	34 (65)
	Chest Retractions; n (%)	31 (60)
	Fever; n (%)	15 (29)
Initial Oxygen Saturation (SpO2)	>= 94%; n (%)	38 (73)
	90 – 94 %; n (%)	11 (21)
	< 90 %; n (%)	3 (6)
Principal Diagnoses	Asthma; n (%)	26 (51)
	Acute Bronchiolitis; n (%)	15 (29)
	Acute Laryngitis; n (%)	10 (20)
Severity (Modified Wood Score)	Mild; n (%)	18 (35)
	Moderate; n (%)	31 (60)
	Severe; n (%)	3 (6)

Management

All asthma patients received bronchodilators, and systemic corticosteroids were administered to 84.6% of them, showing strong adherence to protocols for moderate-to-severe attacks. Similarly, all children diagnosed with laryngitis received nebulized adrenaline, and 40% received dexamethasone. In contrast, a notable deviation from guidelines was observed in bronchiolitis care, where 53.3% of cases received bronchodilators and 33.3% received corticosteroids. Besides, for 33.3% of these cases, antibiotics were prescribed despite the highly suspected viral etiology, while nasopharyngeal suctioning was performed in only 66.6% of cases (Figure 1).

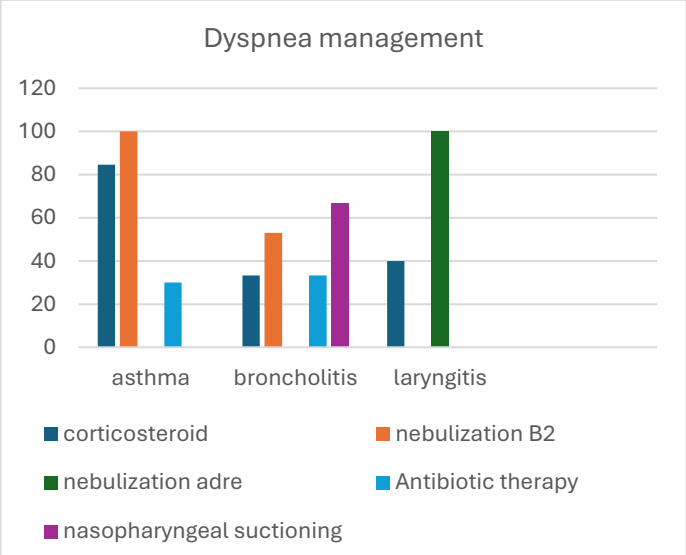

Figure 1: Dyspnea management

The alignment of the administered emergency treatments with international and national clinical guidelines, along with the specific application rates of the defined therapeutic criteria, is detailed in Table 3**.**

Overall, the clinical outcome was favorable, with a 73.1% success rate in local management, while the remaining 26.9% required transfer to a specialized pediatric unit such as the Pediatric Department at IBN Jazzar Hospital, Kairouan.

Table 3: Adherence to Management Guidelines and Rate of Application of Defined Therapeutic Criteria

Diagnosis & Clinical Presentation	Defined Therapeutic Criteria	Application Rate in Study Population (n, %)	Guideline Adherence
Bronchiolitis (n=15)	Nasopharyngeal suctioning (NPS) STP(5)	**10/15 (67)**	Appropriate use of foundational supportive clearance.
	Routine bronchodilators STP(5)	**8/15 (53)**	**Partial adherence** reflects continued reliance on beta-2 agonists in routine practice.
	Systemic / Parenteral Corticosteroids STP(5)	**5/15 (33)**	**Partial adherence**; strictly restricted to severe or refractory presentations. No oral forms used.
Asthma Exacerbation (n=26)	Short-acting beta-2 agonist bronchodilators GINA (4)	**26/26 (100)**	**Complete adherence (100%)** to first-line rescue recommendations.
	Intravenous Corticosteroids GINA (4)	**10/26 (38)**	**Appropriately** reserved for patients classified with moderate to severe distress.
Laryngitis / Croup (n=10)	Nebulized Epinephrine / Adrenaline Acute management of croup (6,7)	**10/10 (100)**	**Complete adherence (100%)** for rapid local airway stabilization.
	Systemic Corticosteroids Acute management of croup (6,7)	**4/10 (40)**	**Underutilization**; gaps identified in mild/moderate forms. Exclusively administered in severe presentations.

STP: Tunisian Society of Pediatrics

Discussion

Severity Distribution and Epidemiological Insights

Our study confirms that asthma exacerbations and acute bronchiolitis are the cornerstones of pediatric emergency activity. While most asthma cases were classified as moderate (65%), bronchiolitis cases were predominantly mild (60%).

This contrast is critical: it suggests that a significant number of infants are brought to emergency departments for symptoms that, according to international consensus, could be managed at home with supportive measures such as nasopharyngeal suctioning.

The Therapeutic Paradox: Guidelines vs. Clinical Reality

The most striking finding of this study is the persistence of non-compliant practices regarding evidence-based medicine (EBM).

Over-medicalization of Bronchiolitis: Although the 2020 guidelines from the Tunisian Society of Pediatrics (5) and international bodies (such as the AAP or HAS) emphasize the lack of benefit from

bronchodilators and corticosteroids in bronchiolitis, our study reports prescription rates of 53% and 33%, respectively. This tendency to "medicalize" a self-limiting viral pathology is a global phenomenon, mirroring observations in Senegal (8) and Spain (9), where systemic drug use remains high despite being discouraged.

Under-utilization in Croup Management: Conversely, for laryngitis (croup), we observed an under-use of corticosteroids (40%). While literature proves that a single dose of dexamethasone drastically reduces the risk of return visits and hospitalization, local practice appears to prioritize the immediate but transient effect of nebulized epinephrine.

Antibiotic Overuse and the Burden of Parental Expectations

The gap between consensus and practice is most evident in the prescription of antibiotics. Despite the predominantly viral etiology of bronchiolitis and asthma, antibiotic use remains alarmingly high in regional data (reaching 70% in similar cohorts).

Our analysis suggests that this non-compliance is largely driven by parental pressure, a decisive factor often underestimated in clinical audits:

1. Antibiotics as a "Safety Net": For many parents, an antibiotic prescription is perceived as a marker of medical competence and a guarantee of safety. Fever, even when isolated and viral in appearance, is often misinterpreted by caregivers as an absolute indication for antimicrobial therapy.
2. The Clinician's Dilemma: Faced with overcrowded waiting rooms and high parental anxiety, physicians may succumb to "complacency prescribing" to shorten consultation times or to provide psychological reassurance to the family.
3. Educational Complexity: Research by Ben Ameur et al. (10) highlights that guidelines like GINA are often perceived as too complex for rapid primary care. Explaining why an antibiotic is not necessary requires significantly more time and communication effort than simply writing a prescription.

Clinical Outcomes and Public Health Implications

Despite these deviations from established protocols, clinical outcomes remained favorable in 73% of cases, with zero mortality recorded. While this is a testament to the emergency department's stabilization efficacy, it masks a significant economic burden and a public health risk regarding antimicrobial resistance.

The stark difference in mortality compared to sub-Saharan African settings (e.g., 20.65% in Mali (11) highlights that our healthcare setting possesses the resources to compensate for management imprecision. However, true optimization of care must involve de-medicalizing mild respiratory cases and strictly adhering to pharmacological restrictive policies.

Finally, several limitations must be acknowledged when interpreting these results. First, the study is monocentric, reflecting the clinical reality of a single district hospital. Second, the sample size was relatively small and not statistically calculated prior to the study, as we included all consecutive pediatric patients presenting during the designated six-month period. Consequently, these findings should be interpreted with caution when generalizing them to other primary care settings in Tunisia.

Conclusion

This study highlights a significant gap between international guidelines and the management of acute pediatric dyspnea, particularly through the over-medicalization of bronchiolitis and the under-treatment of croup. While clinical outcomes remain favorable, therapeutic decisions are

frequently influenced by socio-professional pressures and parental expectations for prescriptions. These findings emphasize the urgent need for continuous medical education and simplified clinical algorithms to curb the irrational use of medications. By adopting "Choosing Wisely" principles, practitioners can transition toward more restrictive pharmacological management for viral etiologies. Ultimately, aligning local practices with evidence-based standards is essential to improve care quality and mitigate the risks associated with antimicrobial resistance.

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Knowledge of Medical and Paramedical Staff in the Intensive Care Unit Regarding Medical Confidentiality

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Abstract

Background: Medical confidentiality is a fundamental ethical and legal obligation that protects patients' privacy and preserves trust in healthcare. In intensive care units (ICUs), maintaining confidentiality is particularly challenging because of the severity of patients' conditions, multidisciplinary care, and frequent interactions with family members. This study aimed to assess the knowledge of medical and paramedical staff regarding medical confidentiality in an ICU setting.
Methods: A cross-sectional observational study was conducted from July 19 to 31, 2025, among healthcare professionals working in the Intensive Care Unit of Habib Bourguiba University Hospital, Sfax, Tunisia. An anonymous questionnaire consisting of sociodemographic data and 30 multiple-choice questions on medical confidentiality was distributed electronically. The questionnaire was developed from the literature, reviewed by experts, and pilot-tested before dissemination.
Results: Of the 65 eligible healthcare professionals invited, 46 completed the survey (response rate: 70.8%). Most participants were women (65.2%), and graduated physicians represented the largest professional group (37%). Knowledge of the fundamental principles of medical confidentiality was generally high. Most participants recognized its legal basis (95.7%), its applicability to all healthcare professionals (100%), its lifelong nature (97.8%), and the legal consequences of breaches (100%). High proportions also identified shared confidentiality among healthcare professionals involved in patient care (97.8%) and the persistence of confidentiality after death (84.8%). However, important gaps were observed regarding disclosure of information to family members without patient consent (32.6%), violence against a consenting adult (65.2%), educational use of medical data without anonymization (71.7%), and students' access to medical records (71.7%).
Conclusion: ICU healthcare professionals demonstrated satisfactory overall knowledge of medical confidentiality. Nevertheless, deficiencies regarding specific legal exceptions highlight the need for continued education in medical ethics, health law, and confidentiality practices.
Keywords: medical confidentiality; intensive care; ethics; legislation; deontology

Introduction

Medical confidentiality is a fundamental pillar of the trust between patients and healthcare professionals [1]. Protected by medical and paramedical ethics as well as by national and international laws, it safeguards patients' privacy, dignity, and fundamental rights [1]. Any breach of this principle may lead to serious legal, ethical, and social consequences, undermining both the credibility of the healthcare system and the quality of patient care [1]. In intensive care, confidentiality holds particular importance. Critically ill patients are often unconscious and dependent on a multidisciplinary team, while their families frequently seek information. The complexity of care and emergencies increases the risk of voluntary or involuntary disclosure of confidential data. This study, conducted among the medical and paramedical staff of the Intensive Care Department at Habib Bourguiba University Hospital in Sfax, aimed to assess their knowledge of medical confidentiality, identify strengths and weaknesses, and promote adherence to ethical and deontological standards.

Methods

This was a cross-sectional observational study conducted among the medical and paramedical staff of the Intensive Care Department at Habib Bourguiba University Hospital in Sfax. The survey took place from July 19 to July 31, 2025. All medical and paramedical professionals working in the Intensive Care Unit during the study period were eligible for inclusion. Non-inclusion criteria were healthcare professionals absent from the department during the survey period and staff members who did not receive the survey invitation. Exclusion criteria were refusal to participate, questionnaires with substantial missing data, and duplicate responses when identified. An anonymous French questionnaire was created using Google Forms and distributed by email. It consisted of two sections: The first collected sociodemographic data. The second contained 30 multiple-choice questions on medical confidentiality (Survey).

Data analysis was based on Google Forms statistics. The investigators developed the questionnaire after a literature review of the concerns regarding medical confidentiality, medical ethics, and professional regulations. The initial version included items covering the legal basis, scope, exceptions, and practical application of medical confidentiality. To assess content validity and clarity, the questionnaire was reviewed by two experts in medical ethics and forensic medicine, and one senior intensivist. Minor modifications were made according to their recommendations. The questionnaire was developed as a descriptive survey tool based on the literature regarding medical confidentiality. A pilot test was subsequently conducted among a small sample of healthcare professionals (n = 10) who were not included in the final analysis. The pilot study evaluated the comprehensibility, relevance, and acceptability of the questions. Following this pre-test, wording adjustments were performed before final dissemination. Internal consistency was not assessed using Cronbach's alpha coefficient. Although Google Forms allows the attribution of a score to each item, no overall knowledge score was calculated in the present study. The objective was to analyze each question individually to identify specific strengths and weaknesses in participants' knowledge regarding medical confidentiality.

Results

Among the 65 eligible healthcare professionals invited to participate, 46 completed the questionnaire (response rate: 70.8%). Nineteen eligible professionals did not respond. No questionnaire was excluded from the analysis.

Most respondents were young: 10.9% were 28 years old, 8.7% were 30 years old, and 8.7% were 36 years old. The median age was 37 years (range: 25–65), with a mean of 39.85 years. Most participants were women (65.2%, n=30). Most were graduated physicians (37%) (Figure 1).

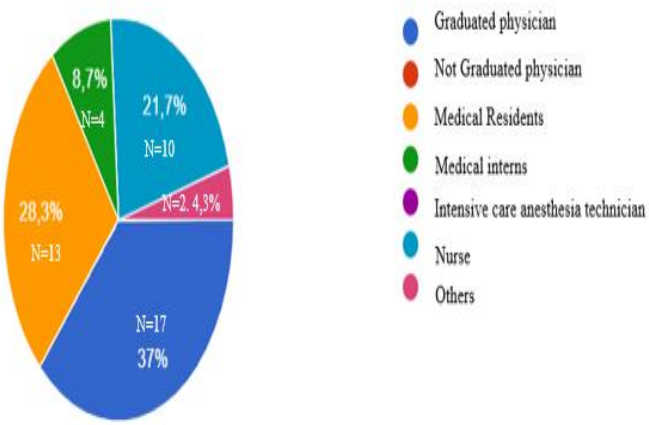

Figure 1: Distribution of participants by professional category

Participants' responses were as follows: 58.7% considered medical confidentiality primarily a legal obligation. 95.7% stated that its legal basis lies in the Penal Code and the Medical Code of Ethics. 100% knew that any violation may result in fines and/or imprisonment. 84.8% recognized that confidentiality persists after the patient's death. 97.8% believed that the obligation of confidentiality never ceases and lasts for life. 100% acknowledged that it applies to all healthcare staff. 97.8% identified each healthcare professional as personally responsible for maintaining confidentiality. 97.8% knew that shared confidentiality applies among caregivers involved in patient management. 91.3% agreed that information can be shared with another professional involved in care. 91.3% believed that nurses may share information with other involved professionals. 95.7% recognized that administrative hospital staff are also bound by confidentiality. 100% agreed that healthcare professionals cannot discuss a patient's case with

Table 1. Correct answers to the questionnaire items (n = 46)

Questions	Correct answer n (%)
Q1. Medical confidentiality is primarily a legal obligation	27 (58)
Q2. Confidentiality applies to all healthcare staff	46 (100)
Q3. Legal basis found in the Penal Code and Medical Ethics Code	44 (95.7)
Q4. Violation may result in legal sanctions	46 (100)
Q5. Confidentiality may be lifted only in cases provided by law	44 (44)
Q6. Disclosure to family requires patient consent	15 (32.6)
Q7. Confidentiality persists after death	39 (84.8)
Q8. Disclosure allowed in cases of child abuse	37 (80.4)
Q9. Shared confidentiality among involved caregivers	45 (97.8)
Q10. Disclosure may be requested by a judge	44 (95.7)
Q11. Nurses may share information with involved professionals	42 (91.3)
Q12. The confidentiality obligation never ceases	45 (97.8)
Q13. Mandatory reporting of notifiable diseases	44 (95.7)
Q14. Anonymous clinical cases may be discussed publicly	41 (89.1)
Q15. Administrative staff are also bound by confidentiality	44 (95.7)
Q16. Confidentiality is a lifelong obligation	45 (97.8)
Q17. Patients may waive confidentiality through written consent	33 (71.7)
Q18. Students cannot freely access all medical records	33 (71.7)
Q19. Identifiable cases should not be discussed in public places	43 (93.5)
Q20. Information cannot be shared with a spouse	46 (100)
Q21. Confidentiality may be lifted in cases of violence against a consenting adult	30 (65.2)
Q22. Confidentiality protects privacy	45 (97.8)
Q23. Reporting of infectious disease transmission	38 (82.6)
Q24. Confidentiality also applies during internships	45 (97.8)
Q25. Educational use requires anonymization	33 (71.7)
Q26. Information may be shared with involved healthcare professionals	42 (91.3)
Q27. Each healthcare professional is individually responsible	45 (97.8)
Q28. Diagnosis is protected by confidentiality	44 (95.7)
Q29. Anonymous clinical information may be used for scientific discussion	42 (91.3)
Q30. Confidentiality covers all health-related information	45 (97.8)

their spouse. 93.5% stated that physicians should not discuss identifiable cases in public areas (e.g., cafeterias). Only 32.6% knew that medical information could be shared with the patient's family only with the patient's consent. 80.4% acknowledged that physicians may break confidentiality in cases of child abuse. 95.7% knew that confidentiality may be lifted in cases provided by law. 95.7% agreed that a judge may request disclosure of confidential information. 95.7% understood that disclosure is mandatory for notifiable diseases. 82.6% knew that infectious disease transmission must be reported. 65.2% believed that confidentiality may be lifted in cases of violence against a consenting adult. 89.1% stated that a clinical case may be discussed publicly if completely anonymous. 71.7% recognized that medical data cannot be used for teaching purposes without anonymization. 71.7% knew that patients can lift confidentiality by written consent. 97.8% acknowledged that confidentiality also applies during internships. 71.7% knew that medical students cannot freely access all patient records. 91.3% recognized that anonymous clinical information may be shared for scientific discussion. 97.8% agreed that confidentiality is also a form of respect for privacy. 95.7% recognized that diagnosis is protected by medical secrecy. 97.8% believed that confidentiality covers all health-related information. Table 1 details the different questions with the value and percentage of correct answers.

Discussion

This study assessed the knowledge of medical and paramedical staff working in an intensive care unit regarding medical confidentiality. The findings revealed an overall satisfactory level of knowledge concerning the fundamental principles of medical confidentiality. However, important deficiencies persisted regarding specific legal exceptions, disclosure of information to family members, educational use of patient data, and situations involving violence or transmissible diseases. Most participants correctly identified the legal basis of medical confidentiality (95.7%), recognized that breaches may result in legal sanctions (100%), and acknowledged that confidentiality applies to all healthcare professionals (100%). Furthermore, almost all respondents understood that confidentiality is a lifelong obligation (97.8%) and that each healthcare professional is individually responsible for maintaining it (97.8%). These findings suggest that the fundamental legal and ethical principles of confidentiality are well integrated into clinical practice within our institution. Our results are consistent with those reported by Tounsi et al. (1), who found that internal medicine residents generally recognized medical confidentiality as a legal obligation and were aware of its legally defined exceptions. However, our participants demonstrated a better understanding of certain aspects of confidentiality. For example, 84.8% of respondents in our study knew that confidentiality persists after the patient's death, whereas only 20.9% of residents in the study by Tounsi et al. (1) correctly identified this principle. Similarly, almost all participants in our survey recognized that confidentiality applies to all healthcare workers, including administrative staff, highlighting a broader understanding of shared professional responsibility. The overall level of knowledge observed in our study also appears higher than that reported in several international studies. In Ethiopia, Tegegn et al. found that only 59.8% of healthcare professionals demonstrated good knowledge regarding patient confidentiality despite working in healthcare institutions (2). Likewise, only 44.6% of participants recognized that non-medical information is also confidential, and only 50.5% knew that confidentiality remains applicable after a patient's death (2).In comparison, our participants showed substantially higher awareness regarding these principles. The authors reported that training in medical ethics and frequent exposure to ethical dilemmas were significantly associated with better knowledge levels (2). This observation may partly explain our findings because intensive care professionals are routinely exposed to complex ethical situations involving critically ill patients and end-of-life

decisions. The high level of knowledge observed despite the heterogeneity of the study population may be explained by several factors. First, the study was conducted in a university hospital environment where healthcare professionals regularly participate in teaching activities, multidisciplinary meetings, and continuing medical education programs. Second, confidentiality issues are particularly prominent in intensive care units because patients are frequently unable to communicate, while relatives require regular information regarding prognosis and treatment decisions. Third, medical ethics and professional deontology have become increasingly integrated into undergraduate and postgraduate healthcare curricula. Similar observations were reported by Alahmad et al., who found that physicians frequently acquire knowledge regarding confidentiality through undergraduate ethics education and clinical experience(3). Our findings also demonstrated a strong understanding of shared confidentiality. Nearly all respondents (97.8%) recognized that confidential information may be shared among healthcare professionals involved in patient management, and 91.3% acknowledged that nurses may communicate relevant information to other professionals participating in care. This result reflects the collaborative nature of intensive care medicine, where multidisciplinary decision-making is essential. Modern healthcare increasingly relies on shared responsibility among healthcare providers while maintaining strict confidentiality standards (4). Nevertheless, important knowledge gaps were identified. Only 32.6% of participants correctly answered the question concerning disclosure of medical information to family members. This finding is particularly relevant in intensive care settings, where relatives often seek information because patients may be unconscious or unable to communicate. The recommendations of the French Society of Intensive Care Medicine emphasize that information delivered to relatives should always respect patient autonomy and confidentiality whenever possible (5). Similar difficulties have been described by Satgé (6), who reported that physicians frequently adapt confidentiality practices according to contextual and familial factors rather than strictly applying legal principles. Knowledge concerning legal exceptions to confidentiality also appeared incomplete. Although most respondents correctly recognized mandatory reporting obligations for notifiable diseases (95.7%), only 65.2% correctly identified situations involving violence against a consenting adult. Similarly, 82.6% recognized the obligation to report transmissible infectious diseases. These findings suggest that while healthcare professionals are generally familiar with common legal obligations, uncertainty persists regarding more complex medico-legal situations. Comparable observations have been reported in studies evaluating physicians' legal knowledge concerning confidentiality and informed consent, where substantial gaps persisted despite adequate general knowledge (7). Another important finding concerns the educational and scientific use of patient information. Nearly one-third of respondents did not know that medical information must be anonymized before educational use, and a similar proportion believed that medical students could freely access all patient records. Similar concerns have been reported in hospital-based surveys assessing confidentiality practices among healthcare professionals, where theoretical knowledge did not always translate into appropriate practical behavior (8). With the increasing use of electronic medical records, digital learning platforms, and artificial intelligence tools in healthcare, awareness regarding anonymization and data protection has become even more important (9). The high proportion of participants recognizing that confidentiality protects patient privacy (97.8%) and applies to all health-related information (97.8%) reflects a strong ethical awareness.

Confidentiality remains one of the foundations of trust between patients and healthcare professionals and represents a core component of respect for autonomy, dignity, and human rights (10,11). In intensive care medicine, where patients are particularly vulnerable, maintaining confidentiality is essential to preserving both trust and quality of care.

Overall, our findings suggest that healthcare professionals working in intensive care possess a solid understanding of the general principles of medical confidentiality. However, significant deficiencies remain regarding specific legal exceptions and practical situations commonly encountered in clinical practice. Continuous education programs focusing on medical ethics, health law, confidentiality, and communication with relatives should therefore be strengthened to improve the application of confidentiality principles in daily clinical practice.

Limitations

This study has several limitations. First, the use of a self-administered questionnaire may have introduced reporting bias. Second, the study was conducted in a single university hospital with a relatively small sample size, limiting the generalizability of the findings. Third, although the questionnaire was reviewed by experts and pilot-tested, its psychometric properties, including Cronbach's alpha, were not formally assessed. Finally, the study evaluated theoretical knowledge rather than actual clinical practices regarding medical confidentiality.

Conclusion

In light of these results, it is essential to integrate continuous medical ethics education throughout the theoretical and practical training of medical students. Such an approach would progressively strengthen their ethical competencies and better prepare them to face the increasingly complex ethical dilemmas of future clinical practice.

Supplementary documents:

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Ischemic Mimics in Cardio-Oncology: Post-Chemotherapy MINOCA dilemma

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Abstract

Advances in neoadjuvant therapies for breast cancer have increased the incidence of acute cardiotoxicity, often presenting as a diagnostic challenge in the emergency setting. We report the case of a 35-year-old female with invasive breast carcinoma, currently receiving neoadjuvant chemotherapy, who presented with acute retrosternal chest pain and ST-segment elevation in the anterior leads. Initial laboratory findings revealed a massively elevated cardiac troponin I level (5,830.60 ng/L) and severe chemotherapy-induced neutropenia. Emergency coronary angiography demonstrated unobstructed epicardial coronary arteries, establishing a working diagnosis of Myocardial Infarction with Non-Obstructive Coronary Arteries (MINOCA).
Subsequent transthoracic echocardiography revealed apical and periapical akinesia, a phenotype consistent with Takotsubo cardiomyopathy. In the context of active oncological treatment, the diagnostic crossover between stress-induced cardiomyopathy and therapy-related myocarditis, particularly immune checkpoint inhibitor-associated myocarditis is critical. While Takotsubo syndrome is primarily managed with supportive care, acute myocarditis mandates immediate cessation of antineoplastic agents and the initiation of high-dose corticosteroids. This creates a formidable therapeutic paradox in the setting of severe neutropenia, where systemic immunosuppression poses a high risk of life-threatening sepsis.

This case underscores that in patients presenting with a STEMI-like MINOCA during chemotherapy, clinical and echocardiographic findings may be insufficient for differentiation. Early Cardiac Magnetic Resonance (CMR) imaging is the definitive arbiter required to distinguish between these entities. Accurate diagnosis is essential to balance the management of fulminant cardiovascular events with the safe continuation of life-saving oncological care.

Keywords: Myocardial Infarction with Non-Obstructive Coronary Artery, Takotsubo Cardiomyopathy, Cardiotoxicity, Breast Neoplasms, ST Elevation Myocardial Infarction

Introduction

The improvement in breast cancer survival rates, driven by advances in neoadjuvant and adjuvant therapies, has unveiled an emerging challenge: acute cardiotoxicity. While historical focus in cardio-oncology has predominantly centered on the chronic, dose-dependent left ventricular dysfunction induced by anthracyclines and HER2(Human Epidermal Growth Factor Receptor 2) (targeted therapies, acute cardiovascular events present an immediate diagnostic difficulty in the emergency department (1).

When a patient undergoing active oncological treatment presents with acute chest pain and ST-segment elevation, the clinical dogma strongly favors acute coronary occlusion. However, the angiographic finding of unobstructed coronary arteries abruptly shifts the paradigm to Myocardial Infarction with Non-Obstructive Coronary Arteries (MINOCA), as defined by the Fourth Universal Definition of Myocardial Infarction (2). In the specific context of cardio-oncology, MINOCA is not a benign condition, but a critical diagnostic challenge where Takotsubo syndrome, coronary vasospasm, and acute myocarditis overlap (3).

This case report shows the challenge of diagnosing MINOCA with an ST-segment elevation, highlighting the need for a multimodal approach to guide life-saving treatments and safely continue her oncological care.

Case presentation

A 35-year-old female with no known cardiovascular risk factors presented to the emergency department with acute and constricting retrosternal chest pain of 3 hours' duration. Her medical history was notable for invasive carcinoma of no special type of the breast HER2 negative and hormone receptor, currently being treated with a neoadjuvant chemotherapy type sequential Anthracycline followed by Taxane regimen. Her most recent cycle of Epirubicin and Cyclophosphamide had been administered 2 weeks prior to presentation. Upon admission, the patient was hemodynamically stable, with a blood pressure of 110/70 mm Hg symmetrical in the two arms and a heart rate of 95 beats per minute. Also, respiratory stable, with no signs of congestive cardiac failure. The patient was very anxious. The pain was graduated as 8 out of ten using the numerical pain scale.

A standard 12-lead electrocardiogram (ECG) (Figure 1) revealed a 4-mm ST-segment elevation in the anterior leads.

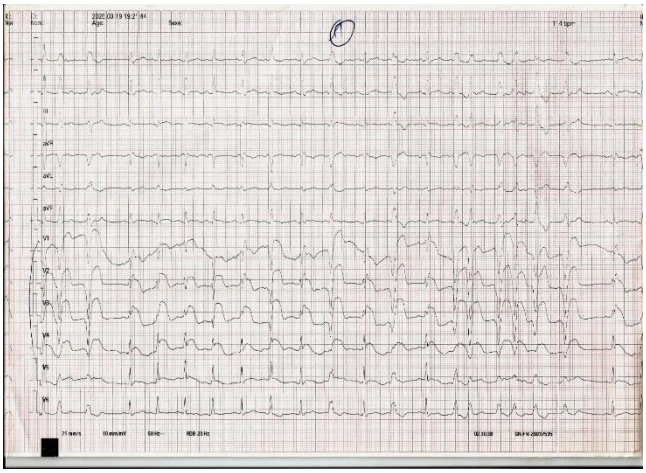

Figure 1: ECG at admission

Initial laboratory investigations confirmed acute myocardial injury, with a cardiac troponin I level massively elevated at 5,830.60 ng/L. Concomitant hematological assessment underscored the systemic impact of her recent cytotoxic therapy, demonstrating marked leukopenia (white-cell count, 1,980 per cubic millimeter) with severe neutropenia (absolute neutrophil count, 520 per cubic millimeter), alongside a mild normocytic anemia (hemoglobin, 10.4 g per deciliter; mean corpuscular volume, 81.5 fL). Her platelet count was preserved at 265,000 per cubic millimeter. We noticed mild hypokalemia (potassium, 3.20 mmol per liter), renal function (creatinine, 62.6 Umol per liter) and coagulation parameters (aPTT ratio, 0.91) remained within normal limits. An acute ST-segment elevation myocardial infarction (STEMI) was the first diagnosis suspected and the patients was emergently transferred to the cardiac

catheterization center. Coronary angiography revealed a strictly normal epicardial coronary tree, with no angiographic evidence of atherosclerosis, intraluminal thrombus, or spontaneous coronary artery dissection (SCAD). An urgent transthoracic echocardiogram (TTE) performed immediately revealed akinesia of the apex and periapical segments with a conserved ejection fraction. Faced with the triad of severe myocardial injury, unobstructed coronary arteries, and profound apical dysfunction, a working diagnosis of MINOCA was established. The primary differential diagnosis hinged between classic Takotsubo cardiomyopathy and an acute, focal post-chemotherapy myocarditis. Patients was admitted to the emergency department, with continuous monitoring of vital signs and pain, treated with beta-blockers and ACE inhibitors with favorable evolution and resolution of chest pain at the second day following admission. No administration of antithrombotic treatment since the coronary angiography was normal. Patient was discharged on day 5.

Figure 2 showed the ECG at discharge.

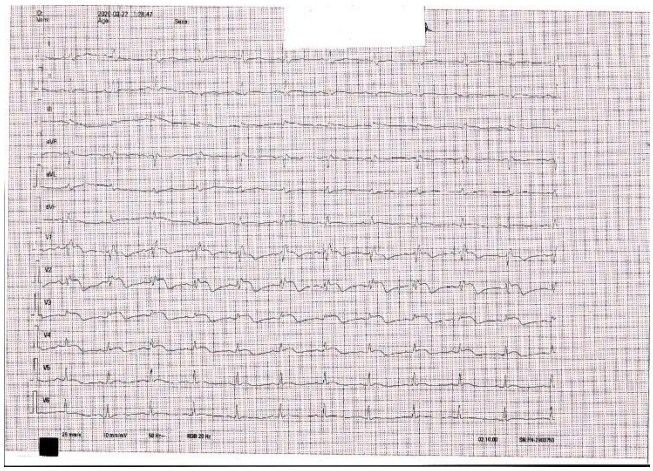

Figure 2: ECG at discharge

For the follow up, the patients was seen by cardiologist 15 days after the episode than seen at emergency department at one month. She reported episods of chest pain scaled 2 out of 10 on numerical pain scale. Laboratory investigations at one month showed white-cell count, 6,660 per cubic millimeter with absolute neutrophil count, 3480 per cubic millimeter, herplatelet count was preserved at 294,000 per cubic millimeter. The other parameters were stable.

Discussion

The presentation of this young patient highlights an increasingly prevalent clinical dilemma in modern emergency care units: the management of Myocardial Infarction with Non-Obstructive Coronary Arteries (MINOCA) in the actively treated oncological patient. According to the Fourth Universal Definition of Myocardial Infarction, MINOCA is not a definitive clinical endpoint but rather a preliminary "working diagnosis" that requires an exhaustive etiologic investigation(2). In the cardio-oncology setting, this diagnostic imperative is amplified. As highlighted by the American Heart Association and the 2022 European Society of Cardiology (ESC) guidelines, cancer patients experience a significantly higher incidence of MINOCA and face worse short- and long-term cardiovascular outcomes compared to the general population(1,4).

Diagnosing MINOCA is exceptionally unreliable when a patient presents with a classic ST-segment elevation. In the context of traditional acute coronary syndromes, ST-segment elevation is the electrocardiographic signature of transmural ischemia driven by acute epicardial vessel occlusion(2). However, in MINOCA, this classical ischemic sign serves as a diagnostic trap, masking a complex pathophysiological crossroads. Transmural myocardial edema whether resulting from intense neurogenic stunning or active inflammation can produce identical repolarization abnormalities (5)

In an oncological patient, the initial evaluation of MINOCA must navigate the risks of the malignancy itself and its treatments. The

prothrombotic state inherent to active breast cancer, combined with systemic endothelial dysfunction, lowers the threshold for transient thrombotic events that may spontaneously lyse prior to angiography (6). As well, the clinician must exclude Spontaneous Coronary Artery Dissection (SCAD), a condition prevalent in young women (7), and coronary vasospasm, a well-documented acute toxicity of antineoplastic agents such as fluoropyrimidines and taxanes. Yet, the echocardiographic revelation of profound acute apical dysfunction in this patient redirects the diagnostic trajectory away from the epicardial vessels and toward direct microvascular or myocardial injury.

The echocardiographic phenotype observed apical akinesia with compensatory basal hyperkinesia is the classic feature of Takotsubo (stress) cardiomyopathy(8). Recent large-scale registry data, including the International Takotsubo Registry, have firmly established a bidirectional relationship between malignancy and stress cardiomyopathy(9). Approximately 1 in 6 patients with Takotsubo syndrome has a concomitant or recent history of cancer (10).

The pathophysiology of Takotsubo in oncology have many sides. It is driven not only by the profound psychological distress of a cancer diagnosis but also by the intense physiological stress of cytotoxic chemotherapy, which acts as an exogenous trigger for a massive catecholamine surge (9). This surge induces diffuse microvascular spasm and direct catecholaminergic myocyte toxicity, preferentially affecting the apex due to the higher density of beta adrenergic receptors in this region(10). While Takotsubo syndrome is often considered a transient and benign condition, its occurrence during active chemotherapy is associated with a high risk of cardiogenic shock and arrhythmias, requiring vigilant intensive care management (10).

While Takotsubo syndrome fits the echocardiographic pattern, acute focal myocarditis can perfectly mimic this clinical and imaging phenotype. Historically, cardiotoxicity in breast cancer was synonymous with the chronic, cumulative, and dose-dependent left ventricular dysfunction induced by anthracyclines or the reversible dysfunction linked to HER2-targeted therapies (1,11). However, the landscape of neoadjuvant therapy for high-risk or triple-negative breast cancer has been revolutionized by the incorporation of immune checkpoint inhibitors (ICIs), such as pembrolizumab, during conventional chemotherapy (12).

This therapeutic evolution has introduced the specter of ICI-associated myocarditis a rare but fulminant autoimmune toxicity. ICI myocarditis typically presents early in the treatment course and frequently mimicking an acute coronary syndrome with ST-segment elevation and massive troponin release(13)**.** The underlying mechanism involves a breakdown of immunological tolerance, leading to aggressive clonal T-cell infiltration into the myocardium, targeting antigens shared between the tumor and the cardiomyocytes(14).In the context of recent chemotherapy, severe interstitial edema and intense focal inflammation can transiently paralyze the myocardium, rendering the initial presentation unclear from the apical ballooning of Takotsubo syndrome.

In the acute phase of a MINOCA presentation featuring ST-segment elevation and regional wall motion abnormalities, early Cardiac Magnetic Resonance (CMR) imaging is the definitive arbiter (15). Relying solely on clinical presentation and echocardiography is insufficient to distinguish between stress cardiomyopathy and acute myocarditis.

Differentiating between acute myocarditis and Takotsubo syndrome dictates a highly divergent and high-risk therapeutic trajectory. Takotsubo syndrome generally warrants supportive care (e.g., beta-blockers, ACE inhibitors) and often allows for the cautious, multidisciplinary-guided

resumption of chemotherapy once the ejection fraction recovers**.**

In contrast, a diagnosis of acute ICI or therapy-induced myocarditis mandates the immediate and absolute cessation of the antineoplastic agents(1,13). The standard of care for ICI myocarditis requires the urgent initiation of high-dose intravenous corticosteroids, potentially escalating to second-line immunosuppressants like mycophenolate mofetil or alemtuzumab if the patient is refractory(14). In this specific case, the hematological panel reveals severe chemotherapy-induced neutropenia. This creates an extreme therapeutic paradox: administering massive doses of immunosuppressive steroids to halt a fatal autoimmune cardiac attack in a patient who is already profoundly immunocompromised and at imminent risk of overwhelming sepsis**.**

Conclusion

Diagnosing MINOCA with an ST-segment elevation in a patient undergoing chemotherapy is a critical clinical challenge. It requires rapid identification between Takotsubo syndrome and therapy-induced acute myocarditis. Early Cardiac Magnetic Resonance (CMR) imaging is essential to make this distinction.

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Pediatric Chilaiditi Syndrome: A Case Report

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Abstract

Chilaiditi syndrome, rare in children, is characterized by the interposition of the colon between the liver and the diaphragm.

We report the case of a 14-year-old teenager, followed for intellectual disability, admitted to the emergency room for respiratory discomfort and vomiting without occlusive syndrome. The chest X-ray showed the right colonic angle in the chest, suggesting a strangulated diaphragmatic hernia. The thoraco-abdominal CT scan corrected the diagnosis by objectifying Chilaiditi syndrome. The course was favorable under conservative treatment (left lateral decubitus).

The objective of this case report is to highlight the importance of discussing this diagnosis to avoid unnecessary exploratory surgery.

Key words: Chilaiditi syndrome, children, management

Introduction

The architecture of the human abdomen is based on a delicate balance between ligament attachments, visceral volumes, and compartmental pressures. When this balance is disrupted, atypical anatomical transpositions can occur, causing profound diagnostic challenges. One of the most enigmatic abnormalities is the hepato-diaphragmatic interposition of the intestine, first documented in 1865 by Cantini. It was then formally characterized in 1910 by the Greek radiologist Demetrius Chilaiditi (1).

By studying patients with free intra-abdominal air on X-ray, he demonstrated that this clarity was not due to visceral perforation, but to the abnormal positioning of the intestine (most often the colon) between the upper surface of the liver and the lower edge of the right hemidiaphragm.

In contemporary clinical practice, a rigorous semantic distinction is maintained between two related but distinct entities: the "Chilaiditi sign" and the "Chilaiditi syndrome".

The sign strictly refers to the fortuitous and asymptomatic radiological discovery of this colonic interposition, a variant that most often remains silent throughout the patient's life. Chilaiditi syndrome refers to the situation where this anatomical alteration is accompanied by clinical symptoms (2).

Case report

A 14-year-old teenager, who was being treated for mental retardation, consulted the emergency room. He was admitted to our department for sudden respiratory discomfort, associated with bilious nausea and vomiting. On clinical examination, the patient was hemodynamically stable and apyretic. The abdomen was supple, though slightly distended. Palpation of the right hypochondrium was sensitive. Percussion revealed a localized tympanism with a disappearance of physiological hepatic dullness. There was no occlusive syndrome or signs of peritoneal irritation. The standard laboratory work-up did not show an inflammatory syndrome.

A chest X-ray was performed. It objectified an elevation of the right diaphragmatic dome associated with a voluminous airy clarity [Figure 1].

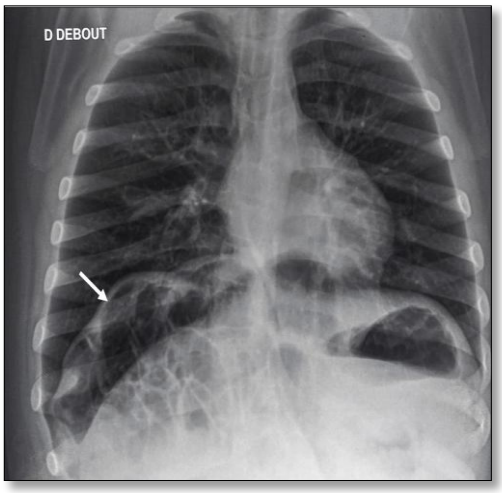

Figure 1: Standard chest X-ray showing digestive contents in the base of the right thoracic hemifield (arrow).

This clarity, interposed between the liver and the diaphragm, presented clear colonic haustrations, without abnormality of the overlying pulmonary parenchyma. This radiological appearance immediately led to the suspicion of a diaphragmatic congenital anomaly (such as Morgagni's or Bochdalek's hernia) complicated by strangulation.

Faced with this suspicion of surgical emergency, a thoraco-abdominal CT scan was requested. During the imaging attempt, the patient was very agitated. In the absence of an anesthesia team immediately available to carry out the sedation examination, strict clinical monitoring was instituted for the next day. This temporizing decision was intended to avoid hasty exploratory surgery in the face of an otherwise stable patient.

The CT imaging could finally be performed under general anesthesia. Analysis of the sections in [Figure 2] made it possible to correct the diagnosis.

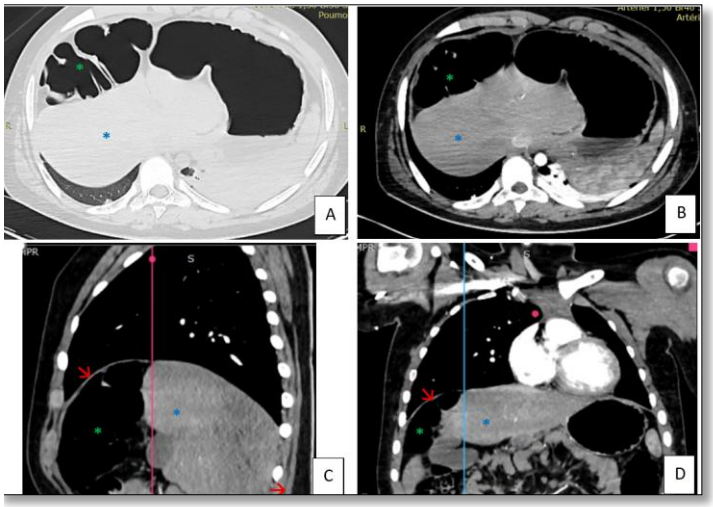

Figure 2: CT scan of Chilaiditi syndrome in this patient: A. Axial section in parenchymal window, B. Axial section in mediastinal window, C. Sagittal section, D. Frontal section

*(→ : Right diaphragmatic cupola, * : liver, * : Right colonic angle)*

The CT scan revealed an interposition of the right colonic angle between the anterior superior aspect of the liver and the diaphragmatic dome. The diaphragm was perfectly continuous and intact, formally excluding a hernia breach. The interposed colon showed no parietal thickening or signs of pneumatosis, ruling out any ischemic suffering. These elements confirmed Chilaiditi syndrome.

The treatment was exclusively conservative. Strict left lateral decubitus treatment was initiated to promote colonic decompression. The clinical course was quickly favorable. The respiratory discomfort improved, and the digestive tolerance returned to normal, allowing the patient to be discharged after 24 hours of observation.

Discussion

Chilaiditi syndrome is a clinical-radiological entity of extreme rarity in the pediatric population (3). Unlike geriatric patients, in whom the anomaly often results from degeneration and laxity of the suspensory ligaments of the liver and colon, interposition in children and adolescents is most often secondary to extreme stercoral or gas distension (4). The terrain of our patient, followed for mental retardation, is also a comorbidity that is classically a source of psychogenic aerophagia or chronic gastrointestinal dysmotility, mechanical factors pushing the colon into the subphrenic space (5).

Pathophysiology involves a loss or laxity of the normal suspensory mechanisms that keep the bowel in place. This allows the colon or the small bowel to slip into the potential space between the right lobe of the liver and the right hemidiaphragm. When the intestine becomes trapped, it can cause intermittent cramping, abdominal pain, nausea, vomiting, or constipation. In some pediatric cases, the upward displacement irritates the diaphragm, leading to respiratory symptoms like shortness of breath. The most common predisposing factors in children are aerophagia and constipation (6).

The main clinical risk of Chilaiditi syndrome lies in its radiological mimicry. The visualization of an airy clarity under the right hemicupola often triggers protocols for the management of surgical emergencies (4). In our observation, the radiological image initially suggested a complicated congenital diaphragmatic hernia. From an anatomical point of view, the difference is strict: in Chilaiditi syndrome, the colon is interposed under a perfectly continuous right hemi-diaphragm, whereas in a hernia, the colon passes through a muscular gap to sit in the thorax (7).

Ignorance of this diagnosis trap or misinterpretation of a simple X-ray can lead to unwarranted exploratory laparotomies or thoracotomies, exposing sometimes stable patients to heavy surgical and iatrogenic morbidity (8). To avoid this pitfall, the thoraco-abdominal CT scan is the reference examination. Its three-dimensional spatial resolution makes it possible to confirm the integrity of the diaphragm and to correct the diagnosis (9).

As soon as the diagnosis is confirmed and in the absence of complications such as volvulus or ischemia, which are extremely rare but possible, management should remain exclusively conservative (10). This medical treatment is based on bed rest, left lateral decubitus, colonic decompression, and hydration. These measures allowed for quick symptom resolution in our patient.

When conservative treatment fails, surgical treatment could be an option. Colopexy under general anesthesia prevents the colon from ascending again by attaching it to the abdominal wall (11).

Conclusion

Chilaiditi syndrome is a diagnostic trap, particularly in adolescents, where its rarity contrasts with the relative frequency of suspicions of complicated congenital diaphragmatic hernias. Our observation underlines a fundamental clinical attitude that must be adopted by emergency physicians: faced with a picture associating respiratory discomfort with an atypical hepato-diaphragmatic aeric image without an occlusive syndrome, it is imperative to evoke this benign interposition. Clinical delay, when permitted by the patient's hemodynamic stability, coupled with imaging in reference sections such as a thoraco-abdominal CT scan, is the only prudent approach. It makes it possible to establish the diagnosis with certainty, to establish a simple conservative treatment, and to avoid a deleterious rush towards unnecessary exploratory surgery.

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