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ANALYSIS OF DETERMINANTS OF MORTALITY AMONG NEWBORNS WITH BACTERIAL INFECTION ADMITTED TO THE MOTHER AND CHILD UNIVERSITY HOSPITAL CENTER (CHU-ME) OF N'DJAMENA, CHAD

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ABSTRACT

Introduction: Neonatal bacterial infections are a major cause of mortality in low-resource countries. In Chad, recent data to guide clinical management remain scarce. This study aimed to identify factors associated with mortality among infected newborns admitted to the Mother and Child University Hospital Center (CHU-ME) of N'Djamena. **Methods:** A retrospective descriptive and analytical study was conducted from January 2023 to April 2024. All newborns hospitalized for confirmed or suspected bacterial infection were included. Clinical, biological, and microbiological data were analyzed. Factors associated with mortality were identified using multivariate logistic regression. Statistical significance was set at $p < 0.05$. **Results:** Of the 2,400 newborns hospitalized during the study period, 720 had bacterial infections, yielding a prevalence of 30%. The overall mortality rate was 16.7%. The most frequently isolated pathogens were *Escherichia coli* (36%) and *Streptococcus agalactiae* (28%). High resistance rates to ampicillin (65%) and gentamicin (42%) were observed. In multivariate analysis, prematurity (adjusted OR = 2.6; $p = 0.004$), low birth weight (adjusted OR = 3.1; $p = 0.001$), and respiratory distress at admission (adjusted OR = 2.4; $p = 0.02$) were independently associated with mortality. **Conclusion:** Infectious neonatal mortality at CHU-ME remains high and is mainly related to neonatal immaturity and initial disease severity. Revising antibiotic protocols, strengthening perinatal screening, and improving neonatal intensive care are priorities to enhance survival.

KEYWORDS: determinants, mortality, infection, newborns, Chad.

INTRODUCTION

Neonatal bacterial infections are a major cause of mortality during the neonatal period, particularly in low-resource countries where access to specialized care remains limited. Despite a decline in infant mortality, neonatal mortality remains high, especially in sub-Saharan Africa.[1,2] Neonatal sepsis, often caused by Gram-negative bacilli, is exacerbated by delayed diagnosis and increasing resistance to first-line antibiotics.[3–5] The main factors associated with mortality include prematurity, low birth weight, and clinical severity.[1,2,6] This study aims to identify these determinants at CHU-ME in N'Djamena.

PATIENTS AND METHODS

This was a retrospective, descriptive, and analytical study conducted in the neonatology department of the Mother and Child University Hospital Center (CHU-ME) in N'Djamena over a sixteen-month period from January 1, 2023, to April 30, 2024.

The study population consisted of all newborns aged 0 to 28 days hospitalized for proven or strongly suspected bacterial infection.

Included cases had either a positive blood culture or cytobacteriological examination, or compatible clinical signs associated with a C-reactive protein (CRP) level ≥ 5 mg/L, justifying antibiotic therapy.

Newborns with viral or parasitic infections and those with incomplete medical records for key variables were excluded.

Maternal variables included age, parity, prenatal care, premature rupture of membranes (PROM), intrapartum fever, and place of delivery. Neonatal variables included age, sex, birth weight, gestational age, Apgar score, type of infection (early ≤ 7 days or late > 7 days), clinical signs at admission (respiratory distress, fever, lethargy, refusal to feed), and laboratory results (complete blood count, CRP, blood culture). The primary outcome was in-hospital neonatal mortality (alive or deceased).

The study was approved by the National Ethics Committee of the University of N'Djamena. Data were handled confidentially and anonymously.

Data were entered and analyzed using Epi Info version 7.2 and SPSS version 25. Frequencies and proportions were calculated for qualitative variables, and means ± standard deviation or medians [IQR] for quantitative variables.

Comparisons between deceased and surviving newborns were performed using the chi-square test. Variables with $p < 0.20$ in bivariate analysis were entered into a multivariate logistic regression model to identify independent determinants of mortality. Results were expressed as odds ratios (ORs) with 95% confidence intervals (CI). Statistical significance was set at $p < 0.05$.

RESULTS

1. General Data

During the study period, 2,400 newborns were hospitalized in the neonatology department of the Mother and Child University Hospital Center (CHU-ME) in N'Djamena. Among them, 720 cases of neonatal bacterial infection were identified, corresponding to a prevalence of 30% of admissions.

The mean age of newborns at admission was 4.8 ± 2.3 days, ranging from 1 to 28 days. The majority were male (54.6%), with a sex ratio of 1.2.

Early-onset infections (≤ 7 days) accounted for 70.8% of cases, compared with 29.2% for late-onset infections.

2. Maternal Characteristics

The mean maternal age was 27.5 ± 5.8 years (range: 17–43 years). The proportion of mothers who attended fewer than four antenatal care visits was 61%, and 32% experienced premature rupture of membranes (PROM) lasting more than 18 hours.

Intrapartum maternal fever was reported in 18% of cases, and 41% of deliveries occurred outside CHU-ME.

Prematurity affected 28% of newborns, and 35% had a birth weight below 2,500 g. An Apgar score below 7 at the 5th minute was observed in 22% of newborns.

3. Main Clinical Signs Observed at Admission

Table 1: Distribution of main clinical signs observed at admission among infected newborns.

Clinical signs	Number (n)	Percentage (%)
Fever or hypothermia	346	48.0
Respiratory distress	277	38.5
Feeding difficulties	246	34.2
Hypotonia	209	29.0
Seizures	86	12.0
Total*	—	100.0

Note: Some newborns presented multiple clinical signs simultaneously, explaining a total percentage greater than 100%.

4. Main Isolated Pathogens

Table 2: Distribution of isolated pathogens among infected newborns.

Isolated pathogens	Number (n)	Percentage (%)
Escherichia coli	84	36.0
Streptococcus agalactiae (Group B)	65	28.0
Klebsiella pneumoniae	33	14.0
Staphylococcus aureus	24	10.0
Other Gram-negative bacilli	28	12.0
Total	234	100.0

Note: Positive blood cultures accounted for 32.5% of all neonatal infections studied (n = 720).

Antibiotic susceptibility testing revealed high resistance to ampicillin (65%) and gentamicin (42%), whereas ceftriaxone and ciprofloxacin retained activity rates of 78% and 85%, respectively.

5. Factors Associated with Neonatal Mortality Due to Infections

Table 3: Factors significantly associated with neonatal mortality due to infections (univariate analysis).

Studied factors	Deaths n (%)	Survivors n (%)	*p*-value
Prematurity (< 37 weeks)	54 (27.0)	148 (73.0)	0.004
Birth weight < 2,500 g	58 (23.0)	194 (77.0)	0.001
Early-onset infection (≤ 7 days)	92 (18.0)	418 (82.0)	0.013
Respiratory distress at admission	63 (23.0)	205 (77.0)	0.020
Hospital stay ≤ 5 days	62 (22.5)	214 (77.5)	0.030
Intrapartum maternal fever	24 (18.5)	106 (81.5)	0.045

Analysis performed using the Chi-square test. Significance level: $p < 0.05$.

6. Factors Independently Associated with Neonatal Mortality Due to Infections

Table 4: Independent factors associated with neonatal mortality due to infections (multivariate analysis).

Independent factors	Adjusted OR	95% CI	*p*-value
Prematurity (< 37 weeks)	2.60	1.30 – 5.10	0.004
Low birth weight (< 2,500 g)	3.10	1.50 – 6.20	0.001
Respiratory distress at admission	2.40	1.20 – 4.90	0.020

Adjusted odds ratios derived from the multivariate logistic regression model. Significance level: $p < 0.05$.

7. Clinical Outcomes of Newborns

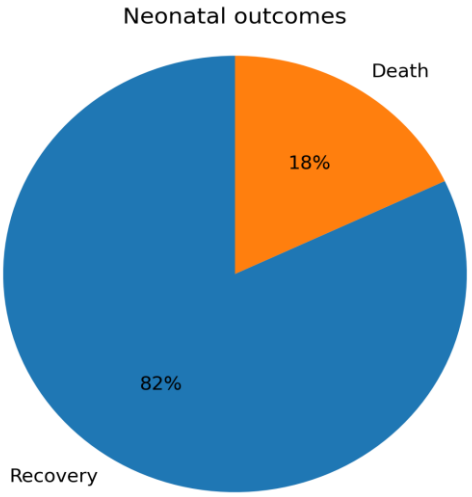

Figure 1: Distribution of newborns according to outcome.

8. Mortality Prediction

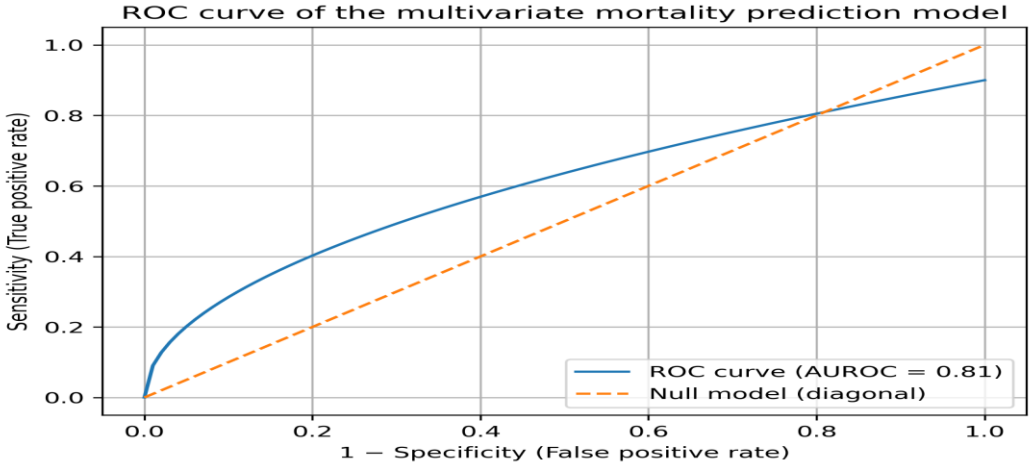

Figure 2: ROC curve of the multivariate mortality prediction model.

The ROC curve illustrates the performance of the multivariate model in predicting mortality. The area under the ROC curve (AUROC) was 0.81 (95% CI: 0.76–0.87), indicating good discriminatory ability of the model to distinguish patients according to mortality risk. The reference line (diagonal) corresponds to the null model, representing no predictive power. The observed curve, located above this diagonal, demonstrates performance superior to chance, indicating satisfactory predictive value of the model.

DISCUSSION

The 30% prevalence observed in this cohort falls within the range commonly reported in sub-Saharan Africa, where neonatal infections account for 25–40% of admissions.[7–9] The high proportion of early-onset infections supports the hypothesis of maternofetal transmission, consistent with the frequency of extrahospital deliveries and prolonged rupture of membranes observed in this study.[8–10]

The predominance of *Escherichia coli* and *Streptococcus agalactiae* aligns with regional data highlighting the major role of enterobacteria in neonatal sepsis.[7,11,12] The lack of systematic maternal screening for *S. agalactiae* may explain its significant contribution.

The resistance patterns observed are concerning. Reduced effectiveness of the ampicillin-gentamicin regimen mirrors findings from other African neonatal units reporting resistance rates of 60–70%.[11–13] Although ceftriaxone and ciprofloxacin remain relatively effective, their widespread use may promote the emergence of extended-spectrum β-lactamase-producing organisms.

Mortality (≈18%) was comparable to rates reported in similar settings.[8,10,11] Prematurity, low birth weight, and respiratory distress were confirmed as independent predictors of death, reflecting the impact of immunological and physiological immaturity and limited access to advanced respiratory support.

CONCLUSION

Neonatal infections represent a significant burden at CHU-ME in N'Djamena, with mortality strongly influenced by prematurity, low birth weight, and initial respiratory distress. The microbiological profile, marked by high resistance to commonly used antibiotics, underscores the need to revise treatment protocols and establish continuous microbiological surveillance. Strengthening antenatal care, improving delivery conditions, and enhancing neonatal intensive care capacities are essential priorities to reduce neonatal mortality in Chad.

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