

Clinical-epidemiological profile of early sepsis in newborns. Single-center observational study

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Abstract

Introduction: Early neonatal sepsis is a clinical syndrome characterized by signs and symptoms associated with systemic infection; it occurs in the first 72 hours after birth. This study aimed to determine the clinical-epidemiological profile of early neonatal sepsis in a neonatal intensive care unit of a regional reference center in Guayaquil, Ecuador.

Methods: The present observational study, carried out at the "Teodoro Maldonado Carbo" Hospital from January 2017 to December 2020, included neonates with early neonatal sepsis with a nonprobabilistic sample. The variables were age, gestational age, sex, route of infection, presence of urinary tract infections, weight, genopathies, Apgar at 1 minute, Silverman scale, clinical stages, capillary refill, urinary output, clinical and laboratory variables, haem culture, and causative organism. The analysis is univariate and descriptive with frequencies and percentages.

Results: A total of 278 patients with a mean gestational age of 33 weeks were included, and 59.4% were men. Maternal risk factors were UTI in pregnancy and transplacental infection. Among the factors associated with the newborn were low weight (56%) and prematurity (67%). The most frequent symptoms were euthermia and tachypnea (54%). In the laboratory profile, neutropenia predominated (49%), while the causative agents were *Staphylococcus hominis* (7%), *Escherichia coli* (4.3%), and *Klebsiella pneumoniae* (4%).

Conclusion: The direct relationship between the epidemiological characteristics and the clinical stages of neonatal sepsis was determined.

Keywords: MESH: Neonatal Sepsis, Epidemiology, Risk Factors, Apgar Score.

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Introduction

Early neonatal sepsis is a clinical picture associated with the invasion and proliferation of pathogens in the blood of newborns. The symptoms appear in the first 72 hours of life after birth, and according to the transmission route, they are classified as vertical and nosocomial. The most frequent etiology is of bacterial origin, given by *Streptococcus agalactiae* or group B streptococcus (GBS) in children weighing more than 1,500 g at birth and *Escherichia coli* (*E. coli*) weighing less than 1,500 g; only 1% corresponds to sepsis due to viruses and fungi [1].

The main risk factors include immaturity of the neonatal immune system, exposure to novel microorganisms from the maternal genital tract, childbirth-related factors, invasive procedures performed in the neonatal intensive care area that increase postnatal exposure, and antibiotic resistance. The clinical presentation is diverse and nonspecific; in the initial phase, hypothermia, fever, difficulty in feeding, tachycardia, and apathy are frequently described. As the disease evolves, systemic involvement is generated that can lead to total organ failure [2].

The present investigation was carried out at the Teodoro Maldonado Carbo Hospital, whose objective was to determine the clinical-epidemiological profile of early neonatal sepsis in newborns from 2017-2020. The results determined that the most frequent clinical picture was established during the initial phase in 24 hours, while the most common risk factors were maternal history of urinary tract infections during pregnancy, transplacental infection route, male sex, gestational age between 28 and 36 weeks, low birth weight, mild respiratory distress and APGAR within normal parameters.

The objective of this study was to determine the clinical-epidemiological profile of early neonatal sepsis in the neonatal intensive care unit of the Teodoro Maldonado Carbo Hospital from January 2017 to December 2020 in the city of Guayaquil, Ecuador.

Materials and methods

Design of the investigation

This is an observational, cross-sectional, retrospective study.

Scenery

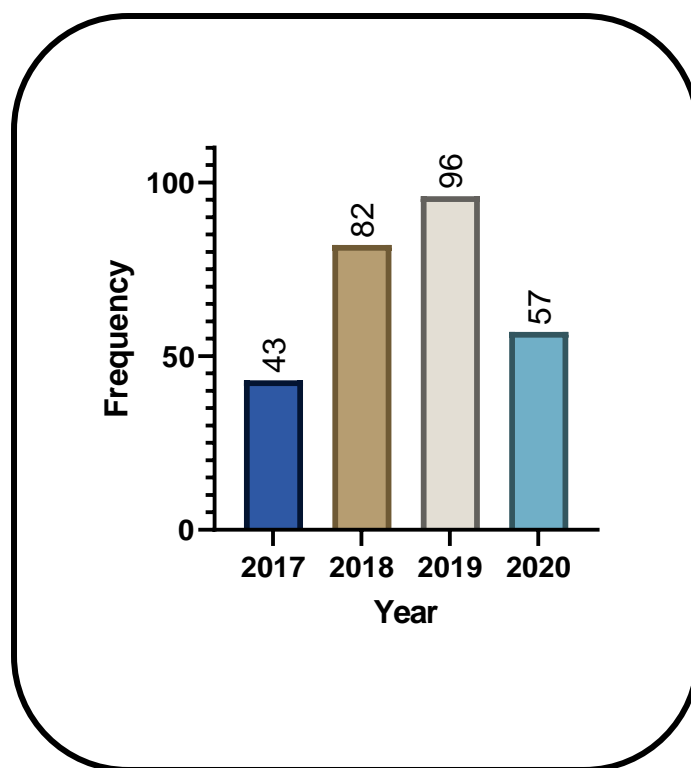
The study was carried out in the neonatology service of the "Teodoro Maldonado Carbo" Specialties Hospital of the Ecuadorian Institute of Social Security, Guayaquil, Ecuador. The study period was from January 1, 2017, to December 31, 2020.

Inclusion criteria

Neonates of both sexes diagnosed with early neonatal sepsis entered the study. Participants with incomplete records were excluded from the analysis.

Study size

The population was composed of patients admitted to the hospital in the neonatal intensive care unit of the institution. The sample calculation was nonprobabilistic, with a census type of all possible cases.



Variables

The variables were age of onset of symptoms, gestational age, sex, history of the mother, route of infection, presence of urinary tract infections, weight, genopathies, Apgar at 1 minute, Silverman scale, clinical stages, filling of capillary, urinary output, state of consciousness, muscle tone, respiratory rate, heart rate,

thermal instability, leukocytes, neutrophils, platelets, PCR, blood culture, and causative organism.

Data sources/measurement

The data were collected from the clinical history in a form designed exclusively for that purpose. The institutional electronic system for case investigation (AS400) was used. The database was coded with serial numbers, thus protecting the confidentiality of the information and identity of the patients.

Statistical method

In the initial phase, the data analysis was univariate and descriptive, with frequencies and percentages. The statistical package SPSS v.25 (Armonk, NY: IBM Corp.) was used for the analysis.

Results

The study included 278 patients; the annual incidence is presented in Figure 1. The year with the highest incidence was 2019.

General characteristics

The clinical characteristics of the patients are detailed in Table 1. It was determined that the most frequent epidemiological characteristics of newborns with early neonatal sepsis were the age group 28-36 weeks, with a predominance of males, in addition to evidence that symptoms occur during the first 24 hours of extrauterine life.

Among the maternal risk factors, we found a history of urinary tract infections during pregnancy, which was treated in 69.4% and was the most frequent transplacental infection route.

The neonatal risk factors identified are gestational age 28-36 weeks, male prevalence, low birth weight, normal range APGAR, and mild Silverman test (Table 1).

Clinical characteristics

Of the stages of early neonatal sepsis, 30 cases (10.8%) were in a late phase, 94 cases (33.8%) had signs of worsening, and 154 cases (55.4%) had an initial clinical stage. The average frequencies of heart rate, respiratory rate, temperature, tone, activity, diuresis, and capillary refill are presented in Figure 2.

Table 1. Age and sex of the study group.

variables	n=278 (%)
Age of onset of symptoms (Hours)	
< 24 hours	275 (98.9%)
24 to 48 hours	2 (0.7%)
49 to 72 hours	1 (0.4%)
Gestational age	
<28 weeks	20 (7.2%)
28 to 36 weeks	187 (67.3%)
>36 weeks	71 (25.5%)
Sex	
Women	113 (40.6%)
Men	165 (59.4%)
Pathological history of the mother	
Urinary tract infection	220 (79.1%)
Premature rupture of membranes	52 (18.7%)
Does not register	6 (2.2%)
Route of infection	
Birth canal	32 (11.5%)
Transplacental	246 (88.5%)
Urinary tract infection in the mother	
Treaties	193 (69.4%)
Not treated	85 (30.6%)
Birth weight	
Great for e.g.	14 (5.0%)
Low birth weight newborn	155 (55.8%)
Newborn of adequate weight	109 (39.2%)
Genopathies	
Presents	19 (6.8%)
Missing	259 (93.2%)
APGAR at 1 minute	
Normal	189 (68.0%)
Moderate difficulty	74 (26.6%)
Severe difficulty	15 (5.4%)
Silverman's assessment	
No difficulty	26 (9.4%)
Mild	157 (56.5%)
Moderate	73 (26.3%)
Severe	22 (7.9%)

In the laboratory data, an absence was identified in the medical records, and most of the causative organisms were isolated in a late phase (Table 2). Leukocyte changes, a drop in nuclear polymorphs with a normal platelet range (77.3%), PCR with a high risk of infection (43.2%) in 60% of patients, and blood culture were performed; however, the vast majority of the results were not recorded.

Table 2. Laboratories in newborns with early neonatal sepsis.

Variables	n=278 (%)
Leukocytes	
Normal	158 (56.8%)
Leukocytosis	111 (39.9%)
Leukopenia	8 (2.94%)
Neutrophil count	
Normal	113 (40.62%)
Neutrophilia	27 (9.7%)
Neutropenia	137 (49.3%)
Platelets	
Normal	215 (77.3%)
Thrombocytosis	12 (4.3%)
Thrombocytopenia	50 (18.0%)
C-reactive protein	
Lower risk of infection	113 (40.6%)
Increased risk of infection	120 (43.2%)
Not registered	45 (16.2%)
Blood culture	
Done	200 (71.9%)
Unrealized	78 (28.1%)
Causative organism	
Not registered	240 (86.4%)
Staphylococcus hominis	19 (6.8%)
Escherichia coli	12 (4.3%)
Enterococcus faecalis	7 (2.5%)

Table 3. Clinical characteristics and outcome.

	Initial clinic n=154	Late phase n=30	Signs of ag- gravation n=94	<i>P</i>
Gestational age				
28-36 GW	104	17	66	<0.0001
>36 GW	45	3	23	0.083
<28 GW	5	10	5	<0.0001
Sex				
Woman	61	13	39	0.9219
Men	93	17	56	
Weight				
LGA	9	1	4	0.7742
LBW	89	21	45	0.0783
NAW	56	8	45	0.06512
Death				
No	154	0	94	<0.0001
Yes	0	30	0	

GW: gestational weeks, RN: newborn. GPEG: large for gestational age. LBW: low birth weight. NAW: Newborn of adequate weight, LGA: Large for gestational age.

Relationship between epidemiological characteristics and evolution of SNT

There was a higher frequency of neonates with early sepsis in the initial phase, with a gestational age of 28-36 weeks and a male predominance. Mortality is related to the late phase; all neonates in this phase died.

Discussion

According to the epidemiological profile of SNT, it was established that the average gestational age for the development of the pathology was 33 weeks, with an increase in cases in 2019 (35%), where the age group with the highest prevalence was between 28 and 36 S (67%), and a predominance of the male sex (59%) similar results found in the study prepared by Borja (Ecuador 2019) that describes a more significant number of cases of NS in male newborns (80%), premature (60%) with low weight (73.1%).

Both neonatal and maternal risk factors had a significant result; the most prevalent in terms of the mother was the history of urinary tract infections during pregnancy (79%), where the majority are identified, treated, but not cured, which increases the risk of ascending infection compromising the placental membranes and the fetus. The present study determined that transplacental infection was the most frequent, at 88%. Among the factors associated with the newborn, low birth weight, prematurity, and being male were the ones with the highest risk for developing NTS. These results are similar to those of Ulloa et al. (Mexico 2019), where the incidence of urinary infections and the transplacental route was 60% in newborns with NTS.

The clinical characteristics observed in the study indicate that the mean onset of symptoms is 4 hours; these results are similar to those detailed by Odabasi (Turkey 2020), who indicates that the initial symptoms occur during the first 18 hours in the most significant number of cases.

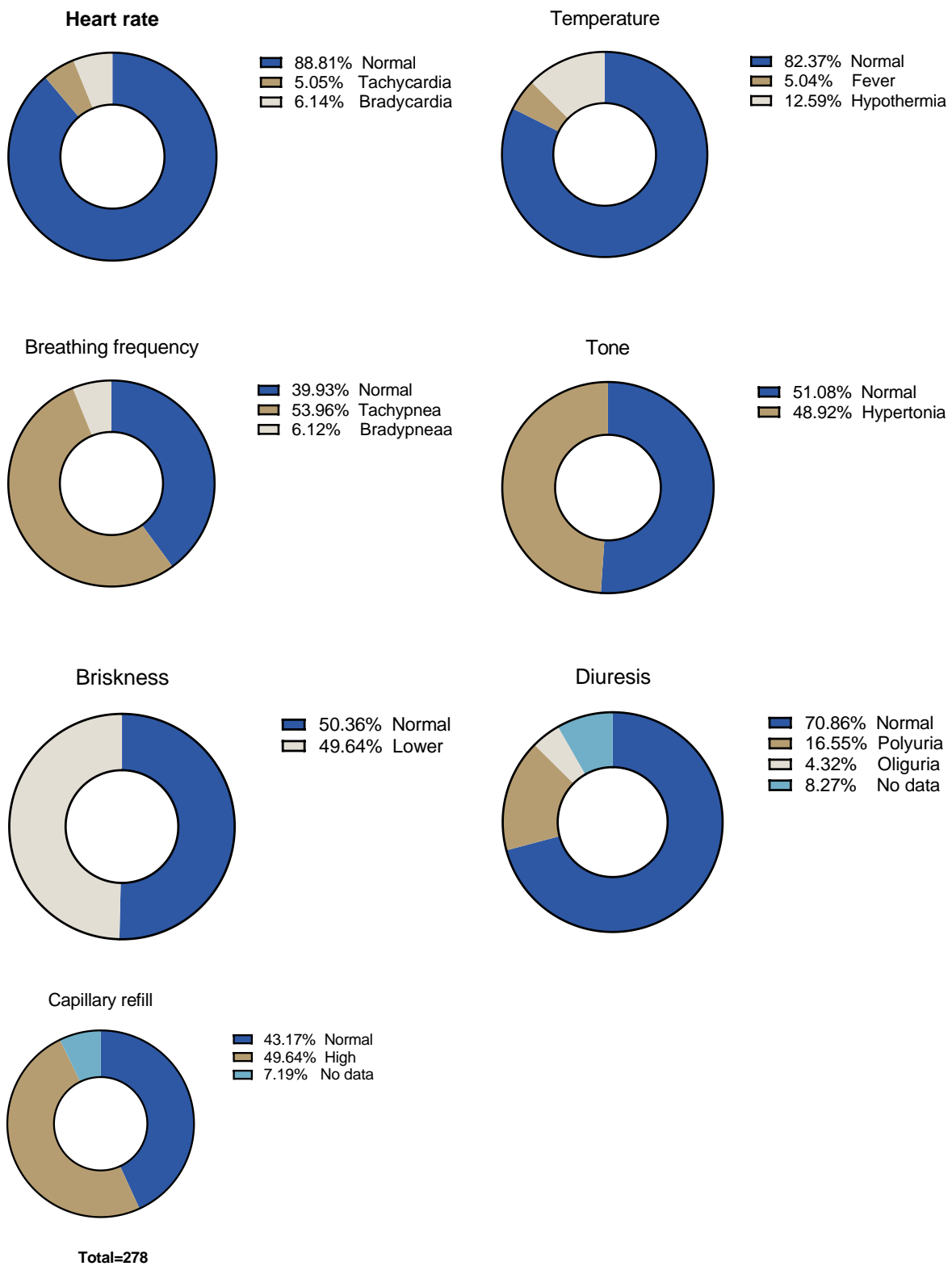


Figure 1. Clinical frequencies of the study group.

On the other hand, the identified clinic did not have significant changes since a large percentage presented euthermia (82.4%), standard heart rate (88.5%), unaltered muscle tone (61.1%), active/reactive (60.4%), and urinary output standard (70.8%). However, they presented tachypnea (64%) and increased capillary refill (49.6%). In that case, these data are similar to those established by Fernández et al. (Brasil 2021), where they detail a higher frequency of early sepsis with characterized symptomatology due to euthermia (70%), heart rate within normal parameters (90%), tachypnea (89.1%), normal muscle tone (76.1%), without alterations of consciousness (89%), standard urinary output (92.4%) and without perfusion alterations (87%), thus determining that the clinical picture may initially present mildly, being confused with transient respiratory distress and worsening as hours pass without treatment. Mortality was closely associated with neonatal sepsis in the late phase with prematurity and male sex, where 13% of deaths were identified, all being late phase.

Regarding the laboratory profile, 68.2% presented leukocytes in normal ranges but with a decrease in polymorphonuclear cells or neutropenia (49.3%), without platelet alterations (77.2%), low PCT (52.6%) but with PCR that shows higher risk of infection (43.2%). These results coincide with the study carried out by Almudeer (KSA 2020), where a more significant presence of standard leukocyte numbers (76.7%) and platelets in the normal range (86.7%) was determined, but differs in the values of PCR and PCT with 90% associated with an increased risk of infection. A large part of the neonates studied had blood culture samples and tracheal aspirates; however, the percentage of results notification was minimal; among these, the following microorganisms were identified: *Staphylococcus hominis* occurred in 7% followed by *Escherichia coli* 4.3% and *Klebsiella pneumoniae* 4%. These data are contrasted with those of Almudeer et al., who identified the *E. coli* agent as the most frequent causative organism of early sepsis in 29%, as well as Ulloa - Ricárdez and Salazar-Espino, where 53.2% reported early sepsis with a predominance of *Escherichia coli* and *Klebsiella pneumoniae* as causative agents, and Borja (Ecuador 2019) determined that the most frequent causative organism was *Staphylococcus aureus* (15.9%).

With a probability of 95%, a statistically significant relationship between gestational age 28-36 weeks and the development of neonatal sepsis with a predominance of the initial phase is assured. In the future, more prospective and controlled studies should study this relationship.

Conclusions

The prevalence of early neonatal sepsis in the HTMC during 2017-2020 showed a significant increase in 2019, with a predominance in preterm neonates.

The epidemiological profile of patients with early neonatal sepsis was characterized by a higher frequency of males, an average of 33 S in age, and the most prevalent age group between 28 and 36 weeks.

Among the identified maternal risk factors, a history of urinary tract infection and transplacental infection prevailed.

Neonatal risk factors for the development of TNS are male sex, prematurity, and low birth weight.

The clinical profile in SNT shows a prevalence of euthermia, standard heart rate, good muscle tone, and APGAR at one minute but shows the presence of tachypnea and mild Silverman Test.

Laboratory data show leukocyte values in the normal range but with a predominance of neutropenia. There is a slight increase in PCR.

The most frequently identified causative agents were *Staphylococcus hominis* and *E. coli*.

Mortality was higher and absolute in children who entered the late phase. There was a statistically significant relationship between gestational age from 28 to 36 S and the development of neonatal sepsis.

Abbreviations

HTMC: Teodoro Maldonado Carbo Hospital.

GPEG: large for gestational age.

RN: newborn.

SG: Weeks of gestation.

SNT: early neonatal sepsis.

Supplementary information

No supplementary materials are declared.

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Author contributions

Stefania Loor Zambrano: Conceptualization, Data preservation, Fundraising, Research, Resources, Software, Writing - original draft.
 Marilyn Urrutia Garcés: Conceptualization, Data preservation, Supervision, Fundraising, Research, Resources, Writing: review and editing.
 Johanna Huacón Mazón: Conceptualization, Data conservation, Supervision, Acquisition of funds, Investigation, Resources.
 Fátima Ramírez Carrillo: Data curation, research, fundraising, supervision, methodology.
 Cindy Lara Morales: Conceptualization, Data retention, Supervision, Supervision, Methodology
 All authors read and approved the final version of the manuscript.

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Availability of data and materials

The data sets generated and analyzed during the current study are not publicly available due to participant confidentiality but are available through the corresponding author upon reasonable scholarly request.

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Statements

Ethics committee approval and consent to participate

It was not required for a retrospective database study.

Publication Consent

This does not apply to studies that do not publish MRI/CT/Rx images or physical examination photographs.

Conflicts of interest

The authors declare they have no conflicts of interest.

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