

Escherichia coli pneumonia in newborn, a case report

Neumonía por Echerichia coli en recién nacido, reporte de un caso

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ABSTRACT

Introduction: early-onset neonatal sepsis caused by *Escherichia coli* shows an increasing incidence, surpassing group B streptococcus in certain contexts, especially in the presence of maternal risk factors and prematurity. **Case report:** a case of a full-term newborn with risk factors of prolonged rupture of membranes and untreated maternal infection is presented. At twelve hours of life, the infant developed severe respiratory distress, fever, and hemodynamic compromise. Studies confirmed bilateral pneumonia and the isolation of ampicillin-resistant *Escherichia coli* in blood cultures. Management included mechanical ventilation and antibiotic treatment with ampicillin and gentamicin, later adjusted to cefotaxime according to microbial sensitivity. **Conclusions:** early diagnosis, immediate respiratory support, and the adaptation of targeted antimicrobial therapy are decisive factors in achieving survival and preventing serious complications in neonatal pneumonia caused by gram-negative bacilli.

Keywords: Anti-bacterial agents; *Escherichia coli*; Infant newborn; Neonatal sepsis; Pneumonia.

RESUMEN

Introducción: la sepsis neonatal de inicio temprano por *Escherichia coli* presenta una incidencia creciente, superando en algunos contextos al estreptococo del grupo B, especialmente ante factores de riesgo maternos y prematuridad. **Reporte de caso:** se presenta el caso de un recién nacido a término con factores de riesgo de ruptura prolongada de membranas e infección materna no tratada. A las doce horas de vida desarrolló dificultad respiratoria severa, fiebre y compromiso hemodinámico. Los estudios confirmaron neumonía bilateral y aislamiento de *Escherichia coli* resistente a ampicilina en hemocultivos. El manejo incluyó ventilación mecánica y tratamiento antibiótico con ampicilina y gentamicina, ajustado posteriormente a cefotaxima según sensibilidad microbiana. **Conclusiones:** el diagnóstico precoz, el soporte respiratorio inmediato y la adecuación de la terapia antimicrobiana dirigida son determinantes para lograr la supervivencia y evitar complicaciones graves en la neumonía neonatal por bacilos gramnegativos.

Palabras clave: Antibacterianos; *Escherichia coli*; Neumonía; Recién nacido; Sepsis neonatal.

Introduction

Escherichia coli (*E. coli*) pneumonia in newborns is a severe manifestation of early-onset neonatal sepsis, a condition that remains a significant clinical challenge in neonatal intensive care units worldwide. In recent decades, the epidemiology of neonatal infections has significantly changed, with a progressive increase in the incidence of *E. coli* infections, particularly in preterm and very-low-birth-weight infants.^{1,2}

Prospective surveillance data from 2015 to 2017 revealed that the incidence of *E. coli* infection (0.40 cases per 1,000 live births) exceeded that of Group B *Streptococcus* (0.33 cases per 1,000 live births) in the general population, with an even more pronounced difference in neonates at 22 to 28 weeks of gestation. This trend has persisted in subsequent years, with reports from 2026 documenting a sustained increase in gram-negative organisms, predominantly *E. coli*, in both early- and late-onset sepsis.^{3,4}

Neonatal pneumonia caused by *E. coli* may present as part of systemic sepsis or as a focal manifestation of infection. Vertical transmission from a colonized mother is the primary mechanism of acquisition, particularly in the context of clinical chorioamnionitis, prolonged rupture of membranes, or maternal colonization by antibiotic-resistant strains. (Preterm infants are particularly vulnerable because of the immaturity of their innate and adaptive immune systems, which explains why 81% of *E. coli* infections occur in this population.⁶

The clinical presentation of *E. coli* pneumonia in newborns is often nonspecific. Respiratory signs include respiratory distress, tachypnea, retractions, grunting, apnea, and cyanosis, which may be accompanied by systemic manifestations such as temperature instability, hypotension, poor perfusion, metabolic acidosis, and hemodynamic abnormalities. In severe cases, pulmonary complications such as multiple pneumothoraxes and lung abscesses may develop, although these are rare and require prolonged antibiotic therapy.⁷

The mortality associated with neonatal sepsis caused by *E. coli* is significantly high, reaching up to 33% in some series, with even higher rates (50%) reported in recent studies. This mortality is inversely proportional to gestational age and is particularly devastating for extremely preterm infants. Predictors of mortality include low birth weight, the need for vasopressor support, the presence of concomitant necrotizing enterocolitis, and thrombocytopenia.⁴

The following article aims to present a case of a newborn with *E. coli* pneumonia and its clinical management.

Case report

A male newborn at 38 weeks of gestation, the first child of a 24-year-old mother, who presented to the obstetric emergency department in active labor. With respect to a significant maternal history, the mother presented with premature rupture of membranes 22 hours prior to delivery and reported dysuria accompanied by unquantified fever two days before admission, and she received only symptomatic paracetamol without prior antibiotic treatment.

The birth was a normal vaginal delivery, resulting in a newborn weighing 3,250 grams (50th percentile) with a head circumference of 34.5 cm (50th percentile). The Apgar scores were 7 at 1 minute and 8 at 5 minutes. Twelve hours after birth, the newborn began to show irritability, refusal to eat orally, and progressive signs of respiratory distress, characterized by constant expiratory grunting and nasal flaring.

Physical examination

During the assessment in the neonatal intensive care unit (NICU), the patient was hypoactive and febrile and showed evident respiratory distress. Vital signs revealed an axillary temperature of 38.4 °C, tachycardia with a heart rate of 182 beats per minute, severe tachypnea at 78 breaths per minute, and an oxygen saturation of 84% on room air. On chest examination, intercostal retraction, xiphoid retraction, and thoracoabdominal dissociation were observed, corresponding to a Silverman-Anderson score of 6 points.

On pulmonary auscultation, bilateral hypoventilation with a predominance in the right basal field was identified, accompanied by fine crackles in both lung fields. The remainder of the physical examination, including cardiovascular and abdominal assessments, revealed no significant abnormalities, with no evidence of visceromegaly, murmurs, or skin lesions. The capillary refill time was 3 seconds, indicating mild hemodynamic compromise.

Additional Tests and Laboratory Work

The samples were immediately collected for laboratory and imaging studies. Arterial blood gas analysis was performed while the patient was breathing room air, and respiratory acidosis with hypoxemia was documented, with a pH of 7.21, a partial pressure of carbon dioxide (pCO₂) of 62 mmHg, a partial pressure of oxygen (pO₂) of 42 mmHg, a bicarbonate (HCO₃) concentration of 18 mEq/L, and a base excess of -6.2 mmol/L.

The complete blood test revealed marked leukocytosis, with a total white blood cell count of 28,500/ μ L and a differential count of 78%. The patient's hemoglobin concentration was 15.8 g/dL, and the hematocrit was 48%. Moderate thrombocytopenia was also noted, with a platelet count of 85,000/ μ L. Acute-phase reactants were markedly elevated, with a quantitative C-reactive protein (CRP) concentration of 94 mg/L and a procalcitonin concentration of 14.5 ng/mL. Glucose, urea, creatinine, and liver transaminase levels remained within normal reference ranges for the patient's age.

An anteroposterior chest X-ray revealed diffuse and heterogeneous alveolar infiltrates bilaterally, with areas of marked consolidation in the lower and middle lobes of the right lung, accompanied by a prominent air bronchogram and blurring of the right cardiac silhouette—findings consistent with an extensive pulmonary process. Prior to the initiation of antimicrobial therapy, two peripheral blood samples were collected for blood culture, and a lumbar puncture was performed. Cytochemical analysis of the cerebrospinal fluid was normal (cells 2/ μ L, protein 60 mg/dL, glucose 55 mg/dL), ruling out initial meningeal involvement.

Medical Management and Clinical Course

Given the early diagnosis of neonatal sepsis with a pulmonary focus and respiratory failure, immediate endotracheal intubation was performed, and the patient was connected to invasive mechanical ventilation in synchronized mode (SIMV). The initial ventilator settings included a peak inspiratory pressure (PIP) of 22 cmH₂O, a positive end-expiratory pressure (PEEP) of 5 cmH₂O, a respiratory rate of 40 breaths per minute, an inspiratory time of 0.35 seconds, and a fraction of inspired oxygen (FiO₂) of 65%, successfully stabilizing oxygen saturation at 94% and improving the control blood gas profile at 2 hours (pH 7.32, pCO₂ 48 mmHg, pO₂ 65 mmHg).

Fluid resuscitation was initiated with a bolus of 0.9% saline solution at a dosage of 10 mL/kg (32.5 mL), which improved the capillary refill time to 2 seconds. The intravenous fluids were subsequently maintained at 70 mL/kg/day with a glucose infusion (VIG) of 5 mg/kg/minute. Empirical antibiotic therapy was initiated immediately with an intravenous regimen of ampicillin at a dosage of 100 mg/kg/day divided every 12 hours (162.5 mg IV every 12 hours) and gentamicin at a dosage of 4 mg/kg/day (13 mg IV every 24 hours), infused over 30 minutes.

On the third day of hospitalization, the patient showed incipient radiological improvement, and it was possible to gradually reduce the ventilatory setting (FiO₂ to 35%, PIP to 16 cmH₂O). That same day, the microbiology laboratory reported bacterial growth in both blood culture bottles, identifying gram-negative bacilli after 36 hours of incubation. At 48 hours, the isolation of *E. coli* was confirmed. Susceptibility testing revealed resistance to ampicillin and amoxicillin-clavulanate but retained susceptibility to aminoglycosides, third- and fourth-generation cephalosporins, and carbapenems. On the basis of this report, the Pediatric Infectious Diseases service recommended discontinuing ampicillin and adjusting the treatment to intravenous cefotaxime at a dosage of 150 mg/kg/day, which was administered every 8 hours (162 mg IV every 8 hours), while Gentamicin was continued for an initial synergistic effect.

The clinical course remained favorable. On the fifth day of life, with resolution of fever, normalization of white blood cell counts (12,000/ μ L), and a decrease in the CRP concentration to 12 mg/L, the newborn met the criteria for extubation. He was transitioned to nasal continuous positive airway pressure (CPAP) at a pressure of 5 cmH₂O and an FiO₂ of 25% (). After ruling out renal or auditory toxicity, gentamicin was discontinued on the seventh day of empirical treatment.

Oral feeding was gradually reintroduced on the sixth day via enteral feeding through an orogastric tube with expressed breast milk, which progressed without complications until full caloric intake via suction was achieved on the ninth day. The patient remained stable on room air from day 8 and completed a full 14-day course of targeted intravenous antibiotic therapy with cefotaxime, being discharged on the fifteenth day of life in excellent clinical condition, with adequate weight gain and no evident neurological or pulmonary sequelae.

TABLE 1. Differential diagnoses

Condition	Arguments in favor	Arguments against
Group B Streptococcal sepsis	The most common cause of early sepsis; clinical presentation of respiratory distress and fever.	Blood culture negative for gram-positive bacteria; isolation of <i>E. coli</i> .
Viral Pneumonia	Interstitial infiltrates on X-ray; respiratory distress.	Maternal history of bacterial infection and very elevated CRP/procalcitonin.
Respiratory Distress Syndrome	Immediate respiratory distress.	Term newborn (38 weeks); presence of fever and elevated acute-phase reactants.
<i>E. coli</i> pneumonia	Confirmed: Maternal risk factors, consolidation on X-ray, and microbiological isolation.	-

TABLE 2. Timeline (Key events)

Day of life	Clinical Events and Management
Day 1 (0–12 h)	Term birth. At 12 h: onset of severe respiratory distress (Silverman 6), fever (38.4 °C), and hypoxemia (SatO ₂ 84%). Admission to the NICU, intubation, and mechanical ventilation (SIMV). Initiation of Ampicillin (162.5 mg every 12 hours) and Gentamicin (13 mg every 24 hours).
Day 3	Blood cultures positive for ampicillin-resistant <i>E. coli</i> . Regimen changed to cefotaxime (162 mg every 8 hours) + gentamicin.
Day 5	Clinical and blood gas improvement. Successful extubation to nasal CPAP.
Day 7	Gentamicin discontinued after ruling out renal and auditory toxicity.
Days 8–9	Transition to room air. Initiation of full breastfeeding.
Days 14–15	End of antibiotic course (14 days). Discharged from the hospital with excellent progress.

After completing the full 14-day course of targeted intravenous antibiotic therapy with cefotaxime, the patient achieved complete clinical recovery, remained afebrile, was hemodynamically stable, and did not require supplemental oxygen support. In the detailed predischARGE evaluation, which was performed on the fifteenth day of life, the neurological examination revealed muscle tone appropriate for gestational age, symmetrical and present primary reflexes, and a vigorous response to environmental stimuli, with no signs of focal neurological findings or acute neurological sequelae resulting from the infectious process.

As part of the follow-up protocol, hearing screening was performed using otoacoustic emissions, which yielded normal results bilaterally, ruling out hearing loss secondary to both sepsis and the therapeutic use of aminoglycosides. Likewise, the follow-up chest X-ray prior to discharge confirmed optimal lung expansion, with complete resolution of the consolidations and alveolar infiltrates observed at admission.

The newborn was discharged in excellent condition, was exclusively fed breast milk via a feeding tube, and experienced satisfactory daily weight gain. A multidisciplinary outpatient follow-up plan was established, with a comprehensive evaluation at one month of age that included a new thorough physical examination, an assessment of psychomotor development, and a follow-up chest X-ray to ensure the absence of chronic pulmonary complications.

This case report was conducted in accordance with the ethical principles established in the Declaration of Helsinki for medical research involving human subjects. The patient's mother provided her written informed consent, authorizing the publication of clinical information and laboratory results for academic and scientific purposes, under the commitment to protect her identity and that of her son and to ensure the confidentiality of both their personal data. Furthermore, the protocol for this study was reviewed and approved by the Ethics Committee of the Faculty of Medicine at the University of Medical Sciences of Villa Clara.

Discussion

This case illustrates a classic presentation of early-onset neonatal sepsis caused by *E. coli* with pneumonia in a term newborn, highlighting the importance of early recognition of maternal risk factors, timely initiation of empirical therapy, and targeted antibiotic adjustment on the basis of susceptibility patterns.

The patient presented with multiple well-established risk factors for early-onset neonatal sepsis. Premature rupture of membranes lasting 22 hours and maternal urinary tract infection with untreated fever constitute significant risk factors for neonatal infection. Premature rupture of membranes increases the risk of early-onset neonatal sepsis by 2.63 times, whereas maternal urinary tract or reproductive tract infection increases the risk by 3.61 times. The combination of these factors in this case underscores ascending vertical transmission as the primary pathogenic mechanism.⁸

The clinical presentation at 12 hours of life, with progressive respiratory distress, fever, and irritability, is characteristic of early-onset sepsis with a pulmonary focus. Radiological findings of bilateral consolidation with air bronchogram confirm bacterial pneumonia, a manifestation that frequently occurs in the context of aspiration of infected amniotic fluid during delivery.⁹

The patient's laboratory parameters reflect the severity of the infection. Marked leukocytosis (28,500/ μ L) with a significant left shift (WRC of 0.17) and moderate thrombocytopenia (85,000/ μ L) are characteristic findings of neonatal sepsis caused by gram-negative bacteria. (Thrombocytopenia is an independent predictor of mortality and severe illness in neonatal sepsis caused by *E. coli*, increasing the risk of mortality nearly fourfold, with an additional sixfold increase in the case of gram-negative sepsis. Thrombocytopenia in neonatal sepsis is independently associated with gram-negative infection (in contrast to gram-positive infection), maternal hypertension, and intravascular thrombosis.¹¹

Elevated acute-phase reactants (CRP concentration of 94 mg/L and procalcitonin concentration of 14.5 ng/mL) confirm the systemic infectious process. Elevated procalcitonin has diagnostic and prognostic value in neonatal sepsis, with recent studies demonstrating that combining procalcitonin with other biomarkers significantly improves diagnostic sensitivity and specificity. Fortunately, the patient did not present with neutropenia, another independent predictor of mortality and severe disease in patients with *E. coli* sepsis.^{12,13}

The immediate initiation of ampicillin and gentamicin as empirical therapy was appropriate and followed international recommendations for early-onset neonatal sepsis. This regimen provides adequate coverage for the most common pathogens, including *E. coli* and Group B Streptococcus, and most isolates remain susceptible to one or both antibiotics. (However, the isolation of ampicillin-resistant *E. coli* reflects a concerning epidemiological trend. Recent data show that approximately 90% of *E. coli* isolates in preterm infants and 37.5% in term infants are resistant to ampicillin.¹⁵

The timely switch to cefotaxime following the susceptibility report was a sound clinical decision. Third-generation cephalosporins maintain excellent activity against *E. coli*, with 90–95% of isolates remaining susceptible. The decision to continue gentamicin initially for synergistic effects is reasonable, although its discontinuation on the seventh day after ruling out toxicity reflects good antimicrobial stewardship practices.¹⁵

The 14-day duration of antibiotic therapy for *E. coli* bacteremia with pneumonia is appropriate according to current guidelines. Recommendations suggest a minimum of 7 days for bloodstream infections, with longer durations (7–21 days) depending on the pathogen, response to treatment, and site of infection. For gram-negative infections with a pulmonary focus, 10–14 days is a reasonable duration, especially considering the patient's favorable clinical course.^{5,16}

Respiratory management was stepwise and appropriate. Immediate endotracheal intubation in the face of respiratory failure with severe hypoxemia (oxygen saturation 84%, pO₂ 42 mmHg) and respiratory acidosis (pH 7.21, pCO₂ 62 mmHg) was necessary and timely. The successful transition to nasal CPAP on the fifth day and subsequently to room air on the eighth day reflects adequate resolution of the pulmonary process, correlating with radiological improvement and normalization of inflammatory parameters.⁹

Factors contributing to the favorable outcome in this case included full-term gestational age, adequate birth weight, early recognition of the disease, immediate initiation of appropriate empirical antibiotics, timely adjustment on the basis of susceptibility, adequate respiratory support, and the absence of neutropenia. The absence of meningeal involvement was also favorable, as *E. coli* meningitis requires longer treatment (21 days) and is associated with higher morbidity.⁵

It is essential to recognize the inherent limitations of this case report. By focusing on the clinical experience of a single patient, the findings and observed course cannot be generalized to the neonatal population as a whole, nor do they allow for definitive statistical conclusions regarding the efficacy of management protocols. Although the report successfully describes the approach in term newborns, available evidence indicates that the highest burden of morbidity and mortality (up to 50% in some series) is concentrated in preterm newborns, which limits the extrapolation of these results to the most vulnerable groups.^{4,15}

Conclusions

Escherichia coli pneumonia is a critical manifestation of early-onset neonatal sepsis that requires immediate clinical suspicion in the presence of risk factors such as prolonged rupture of membranes and maternal urinary tract infection. The therapeutic success in this case depended primarily on the rapid initiation of invasive ventilation and appropriate empirical antibiotic therapy that effectively covered gram-negative pathogens. This report underscores the need to strengthen epidemiological surveillance in light of the changing prevalence of neonatal pathogens and the emergence of antimicrobial resistance.

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