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Case Report

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Fatal Hemorrhagic Bacteremic *Escherichia Coli* Pneumonia in Neonate Post Cardiac Surgery

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Abstract

Pneumonia is an important cause of neonatal infection with the potential of high morbidity and mortality, especially if complicated by blood-borne infection. We presented a fatal case with correlated radiological images of neonatal hemorrhagic bacteremic *Escherichia coli* pneumonia in cardiac patient post coarctation of aorta repair. The presentation was unusual with massive pulmonary hemorrhage and unilateral lung involvement leading to respiratory and hemodynamic failure that failed mechanical ventilator support and rescue extracorporeal membrane oxygenation (ECMO).

Keywords

Neonatal sepsis, Pneumonia, *Escherichia coli*, Dynamic air bronchogram

Introduction

Neonatal sepsis is a systemic infection occurring in infants at ≤28 days of life. It is an important cause of morbidity and mortality of newborns [1]. Neonatal sepsis has been variably classified based on the age at onset, and is commonly categorized as early onset (within the first 3 or 7 days of life), versus late onset [2]. Neonatal pneumonia is a serious condition [3]; the diagnosis may be challenging and is based on a combination of perinatal risk factors, signs of neonatal respiratory distress, positive laboratory studies, radiological signs and a typical clinical course [4]. Although radiological evidence of pneumonia is an important feature of diagnosis, it may present late and lag beyond clinical presentation. Recently, Lung ultrasound has been advocated as a useful tool for detecting pneumonia in the pediatric population [5]. Increased rates of illness and death, especially in neonatal ICUs, have been reported with sepsis or pneumonia caused by extended-spectrum β-lactamase–producing *Escherichia coli* (ESBL *E. coli)* [1, 2, 4]. Severe cases of pneumonia with respiratory insufficiency not responding to conventional therapy may occasionally be candidates for extracorporeal membrane oxygenation (ECMO) [4].

In this report, we present a case of neonate who suffered from ESBL *E. coli* hemorrhagic pneumonia leading to refractory respiratory failure and overwhelming fulminant sepsis. All possible effort to save his life failed including conventional and non-conventional ventilator support and ECMO.

Case report

A full term baby girl, 3.3 kg appropriate for gestational age, was born to a primigravida with diet controlled gestational diabetes mellitus, following

uneventful caesarean delivery. The diagnosis of coarctation of aorta was suspected due to positive pulse oximetry screening and presence of murmur; Echocardiography confirmed the diagnosis. Prostaglandin infusion was started and surgical repair - coarctoplasty (extended end to end) - through left thoracotomy was performed in the third day of life. Patient was extubated within 24 hours to nasal cannula. In the fifth day of life, the patient became febrile with increased work of breathing and respiratory acidosis requiring (initially) non-invasive mechanical ventilation support. Due to sepsis suspicion, a sepsis screen that includes respiratory, blood and urine cultures was performed and broad-spectrum intravenous antibiotics (vancomycin 10 mg/kg every 6 hours and meropenem 40 mg/kg every 8 hours) were initiated. Within 4 hours, the patient progressed with significant unceasing frothy tracheal secretion and severe hypoxic respiratory failure similar to acute respiratory distress syndrome (ARDS) with a ratio of arterial oxygen tension to fraction of inspired oxygen (PaO_2/FiO_2) of 60, oxygen index of 40. Initial chest X-ray revealed right upper lobe haziness that progressed within few hours to completely consolidated whiteout right lung (Figure 1). Echocardiography ruled out any residual coarctation or other cardiac lesions that may contribute to pulmonary hemorrhage. Lung ultrasound demonstrated consolidated right lung with diffuse dynamic air bronchogram (Video 1). Pulmonary hemorrhage continued to be significant despite initial normal coagulation. Persistent severe hypoxic and hypercapnic respiratory failure (PH: 7.03, PCO_2 88, BE -9.8, Sat O_2 80%) sustained even with optimization of the ventilator settings, including the fraction of inspired oxygen (FiO_2 of 100%) and positive end-expiratory pressure (PEEP of 10 cmH_2O). High peak inspiratory pressure was continuously recorded on the conventional ventilation between 35-40 cmH_2O. In the presence of continuous pulmonary hemorrhage and failure of both conventional mechanical ventilation and conservative management with decompensated shock, the patient was put on rescue veno-arterial extracorporeal membrane oxygenation (V-A ECMO) with full flow rate 150 mL/kg/min. Severe disseminated intravascular coagulopathy (DIC) despite appropriate heparinization and multiple blood products replacements, with tissue hypoxia mandated ending ECMO support within few hours and patient succumbed due to fulminant refractory shock with overwhelming DIC. Septic screen showed significant inflammatory markers (high C-reactive protein 174 mg/L, leukopenia with white blood cell count of 3.5 x10^9/L) and cultures from blood, urine and endotracheal tube secretions grew ESBL *E. coli* confirming the diagnosis of fulminant *E. coli* sepsis associated with pneumonia.

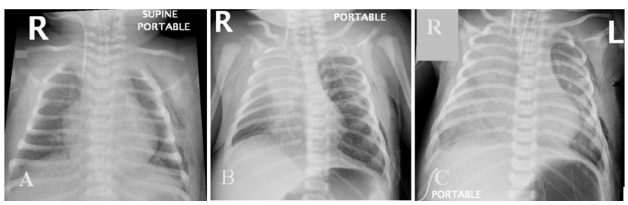


Figure 1: Figure 1: 6 days female post Coarctaion of aorta repair presented with apnea and pulmonary hemorrhage due to *E. coli* pneumonia with fulminant sepsis. Chest X-ray showed rapid progressive consolidating changes in the right lung within 24 hour:
A. Chest X-ray showed initially normal bilateral lungs field.
B. Chest X-ray showed right upper lung lobe consolidation.
C. Chest X-ray showed complete white out right lung after intubation

Discussion

Neonatal pneumonia is a serious respiratory infectious disease caused by a variety of microorganisms, mainly viruses and bacteria, with the potential of high mortality and morbidity especially if complicated by blood-borne infection [4]. Early-onset pneumonia can be part of generalized sepsis. Organisms are acquired from the maternal genital tract or nosocomial infection from the nursery. Group B *Streptococcus* is the most common etiologic agent, while *Escherichia coli* is the most common cause of mortality in the early neonatal sepsis especially ESBL *E. coli* [3]. ESBL *E. coli* are among the most multidrug-resistant pathogens in hospitals and are spreading worldwide [3]. In our case, there was fulminant sepsis; ESBL *E. coli* was isolated form tracheal aspirate, urine and blood cultures (central and arterial liens). The inflammation invaded the right lung with continuous pulmonary hemorrhage leading to refractory hypoxic respiratory failure similar to acute respiratory distress syndrome (ARDS). Significant pulmonary hemorrhage led to airway obstruction, significant ventilation/perfusion mismatching and anemia requiring blood replacement. Echocardiography ruled out the possibilities of contributory cardiac lesions (such as residual coarctation, depressed cardiac function, pulmonary artery thrombus). Wide spectrums of non-specific radiological abnormalities have been described in neonatal pneumonia [4]. Although chest X-ray showed rapid progressive consolidating changes in the right lung, but lung ultrasound was more specific revealing dynamic air bronchogram and lung hepatization indicating alveolar-interstitial syndrome consistent with clinical picture of severe hemorrhagic pneumonia (Video 1). Dynamic air bronchogram within consolidated lung had 94% specificity for diagnosing pneumonia [6]. The inflammatory markers and bacteriological cultures are consistent with diagnose of pneumonia, but the cultures results took 12 hours in our case while the lung ultrasound presented as a very early useful clue to make diagnosis of pneumonia.

Video 1: 6 days female post coarctation of aorta repair presented with Escherichia coli pneumonia. Lung ultrasound showed consolidated right lung displaying dynamic air bronchograms (arrow), the cardiac function is preserved with no pleural or cardiac effusion.

The constellation of rapid progressive unilateral lung involvement, positive cultures, significant pulmonary hemorrhage, and lung ultrasound finding made the diagnosis of hemorrhagic bacteremic *Escherichia coli* pneumonia is the most likely cause in our case. Additional investigations like, high-resolution computed tomography, lung biopsy, cardiac catheterization may be helpful in the diagnostic work up but the rapid clinical deterioration and unstable condition with overwhelming DIC did not allow using such diagnostic modalities.

Acute hemorrhagic pneumonia is fatal medical presentation that has been described with more details in animals [7]. Many studies tried to investigate the potential impact of bacteremic pneumonia due to a worse outcome. However, clinical studies of bacteremic pneumonia caused by ESBL producers are limited [8].

Currently, there is no prevention strategy for *Escherichia coli* early-onset neonatal sepsis. Intrapartum antibiotic prophylaxis for Group B *Streptococcus* neither prevents nor decreases the risk of *E. coli* early-onset neonatal sepsis [9]. Antimicrobial therapy in early-onset pneumonia is similar to that for neonatal sepsis including vancomycin and a broad-spectrum β-lactam drug [6] which were applied empirically early in our case before the results of cultures and antibiotics sensitivity. The patient manifested rapid overt clinical deterioration although the isolated ESBL *E. coli* was sensitive to meropenem with the minimum inhibitory concentration (MIC) of < 0.25 μg/mL, and despite bactericidal meropenem infusion dosing at 40 mg/kg over 30 minutes every 8 hours [10]. Many factors may affect drugs pharmacokinetics during extracorporeal membrane oxygenation, and therapeutic drug monitoring during ECMO is essential to maintain therapeutic concentrations of antibiotics notably for meropenem [11]. However the clinical deterioration and ECMO course were short and did not allow monitoring drug level.

Severe cases of neonatal respiratory insufficiency and sepsis not responding to conventional therapy may occasionally be candidates for ECMO [4] despite the advances in other less invasive therapies such as high frequency oscillatory ventilation, inhaled nitric oxide, surfactant and antibiotic therapy. Rescue neonatal ECMO had a mortality rate up to 50% [4].

The presentation in our case, with pulmonary hemorrhage and unilateral lung pneumonia on ultrasound in the presence of neonatal *Escherichia coli*, is unusual in the literature. Ultrasound helped to detect dynamic air bronchogram with alveolar interstitial syndrome and to identify pneumonia early even prior the results of cultures and laboratories findings.

Conclusion

Despite advances in neonatal medicine, *Escherichia coli* can still lead to lethal neonatal pneumonia with fulminant sepsis. US of lungs can be useful tool to make early diagnosis and proper management plan.

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