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Short Communication

The Clinical Picture of Neonatal Infection with *Pantoea* Species

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SUMMARY: *Pantoea* infections are uncommon in humans. Most reports have involved adults or children after thorn injuries. There are only a few reports of systemic infections with *Pantoea*. This is the first report of the clinical picture of systemic *Pantoea* spp. infection in neonates as observed during an outbreak in a neonatal intensive care unit caused by infected parenteral nutrition solutions. Even though detected early, the infections had a fulminant course, causing septicemic shock and respiratory failure. Pulmonary disease was prominent and presented mainly as pulmonary hemorrhage and adult respiratory distress syndrome. The organism was sensitive to most antibiotics used in neonatal intensive care units, but the clinical response to antibiotic therapy was poor. The fatality rate was very high: 7 out of 8 infected infants succumbed to the infection (87.5%).

Pantoea agglomerans, formerly known as *Enterobacter agglomerans* (or earlier still as *Erwinia herbicola*), is primarily an environmental and agricultural organism. It rarely causes infection in humans. The most common infection caused by *P. agglomerans* is septic arthritis or synovitis (1). Other reported infections caused by *Pantoea* include ostitis (2), cholelithiasis (3), occupational respiratory infections and skin allergy (4), and blood stream infection in an elderly person (5). These patients recovered from the infection. There is one report of peritonitis where *Pantoea* was one of multiple organisms cultured (6).

Here, we describe the clinical picture of *Pantoea* spp. infection in neonates as observed during an outbreak in a neonatal intensive care unit (NICU) due to infected parenteral nutrition (PN) solutions. The outbreak occurred in January 2004 and involved 8 babies. A description of the outbreak and how it was controlled has been reported elsewhere (7).

Case 1 was a preterm baby with a birth weight of 900 g. He had been treated for respiratory distress syndrome (RDS) and was on nasal continuous positive airway pressure (CPAP). At the age of 11 days, he presented with subtle signs of sepsis, i.e., hyperglycemia and mild metabolic acidosis after 10 h on the new batch of PN. He was started on intravenous (IV) amikacin and vancomycin and showed initial improvement. However, 10 h later he developed diffuse intravascular coagulation (DIC) and pulmonary and intraventricular hemorrhage and died within 24 h of presentation. His blood and cerebrospinal fluid grew *Pantoea* spp.

Case 2 was a term baby admitted to the ward because of perinatal asphyxia. He was 4 days old and on nasal CPAP when he began to show signs of deterioration. He developed tachycardia and hypotension approximately 2 h after the new PN batch was hanged. He had worsening respiratory distress and pneumonic changes on the chest radiograph and required mechanical ventilation for 6 days. *Pantoea* spp. was isolated from the blood. The parents refused lumbar puncture, and he was treated with meropenem for 2 weeks. He was the only survivor in this outbreak.

Cases 3 to 8 had a very similar clinical course to Case 1. Among them, there were two severely preterm babies who were in the recovery phase of their RDS, two borderline preterm babies (one with asphyxia and one with severe intrauterine growth retardation [IUGR]) and one term baby with VACTERL association (vertebral, anal, cardiac, tracheoesophageal fistula, renal and limb abnormalities). One of the 8 patients had Down syndrome. This patient had been born prematurely and had been on home oxygen therapy because of chronic lung disease before he was admitted for community acquired bronchopneumonia. The severity of the infections made Gram-negative infection likely, and Cases 3 to 8 received imipenem from the moment infection was suspected.

Each patient developed severe pneumonia with respiratory failure and septicemic shock. These were the main causes of death. All patients had temperature instability, and 7 patients (87.5%) developed DIC as evidenced by bleeding tendency, abnormal coagulation profile, and thrombocytopenia. Six patients (6/8) had platelet counts of less than 50×10^9/l within 24 h of infection. Mild conjugated hyperbilirubinemia occurred in 75% of cases. Half of the patients developed leukopenia (white cell count $< 5 \times 10^9$/l). Only one patient had lumbar puncture done (postmortem), and the cerebrospinal fluid grew *Pantoea* spp. Table 1 shows a summary of the course and complications of each patient.

For each baby the same organism was grown from the blood. The organism was labeled as *Pantoea* spp. Routine testing showed that it belonged to the family *Enterobacteriacae*. Some of the further tests (no reaction with lysine decarboxylase, arginine dihydrolase and ornithine decarboxylase) were suggestive of *P. agglomerans* (8), but the amylase was positive and the gelatinase was negative, which is against *P. agglomerans*. The full profile of API only gave 40.7% identification of *P. agglomerans*, which made us classify the organism as *Pantoea* spp. alone. The DNase was negative, which excludes the possibility of *Serratia*. The organism was sensitive to most antibiotics commonly used in the NICU, as shown in Table 2, and also to the antibiotics on which each patient was started at presentation. The same organism could

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Table 1. Summary of clinical features of cases

Case	Birth weight (g)	Gestational age (weeks)	Onset of sepsis (age in days)	Clinical condition	Pneu-monia	Pulmonary hemorrhage	Shock	DIC	Renal failure	Conjugated hyper-bilirubinemia	Lowest platelet count (10^9/l)	Lowest white cell count (10^9/l)	Outcome (time from presentation to death - in days)
1	950	26	11	RDS	Y	Y	Y	Y	N	Y	86	2.7	Death (1)
2	3,300	40	4	Asphyxia	Y	N	Y	Y	N	Y	19	6.4	Survival
3	1,700	33	180	Pneumonia[1)]	Y	N	Y	Y	N	Y	29	8.6	Death (5)
4	1,500	32	3	RDS	Y	Y	Y	Y	N	Y	33	6.1	Death (1)
5	3,200	40	5	VACTERL	Y	N	Y	N	N	NA	53	7.3	Death (1)
6	1,670	36	5	IUGR[2)]	Y	Y	Y	Y	Y	N	23	1.9	Death (2)
7	2,000	36	4	Asphyxia	Y	Y	Y	Y	N	Y	25	3.7	Death (4)
8	1,200	26	5	RDS	Y	Y	Y	Y	N	Y	13	4	Death (5)

[1)]: Pneumonia in an ex-premature Down syndrome patient with chronic lung disease.
[2)]: Intrauterine growth retardation in a baby with also polycythaemia and feeding intolerance.
DIC, disseminated intravascular coagulation; RDS, respiratory distress syndrome; VACTERL, vertebral, anal, cardiac, tracheoesophageal fistula, renal and limb anomaly; Y, yes; N, no; NA, not available.

Table 2. Results of antibiotic sensitivity testing of the isolated *Pantoea* spp.

Type of bacteria	Sensitive to	Resistant to
Pantoea spp.	Gentamicin	Ampicillin
	Netilmicin	
	Amikacin	
	Piperacillin	
	Tazocin	
	Cefuroxime	
	Ciprofloxacin	
	Imipenem	
	Meropenem	

The sensitivity was the same for all isolates (from each patient and from the parenteral nutrition solutions).

be cultured from the total PN the babies were on, as well as from a sample of the PN solution directly sent from the pharmacy.

This is the first report on the clinical presentation and course of *Pantoea* infections in neonates and infants. Previous reports have primarily focused on community acquired localized infections through thorn injuries. The infections reported here were caused by contaminated PN solutions.

The severity of infection and the poor outcomes may be related to the relative immune deficient status that is found in preterm and sick term infants. Otherwise, the virulence of the particular strain or a massive load of bacteria infused through the PN solution may be responsible for the severity of infections. These factors and a possible difference between in vitro and in vivo sensitivity may explain why antibiotic therapy was not successful in most of these patients.

The data presented here suggest that *Pantoea* spp., when involved in a systemic infection, has a predilection for the lungs. All babies developed severe respiratory problems soon after presentation, and respiratory failure was among the main causes of death.

Pantoea infection in neonates seems to have a particularly severe course with a high mortality rate. The organism seems to have some predilection for the lungs.

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