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Briefly Legal: PICC Not Placed Centrally Causes Necrotizing Fasciitis

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A 22-year-old G3P2 developed preterm labor at 27.5 weeks gestation. Upon admission to the hospital, an evaluation revealed the patient to be in advanced labor with bulging membranes and a transverse lie. With minimal delay, an immediate Cesarean section was performed with the delivery of an 1170-gram female infant with a birthweight of 1170-grams. Her Apgar scores were 2,4,7 at 1, 5, and 10 minutes, respectively. In the delivery room, she was intubated for 3 minutes for increased work of breathing. She was then brought to the Newborn Intensive Care Unit (NICU), where she was given surfactant replacement and empirically begun on ampicillin and gentamicin. Physical examination revealed significant bruising of the arms, legs, face, and trunk, for which prophylactic phototherapy was begun. A Ballard exam was consistent with a 30-week gestational age. Complete blood count (CBC) was unremarkable. Umbilical venous and arterial lines were placed.

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On **day 1**, she required another dose of surfactant, while antibiotics were discontinued. She was extubated, and trophic feeds were started.

On **day 3,** CXR revealed pulmonary interstitial emphysema (PIE), and she was reintubated.

On **day 6,** with worsening PIE, she was placed on continuous positive airway pressure (CPAP) without improvement, and she was reintubated and placed on high-frequency oscillatory ventilation (HFOV) but later changed to Jet ventilation.

On **day 7,** a cranial ultrasound showed a grade 2 intraventricular hemorrhage (IVH). Her feeds were advanced. On **day 11,** a NICU nurse attempted to place a percutaneous intravascular central catheter (PICC) line in the left hand to supplement the feedings with total parental nutrition (TPN). After placement, a radiograph revealed that the central line extended to the left shoulder and curved inferiorly and laterally with the tip overlying the left axilla. The nurse attempted to advance the catheter but had difficulty doing so. Only after 3 hours of manipulation was blood flow return achieved and the catheter secured in the left hand. The umbilical venous line was removed, and TPN was administered through the PICC line. The final radiograph that day reported that the PICC tip was at the level of the left subclavian vein just external to the rib cage. The components of the parenteral solution included osmolarity in far excess of 900 mOsm with calcium gluconate, a known vesicant.

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On **day 12,** several ventilator adjustments were required due to elevated pC02, and two more doses of surfactant were given.

On **day 13,** the patient was clinically hypotensive with a combined respiratory and metabolic acidosis. The blood gas showed a pH of 7.1. Because of increasing agitation, she was given phenobarbital and morphine.

By **day 14,** worsening hypotension. She required 100% inspired oxygen, and The chest radiograph showed noticeable increased soft tissue swelling at the site of the PICC tip, which the radiologist failed to mention. Trophic feeds were at 9 cc q 3 hours, and generalized edema and urine output diminished to the point of

anuria were noted in the evening.

On day 15, feeds were increased to 12 ml q3, while morphine was increased because of agitation. The infant's weight had increased by 190 grams. A lack of urine output for 12 hours and low blood pressure that evening prompted the nurse to call the neonatologist, who ordered electrolytes.

In the early morning hours of **day 16**, serum Na was found to be 119 meq/L and the K 9 meq/L; the neonatologist came to the bedside (6 hours after the call the prior evening). A CXR showed small gas bubbles in the left axillary region medial to the scapula. On physical examination, the left lower flank had blanching erythema and generalized edema. There was also poor perfusion with a capillary refill of >5 seconds, weak pulses, and a heart rate of >200 beats per minute. The baby was placed on 100% inspired oxygen on high ventilator settings, and dopamine was started. A CBC showed a WBC of 6, hct 26%, and platelets of 496. Two hours after the neonatologist arrived at the bedside and 90 minutes after the radiograph showed the bubbles of gas, the PICC was pulled, and a Replogle was placed. An hour later, a blood gas showed a profound metabolic acidosis with a base deficit (BD) of 18. About 3 ½ hours after the neonatologist arrived at the bedside that morning, Vancomycin and cefotaxime were started. An abdominal radiograph with a cross-table lateral film showed a nonspecific bowel gas pattern, relative paucity of bowel gas, no free air, and a gastric tube in the esophagus. The stool was negative for occult blood. A surgical consult was obtained to consider doing a laparotomy to rule out necrotizing enterocolitis. Cleocin was added to the antibiotics, and a bedside laparotomy was started. The bowel was intact, but copious fluid was found in the peritoneum.

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After surgery, the baby developed disseminated intravascular coagulopathy (DIC), and the skin discoloration noted prior to surgery became broader and deeper with discoloration.

On **day 17,** wound consultants recommended various topical solutions. The parents who requested a transfer of their baby to the local Children's hospital were told it was not necessary. In a deposition, the parents said they had called the Children's Hospital earlier in the week but were told that the doctors needed to arrange the transport.

On **day 18,** the skin lesions spread, with some blackened discolorations. Endotracheal, blood, PICC, skin, and peritoneum cultures were positive for Enterococcus faecalis Group D. Because the baby was unstable, no lumbar puncture was performed.

On **day 19,** the baby was transported to a Children's Hospital, whereupon, within 4 hours of arrival, she was brought to the operating room for debridement of the necrotizing fasciitis. Over the next several months, the baby pursued a complicated, stormy course with multiple debridements. Eventually, she was transferred to a full 24/7 care facility.

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The neonatologists and hospital were sued. The case was settled before going to court.

Plaintiff allegations:

- The catheter was not central.
- The non-central catheter contained an infusate with an osmolality >900 mOmol that was below the standard of care and created extravasation into the tissues where the PICC tip ended.
- The non-central catheter contained a high concentration of a vesicant of 10% calcium gluconate, was below the standard

of care, and created extravasation at the PICC tip-end

- The infusate eroded the subclavian vein where the PICC tip resided
- The extravasation was evident by day 13 with soft tissue swelling on the morning of the chest radiograph, but it was not recognized, and therefore, the high osmolar and vesicant-containing fluids were allowed to continue, causing pain, agitation, hypotension, and eventually infection
- The hypotension that ensued secondary to fluids being infused subcutaneously was not appreciated, and intervened promptly.
- The right ante cubical vein is preferred since it most directly connects to the desired central location (junction between the superior vena cava and the right atrium).
- There is no documentation or reason why the left hand was chosen instead of the right antecubital area.
- Delay in evaluation and intervention of hypotension, edema, decreased urine output
- Delay in discontinuing the catheter placed
- Lack of recognition of infection with signs of instability clinically and by laboratory, days 12-13
- Delay in antibiotic administration when infection was probably occurring on days 12-13
- Nurses not recognizing and insisting on evaluations, intervention, or transfer
- Exposing the baby to a laparotomy despite the gas bubbles on the radiograph 6 hours in the
- left chest wall where the tip of the catheter was present
- Putting NEC as the probable diagnosis for clinical deterioration in the face of soft tissue findings on the flank and chest of rapid spreading swelling and erythema,
- Not appreciating the soft tissue findings of swelling erythema despite the documentation of the findings on nursing notes and nursing depositions
- Not recognizing necrotizing fasciitis at any point in the entire hospital stay
- Not transferring timely despite parents' requests days earlier
- The hospital does not have a pediatric radiologist or infectious disease expert on staff
- Despite multiple requests for PICC policy, it was not produced until a trial was being undertaken. The policy was lacking in several details, and many that were listed were not followed.

Defense:

- Everyone met the standard of care
- She was too unstable to transfer
- 27-week babies with IVH have adverse outcomes because of prematurity
- NF is difficult to diagnose and can only be diagnosed at surgery

"Necrotizing fasciitis (NF), or flesh-eating disease, is a rapidly progressive bacterial infection of the subcutaneous tissue. While predominantly an adult disorder, it has been reported in children with immunocompromised conditions and as a complication of bacterial infection from dental issues; it is exceedingly rare in a newborn. The incidence in children is 0.08 to 0.13 per 100,000 per year compared with 0.4 per 100,000 per year in adults. In children, most infections affect the trunk and lower extremities and, occasionally, in those with dental issues."

Discussion:

Necrotizing fasciitis (NF), or flesh-eating disease, is a rapidly progressive bacterial infection of the subcutaneous tissue. While predominantly an adult disorder, it has been reported in children with immunocompromised conditions and as a complication of bacterial infection from dental issues; it is exceedingly rare in a newborn. The incidence in children is 0.08 to 0.13 per 100,000 per year compared with 0.4 per 100,000 per year in adults. In children, most infections affect the trunk and lower extremities and, occasionally, in those with dental issues. In the rare neonate, most cases are attributable to infection of omphalitis, balanitis, mastitis, postoperative complications, and fetal monitoring. NF is characterized by marked tissue erythema, edema, rapid spread, blebs, bullae, necrosis, and signs of systemic toxicity. It is usually a polymicrobial infection. The infection typically spreads along the muscle fascia, where the blood supply is scant. The muscle tissue is often spared because of its generous blood supply. In contrast to cellulitis, necrotizing fasciitis is an aggressive infection that may rapidly cascade to organ failure and death within hours. In its early stages, NF can look clinically very much like cellulitis.

A high index of suspicion is needed for the early diagnosis of NF since its presentation is often obscure, and the disorder carries a high rate of morbidity and mortality, especially if the diagnosis is missed. Early recognition is critical to improved mortality and morbidity, but it is challenging to recognize in its initial stages with its nonspecific presentation. Some clinicians have found "triple diagnostics" useful. This approach consists of incisional biopsy with macroscopic, histologic, and microbiotic evaluations of the most affected area.

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Imaging modalities are sometimes used when practical. Ultrasound, however, is not sensitive enough to exclude the diagnosis of NF, but the findings may be helpful in the rapid evaluation of unstable patients under consideration of NF. The findings on ultrasound generated the mnemonic STAFF, which stands for Subcutaneous Thickening, Air, and Fascial Fluid. Computed tomography (CT) and magnetic resonance imaging (MRI), while sensitive and specific modalities are often time-consuming or unavailable for a critically ill baby. CT scans show soft-tissue thickening, swelling, fat stranding, and enhancement or hyperemia. The presence of soft-tissue gas in the absence of penetrating trauma suggests NF. The CT hallmark of soft-tissue air with deep fascial fluid collections is not always seen, and its absence should not prompt the exclusion of NF because, in the early phase of the disease, gas may not yet have been formed or reached detectable levels. While MRI is the modality of choice for detailed evaluation of soft-tissue infection, it is not generally performed for NF evaluation because it is time-consuming and delays treatment.

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Clinical suspicion should outweigh laboratory and imaging adjuncts for diagnosing NF, especially in the early stages of the disease, where the therapeutic benefit of debridement is the greatest. Clinical suspicion can be supported by a fresh frozen section and Gram staining during incisional biopsy, which might result in a more timely identification of this life-threatening condition.

Prompt surgical debridement, appropriate antibiotics, and supportive care are the mainstays of its management. Timely transfer to a medical center equipped to handle the complex nature of care is critical.

Suggested reading:

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