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Fatal *Clostridium perfringens* Meningitis Following Caudal Anesthesia in an Infant: A Case Report

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Caudal anesthesia is referred to as a simple and safe method to obtain analgesia in infants during various surgical procedures. Here, we present a fatal course of a premature infant that received caudal anesthesia for inguinal hernia repair. While anesthesia and surgery were uneventful, the child developed an acute bacterial meningoencephalitis within a few hours. Microbiology revealed the presence of *Clostridium perfringens* in the cerebrospinal fluid (CSF). The infant died 17 days after surgery. Preoperative screening for *C. perfringens* and particular caution in infants with intracerebral hemorrhages are discussed as potential factors to be considered when anesthesia is planned. (A&A Practice. 2020;14:e01188.)

GLOSSARY

CPAP = continuous positive airway pressure; **CRP** = C-reactive protein; **CSF** = cerebrospinal fluid; **IL-6** = interleukin-6; **i.v.** = intravenous; **OR** = operating room

Single-shot caudal anesthesia has an excellent safety record, and long-term sequelae have not yet been reported.[1] Recent literature suggests to prefer caudal blockade over general anesthesia in neonates and infants when applicable.[2] Although short-term exposure may not result in significant neurotoxicity, long-term or repeated exposure may have an impact on children's cognitive development.[3] Sufficient caudal blockade can be achieved in many, although not in all subjects; ultrasound has been proven to improve the success rate in some patients.[4]

Besides hematomas, infectious complications are the most common and feared hazard associated with neuraxial anesthesia. Aseptic procedure, including rigorous skin disinfection, is substantial to minimize the risk. However, commonly used disinfectants—alcohol and/or iodine based—are not effective against bacterial spores. Additional individual risk factors have not been described.

Here, we present a fatal course of an infant receiving caudal anesthesia. Written consent has been obtained from the patient's relatives.

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CASE DESCRIPTION

A male child (400 g, 27th week of gestation) was delivered by primary cesarean delivery due to small for gestational age and signs of placental insufficiency. Amniotic fluid was clear; however, the newborn adaptation was delayed and he required respiratory support by continuous positive airway pressure (CPAP) mask. The child was subsequently transferred to the neonatal intensive care unit where respiratory support was continued. Intensive care included the administration of surfactant, caffeine citrate, empirical antibacterial therapy with piperacillin, spironolactone, and hydrochlorothiazide. Sonography of the central nervous system revealed intracranial hemorrhages grade 1 (right side) and 2 (left side). Initial perianal smear was negative; however, it revealed colonization with multidrug-resistant *Acinetobacter pittii* on day 14. Further course was uneventful, and the child recovered appropriately.

Anesthesia and Surgery

At the age of 3 months (body weight 2620 g), the child was planned for an open both-sided inguinal hernia repair in awake caudal anesthesia. In the operating room (OR), blood pressure, oxygen saturation, and heart rate were monitored noninvasively. The child was sedated with propofol (2 mg/kg intravenously [i.v.]) and positioned in the left lateral position. Spontaneous breathing was maintained during the whole procedure. Caudal anesthesia was performed by an experienced senior anesthetist according to our hospital standard operating procedure under aseptic conditions. In detail, skin was disinfected with a colored, alcohol-based disinfectant (Braunoderm, 50% isopropyl alcohol and 1% povidone-iodine; BBraun AG, Melsungen, Germany) 3 times in a craniocaudal direction according to the manufacturer's instructions (>1 minute each). Surgical face masks were worn by all personnel in the OR; sterile gloves were worn by the anesthetist during the procedure. Caudal space was identified with ultrasound (SonoSite X-Porte, sterile cover; SonoSite, Bothell, WA), and a 22-gauge hollow needle with obturator (Epican Paed; BBraun AG, Melsungen, Germany) was entered through the hiatus sacralis, advanced

into the epidural space, and 1.15 mL/kg of 0.375% solution of ropivacaine was instilled after aspiration was negative for blood and cerebrospinal fluid (CSF). Epidural spread of the local anesthetics was confirmed by ultrasound. After about 10 minutes, sufficient analgesia was confirmed and surgery started. Surgery was finished after 51 minutes, no further analgesics were required, and neurology remained adequate at any time. No signs of spinal block were noted.

Postoperative Course

In the subsequent night, the child developed fever up to 39°C and elevated infect parameters in the blood (C-reactive protein [CRP] 3 mg/dL, interleukin-6 [IL-6] 1477 pg/dL). Both parameters further increased with a maximum of 27.6 mg/dL (CRP) on day 3 and 26,105 pg/dL (IL-6) on day 1 after surgery. An empiric broad antibacterial therapy was initiated with i.v. cefotaxime, ampicillin, and gentamycin. Although the abdomen was firm and painful, abdominal sonography and x-ray did not present any signs of intestinal perforation. However, an explorative laparotomy was performed in general anesthesia on the next day without pathological findings.

On the second postoperative day, brain sonography showed signs that appeared compatible with an inflammatory process, for example, ventriculitis or periventricular leukomalacia. Spinal cord occurred without pathologies. However, lumbar puncture revealed increased cell counts (10,054/µL), protein (992 mg/dL), and lactate (74 mg/dL) in the CSF. Differential count showed predominantly polymorphonuclear (95%) and few mononuclear (5%) leukocytes. Gram stain assay identified Gram-instable rods; however, microbiological culture did not show any bacterial growth. Antibacterial therapy was switched to meropenem and vancomycin. Lumbar puncture was repeated after 2 days and showed still high lactate (85.6 mg/dL) while both cell counts and protein decreased (450/µL and 674 mg/dL, respectively). Blood cultures did not show any bacterial growth. However, the presence of *Clostridium perfringens* was detected in the CSF by means of real-time polymerase chain reaction. In addition to the antibacterial therapy, dexamethasone was administered over 48 hours to prevent brain edema.

Despite all efforts, clinical condition deteriorated rapidly. Sonography exhibited significant cystic remodeling of the brain tissue (Figure) 3 days after surgery. The child developed a secondary brain edema grade 3, accompanied by generalized epileptic seizures that required anticonvulsive therapy (diazepam and phenobarbital). In the further course, apnea and severe disturbance of the temperature homeostasis developed.

The child died 1 week later with a fulminant bacterial meningoencephalitis and multiorgan failure.

DISCUSSION

Safety of Neuraxial Blockades

In a recent analysis of more than 100,000 regional blockades, no permanent neurologic deficits occurred with any type of regional anesthesia in children [1]. A retrospective analysis of more than 24,000 infants and children revealed complications caused or associated with neuraxial blockades in 0.45%, the majority of them without any late sequelae.[5] However, 5 serious accidents (0.02%) were described; all these infants were <3 months old and died (3) or remained tetraplegic (1) or paraplegic (1) after the use of lumbar epidural anesthesia in combination with general anesthesia. All of them exhibited neuroradiological pathologies (hypo- or hyperdensities) in the spinal cord; all of these findings were suggestive of ischemic lesions. Interestingly, all children in this series received bupivacaine, and lesions could be attributed to the neurotoxicity of this local anesthetic, particularly in small infants that might be more vulnerable due to their unmyelinated fibers. Cystic remodeling of the brain, as observed in our case, has not been described elsewhere. A case of sacral osteomyelitis after single-shot epidural anesthesia in a 6-year-old child with complete recovery has also been reported.[6]

A further survey reports 41 complications in more than 31,000 children; none of them resulted in either sequelae or harm.[7] However, complications occurred more often in younger (<6 months) than in older children and more often with central than with peripheral blocks. No serious infectious complications were observed. A survey in the United Kingdom detected 5 serious incidents after epidural anesthesia in more than 10,000 children, including 2 epidural abscesses and 1 meningism.[8] Infections occurred delayed after several days; all of them recovered completely. Caudal anesthesia was associated with the lowest infection rate as compared to lumbar and thoracic epidural. Asymptomatic colonization of epidural catheters has also been described by others.[9] The majority of infectious complications has been with the use of catheter techniques, not with single-shot blockades.

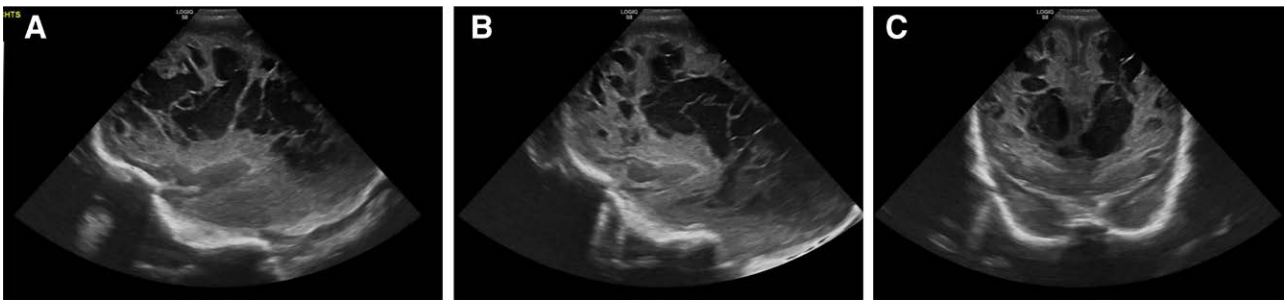

Figure. Cerebral sonography 15 d after surgery. A and B, Right and left parasagittal sections. C, Coronal section. All sections show multiple cystic lesions of the white matter (leukodystrophia). The lateral ventricles are dilated and show multiple free-floating echos and fibrous strands compatible with a ventriculitis. In the right frontal horn region, aligned hyperechogenic small regions are seen resembling gas bubbles.

In summary, caudal anesthesia has been attested an "excellent safety record" by experts in the field.[10]

Cause or Coincidence?

Clostridium perfringens is a ubiquitous, obligately anaerobic, Gram-positive, spore-forming, rod-shaped bacterium that is widely distributed in the environment. Clostridia species are common inhabitants of the gastrointestinal tract and of the female genital tract. In infants, clostridial infections represent a rare but significant cause of neonatal sepsis that is often transferred by the mother during birth. In addition, *C. perfringens* meningitis has been described in a few anecdotic case reports as a complication of surgical procedures such as craniotomy or insertion of a ventriculoperitoneal shunt in adults and children. The disease is referred to as usually foudroyant and the outcome fatal.

Clostridial meningitis has also been described as a possible consequence of a lumbar puncture procedure in a small infant.[11] This report shares some similarities to our case. The child was born immature and presented a complicated clinical course with group B streptococcal pneumonia, septicemia, and bilateral intracerebral hemorrhages. Acute deterioration occurred 14 hours after a lumbar puncture that was indicated to release post-hemorrhagic hydrocephalus. Postmortem examination revealed typical signs of clostridial meningoencephalitis, including gas formation, necrotic areas, and leukomalacia. Posthemorrhagic necrotic areas in the brain may have paved the way for growth of *C. perfringens* in both cases. Intracerebral hemorrhage might even promote *C. perfringens* meningitis without prior lumbar puncture procedure.[12]

Although an alternative route of infection remains—theoretically at least—possible, time course and negative blood cultures strongly suggest a caudal route of entry.

This case illustrates that infectious complications are a continuously present threat with every invasive procedure. Aseptic precautions can minimize but never guarantee prevention of infections. Until today, no skin disinfectant is known to be effective against bacterial spores, unless residence time exceeds many hours.[13] Future studies should address the impact of screening measures for the presence of spores in infants undergoing surgical procedures. The presence of intracerebral hemorrhages in history may increase the risk to develop a meningitis with *C. perfringens* species and should therefore be considered when anesthesia regime is planned.

DISCLOSURES

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