Lipid Infusion Through Malpositioned Central Venous Catheter: Head Ultrasound Features

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ABSTRACT

Properly placed central venous catheters have been effective in establishing prolonged access for total parenteral nutrition infusion in ill neonates. However, malposition of the catheter may lead to lethal complications. Malposition and infusion into the epidural venous plexus is most commonly diagnosed on the basis of radiographs and has been confirmed by lumbar puncture. Several studies describe catheter malposition and associated complications. None, however, demonstrate head ultrasound features. We present sonographic findings in a patient who received hyperalimentation for 15 days through a malpositioned lower extremity peripherally inserted central venous catheter.

CASE REPORT

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The patient was a 1,430 gram male neonate born at 30 4/7 weeks via vaginal delivery to an 18-year-old gravida 1, para 0 mother. The mother received 1 dose of steroids and 2 doses of antibiotics for prophylaxis prior to delivery. Non reassuring fetal heart tones led to induction of labor and artificial rupture of membranes. APGAR scores were 3 and 7, at 1 and 5 minutes respectively. The patient continued to experience respiratory distress, was intubated immediately upon arrival to the neonatal intensive care unit, and received 1 dose of surfactant. The first day after delivery, a peripherally inserted central venous catheter (PICC) was inserted into the patient's left saphenous vein. An AP abdominal radiograph was obtained, the radiologist's interpretation was that the line terminated at the L3 level, and total parenteral nutrition was initiated. The patient developed a new cardiac murmur on day 4 and subsequent echocardiogram revealed a PDA. The patient was started on an intravenous NSAID in attempt to close the PDA, which was discontinued on day 5 after head ultrasound revealed a grade 3 left germinal matrix hemorrhage and a grade 1 right germinal matrix hemorrhage (Fig. 1a,1b, 2). The NSAID was subsequently re-initiated after the germinal matrix hemorrhage remained stable for 48 hours. On day 8, the patient began to experience changes on physical examination and was described as limp and minimally responsive. It was hypothesized that clinical deterioration was due to the large PDA, for which he underwent ligation on day 10. On day 12, follow-up head ultrasound revealed echogenic material within the subarachnoid space and venous sinuses (Fig. 3,4). A sepsis evaluation including lumbar puncture was conducted on day 15. The cerebrospinal fluid appeared milky white, and laboratories indicated 9292mg/dl glucose, 3375 mg/dL triglycerides, 112 mg/dL proteins, and no organisms. These findings, consistent with parenteral nutrition infusion, prompted review of the initial frontal radiograph; the catheter projected towards the midline and there was an abnormal kink. This led to suspicion that the catheter was not in the appropriate vessel (Fig. 5). A subsequent cross table lateral radiograph confirmed that the catheter deviated posteriorly and into the ascending lumbar vein (Fig. 6). Hyperalimentation was terminated immediately and the catheter was removed. An MRI of the brain and spine conducted 4 days later demonstrated dependently layering proteinaceous material and

or hemorrhage in the lateral ventricles (Fig. 7,8), subarachnoid/subdural space, (Fig. 9,10) and an extensive fluid containing epidural collection consistent with cord compression (Fig. 11,12). The patient subsequently underwent several exploratory spinal surgeries in an attempt to relieve pressure, but the patient did not clinically improve. The attending neurosurgeon identified fibrosis and scarring around the spinal cord likely due to chemical irritation and necrosis, rather than compression of the spinal cord. Unfortunately, the patient passed 36 days after the malpositioned catheter was identified and removed.

DISCUSSION

Properly placed PICC lines into the left saphenous vein ascend via the left iliac vein, project to the right of midline at the L4-L5 level, and ascend in the inferior vena cava. However, it is possible for the catheter to deviate posteriorly and enter the epidural venous plexus via the ascending lumbar vein (1-3). This case describes a patient whose central catheter entered the epidural venous plexus through an ascending lumbar vein and perforated it, with subsequent infusion into the CSF.

The absence of blood with line aspiration, respiratory distress, neurologic deficits, elevated cerebrospinal protein, glucose, and lipid in a patient receiving central venous hyperalimentation may indicate line malposition (2, 3). Likewise, subtle lateral deviation of the catheter at the level of L4 -L5 and catheter path directly over the vertebral column, rather than to the right of midline on frontal abdominal radiographs, suggests malposition (2,4). Furthermore, pulsatile flow of bright red blood suggests arterial placement.

Complications associated with catheter malposition into the epidural venous plexus include venous stasis and thrombosis, vasculitis, increased pressure in the spinal canal, spinal cord injury, and perforation into the subarachnoid space (2). The literature describes at least 12 patients with central venous catheter malposition (2, 4- 8). 5 of these patients were found to have milky cerebrospinal fluid, 2 developed neurologic sequele including seizure, quadriplegia, urinary retention, and 1 suffered cardiac arrest. Full recovery was observed in 7 of these patients when the catheter was removed immediately and 2 suffered lethal complications related to malposition (2). There have been at least 10 cases of neurologic complications reported in neonates caused by malposition of lower extremity central venous catheters into the ascending lumbar vein. The interval between placement of the catheter and appearance of symptoms ranged from 1 to 11 days. Our patient developed neurologic changes on day 8. In all cases, initial placement of the catheter was considered satisfactory based on standard anteroposterior radiographs (2, 3, 4, 9-16).

When frontal radiographs are difficult to interpret, cross table lateral radiographs more clearly demonstrate the posterior course of malpositioned catheters into the ascending lumbar veins. The subtle posterior deviation of the catheter was not recognized in our patient on the initial radiograph. Head ultrasound revealed hyperechoic material in the subarachnoid space. Initially, this material was felt to represent blood. Sonographic features of hyperalimentation infusion through malpositioned catheters have not been described in the literature. Consequently, clinical correlation, cerebrospinal laboratories, and review of the initial AP and cross table lateral radiographs supports that our patient's ultrasound findings are a result of the catheters malposition.

TEACHING POINT

Cross table lateral radiographs are recommended in neonates to confirm initial lower extremity PICC line placement. If head ultrasound reveals hyperechoic material in the subarachnoid space, review of the patients line position may be warranted.

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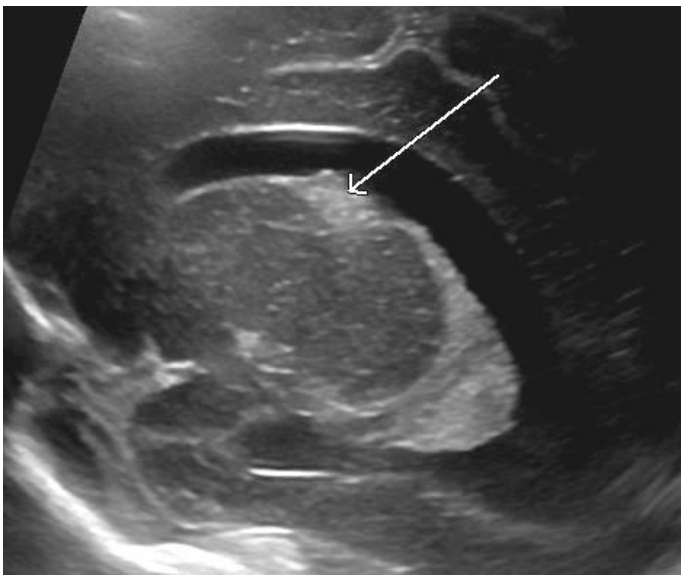
FIGURES



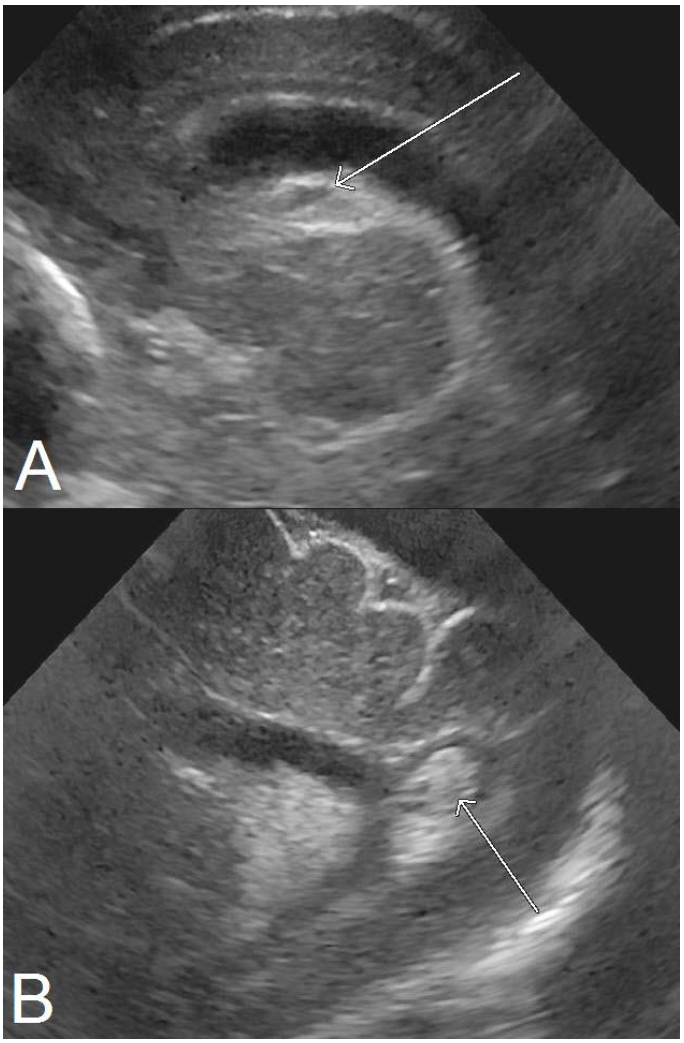


Figure 1 (top). 5 day old male with grade 3 left germinal matrix hemorrhage. Grayscale ultrasound images through the anterior fontanelle in the parasagittal plane demonstrate echogenic material in the left caudothalamic groove and in the atria of the left ventricle. There is hydrocephalus.

Figure 2 (left). 5 day old male with grade 1 right germinal matrix hemorrhage. Grayscale ultrasound image through the anterior fontanelle in the parasagittal plane demonstrates echogenic material in the right caudothalamic groove.

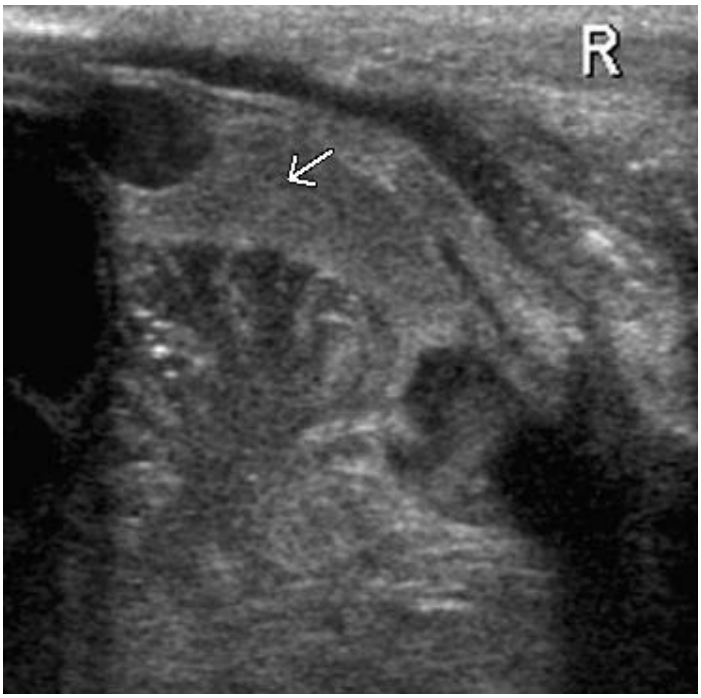


Figure 3. 12 day old male with malpositioned central venous catheter. Grayscale ultrasound image of the posterior fossa through the mastoid fontanelle in the axial plane demonstrates echogenic material within subarachnoid/subdural space surrounding the right cerebellum.

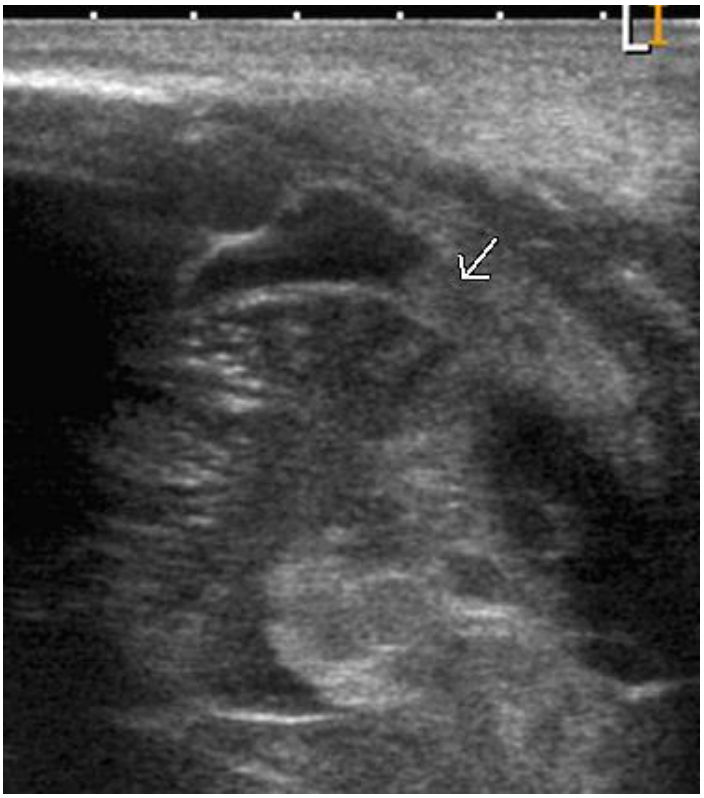


Figure 4. 12 day old male with malpositioned central venous catheter. Grayscale ultrasound image of the posterior fossa through the mastoid fontanelle in the axial plane demonstrates echogenic material within subarachnoid/subdural space surrounding the left cerebellum.

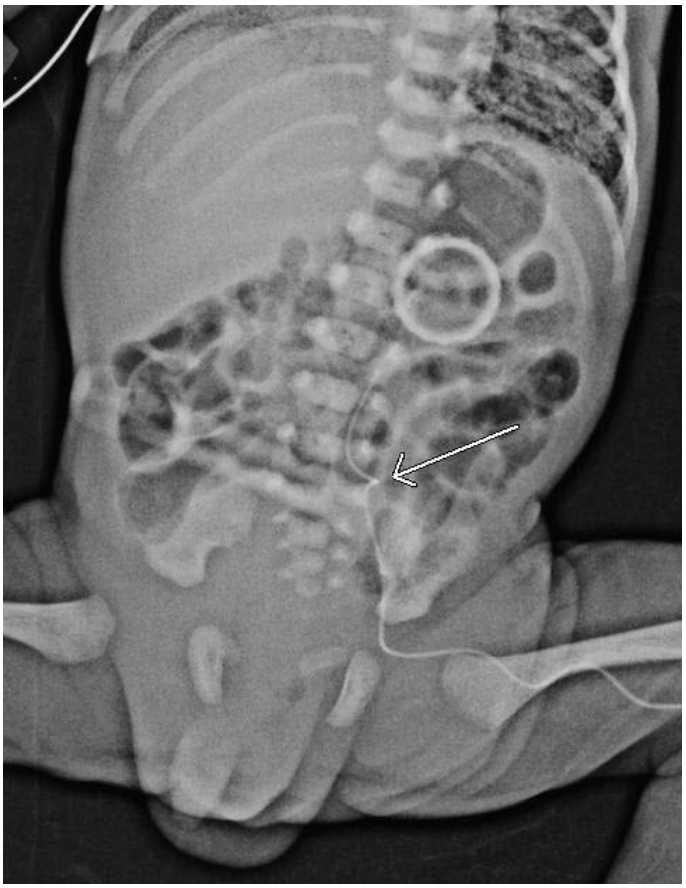


Figure 5. 1 day old male with malpositioned central venous catheter. Frontal abdominal radiograph demonstrates abnormal kink and that the catheter tip terminates left of the midline.

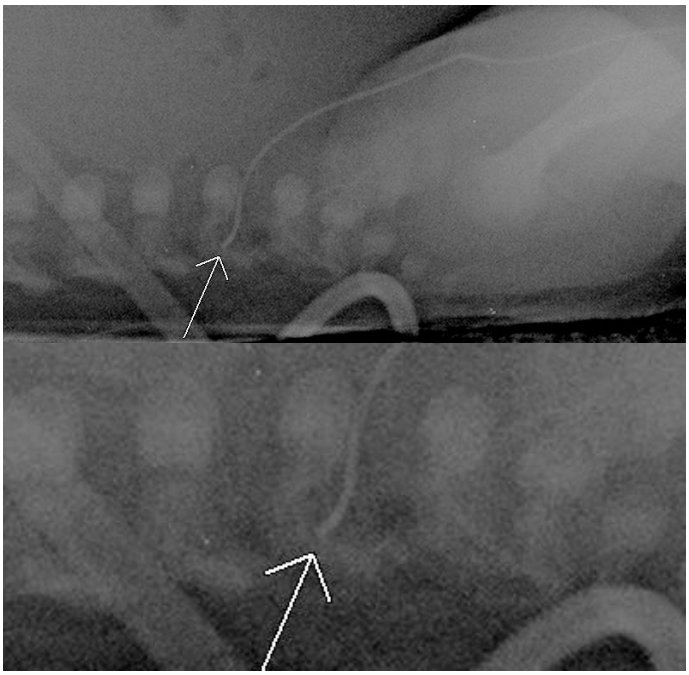


Figure 6. 15 day old male with malpositioned central venous catheter. Cross table lateral radiograph demonstrating posterior projection of the catheter into the ascending lumbar vein (magnification in lower half of figure).

Figure 7. 20 day old male with malpositioned central venous catheter. Axial T2W FLAIR MRI image (TR=8002, TE=128.66, 1.5T, SL=4mm) without intravenous contrast through the brain at the level of the lateral ventricles demonstrates material with abnormally decreased T2 signal layering in the dependent portion of the right lateral ventricle.

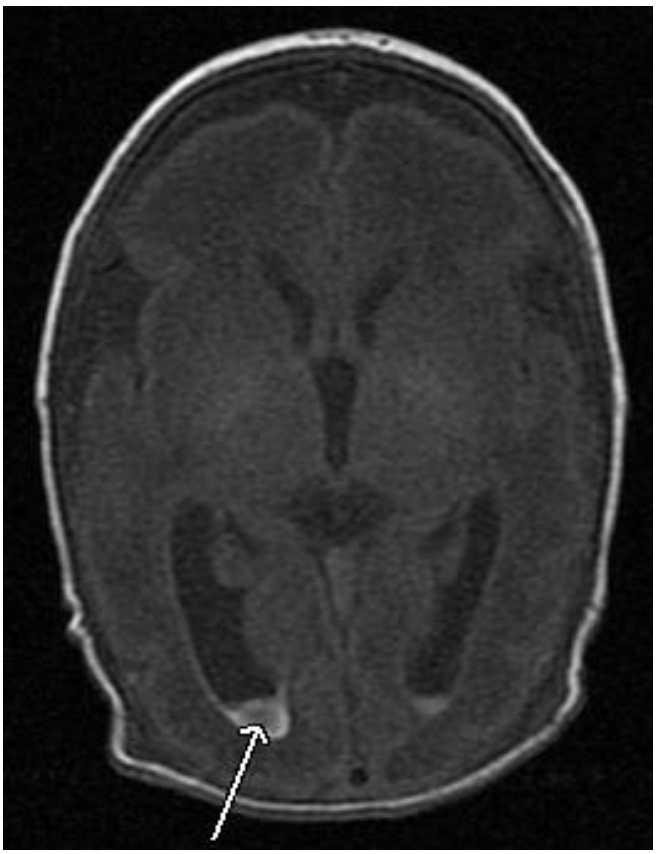


Figure 8. 20 day old male with malpositioned central venous catheter. Axial T1W MRI image (TR=416.66, TE=16, 1.5T, SL=4mm) without intravenous contrast through the brain at the level of the lateral ventricles demonstrates increased T1 signal material layering posteriorly in the right lateral ventricle.

Figure 9 (left). 20 day old male with malpositioned central venous catheter. Axial T2W FLAIR MRI image (TR=8002, TE= 128.66, 1.5T, SL=4mm) without intravenous contrast through the brain at the level of the cerebellum demonstrates hyperintense signal within the subarachnoid/subdural space surrounding the cerebellum.

Figure 10. 20 day old male with malpositioned central venous catheter. Axial T1W MRI image (TR=416.66, TE=16, 1.5T, SL=4mm) without intravenous contrast through the brain at the level of the cerebellum demonstrates hyperintense signal within the subarachnoid/subdural space surrounding the cerebellum.

Figure 11. 20 day old male with malpositioned central venous catheter. Sagittal post contrast T1W MRI image of the spine (TR=400, TE=11, 1.5T, SL=3mm) with fat saturation after injecting 0.35mL of magnevist (gadopentetate dimeglumine) demonstrates a prominent collection of low signal in the posterior epidural space along the majority of the spine compatible with lipid and fluid. (long arrow) The thecal sac is effaced in the cervical to upper thoracic spine and there is mass effect on the spinal cord. Note is made of an enhancing epidural vein. (short arrow)

Figure 12 (bottom). 20 day old male with malpositioned central venous catheter. Sagittal post contrast T2W MRI image of the spine (TR=2616.66, TE=96.45, 1.5T, SL=3mm) after injecting 0.35mL of magnevist (gadopentetate dimeglumine) demonstrates a prominent collection of high T2 weighted signal in the posterior epidural space along the majority of the spine compatible with lipid and fluid. The thecal sac is effaced in the cervical to upper thoracic spine and there is mass effect on the spinal cord.

ABBREVIATIONS

PICC = peripherally inserted central catheter
PDA = patent ductus arteriosis
NSAID = non-steroidal anti-inflammatory
MRI = magnetic resonance imaging

KEYWORDS

Catheter, Malposition, Ultrasound