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Lactescent urine following pediatric cardiac surgery due to catheter migration

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Abstract

Background Central venous catheterization is crucial for the perioperative and postoperative management of neonatal cardiac surgery patients. The procedure can be challenging due to the small size of the vessels, and it carries a high risk of morbidity and mortality. The most common sites for catheter insertion are the jugular or femoral veins; however, jugular access is typically avoided in patients with univentricular heart disease. The most frequent complications associated with central venous catheters are thromboembolic events and infections. Here, we present a case of lactescent urine in the postoperative period following cardiac surgery, attributed to the migration of a central venous catheter into the renal vein.

Case presentation We report the case of a newborn with an antenatal diagnosis of type B aortic arch interruption, who underwent complete surgical correction on day 9 of life. The infant presented with lactescent urine on postoperative day 5. Extensive investigations revealed that the central venous catheter had migrated into the right renal vein.

Conclusion Lactescent urine is an uncommon presentation in children and is most often associated with parasitic infections. In our case, this condition was related to the diffusion of parenteral nutrition into the renal vein. This case illustrates a rare postoperative complication, where a central venous catheter migrated into the renal vein following cardiac surgery.

Keywords Aortic arch interruption, Cardiac surgery, Lactescent urine, Pediatric critical care, Central venous catheter, Catheter migration, Catheter-related renal complications

Background

In pediatric critical care, particularly following cardiac surgery, the use of venous central catheters is essential for administering medications and providing parenteral nutrition [1]. There is no clear guidelines for size or insertion site in pediatric cardiac surgery [2], with specific complications for each site. The procedure can be challenging due to the small size of the vessels, and it is associated with high morbidity and mortality [3]. The most common complications include thromboembolic events and infections [4, 5]. Lactescent urine, characterized by a milky appearance, is defined as chyluria. The differential diagnoses include several medical conditions,

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Fig. 1 Radiography showing the catheter tip at the entrance of the atria the day of its placement (red arrow showing the catheter tip)

such as chyluria caused by lymphatic filariasis (a parasitic infection), trauma, surgeries, and malformations of the lymphatic system [6]. In this report, we describe the migration of a venous central catheter into the renal vein during the postoperative period of cardiac surgery. This is the first documented case of lactescent urine caused by renal vein perfusion with parenteral nutrition.

Case presentation

The patient was a female neonate with and antenatal diagnosis of type B aortic arch interruption, with Di George syndrome. The patient was born at 39 weeks and 4 days of gestation, weighing 2780 g and measuring 50 cm in length. She was being monitored for a prenatal diagnosis of DiGeorge syndrome (22q11 microdeletion) without any other extracardiac abnormalities upon

Fig. 2 Lactescent urine in urinary catheter

evaluation, including a normal abdominal ultrasound, phosphocalcium balance, thyroid function, and immune profile. She required a 3 lumens 13 cm 4,5 french right femoral central venous catheter at two days of life for alprostadil perfusion. The femoral position for the catheter was chosen to preserve upper vascular access for the surgeon. A radiographic check of the catheter placement on the same day confirmed the catheter tip at the entrance of the right atrium (Fig. 1).

On day 9 (7 days after catheter placement), she underwent cardiac surgery which included closure of the ventricular septum defect and repair of the aortic arch. The procedure was performed under deep hypothermia at 24 °C with the use of extracorporeal circulation. To facilitate auricular drainage during cardiopulmonary bypass, a cannula was placed in the inferior vena cava.

The functionality of the right femoral venous catheter was verified, and it was left in place. The patient was transferred from the operating room on a regimen of adrenaline and noradrenaline, with a delayed sternal closure. Sedation was maintained with midazolam and sufentanil. All treatments, including infusions of inotropes, antibiotics, and parenteral nutrition, were administered via the femoral venous catheter. The postoperative course was notable for successful sternal closure on day 2 and extubation on day 5. However, on postoperative day 5 (12 days after catheter placement), the patient's urine became lactescent (Fig. 2).

Investigations included a urine culture, which revealed white blood cells at 81/mm^3, red blood cells at 282/mm^3, and 10^6 CFU/mL of Candida species. A urinary ionogram showed sodium at 73 mmol/L, potassium at 8 mmol/L, creatinine at 0.6 mmol/L, urea at 49 mmol/L, glucose at 131.8 mmol/L, protein at 31 g/L, and a protein/creatinine ratio of 52.5 g/mmol. Blood tests revealed urea at 8.3 mmol/L, creatinine at 34 µmol/L, and CRP at 18 mg/L. A renal ultrasound indicated right nephromegaly with

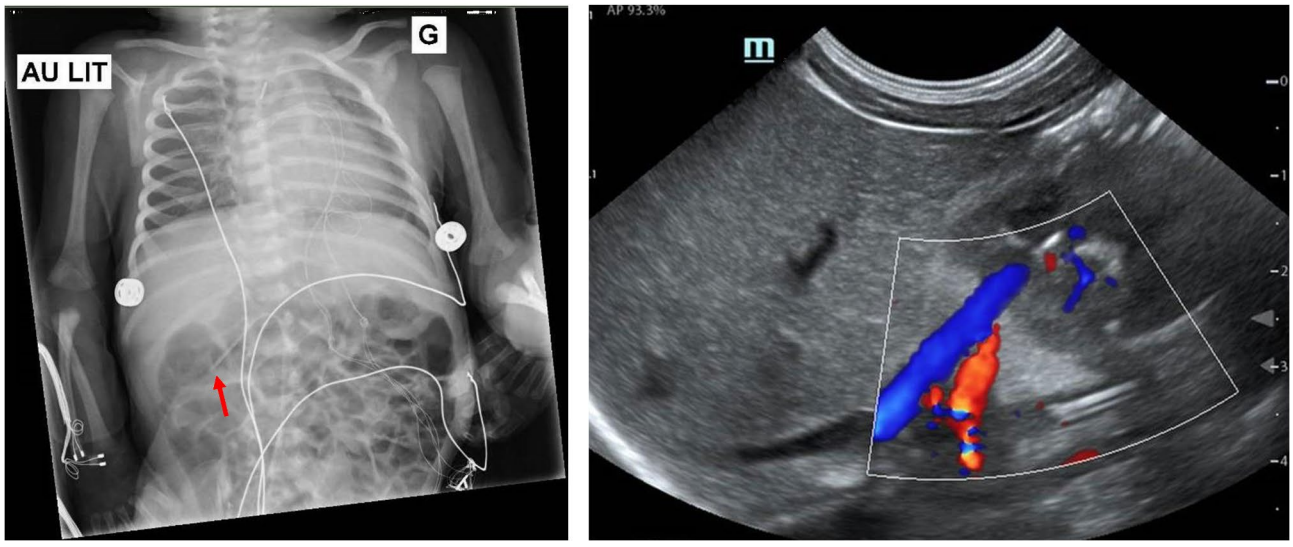

Fig. 3 X-Ray and ultrasound showing the end of the veinous central catheter into the right renal vein (red arrow showing the catheter tip)

uncollected nephritis but no dilation of the pyelocaliceal cavities. Chylomicron testing in the drainage fluid was negative. Initially, a diagnosis of Candida pyelonephritis was considered, and the infant was treated with fluconazole. An alternative hypothesis of chyluria due to a fistula post-cardiac surgery was also considered. Despite antifungal treatment and a no-fat milk diet, the lactescent urine persisted.

The medical team remained uncertain about the diagnosis of pyelonephritis and explored alternative treatment strategies. Ultimately, the lipid infusion was discontinued on post operative day 8 (15 days after catheter placement), leading to the clearance of the urine within one hour. The urinary ionogram revealed very high concentrations of glucose and protein, consistent with the components of the parenteral nutrition being administered. A retrospective review of chest X-rays indicated a posterior migration of the central catheter into the right renal vein, which was confirmed via ultrasound (Fig. 3).

Following the removal of the catheter, the urine initially turned hemorrhagic and then normalized within 24 h. Renal function remained normal throughout the process. Follow-up imaging performed nine months later showed resolution of the nephromegaly.

Discussion and conclusions

Complications related to vascular access in pediatric intensive care units are common, particularly infections and thrombosis. The anatomical and hemodynamic specificities of pediatric cardiac surgery necessitate tailored approaches, with a preference for using femoral veins, even in neonates. Chyluria is characterized by the appearance of milky white urine, which contains chyle composed of albumin, fat, and fibrin [6]. This condition is caused by an abnormal retrograde or lateral flow of lymph from the intestinal lymphatics into the kidneys, ureters, or bladder, allowing chylous material to enter the urinary collecting system. Chyluria is an uncommon and frequently under-reported condition in children. It can be categorized into parasitic and non-parasitic causes, with non-parasitic causes including postoperative complications, lymphatic malformations, congenital abnormalities, and thoracic duct stenosis. Treatment varies depending on the underlying cause, ranging from antiparasitic therapy for parasitic infections to medical or interventional approaches for structural abnormalities [6].

This is the first case described of catheter migration into the right renal vein. Regarding the pathophysiology of lactescent urine excretion, we draw a parallel with the retrofiltration of hemodiafiltration [7]. In our case, the renal vein was perfused with parenteral nutrition flow rate of 10mL/h with 1.5 mL/h of lipids. We assume that the infusion may have created renal hyperpressure, leading to the backward flow of large molecular proteins, such as saturated fatty acids, from the renal vein into the urine. Supporting this hypothesis, we observed that stopping the lipid infusion via the catheter caused the urine to lose its lactescence within minutes. Furthermore, her glycosuria had the same concentration as the infusion solution, reinforcing the idea of renal hyperpressure causing retrograde flow.

Previous cases have reported other complications involving catheters in the renal vein, such as extravasation of parenteral nutrition fluid into the right renal pelvis

due to perforation of the renal vein [8], or the development of a renal vein-to-renal collecting system fistula as a severe complication of central venous thrombosis associated with a long-term catheter [9]. However, in our case, no fistula or extravasation was identified; only catheter misplacement was observed.

Postoperative cardiac surgery patients often leave the operating room with multiple medical devices, including drains, electrodes, catheters, and tubes. It is crucial to maintain a critical and vigilant approach when reviewing postoperative X-rays to monitor the correct placement and function of these devices. Currently, there is only expert consensus regarding the selection of catheter type, including considerations of size, length, and the number of lumens, in pediatric critical care settings [1]. To minimize the risk of catheter-related complications in neonatal patients post-cardiac surgery, we recommend daily position monitoring, testing of functionality during dressing changes and routine imaging (e.g., X-rays) to confirm catheter placement and function [10]. Furthermore, establishing and implementing standardized protocols for pediatric cardiac surgery patients, including daily imaging and considerations for using shorter catheters, could standardize practices and reduce the risk of such complications.

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Data availability
Data is provided within the manuscript.

Declarations

Ethics approval and consent to participate
The patient's parents provided their written consent for the participation to the study. This study has been registered in the General Data Protection Register of the APHP under the registration number: 2025 0224180753.

Consent for publication
The patient's parents provided their written consent for the publication of this case.

Competing interests
The authors declare no competing interests.

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