Catheter Access Management for Acute Peritoneal Dialysis

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Abstract
Insertion of a peritoneal dialysis (PD) catheter is frequently done by interventional nephrologists, but these procedures are typically only performed for adults. Almost all invasive procedures in children are performed by pediatric surgeons. If a pediatric surgeon is unavailable, the initiation of PD in acute situations may be delayed, thus increasing the risk of complications and chronic kidney disease. For these patients, the main obstacle to initiating renal replacement therapy is access, even when involving central vein catheter (CVC) or peritoneal access. Here we report the case of a 10-kg baby affected by hemolytic and uremic syndrome diarrhea in whom all of the procedures to manage the complications of acute kidney injury (PD catheter insertion, PD catheter revision, CVC placement, and CVC revision) were undertaken by interventional nephrologists. This experience allowed us to rapidly treat the acute kidney injury, recover normal kidney function thereby avoiding chronic complications, and allowing us to discharge the baby from the intensive care unit.
Introduction

In the pediatric intensive care unit, the management of complications of acute kidney injury, such as fluid overload and electrolytes complications, depends mainly on the different access routes, whether venous or peritoneal. The main obstacles to span to realize a renal replacement therapy for a small baby are the thin abdominal wall for the insertion of the peritoneal dialysis (PD) catheter and the risk of organ perforation as well as the small diameter of the veins for the central vein catheter (CVC) placement. Complications of these procedures could be severe and delay kidney function recovery. As already outlined, the risk for chronic renal disease and duration of renal replacement therapy requirement are closely associated. Placement of the PD catheter and CVC for adults is widely performing by interventional nephrologists, but not for pediatric patients, where the pediatric surgeons keep the leadership of almost all procedures.

Here we report the case of an 8-month-old baby in whom all of the procedures to treat the complications of acute kidney injury were undertaken by interventional nephrologists.

Case Presentation

A previously healthy 8-month-old baby was admitted to the pediatric intensive care unit of Bachir Ben Nacer Hospital (Biskra, Algeria). The baby presented with severe dyspnea with pallor, irritability, periorbital edema, and high blood pressure. The baby’s weight was 10 kg. The family had noticed bloody diarrhea and vomiting 10 days prior to admission.

Initial laboratory studies included blood analysis and protein measurements: Hb, 8.0 mg/dL; WBC, 22,400/mm³; platelets, 77,000/mm³; serum creatinine level, 2.7 mg/dL; blood urea nitrogen, 20 mg/dL; sodium, 134 mEq/L; potassium, 3.8 mEq/L; high anion gap metabolic acidosis; and albumin, 28 g/L.

The diagnosis of diarrhea-positive hemolytic and uremic syndrome requiring renal replacement therapy was retained by the pediatric intensivist and PD was to be initiated in an emergency setting. The pediatric surgeon was not available. Despite the small weight of the baby, the interventional nephrologists and intensive pediatricians decided to proceed with treatment.

The baby was installed in an operating room and all procedures were done in sterile fashion. After induction of general anesthesia, an infra-umbilical mini-laparotomy was performed, and a straight single cuffed PD catheter stiffened by a stylet was inserted into the Douglas pouch through the peritoneal cavity. Saline solution was infused and drained through the catheter to check for adequate function. Fluoroscopy was not used. The single cuff was sutured to the aponeurosis with a purse string suture and a small tunnel was done in order to have 3–4 cm between the incision and the catheter exit site. The incision was then closed in multiples layers and dressed so that the catheter remained connected to the peritoneal dialysate bag.

Dialysis was started immediately with 10 mL/kg of dialysate (Fig. 1). No dialysate leakage or catheter dysfunction was seen during the next hours. After 2 days, the straight PD catheter presented drainage dysfunction with dialysate leakage secondary to abdominal distention after several infusions without adequate drainage. An abdominal X-ray was done showing a catheter tip out of the pelvis (Fig. 2). In addition, the baby presented exhaustion of the peripheral veins due to repeated peripheral vein needling for medications and blood transfusion.
We decided to remove the straight PD catheter, switching to a single coiled PD catheter, and to use a triple lumen catheter for medications in the left jugular vein using ultrasound-guided insertion (Fig. 3). The coiled PD catheter was inserted in the same fashion as the straight catheter and at the same site. The peritoneal cavity was drained by the new catheter before making the sutures and performing the tunnel to avoid dialysate leakage. No suture was done to hold the catheter in the pelvis.

After 2 weeks of PD and central vein infusion, the baby presented CVC-related infection and peritonitis. We decided to exchange the CVC over a wire and to treat both infections by intravenous antibiotics. The PD catheter remained in place. Four weeks later, the baby recovered normal kidney function, and thus the PD catheter and CVC were removed and the baby was discharged home.

Discussion

Hemolytic and uremic syndrome is a common cause of acute kidney injury in the intensive care setting. Renal replacement therapy is required in 30–50% of children, despite adequate and quick management of acute kidney injury.

Early insertion of a PD catheter should be performed in patients with oligoanuria to avoid fluid overload or electrolyte complications. Studies have shown that patients with less volume overload and a lower level of uremia might have an overall better prognosis [1, 2]. Also, an optimal central venous line is requested even if the baby's weight is low, thereby enabling blood, drug, or nutrition infusion, thus avoiding repeated failed peripheral vein cannulation.

Almost all invasive procedures in pediatric patients are carried out by pediatric surgeons. Thus, the management of renal replacement therapy may be delayed if a pediatric surgeon is not available in the facility. Interventional nephrologists experiment in invasive procedures for adults, but not for children. In this case, surgical insertion of the PD catheter must be performed by an interventional nephrologist; also, an ultrasound-guided central venous line was necessary to provide the best caring support.

Difficulties encountered by the nephrologists were the small weight of the baby, the thin abdominal wall, the risk of organ perforation, and the risk of hernia increasing in the future if the incision was large. The infra-umbilical midline incision is the only technique done in our facility. Many surgeons and other nephrologists use different techniques, such as infra-umbilical midline, paramedian, or lateral to the border of the rectus muscle. The advantage of midline incision avoidance of epigastric vessels, but it is associated with the risk of hernia. The left side is interesting because the cecum can be avoided. Currently the paramedian incision at the left side with transrectal dissection of the muscle is the most frequently used site by surgeons [3].

In this case all complications, such a PD catheter tip migration, dialysate flow dysfunction, dialysate leakage, or CVC-related infection, were managed by an interventional nephrologist [4–8]. This experience allowed us to rapidly treat the acute kidney injury and recover normal kidney function, ultimately discharging the baby from the intensive care unit and avoiding further complications [9–12].
Conclusion

In pediatric patients, invasive procedures for renal replacement therapy, such as CVC or PD catheter insertion, remain widely dominated by pediatric surgeons. This may delay the management of acute kidney injury if the surgeon is unavailable. Interventional nephrologists could safely perform those procedures to promptly deliver optimal care.

Statement of Ethics

This article does not contain any studies with human participants or animals performed by any of the authors. Informed consent for publication was obtained from the parents.

Disclosure Statement

The authors declare that they have no conflict of interest. No financial or nonfinancial benefits have been received or will be received from any party related directly or indirectly to the subject of this article.

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Author Contributions

M.A. Rahil is the corresponding author, performed the PD catheter insertion and the ultrasound-guided CVC placement and wrote the manuscript. A. Bouzgueg is the co-author, performed several peripheral access lines, managed all metabolic disorders, and wrote the manuscript. Both authors read and approved the manuscript in its final version.

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**Fig. 1.** Peritoneal dialysis started as an emergency procedure in the intensive care unit.
Fig. 2. The tip migration of the straight peritoneal dialysis catheter in the distended abdomen.
Fig. 3. The coiled catheter in the Douglas pouch.