Peritoneal Dialysis in the Pediatric Intensive Care Unit

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Acute renal failure is a fairly common complication of critical illness in children including septic shock, cardiogenic shock, trauma and renal transplantation. Primary renal failure also occurs with hemolytic uremic syndrome, post infectious acute glomerulonephritis, and rapidly progressive glomerulonephritis, conditions capable of producing critical illness. In addition to patients with established tubular or glomerular injury, there are significant numbers of patients with severe oliguria and mild azotemia on a pre-renal basis. These patients are frequently resistant to diuretic treatment. Fluid retention may become the primary management problem far exceeding any chemical disturbance.

Ideally, all of these patients would have available the full spectrum of renal services: hemodialysis, CAVH, CAVHD and peritoneal dialysis (PD), along with expert pediatric neurology consultation. However, when resources are limited and patient transfer is not possible, most of these problems can be managed using PD.

It is the purpose of this paper to review the basics of the PD technique and utilization primarily for the non-nephrologist.

Although this procedure can be done by critical care physicians, the additional expertise of nephrology specialists should certainly be utilized when available.

Indications

Indications for acute dialysis are frequently relative, with overall patient condition affecting individual judgements. In general, it is appropriate to use dialysis to correct azotemia, when the BUN is greater than 100 and expected to remain so, when creatinine exceeds 4-10 mg per deciliter (age dependent), or when hyperkalemia, hyperphosphatemia/hypocalcemia, acidosis, or fluid retention require aggressive management. PD is generally not the most effective means of managing intoxications or metabolic defects, although its use has been reported.

The shocky patient with oliguria deserves some specific comment. These patients frequently have respiratory compromise as well as unstable hemodynamics. Either hemodialysis or PD can be used effectively in these patients provided there is technical expertise available. Intravascular volume shifts are more likely with hemodialysis, and respiratory compromise or inadequate fluid removal may be more likely with PD. Each case must be judged carefully in view of the resources at hand.
Technique

The bladder should be emptied by catheter. Access to the peritoneal cavity may be obtained with surgical placement of a soft catheter or percutaneous over-the-wire placement of a firm dialysis catheter. In addition, an over-the-wire placement of a peel away sheath may allow percutaneous placement of soft catheters. The most common site for primary placement of an acute catheter is in the midline, 1/3 of the way from the umbilicus to the symphysis pubis. Our most common secondary site would be the left lower quadrant with the catheter directed horizontally towards the right lower quadrant in a very small child, or into the pelvis on a larger patient. Surgical placement is obligatory when there is likelihood of adhesions of bowel to abdominal wall. For percutaneous placement, adequate systemic sedation is provided followed by local prep and infiltration of lidocaine down to, and including the peritoneum. A small needle or over-the-needle catheter is then placed into the peritoneal cavity and approximately 10 to 15 ml/kg body weight of 1.5% dialysis solution is infused into the peritoneal cavity. This makes subsequent puncture of the peritoneal cavity safer and easier to recognize. The initial small needle is withdrawn and a larger needle is placed, through which an appropriate guide wire is passed into the peritoneal cavity, and the needle or catheter removed. It must be kept in mind that the aortic bifurcation occurs at or just below the umbilicus and that each lower quadrant is bisected diagonally by the ilea vessels. After a small nick and skin dilation, the peritoneal catheter or peel away sheath is then passed into the peritoneal cavity. If a firm catheter is used, the guide wire is removed and the catheter checked for free outflow of fluid. If a peel away sheath is passed, the guide wire and obstructor are removed and the soft catheter passed down the lumen of the peel away sheath. The sheath is then removed according to manufacturers instructions, and the catheter is assessed for patency. The catheter should then be secured by tape, sutures, or a combination.

The catheter is then connected to the drainage system and the abdomen allowed to drain. It should not be alarming if the volume of drainage is significantly less than what was initially placed in the abdomen. However, within one or two cycles, the volume removed should be at least equal to that administered, or else a mechanical problem with catheter outflow is likely present. This may require repositioning or replacement of the catheter.

Blood tinged fluid will usually clear rapidly. Any suggestions of major hemorrhage should prompt immediate surgical consultation. If the infusion of fluid through the dialysis catheter is followed by diarrhea, that diarrhea fluid should be tested for glucose and possible intestinal perforation considered. Despite the possibility of significant complications, guide wire placement of acute catheters seems to have made this a much safer procedure with no serious complications occurring in the last ten years at this institution.

After placing and securing the PD catheter, it is helpful to rapidly administer and drain one or two cycles of about ten cc’s per kilo volume. This allows detection of mechanical problems. The volume should be infused and then immediately drained.