Management of common problems in a child undergoing a renal transplant

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Case Objectives

1. Review the etiologies and multi-systemic effects of ESRD in pediatric patients.
2. Develop a preoperative and intraoperative plan for the placement of a large kidney in a small child.
3. Discuss options for pain management including regional anesthesia. Evaluate the risks and benefits of alternative pain management strategies in the pediatric renal failure population.
4. Describe the pharmacologic and pharmacodynamic implications of renal failure.
5. Understand the risks of renal transplant. Describe factors leading to improved outcomes in pediatric renal transplantation.

Case Discussion

The patient is a 14 month old female with end stage renal disease presenting for a living-related renal transplantation. Her renal failure was caused by renal dysplasia. She has poor growth, 7.8 kg, despite supplement NGT feedings. The patient is receiving continuous peritoneal dialysis. The donor will be the patient’s mother.

The patient was recently started on an ACE inhibitor and has a baseline BP of 128/68. Her physical examination is essentially normal. A CXR was obtained which depicted a mildly enlarged heart. ECG is normal. Her preoperative labs are significant for a potassium of 5.5 and hematocrit of 26.

The child arrives in the preoperative holding area crying and inconsolable. Her mother, in the next stretcher, is obviously very upset, “I don’t want my baby to be in pain!” The floor nurse tells you that the child’s IV “fell out” 20 minutes ago. Meanwhile, the transplant surgeon pages you and wants to know why the patient is not yet in the room.
Key Questions

A. Background

1. What are the common etiologies of ESRD in pediatric patients?
2. What are some of the pathophysiologic changes associated with ESRD?
3. What are the options and potential problems for renal replacement therapy in pediatric patients?
4. Are there any significant differences in patient/graft survival regarding age at transplantation or organs obtained from living-related vs. cadaveric donors?
5. What are the possible immunosuppressive regimens utilized? What are the mechanisms of action, side effect profiles and potential anesthetic implications of these agents?
6. What are the risks associated with being a living-related kidney donor? Is laparoscopic donation equivalent to an open traditional approach in regards to donor recovery and graft function?

B. Preoperative assessment

1. Would you request any further clinical testing? ECHO?
2. What are the expected laboratory abnormalities in this patient population? What is renal osteodystrophy?
3. What are your plans for the serum potassium? Redraw or treatment? Are you going to transfuse this patient? How do uremic patients compensate for anemia?
4. Are you concerned the child is taking an ACE inhibitor?

C. Intraoperative management – Induction issues

1. Are you going to premedicate this child? How?
2. What are your plans for induction (inhalation vs. intravenous) – remember the IV has recently “fallen out”. Does this patient require an RSI? Is succinylcholine dangerous for this patient? Which induction agent would you choose? Which non-depolarizing muscle relaxant would you select?
3. What will be the surgical approach for graft placement? Will this alter your anesthetic management?

D. Intraoperative management – Maintenance issues

2. What fluid replacement therapy are you going to utilize? What are your thresholds for transfusing the patient? Do blood products need any special processing?
3. What is your plan in anticipation of cross clamp release? Are there any hemodynamic considerations when placing an adult sized kidney in a small child? The surgeon requests a CVP of 15 mmHg – is this necessary? What arterial blood pressure is adequate?
4. Cross clamp release results in profound hypotension with peaked t-waves and a widening QRS noted on ECG – why is this happening? Etiology? Treatment?
5. How will adequacy of perfusion in the transplanted graft be assessed?
6. Following closure of the abdomen a progressive decrease in urine output is appreciated. The CVP is within the desired range – what could be happening? Are any tests indicated?
E. Postoperative Management

1. A nuclear scan is ordered. The scan shows absent perfusion to the transplanted kidney. While in nuclear medicine the patient becomes progressively harder to ventilate, oxygenation worsens, and hypotension develops. Why is this occurring? What are you going to do?
2. Are you going to extubate this child?
3. What specific problems is this patient likely to experience in the ICU?
4. What are some of the causes of postoperative graft failure? Is this patient at any increased risk?
5. What medical co-morbidities will this patient likely experience in the ensuing years?

Model Discussion

Background:

The most common causes of renal failure in children include hereditary nephropathies, cystic kidney, and hypoplasia, accounting for 30% to 50% of transplants. Pyelonephritis and glomerulopathies account for 20 to 30% each, followed by vascular nephropathies and other rarer causes such as Wilm’s tumor. Congenital obstruction with posterior urethral valves may also contribute.

Renal failure is associated with multiple systemic changes including periiphery neuropathy, growth delay, anemia, and platelet dysfunction.

In the child with renal failure increased cardiac output and hypertension are common, as is congestive heart failure, which may be associated with arrhythmias. Patients also experience delayed gastric emptying. Reduced serum protein and plasma cholinesterase affect pharmacodynamics, as does relative volume overload.

Studies of graft and patient outcome in the pediatric population suggest that the mass of an adult size kidney without ATN has a positive effect on graft survival. Uejima reports that living related grafts do have a higher survival rate than cadaver grafts at both 1 and 3 years. Immunosuppression is necessary after renal transplant and may include steroids, cyclosporine and OKT3. OKT3 may be associated with a cytokine releasesyndrome, which may be attenuated by the administration of prednisone and diphenhydramine.

Preoperative Assessment

Further testing should include an echo, given the relatively high risk of left ventricular dysfunction and congestive heart failure. Transplantation of a large kidney will require the heart to function well. Expected laboratory abnormalities include hyperkalemia, hypoalbuminemia, hypocalcemia, and hyponatremia. Patients often have chronically elevated potassium. Succinylcholine may increase extracellular potassium. It is generally recommended that succinylcholine not be used in patients with potassium levels greater than 5.5. Rocuronium is eliminated 10-25% by renal excretion. It is an acceptable alternative to succinylcholine. Twitches should be monitored closely. Hyperkalemia is also associated with an increased incidence of arrhythmias.
Intraoperative management

Preoperative medicine may be administered to the child in renal failure. Midazolam may be indicated in children old enough to experience separation anxiety. The risks of aspiration must be individually evaluated based on NPO status and GERD symptoms. ESRD patients do have delayed gastric emptying. Inhalation induction may be performed. CVP monitoring is recommended for all transplantation of adult kidneys into pediatric patients. Arterial monitoring is used on an as needed basis.

In small patients, a large midline incision for graft placement is generally used. The renal vein is anastomosed to the inferior vena cava, and the renal vein to the aorta. A side or a cross clamp may be utilized.

Recent data suggest improved graft outcome and hemodynamic stability with the use of epidural catheters for pain control. There are concerns over the risk of catheter placement in the setting of platelet dysfunction, but no bleeding complications have been reported in a large series. (Coupe)

Fluid replacement should be utilized to keep the CVP in the range of 12-15. The patient should not receive potassium containing fluids. Transfusion can affect rejection rates, and blood products should be irradiated to prevent immune reactions. Hemoglobin levels should be kept relatively high prior to cross clamp release. The adult kidney may require up to 300 cc of volume for perfusion; quite high in relation to the patient’s blood volume.

Cross clamp release involves not only volume issues, but the release of a large volume of cold, potassium containing perfusate, which commonly results in hyperkalemia, which may be treated with glucose and insulin. Calcium administration decreases arrhythmias.

A well perfused graft will begin to make urine relatively quickly. Abdominal closure may compromise flow to the new organ because of increased compartment pressures. Pulmonary compromise may also be seen.

Postoperative management

Add info on nuc med scan. Are you thinking of arterial anastomosis issues or acute rejection here?

It is unlikely that small patients with adult sized kidneys can be extubated immediately after surgery. Increased pulmonary pressures and abdominal pressures are likely. The patient will continue to require meticulous fluid and electrolyte management in the intensive care unit. The patient should also be monitored for urine output and signs of rejection. Postoperative graft failure may be associated with primary nonfunction, vascular thrombosis, technical problems or rejection. In the long term, a dysfunctional bladder is also associated with rejection. Patients post renal transplant are at risk for diseases related to immunosuppression such as lymphoproliferative disease and frequently return for tonsillectomy. They do however, often recover normal growth. Sarcoma and thyroid carcinoma have also been reported. Patients are also susceptible to infection.
References


