Surgical Modalities of Dialysis in Children

An Essay
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By

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TABLE OF CONTENTS

Page

page

List of Abbreviations

ACT	Activated Clotting Time
APD	Automated Peritoneal Dialysis
ARF	Acute Renal Failure
ASA	American Society of Anesthesiologists
AV	Arteriovenous
AVF	Arteriovenous Fistula
BUN	Blood Urea Nitrogen
CAPD	Chronic Ambulatory Peritoneal Dialysis
CAVH	Continuous Arteriovenous Hemofiltration
CAVHD	Continuous Arteriovenous Hemofiltration With Dialysate
CNS	Central Nervous System
CRF	Chronic Renal Failure
CVVH	Continuous Venovenous Hemofiltration
CVVHD	Continuous Venovenous Hemofiltration With Dialysate
ECG	Electrocardiogram
ePTFE	Expanded Polytetrafluorethylene
ESRD	End-Stage Renal Disease
ESRF	End-Stage Renal Failure
GFR	Glomerular Filtration Rate
HD	Hemodialysis

LA	Local Anesthetics
MAC	Monitored Anesthesia Care
NKF-DOQI	National Kidney Foundation-Dialysis Outcomes Quality Initiative
PABA	Paraaminobenzoic Acid
PET	Peritoneal Equilibration Testing
PTFE	Polytetrafluoroethylene
rhGH	recombinant Human Growth Hormone
rHu-EPO	recombinant Human Erythropoietin
RSD	Reflex Sympathetic Dystrophy
rTPA	recombinant Tissue Plasminogen Activator
TPA	Tissue Plasminogen Activator
URR	Urea Reduction Rate
US	Ultrasonography

List of Figures

List of Tables

Introduction

The many medical problems that affect patients with end-stage renal disease (ESRD) who require life-maintaining dialysis therapies may have a somewhat different and often very significant impact on the lives of infants, children, and adolescents (compared with adults) with renal failure. Therapy for renal failure in infants and children is often quite challenging considering the infant or child's small size together with the increased metabolic demands of the growing and developing human. The relative physiologic homeostasis that is needed to support the physical and emotional growth and maturation of a child, combined with the complex interpersonal and multidisciplinary interactions required in caring for these patients, suggests the need for a coordinated team of individuals with interest and expertise in the management of children with ESRD **(Lumsden, et al, 2004)**.

When evaluating the causes of ESRD leading to renal transplantation, 3 of the 4 leading causes of CRF were congenital urinary tract disorders (including obstructive uropathy, aplastic/hypoplastic /dysplastic kidneys, and reflux nephropathy). Children with vesicoureteral reflux

and some forms of congenital obstructive uropathy may have conditions that are potentially treatable if diagnosed early in life, or diagnosed on prenatal ultrasound **(Lloyd-Still and Atwell, 2001)**.

Pediatric nephrologists have been judging the need for the initiation of chronic dialysis therapies based on the overall clinical status of the patient, with less reliance on laboratory values representing the degree of renal functional impairment i.e. blood urea nitrogen (BUN) or serum creatinine levels **(Butler, 2006)**.

The decision regarding the methodology of dialysis depends on a number of factors related both to the patient and to the dialysis center's experience and preference. In North America, approximately 66% of persons < 21 years of age with ESRD requiring dialysis were treated with PD, while 34% were treated with HD**.** However, the relative contribution of PD and HD in the treatment of children with ESRD requiring dialysis, varies worldwide on a country to country basis. The European Dialysis and Transplantation Association reported recently that 29% of newly dialyzed children were treated with PD, while 50% of those < 2 years of age were placed on PD. The use of PD

as maintenance renal replacement therapy has continued to expand over the past 15 years, and reports suggest that the majority of children (50–75%) can be successfully treated with chronic PD for at least several years while awaiting renal transplantation. Despite the recent increase in the use of PD to treat ESRD in transplantation in children, HD continues to be a viable option in adolescents and older children, especially those awaiting transplantation **(Knight, et al, 2001)**.

Achieving venous access in infants and young children has been challenging pediatricians and pediatric surgeons for many years. The often very small size of the child, the small size/caliber of their veins and arteries, and, often, the lack of easily visible or palpable veins makes the creation and maintenance of adequate access both challenging, frustrating, and rewarding in these young patients. In infants and children who are to be started on HD as their maintenance dialysis therapy, single and dual-lumen venous catheters, placed either percutaneously or surgically implanted, accounts for vascular access in about half of children on HD, with the remainder divided equally between arteriovenous fistulas and grafts **(Feldman, et al, 2004)**.

Introduction

The peritoneal access most commonly utilized in children is Tenckhoff curled catheters with single pre-peritoneal cuff and straight tunnels. Most of these catheters are surgically implanted in the operating room **(Alexander and Honda, 2002)**.

This point to problems related to vascular access, including thrombosis, stenosis, poor flow, ischemia in the access extremity and infection .of these, thrombosis is the most common reason for loss of access to the child's circulation. It should be noted that long term or repeated use of the centeral venous lines results in vessel scarring with impaired blood flow from the veins which may limit the availability of the good venous drainage needed for the future creation of arteriovenous fistulas (**Ballard, et al, 1992)**.

The major complications associated with PD include loss of PD catheter patency due to fibrin deposition or thrombosis within the lumen of the PD catheter, occlusion of the PD catheter with the peritoneum preventing inflow or outflow of dialysate (often associated with catheter migration or omental occlusion), and catheter-associated infection. Infections in PD patients include infections of the catheter skin exit site ("exit site" infections), infections of the PD catheter tunnel, and peritonitis **(Bunchman, 2004)**.

Aim of the Essay

The aim of this work is to evaluate the different surgical modalities in pediatric dialysis, illustrating their indications, ways of their vascular access, difficulties & complication of each; to find out the most appropriate method in children.