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## Dialysis therapy for children with acute renal failure: survey results

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**Abstract** We surveyed 123 pediatric nephrologists to investigate the current dialytic management of acute renal failure (ARF) in children. Data collected from 92 responding physicians revealed that hemodialysis (HD), peritoneal dialysis (PD), and continuous renal replacement therapy (CRRT) are currently used as the primary means of acute renal replacement therapy in a nearly equal percentage of centers. The preferential use of CRRT appears to be increasing, while PD usage is decreasing except for the youngest infants and those patients likely to develop end-stage renal disease (ESRD). Additional data correlating patient outcome to dialytic modality should be collected to compare the efficacy of the three techniques.

**Key words** Peritoneal dialysis · Hemodialysis · Continuous renal replacement therapy · Acute renal failure · Pediatrics

### Introduction

Historically, peritoneal dialysis (PD) has served as the primary means of dialytic management for children with acute renal failure (ARF) [1, 2]. In large part, PD has been chosen because of its efficacy, its ease of implementation, and the lack of need for vascular access. However, improvements in equipment and the availability of small intravenous catheters have been associated with a number of reports documenting the successful use of hemodialysis (HD) and continuous renal replacement therapy (CRRT) in children with acute renal failure in the intensive care unit (ICU) setting [3, 4]. To investigate the current dialytic management of ARF in childhood, a survey of North

American and European pediatric nephrologists was conducted in preparation for the annual meeting of the American Society of Pediatric Nephrology in May, 1999.

### Materials and methods

A two-page questionnaire was mailed to 123 pediatric nephrologists (North America – 116, Europe – 7), all of whom provide renal replacement therapy for treatment of ARF. The 123 nephrologists represented 123 different pediatric nephrology centers. The survey addressed the following issues: (a) the most and least frequently used acute dialysis modality in the past (e.g., 1995), present, and projected for the future (e.g., 2003), (b) the relationship between the choice of dialysis modality and patient age, (c) the relationship between projected patient outcome (e.g., renal recovery vs. end-stage renal disease [ESRD]) and the choice of dialysis modality. The usage of each dialysis modality was rated subjectively as “used most often,” “used least often,” and “never used.” In a few instances, two modalities were reported to be used with a similar frequency and were scored equally. A total of 92 completed forms were returned, for an excellent response rate of 74.7%. Whereas not all questions were answered on each form, no single question received fewer than 89 responses.

### Results

The survey results reflected a substantial change in the frequency of CRRT and PD usage over time as treatment for ARF in children. Whereas CRRT and PD were the dialysis modalities of choice in 1995 at 18% and 45% of responding centers, respectively, these two modalities along with HD are currently the primary means of acute renal replacement therapy in a nearly equal percentage of responding centers (Table 1). The survey results also suggest that within the next 5 years, CRRT will serve as the primary dialysis modality at the majority of centers. Twenty-six centers reported never having used CRRT in 1995, while less than 5% project that they will not have used this modality by the year 2003.

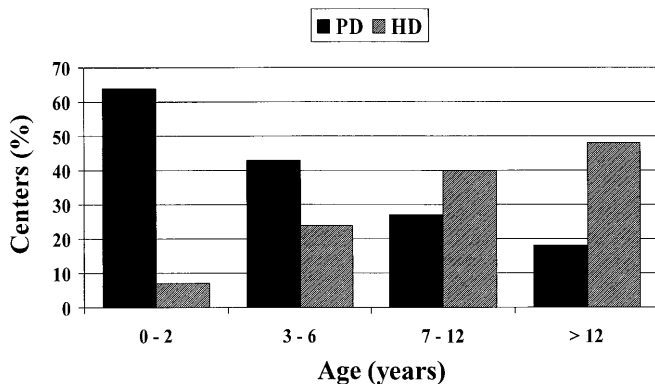
Not unexpectedly, patient age was shown to be a significant factor influencing the use of either PD or HD as a treatment modality. At 64% of centers, PD is the pri-

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**Table 1** Most frequently used dialysis modality (% of centers). (CRRT continuous renal replacement therapy, PD peritoneal dialysis, HD hemodialysis)

Year	CRRT	PD	HD
1995	18	45	38
1999	36	31	33
2003	53	20	25



**Fig. 1** Relationship between patient age and preferential use of acute peritoneal dialysis and hemodialysis by center

mary dialysis choice for patients 0–2 years of age, whereas it is the primary modality at <20% of centers for children >12 years (Fig. 1). In contrast, HD is used preferentially in only 7% of centers for the youngest patients, while it is the primary modality of choice at nearly 50% of centers for adolescent patients (Fig. 1). Continuous renal replacement therapy is currently considered the treatment of choice at approximately 30% of centers irrespective of patient age.

Finally, 48 (53%) of 90 respondents suggested that the possibility that a child with ARF may not recover renal function did influence their choice of the acute dialysis modality. Of the 48 centers, 44 (91%) responded that in those situations they would be more likely to use PD.

## Discussion

The provision of acute renal replacement therapy to children with ARF is a critical component of the care provided in an ICU setting. Available renal replacement therapy modalities include peritoneal dialysis, hemodialysis, and continuous renal replacement therapy. Little is known about the frequency with which each of these modalities is used in the care of children. While a survey conducted in 1995 by Belsha et al. for the Pediatric Peritoneal Dialysis Study Consortium (PPDSC) suggested that CRRT was most often the dialysis modality of choice, only 15 centers participated in that survey and the range of responses was extremely broad [5]. In addition, a change in practice pattern was felt to be likely because of the increased availability of equipment designed for small children, along with increased clinical experience with all

modalities. Accordingly, this survey was conducted to assess the current clinical practice of acute dialysis in a large number of pediatric centers for presentation at the American Society of Pediatric Nephrology meeting. The fact that more than 90 centers responded to the survey makes it very likely that these results reliably reflect clinical practice within the pediatric nephrology community.

The use of PD as an integral component of the treatment regimen for children with ARF became widespread after reports of its clinical success were published in the late 1940s [6, 7]. The major advantage of PD in pediatrics is that it avoids the often troublesome matter of vascular access that can be a limiting factor in dialyzing infants and small children [8, 9]. Peritoneal dialysis can also be performed in locations where the expertise for pediatric HD and CRRT is unavailable. While the risk of infection, specifically peritonitis, is a major concern associated with the use of PD, its development in the acute setting is relatively infrequent [1, 10, 11].

Our results provide evidence that although PD continues to be the dialysis modality of choice at a substantial number of centers, this number has decreased over the past 5 years and is likely to decrease further in the future. However, our data also reflect the fact that PD continues to be used preferentially in the youngest infants, most assuredly because of its ease of application, its proven efficacy, and the difficulty associated with the establishment of vascular access in the smallest patients. An additional subset of patients who may preferentially receive acute PD appears to be those who are deemed unlikely to recover renal function and who will require long-term dialysis. The choice of PD in this case is consistent with the common selection of this modality for all children with ESRD, irrespective of etiology [12].

In contrast to the delivery of PD in the ICU, the use of CRRT (either continuous arteriovenous hemofiltration [CAVH] or continuous venovenous hemofiltration [CVVH]) has clearly increased over the past several years [3, 4, 13, 14, 15]. Progress with this modality has been hindered by the lack of pediatric-specific equipment. Advantages of the technique include its continuous nature and the associated patient tolerance, despite the frequent necessity for substantial fluid removal. Although there is the potential for complications related to the characteristic need for patient anticoagulation to prevent filter clotting, the current availability of CAVH/CVVH equipment adapted to the needs of small children, the production of small vascular catheters, and the publication of successful experiences with this modality in children are all factors which have contributed to the more universal use of this technique in an age-independent manner [3, 4, 13, 14, 15]. Greater pediatric experience with CRRT in the pediatric ICU and in the neonatal ICU (with or without extracorporeal membrane oxygenation) as treatment for disorders such as ARF following cardiac surgery or inborn errors of metabolism makes it likely that, as reflected in our survey, CRRT will soon be used at virtually all pediatric centers [16, 17].

Finally, our survey revealed little change in the use of HD for the treatment of ARF in children. It remains a

valuable means of dialytic support and is the preferred modality for the treatment of acute poisoning and life-threatening hyperkalemia. The performance of HD does require significant technical expertise, especially in infants and small children and to prevent complications such as disequilibrium secondary to rapid osmolar shifts. While improvements in HD equipment for children which facilitates fluid management and the availability of small vascular catheters make the use of HD possible in patients of all ages, our data document its infrequent preferential use in children <2 years of age.

In summary, it is apparent from this survey of practicing pediatric nephrologists that PD, HD, and CRRT are all means of dialytic support that can be successfully applied to the pediatric patient. Although a significant survival benefit associated with the use of one modality vs. another would certainly influence treatment selection, little comparative information exists, and the recent experience reported by Bunchman et al. does not provide evidence of the superiority of any one technique [16, 18]. Thus, the choice of acute dialysis modality at present will likely continue to be a result of individual patient factors such as size and hemodynamic stability, as well as facility and nephrologist preference and experience.

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