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Effect of Short Daily Hemodialysis and Nightly Home Hemodialysis on Phosphorus Status

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This article has been approved for 1.5 CPE units. The online CPEU quiz and certificate of completion can be accessed in the Members Only section of the RPG web site via the My CPEU link. In addition, this CPE offering is available to current RPG members only and the expiration date is July 31, 2011.

Introduction

Short daily hemodialysis (SDHD) and nightly home hemodialysis (NHHD) provide options to dialysis patients and the renal dietitians that work with them with respect to phosphorus (P). Conventional three times weekly hemodialysis is not efficient enough with regards to removal of middle molecules such as phosphate to maintain P balance in the majority of patients (1). This leaves the patient on conventional therapy captive to severe P diet restrictions and high phosphate binder pill burdens that can significantly affect the patient's quality of life. While peritoneal dialysis (PD) is more effective than conventional hemodialysis (CHD) at removing P, it still does not alleviate the need for diet restrictions and binders completely (2).

Home dialysis was the norm in the 1970's as in-center dialysis was not readily available. With the number of dialysis patients in the United States rising to an expected 520,000 by the year 2010, strategies to improve quality of life with regards to P control need to be analyzed (3). Studies have demonstrated a higher quality of life in home hemodialysis patients with longer, increased frequency of treatment times as well as significantly improved P control (4). Controlling P is an asset for improved quality of life. Hyperphosphatemia is a major contributor to loss of life in dialysis patients. This paper provides evidence that home therapies are still optimal for improving P control.

The Effect of SDHD on P Control

Clinical studies have investigated the use of SDHD of fewer than 3 hours for improvements in P control. A review of three such studies involving SDHD of 2 hours revealed no significant change in serum P levels when compared with CHD. Also, binder use was not decreased, but was increased in some cases. This is possibly because patients may feel better when on SDHD and show improvements in appetite, thus increasing intake of P. This is an improvement in quality of life with regards to improved appetite and nutritional status. Phosphorus control, however, is still an issue in SDHD of 2 hours or less. SDHD must be increased to significantly reduce serum P levels (5-7).

The Effect of Daily Dialysis of Increased Duration on P Control

Research reveals that SDHD of 3 hours duration is more effective at removing P than CHD and SDHD of lesser duration. In a prospective, nonrandomized, controlled study of 77 HD patients where 51 were on CHD and 26 were treated with SDHD of 3 hours, results regarding P were significant. Mean serum P levels were greatly improved from baseline to end-of-study. Binder usage among 3 hour SDHD patients was significantly lower and phosphate removal was much higher compared to CHD. If only the first 2 hours of dialysis are taken into consideration in the SDHD group, weekly P removal would not have been significantly different from CHD removal. This suggests that at least 3 hours daily is needed for significant improvements in P parameters (8).

time and solute removal was evaluated in a study of nine stable chronic hemodialysis patients. The patients were dialyzed for 4, 6, or 8 hours but the total volume of processed blood and dialysate remained the same. The patients receiving longer treatments had a larger amount of total solutes removed and less solute content in the patient in the intradialytic period. This was true regarding P, suggesting that treatment duration plays an important role in P control (9). Figure 1 explains how duration of dialysis improves P removal.

The London, Ontario Daily/Nocturnal Dialysis study assigned patients to either SDHD or NHHD and followed them for 5-36 months. The data derived from these patients was compared with CHD patient data. The study was observational and nonrandomized, allowing patients to choose their treatment

Table 1
The Effect of SDHD on Serum P and the Use of Binders

	Mean treatment time in min		Average days dialyzed per week		Serum P mg/dL		Binders	
SDHD <3 Hours	**CHD**	**SDHD < 3hrs**	**CHD**	**SDHD < 3hrs**	**CHD**	**SDHD < 3hrs**	**CHD**	**SDHD < 3hrs**
Kumar and Colleagues (5)	NA	147	3	5.3	5.1 +/- 1.6	5.4 +/- 1.4	2.6 +/- 1.4	4.2 +/- 2.6
Williams and Colleagues (6)	232	116	3	6	5.5 +/- 1.7	5.5 +/- 1.7	NA	NA
Lugon and Colleagues (7)	NA	120	3	6	7.2 +/- 2.7	5.8-6.3	NA	NA
SDHD ≥ 3 Hours	**CHD**	**SDHD > 3hrs**	**CHD**	**SDHD >3hrs**	**CHD**	**SDHD >3hrs**	**CHD**	**SDHD >3hrs**
Ayus and Colleagues (8)	240	180	NA	NA	5.02	4.2	No change	77%-40%

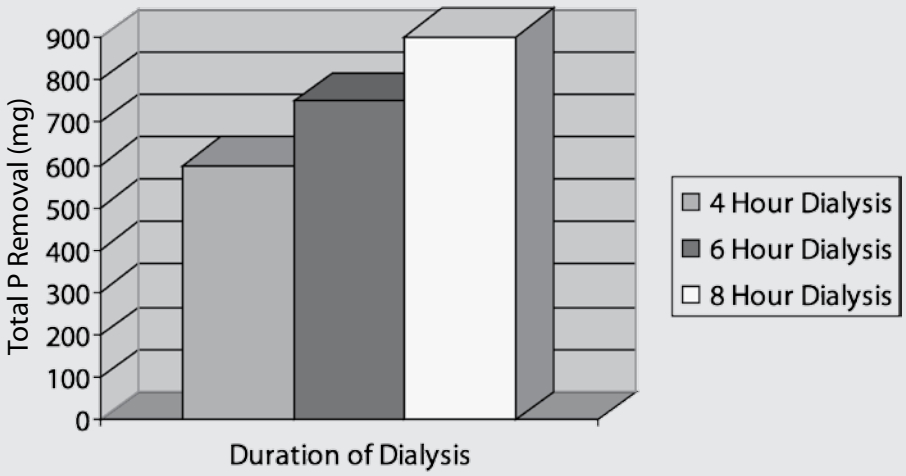
NA= not available

Data derived from SDHD studies of 2 and 3 hours are summarized in Table 1.

NHHD and P Removal

Serum P control in patients on CHD has been compared with those on NHHD and has been remarkably in favor of NHHD. Additionally, as 3 hour SDHD dialysis is more effective than 2 hour SDHD, one could conclude increased duration of NHHD is definitely superior with regards to P removal. The factor of as forcing patients to receive a specific treatment may influence quality of life negatively. CHD in the control group was performed 3 days per week for 3.5 to 4.5 hours. SDHD was performed 5-6 days per week for 1.5 to 2.5 hours per treatment. NHHD was performed 5-6 days per week for 6 to 8 hours while the patients were sleeping. With regards to diet and P, the study revealed that P control was best achieved in the NHHD patients. These patients became virtually free from the need of phosphate binders, which was not the case for SDHD or CHD patients (10).

Figure 1
Phosphorus Removal as Duration of Dialysis Increases



Lynchburg Nephrology Dialysis, Inc in Lynchburg, Virginia began a NHHD program and studied their patients after reviewing the results of the London, Ontario study. Assessment of nutritional parameters, serum chemistries, and quality of life was taken before the program was initiated and again at 3, 6, 12, and 18 months. A marked decrease in P was seen with an average P of 6.8 mg/dL 6 months prior to NHHD and declining to an average of 3.2 mg/dL post NHHD. Phosphate binders were stopped and not restarted on all patients. Three patients had to have a P additive added to their bicarbonate bath due to low serum P levels. Dietary restrictions regarding P were lifted on all patients even though their protein intake had increased (11).

Discussion

The evidence suggests that patients on home therapies fare significantly better than CHD with regards to P control. This is particularly true in NHHD. Each study reviewed concluded that CHD is inefficient in P removal, resulting in the need for dietary restrictions and binder usage. The duration of dialysis therapy is an important factor for P control. Three hour SDHD is more effective than shorter dialysis durations and gives patients freedom from large binder dosages and diet restrictions. However, one would have to consider the number of people who would devote 3 hours daily to dialysis less likely. Most patients consider CHD for 3-5 hours 3 times weekly burdensome. Evidence lies strongly in favor of NHHD as the most effective treatment option for P control. As treatment time increased from 4 to 6 to 8 hours, more P was removed and less was present in the blood in the intradialytic period. Additionally, the 8 hours spent having one's blood dialyzed would be accomplished while the patient sleeps. This would free a patient's days for other activities.

Drawbacks to home therapies were not discussed in the studies. Patient eligibility and acceptance must be considered when reviewing treatment options. Patients and family members have to have the capacity to learn asceptic techniques for self-cannulation. Trouble shooting when a machine alarms or dysfunctions would also be a skill to be acquired by perspective NHHD patients. While most patients on NHHD speak highly of the treatment, it is still not widely accepted among patients on CHD (12). Safety issues such as unintentional disconnection with the machine or possible air embolism cause patients to fear NHHD. Time and energy required by the patient for machine assembly requires motivation some patients may not possess (13). Additional research needs to be done regarding patient ability and acceptance of NHHD so that these issues can be addressed to make it a conceivable option for more patients. Research in this area could lead to improvements in ease of use and safety features of the machines. Additionally, educational materials for patients could be tailored more specifically to address issues that cause patients to reject NHHD. Renal dietitians should join with other renal health care professionals to inform patients of their treatment options. Many patients are not aware that anything but CHD is available. Promotion of home therapies could provide relief to the renal nursing shortage, and a solution to growth of the end stage renal disease (ESRD) and chronic kidney disease populations and the potential shortage of nephrologists in the next decade (14).

Conclusion

NHHD as a treatment option should be strongly encouraged to capable patients as a life and health improving option particularly regarding P control. Patients report that dietary restrictions are one of the most difficult parts of the treatment for ESRD, with P restrictions being the most commonly abused (15). The International Dialysis and Practice Patterns data reveals that fewer than 50% of patients meet target levels for serum P. Despite valiant efforts by renal dietitians this number has not improved since 1999 (16). These statistics are not acceptable as a low P diet and binder recommendations do not only affect a patient's lifestyle. Hyperphosphatemia is a strong predictor of morbidity and mortality among ESRD patients due to cardiovascular disease and soft tissue calcification (17).

PD is definitely a viable option that will improve P control and increase freedom of patients to a degree, but will not fully eliminate the need for binders and diet restrictions. Phosphorus control has been described as exquisite in NHHD patients. Control is typically achieved within the first week of treatment, eliminating the use of binders and leading to an unrestricted diet. In fact, many patients have to have sodium phosphate added to the dialysate to avoid hypophosphatemia due to the extreme improvements in weekly P removal (18). Additionally, the 8 hours spent having one's blood cleaned would be accomplished while the patient sleeps freeing the patient's days. With the removal of preoccupation with P, renal dietitians could focus on working with the patients to eat a well balanced, nutritious diet that includes a variety of foods rather than worrying the patient is contributing to their own death through the intake of minerals they cannot eliminate. ◆

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