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Clinical Outcomes in Patients Receiving Icodextrin Only for Peritoneal Dialysis vs Dextrose in Peritoneal Dialysis

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Abstract

Peritoneal Dialysis (PD), used for patients with ESRD, can involve 7.5% Icodextrin, dextrose, or a combination. Icodextrin-only PD has been shown to improve sodium removal, blood pressure, glycemic control, and reduce PD failure rates, yet it remains underutilized. This study analyzed outcomes from patients at Davita Home Dialysis Center in Wall Township, NJ, over a 5-year period. We compared clinical outcomes between patients using Icodextrin-only peritoneal dialysis (PD) and those using dextrose-based or combined dextrose-Icodextrin solutions for a minimum of six months. A retrospective review of de-identified patient data (Sept 2019-Jan 2024) compared serum potassium, phosphate, hemoglobin, albumin, residual urine, peritonitis events, and conversion to hemodialysis in patients using Icodextrin-only PD versus dextrose-based or combination solutions. Icodextrin-only PD achieved comparable dialysis adequacy to dextrose-based regimens and provided better control of potassium, anemia, and phosphate. Additionally, it maintained serum bicarbonate and albumin levels effectively. Icodextrin-only PD allows patients to perform fewer exchanges allowing for improved quality of life and thus better adherence to treatment. Despite all the established benefits, Icodextrin only incremental peritoneal dialysis is still underutilized. Hopefully this study will encourage more nephrologists to utilize this PD technique for more of their dialysis new starts. Future studies should aim to highlight long term impacts of Icodextrin only PD on longitudinal outcomes as well as its impact on mortality.

Keywords: Icodextrin, Peritoneal dialysis, Continuous ambulatory peritoneal dialysis, Continuous cycler peritoneal dialysis

1. Introduction

Approximately 15% of dialysis patients worldwide undergo peritoneal dialysis and this percentage is on the rise [1]. Glucose, often used as an osmotic agent in PD, is not optimal because it is readily reabsorbed, which diminishes the osmotic gradient needed for effective ultrafiltration. This absorption can contribute to complications such as hyperinsulinemia, hyperlipidemia and weight gain. However, despite Icodextrin having fewer side effects and being an easier alternative with fewer exchanges than with the standard PD solution using dextrose, it is not widely used in patients undergoing PD. The purpose of this study is to compare differences in clinical outcomes in patients receiving Icodextrin for PD to those receiving the standard PD solution containing dextrose or a combination of dextrose and Icodextrin for a minimum of 6 months. In addition, this study hopes to highlight the benefits of icodextrin for PD as a way of promoting better outcomes in patients with ESRD undergoing dialysis. Given the paucity of data regarding clinical outcomes in patients receiving Icodextrin only for PD, this study hopes to inform nephrologists regarding its utility in clinical settings as well give recommendations for use.

2. Methods

A retrospective chart review was conducted using data from de-identified patients from September 1st 2019 to January 1st 2024 from Davita Home Dialysis center in Wall township, NJ. This was a single center study. Patients included in the study had ESRD and were undergoing PD with either 7.5% icodextrin only, dextrose only, or icodextrin and dextrose combination solution. Patients that were lost to follow-up, passed away during the minimum 6 month follow-up period, or were non-adherent to treatment were excluded

from the study. Initially, patients who were receiving peritoneal dialysis were broken up into 3 different groups consisting of patients receiving icodextrin (n=12), dextrose (n=13), or a combination of icodextrin and dextrose (n=5). Differences in serum Potassium and Phosphate control, adequacy of dialysis, residual urine output, hemoglobin levels, peritonitis events, albumin levels and rates of conversion to hemodialysis in patients receiving icodextrin only were compared to those receiving the standard PD solution with either dextrose only or dextrose plus icodextrin. The values utilized were the last recorded actual readings from the patient charts during the study period. In addition, a brief literature review was conducted using studies published in peer-reviewed journals to gather existing data.

3. Results

Measured parameter goals during study period of 1-3 years	**Icodextrin Only Pd** (Total patients=12)	**Dextrose Only Pd** (Total patients=13)	**Dextrose Plus Icodextrin Pd** (Total patients=5)
Albumin ≥ 3.5 mg/dl	75%	61.5%	80%
Adequacy ≥ 1.7	91.7%	92%	100%
Serum Bicarbonate			
≥ 22 mg/dl	91.7%	100%	100%
Serum Potassium ≤ 5.2 mg/dl	91.7%	100%	100%
Urine output at end of study period ≥1000 ml	91.7%	36%	0%
Urine output at end of study period ≥1500 ml	75%	0%	0%
Hemoglobin ≥ 10 g/dl	91.7%	69.2%	60%
Hyponatremia ≤ 130 mg/dl	8.3%	0%	0%
Peritonitis	0%	0%	0%
Conversion to Hemodialysis	0%	15.3%	40%
PHOSPHORUS ≤ 5.5 mg/dl	66.7%	46.1%	100%
% of patients with Creatinines >4.5 mg/dl at dialysis start.	83%	76%	60%

4. Discussion

Our study results were encouraging as they demonstrated that a much simpler Peritoneal dialysis technique using Icodextrin single or two exchanges per day allows for excellent dialysis clearance shown by comparable Adequacy results between the Icodextrin only and Dextrose PD groups. In addition Icodextrin only PD demonstrated excellent potassium control, maintained serum Bicarbonate levels and serum albumin levels. Furthermore anemia and serum phosphate control was found to be better in the Icodextrin only PD group.

None of our Icodextrin group patients had to be transitioned to HD whereas some Dextrose group patients had to be transitioned to HD. We postulate this could be the result of better preservation of peritoneal membrane in the Icodextrin only group. This could also be the reason for the reduced dropout rate in Icodextrin PD patients [2]. Greater residual renal function helps with better overall volume control [3]. The most encouraging result was much better preservation of residual urine output seen in our Icodextrin only group of patients compared to the Dextrose group. 75% of patients had daily urine output >1500 ml in the Icodextrin only group at the end of study period compared with no patients having >1500 ml daily urine output in the Dextrose and Dextrose plus Icodextrin combined groups. This shows better preservation of residual kidney function in the Icodextrin only group.

The proposed mechanism is the improved preservation of intravascular volume due to the oncotic effect of Icodextrin metabolites despite reduction in extracellular volume [4]. It might be argued that the Icodextrin only patients may have started off with better residual renal function, however a greater proportion of patients studied in the Icodextrin group had Creatinines >4.5 mg/dl at start of study compared to the other groups. Preservation of the peritoneal membrane is likely due to reduced generation of advanced glycation end products which are known to damage peritoneal membrane [4]. These products have been shown to alter peritoneal membrane transport characteristics by inducing neoangiogenesis resulting in eventual membrane failure [5].

Hyponatremia was observed in several patients in the Icodextrin group as expected partly due to proposed mechanism of extracellular water shifts caused by reabsorbed Icodextrin metabolites Maltose and maltotriose6 and partly due to lack of sodium sieving [7]. However this occasional mild hyponatremia was easily managed by appropriate increase in solute intake, better glycemic control, fluid restriction and Loop diuretic use.

Icodextrin's colloidal mechanism of action and less reabsorption allows for more sustained ultrafiltration that results in better blood pressure and volume control [8]. This can potentially result in reduced mortality. Better anemia control was also discovered in

the Icodextrin group. Icodextrin has been shown to improve EPO responsiveness [9].

Htay et al. meta-analysis shows that patients using Icodextrin have a lower risk of uncontrolled fluid overload compared to those using dextrose-only PD, with a Relative Risk of 0.30 (0.15-0.59). Additionally, icodextrin users average 448.54 ml more daily net ultrafiltration than dextrose patients [10]. He et al. conducted a metaanalysis of Randomized controlled trials (RCT's) published from 1990 to December 2010. Their findings indicated that Icodextrin enhances small solute clearance due to increased Ultra filtration. Additionally, no significant differences were observed in fasting plasma glucose or triglyceride levels among patients using Icodextrin. However, those in Icodextrin group did experience lower total cholesterol levels. Importantly, there was no evidence supporting Icodextrin's effect on long-term survival. Interestingly, diabetic patients using Icodextrin may acheive better plasma glucose levels compared to those using dextrose dialysate [11]. Goossen et al. conducted a meta-analysis of 19 RCT's involving 1,714 patients, comparing Icodextrin (ICO) and Dextrose in Peritoneal dialysis (PD). They found a moderate certainty of mortality benefits for patients on Icodextrin, with an odds ratio of 0.49 (95% CI: 0.24-1). Additionally, Icodextrin was associated with increased ultrafiltration, fewer fluid overload episodes, reduced daily glucose absorption and potentially lower mortality risk [12].

5. Limitations of this Study

1. This study is an observational study with limited power from one dialysis unit.
2. The Icodextrin along with Dextrose combination technique is not widely used.
3. The low potassium seen in Dextrose plus Icodextrin PD group of patients could be due to strict dietary restriction as well, which explains the 100 percent result of potassium of less than 5.2mg/dl.
4. This is a non blinded study, hence observer bias can't be excluded.

6. Conclusion

Icodextrin PD can be considered for patients on peritoneal dialysis as it allows for excellent dialysis clearance, electrolyte control and most importantly may provide better preservation of residual renal function and integrity of peritoneal membrane compared to Dextrose based PD alone. In addition, Icodextrin PD allows patients to perform fewer exchanges allowing for improved quality of life and thus better adherence to treatment. Despite all the established benefits, Icodextrin incremental peritoneal dialysis is still underutilized. Hopefully this study will encourage more nephrologists to utilize this PD technique for more of their dialysis new starts.

Future studies should aim to highlight long term impacts of icodextrin PD on longitudinal outcomes as well as its impact on mortality. Given the fact that Icodextrin alone is not widely used for peritoneal dialysis, this study was limited by the relatively small number of patients undergoing PD with Icodextrin. Future studies should aim to gather more patient data from various dialysis centers across the United States for improved statistical analysis.

Conflict of Interest Statement

The authors have no personal or financial disclosures.

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