

PD fluid Type
Old/New
Hazard & Benefit

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KIDNEY ISSUES

Information for kidney patients and their families from the National Kidney Federation



Types of PD fluid

- Standard PD fluid can contain different amounts of glucose or calcium
- Special dialysis fluids

Strong, Medium and Weak Glucose bags

- Strong bags (3.86% or 4.25% glucose solution)
- Medium bags (2.27% or 2.25% glucose)
- Weak bags (1.36% or 1.5% glucose)

High, Medium and Low Calcium bags

- 1.75 mmols
- 1.25 mmols
- 1 mmol

Special dialysis fluids

- Icodextrin
 - This fluid (also known as Extraneal) is sometimes used to help with people who have difficulty with fluid removal
 - Icodextrin is less likely than ordinary glucose to be absorbed into the body

Amino Acid

- This is a PD fluid containing Amino acids instead of glucose (sometimes known as Nutrineal)
- Useful for patients who do not eat well or who have malnutrition.

Bicarbonate

- Help people who have problems regulating the level of acid in their bodies
- Helps people who get a lot of pain when they have the standard PD fluid

PD Solutions: New and Old

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Dialysis & Transplantation August 2011

Peritoneal dialysis (PD) solutions have evolved since Boen described the appropriate composition of a suitable fluid comprising an osmotic agent, electrolytes, and buffer substance in 1969. New solutions introducing alternative osmotic agents and bicarbonate as an alternative to lactate-buffered solutions have been developed. These so-called biocompatible solutions belong to a very heterogeneous group of PD fluids that share some features but are distinct in other aspects. All biocompatible solutions have a substantially reduced level of toxic glucose degradation products (GDPs). However, the new solutions differ in their absolute GDP content, osmotic agent, buffer substance, and pH. The differences from the conventional solutions and the characteristics of the distinct new solutions are presented in this review together with a discussion of their potential clinical benefits and implications.

Conventional or standard solution

- Current conventional PD solutions consist of
 - lactate-based buffer
 - Electrolytes
 - An osmotic agent
 - PH of approximately 5.5
- The glucose concentrations of these dialysis solutions are mostly specified as g/L
 - or percent of monohydrous or anhydrous glucose.

TABLE I. Typical composition of conventional PD solutions.

Component	Concentration
Electrolytes	
Sodium	132–134 mEq/L
Potassium	None
Calcium	1.5–3.5 mEq/L
Chloride	95–102.5 mEq/L
Magnesium	0.5–1.5 mEq/L
Buffer	
Sodium lactate	35–40 mmol/L
Osmotic agent	
Dextrose (glucose monohydrate)	1.5–4.25%

New Biocompatible Solutions

- Compared with conventional PD solutions, new biocompatible solutions consist of the same basic components
 - Buffer
 - Electrolytes
 - Osmotic agent

New Osmotic Agents

- Icodextrin Currently in the United States, polyglucose is available as an alternative to glucose as an osmotic agent.

- The solution pH of 5.5-6
- 7.5% polyglucose (MW 15-17 kDa)
- Sodium (133 mEq/L)
- Calcium (1.75 mEq/L)
- magnesium (0.5 mEq/L).
- Chloride (96 mEq/L)
- lactate (40 mEq/L) as the buffer.

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Dextrose (glucose monohydrate)	1.5–4.25%

- Absorption of polyglucose is slower than that of glucose, making it more suitable for long dwells

The absorption rate of polyglucose

- 14.4% at 6 hours
- 28.1.% at 12 hours
- In a single-dose pharmacokinetic study using icodextrin
- Number of subject 13 Median of 40% (60 g) of the instilled icodextrin was absorbed from the peritoneal solution during a 12-hour dwell



Cochrane
Library

Cochrane Database of Systematic Reviews

Biocompatible dialysis fluids for peritoneal dialysis (Review)

Htay H, Johnson DW, Wiggins KJ, Badve SV, Craig JC, Strippoli GFM, Cho Y

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Biocompatible dialysis fluids for peritoneal dialysis.

Cochrane Database of Systematic Reviews 2018, Issue 10. Art. No.: CD007554.

DOI: [10.1002/14651858.CD007554.pub3](https://doi.org/10.1002/14651858.CD007554.pub3).

Biocompatible dialysis fluids for peritoneal dialysis

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• Background

- Biocompatible peritoneal dialysis solutions have been manufactured with the aim of providing patient benefit
- Review to examine the benefits and harms from the use of biocompatible peritoneal dialysis solutions.
- Several RCT evaluating biocompatible solutions in PD patients
- This is an update of a review first published in 2014

• Objectives

- Aimed : look at the benefits and harms of biocompatible PD solutions in comparison to standard PD solutions

Biocompatible dialysis fluids for peritoneal dialysis

- **Search methods**

- Studies in the Specialized Register are identified through searches of CENTRAL, MEDLINE, and EMBASE, conference proceedings, the International Clinical Trials Register Search Portal and ClinicalTrials.gov.

- **Main results**

- included 42 eligible studies (3262 participants)

- Overall, 29 studies (1971 participants) compared neutral pH, low GDP PD solution with conventional PD solution
- 13 studies (1291 participants) compared icodextrin with conventional PD solution.

Neutral pH, low GDP versus conventional glucose PD solution (residual renal function)

- 15 studies, 835 participants: SMD 0.19, 95% CI 0.05 to 0.33; high certainty evidence
 - Use of neutral pH, low GDP PD solutions improved residual renal function (RRF) preservation

Neutral pH, low GDP versus conventional glucose PD solution (residual urine volume)

- 11 studies, 791 participants: MD 114.37 mL/day, 95% CI 47.09 to 181.65; high certainty evidence
 - Neutral pH, low GDP PD solution use also improved residual urine volume preservation

Neutral pH, low GDP versus conventional glucose PD solution (peritonitis occurrence, hospitalization, adverse events)

- 6 studies, 519 participants) or inflow pain (1 study, 58 participants: RR 0.51, 95% CI 0.24 to 1.08
 - It is uncertain whether neutral pH, low GDP PD solution use led to any differences in peritonitis occurrence, hospitalization, adverse events

Glucose polymer (icodextrin) versus conventional glucose PD solution

- Reduced Episodes of uncontrolled fluid overload (2 studies, 100 participants: RR 0.30, 95% CI 0.15 to 0.59)
- Augmented peritoneal ultrafiltration (4 studies, 102 participants: MD 448.54 mL/d, 95% CI 289.28 to 607.80)
- Compromising RRF (4 studies, 114 participants: SMD 0.12, 95% CI -0.26 to 0.49; low certainty evidence)
- It is uncertain whether icodextrin use led to any differences in adverse events

Conclusions

- Those treated with biocompatible solutions experience important benefits including
 - Better preservation of their own kidney function
 - Urine volume
 - Less fluid overload
- Whether these benefits help patients to stay on peritoneal dialysis longer or live longer are uncertain and require further study.

Safety and Efficacy

ORIGINAL ARTICLES

PERITONEAL DIALYSIS FLUID AND SOME OF ITS COMPONENTS POTENTIATE FIBROCYTE DIFFERENTIATION

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Introduction

- Long-term peritoneal dialysis (PD) often results in the development of peritoneal fibrosis.
- PD fluid potentiates human fibrocyte differentiation *in vitro* and implicates sodium lactate in this potentiation
- The plasma protein serum amyloid P (SAP) inhibits fibrocyte differentiation
- Peritoneal dialysis fluid and sodium chloride decrease the ability of human SAP to inhibit human fibrocyte differentiation *in vitro*.
- These results suggest that PD fluid contributes to the development of peritoneal fibrosis by potentiating fibrocyte differentiation.

METHODS

- IMMUNOSTAINING

- Peritoneal membrane biopsy samples were obtained from Wales Kidney Research Tissue Bank
- Stained and processed
- Images were acquired on a Nikon Eclipse 80i microscope

- CELL CULTURE AND FIBROCYTE DIFFERENTIATION ASSAYS

- Human blood was collected from adult volunteers
- Peripheral blood mononuclear cells (PBMC) were isolated
- Peripheral blood mononuclear cells were cultured in 96-well cell plates
 - with PD fluid (132 mM sodium, 96 mM chloride, 3.5 mM calcium, 0.5 mM magnesium, 40 mM lactate, and 1.5% dextrose)
 - or individual components of PD fluid (sodium chloride, calcium chloride, magnesium chloride, sodium lactate, or dextrose)

COLLAGEN AND DAPI STAINING

- Collagen staining of cultured PBMC
- To count total cells, cell nuclei in plates from the fibrocyte differentiation assays were stained with 2 $\mu\text{g}/\text{mL}$ DAPI (Sigma-Aldrich, St. Louis, MO, USA) and fluorescence in 4 fields
- The nuclei in the images were counted with Cell Profiler software

RESULTS

- LONG-TERM PD IS ASSOCIATED WITH AN INCREASE IN FIBROCYTES
- PD FLUID POTENTIATES FIBROCYTE DIFFERENTIATION
- SOME COMPONENTS OF PD FLUID POTENTIATE FIBROCYTE DIFFERENTIATION

Conclusion

- Both PD fluid and sodium chloride decreased the ability of SAP to inhibit fibrocyte differentiation
- Sodium lactate did not significantly influence SAP activity, suggesting that the sodium lactate potentiation of fibrocyte differentiation could be through a mechanism independent of SAP inhibition
- These data suggest that peritoneal fibrosis may be alleviated in patients undergoing long-term PD
 - Including changes in the composition of the dialysate and additives specifically targeting the fibrocyte differentiation pathway

Thanks for attention