CLINICAL VIGNETTE

Onset of Right-Sided Pleural Effusion after Peritoneal Dialysis Initiation – A Rare Complication of Dialysate Leakage from Diaphragmatic Hernia: The Sweet Hydrothorax Phenomenon

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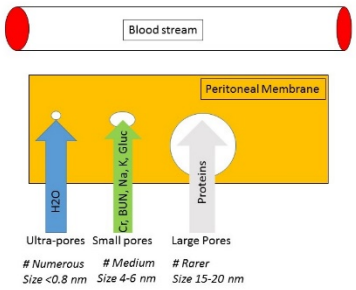
Introduction

Peritoneal dialysis is a home dialysis modality that offers excellent solute clearance, phosphorous and potassium control in patients with end stage renal disease.[1] Peritoneal dialysis allows for solute exchange and fluid removal utilized in patients who desire to perform their renal replacement therapy at home and/or at night. The principle behind peritoneal dialysis is the use of the omental blood vessels as a biological exchanger whereby nitrogenous wastes diffuse into clean dialysate. The higher osmolality of the dialysate fluid also serves to drive fluid exchange of water with solutes (sodium, potassium, etc.) following via solvent drag.

There are different types of transporters on peritoneal membrane ultra-pores (aquaporins), small pores, and large pores that can be seen in Figure 1 that allow peritoneal dialysis to occur.[2] The omental membrane defines the success of peritoneal dialysis, as properties of the peritoneal membrane (transport characteristics) can predict how successful peritoneal dialysis will be. The main challenges occur in rapid transporters who quickly transport glucose across the membrane dissipating the dialysate-serum osmolal gradient leading to need for higher concentrations of dextrose or ico-dextran based molecules to induce ultrafiltration. Slow transporters on the other hand are able to achieve net ultrafiltration easily, but do not clear urea and nitrogenous wastes as easily.

Figure 1



While early intensive training is required for successful peritoneal dialysis due to the autonomy required of the patient, there are some factors that complicate peritoneal dialysis initiation. Prior abdominal surgeries make catheter insertion and continued function a challenge and constipation can impair catheter use. One rare complication is diaphragmatic hernia with leakage of peritoneal dialysate from the peritoneal space to the pleural space.[3] There have been reports of repair of such lesions to continue peritoneal dialysis but recurrences can occur and thoracic surgery is certainly not without risks.[4,5]

Case Report

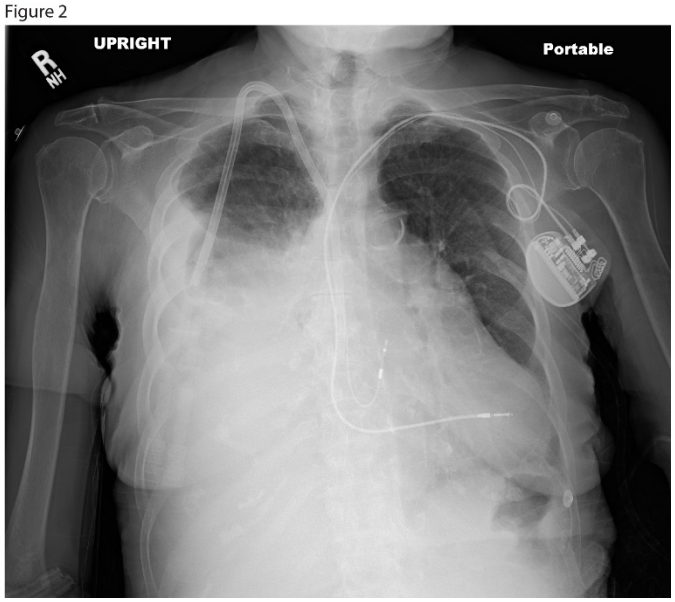
An 85-year-old Asian female with End-Stage Renal Disease (ESRD) secondary to hypertensive nephrosclerosis on hemodialysis via a permcath requested to transition to peritoneal dialysis to be able to perform home daily dialysis. She underwent training with her caregivers and transitioned to home Continuous Cyclic Peritoneal Dialysis (CCPD) with prescription of three 1.8 liters of 2.5% dextrose dialysate for a total of 9 hours of total therapy time. Four days after she started training she developed shortness of breath and weight gain of 2 liters. She presented to the emergency department and noted to have an oral temperature 37.1 °C (98.7 °F), blood pressure of 194/94, pulse 92, respirations 20, and oxygen saturation of 97% on oxygen face-mask. Chest x-ray revealed a large right pleural effusion and her brain natriuretic peptide was elevated at 340 µg/mL.

She underwent dialysis without improvement in her shortness of breath and thoracentesis removed 1.5 L of transudative fluid. The initial concern was volume overload due to a rapid transporter phenotype resulting in poor ultrafiltration. Further peritoneal dialysis with 2.5% dextrose with increased exchanges with a shorter dwell period did not improve her shortness of breath and the effusion was related to volume overload. Repeat hemodialysis did not decrease the size of effusion and a second thoracentesis removed 1.5 L. Pleural fluid showed an extremely elevated glucose and the effusion was attributed to peritoneal dialysate leakage across the diaphragm into the pleural membrane. Please see Table 1 for lab values of

fluid analysis and see figure 2 for chest x-ray showing peritoneal dialysate hydrothorax.

Table 1: lab analysis of body fluid from thoracentesis		
Laboratory test name	Lab value	Interpertation
Serum Lactate dehydrogenase	305 IU/L	borderline elevation
Serum Albumin	4.2 g/dL	well nourished
Serum total protein	7.8 g/dL	well nourished
Serum glucose	115 mg/dL	Non diabetic
Body fluid lactate dehydrogenase	<23 Units/L	Transudate
Body fluid alubmin	<1 g/dL	Transudate
Body fluid total protein	<2.5 g/dL	Transudate
Body fluid glucose	279 mg/dL	Abnormally high
Body fluid white blood cell count	85/mm^3	not consistent with peritonitis
% Neutrophils	3	not consistent with infection
% Lymphocytes	90	not consistent with infection
Table legend: dL: deciliter, g=gram, IU: interational unit, L: liter, mm^3: cubic millimiter, %=percent		

Figure 2



Discussion

Peritoneal dialysis has mobility and autonomy advantages which allow well-trained patients to reduce the burden of in center hemodialysis.[6] We present a difficult anatomical complication that may eliminate the option for peritoneal dialysis. The fluid analysis and timing of the pleural effusion prove the effusion was due to peritoneal dialysate leak across the diaphragm from the peritoneum into the right pleural cavity. Key findings include the transudative nature of the fluid, the lack of infection, and the body fluid glucose several times higher than serum.

The patient had elected a DNR (do-not-resuscitate) status and thus wanted to limit the risk of repeat pleural effusions following diaphragmatic hernia repair. She also did not want to undergo thoracic surgery. It is important to note that surgical repair was possible but not accepted by the patient.[7] She has chosen to switch to hemodialysis and will undergo arteriovenous fistula placement with removal of peritoneal dialysis catheter to avoid repeat peritonitis.

Figure Legends

Figure 1**:** Mechanism of peritoneal dialysis
number, BUN=blood urea nitrogen, Cr=creatinine, H20=water, K=potassium, Na=sodium, Nm nanometer

Figure 2: Chest x-ray showing large right hydrothorax that upon examination had a very high glucose content, consistent with diagnosis of "sweet hydrothorax" due to leakage of peritoneal dialysate into pleural space across a diaphragmatic hernia.
Table 1: See attached table legend

REFERENCES

1. **Yavuz A, Ersoy FF, Passadakis PS, Tam P, Evaggelos DM, Katopodis KP, Ozener C, Akçiçek F, Camsari T, Ateş K, Ataman R, Vlachojannis GJ, Dombros NA, Utaş C, Akpolat T, Bozfakioğlu S, Wu G, Karayaylali I, Arinsoy T, Stathakis CP, Yavuz M, Tsakiris DJ, Dimitriades AC, Yilmaz ME, Gültekin M, Süleymanlar G, Oreopoulos DG.** Phosphorus control in peritoneal dialysis patients. *Kidney Int Suppl*. 2008 Apr;(108):S152-8. doi: 10.1038/sj.ki.5002617. PubMed PMID: 18379539.
2. **Flessner MF.** Peritoneal ultrafiltration: mechanisms and measures. *Contrib Nephrol*. 2006;150:28-36. Review. PubMed PMID: 16720988.
3. **McCormick BB, Bargman JM.** Noninfectious complications of peritoneal dialysis: implications for patient and technique survival. *J Am Soc Nephrol.* 2007 Dec;18(12):3023-5. Epub 2007 Nov 14. PubMed PMID: 18003770.
4. **Kennedy C, McCarthy C, Alken S, McWilliams J, Morgan RK, Denton M, Conlon PJ, Magee C.** Pleuroperitoneal leak complicating peritoneal dialysis: a case series. *Int J Nephrol.* 2011;2011:526753. doi: 10.4061/2011/526753. Epub 2011 Aug 17. PubMed PMID: 21876802; PubMed Central PMCID: PMC3161202.
5. **Yaxley J, Twomey K.** Peritoneal Dialysis Complicated by Pleuroperitoneal Communication and Hydrothorax. *Ochsner J.* 2017 Spring;17(1):124-127. PubMed PMID:28331461; PubMed Central PMCID: PMC5349625.
6. **Chang YT, Hwang JS, Hung SY, Tsai MS, Wu JL, Sung JM, Wang JD.** Cost-effectiveness of hemodialysis and peritoneal dialysis: A national cohort study with 14 years follow-up and matched for comorbidities and propensity score. *Sci Rep.* 2016 Jul 27;6:30266. doi: 10.1038/srep30266. PubMed PMID: 27461186; PubMed Central PMCID: PMC4962092.
7. **Szeto CC, Chow KM.** Pathogenesis and management of hydrothorax complicating peritoneal dialysis. *Curr Opin Pulm Med.* 2004 Jul;10(4):315-9. Review. PubMed PMID: 15220759.

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