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A Novel Diagnostic Approach for Suspected Icodextrin Pleural Effusion in a Peritoneal Dialysis Patient

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Abstract

Symptomatic pleural effusion secondary to pleuroperitoneal communication in patients undergoing peritoneal dialysis (PD) occurs in approximately 2% of patients undergoing continuous ambulatory PD. The classic presentation is that of a low-protein, high-glucose pleural aspirate consistent with the high dextrose concentrations present in standard PD fluids, hence the name *sweet hydrothorax*. Nevertheless, the increasing use of icodextrin calls for an innovative bedside diagnostic approach because icodextrin does not contain high concentrations of dextrose after all. We describe a patient with newly symptomatic right pleural effusion 2 months after starting continuous ambulatory PD with 2 exchanges every 12 hours. Prompt relief was achieved with therapeutic thoracentesis, but the pleural aspirate had less than 2 g/dL of protein (to convert to g/L, multiply by 10) and a glucose level of 108 mg/dL (to convert to mmol/L, multiply by 0.0555), lower than the blood glucose level of 139 mg/dL in the emergency department earlier the same night. The patient was allergic to iodinated contrast. We, therefore, used an innovative approach with biochemical fingerprint analysis of simultaneous pleural and peritoneal fluids for electrolytes, urea, creatinine, and measured osmolality. With the increasing use of icodextrin in contemporary PD worldwide, this innovative tactic is cheap, is easily available, and does not require sophisticated, expensive, and often unavailable options, such as isotope studies, dye studies, and iodinated contrast-enhanced computed tomography. To our knowledge, this is the first time that biochemical fingerprint analysis of simultaneous pleural and peritoneal fluids has been reported in the literature.

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Symptomatic pleural effusion secondary to pleuroperitoneal communication in patients undergoing peritoneal dialysis (PD) occurs in approximately 2% of patients undergoing continuous ambulatory PD (CAPD).[1,2] The presence of diaphragmatic defects means that unless the defects are repaired, the patient cannot return to CAPD without an increased risk of recurrence of the pleural effusion.[1,2] The classic presentation is that of a low-protein, high-glucose pleural aspirate consistent with the high dextrose concentrations present in standard PD fluids, hence the name *sweet hydrothorax*.[3,4] Icodextrin, a high-molecular-weight glucose polymer developed specifically for use as an alternative osmotic agent in PD, does not contain high concentrations of dextrose. Therefore, the increasing use of icodextrin in contemporary PD prescriptions calls for alternative diagnostic biochemical options in the investigative evaluation of this condition. Radioisotope tracer studies and iodinated contrast-enhanced radiologic examination, of course, remain, but these may not be available in resource-poor settings, may be too expensive, or may even be contraindicated by allergy or pregnancy.

CASE REPORT

An obese woman was admitted to the emergency department with worsening shortness of breath after 2 months of CAPD. End-stage renal disease was secondary to focal segmental

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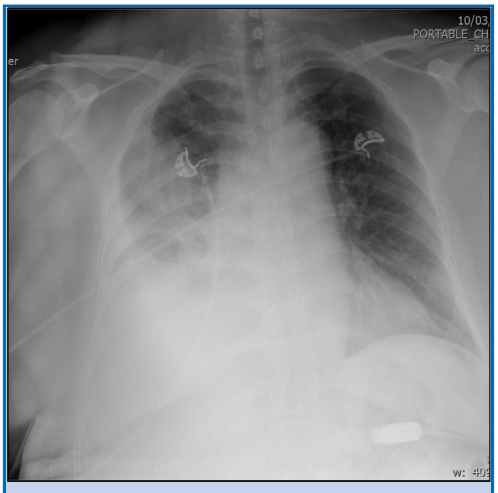

FIGURE. Chest radiograph showing new symptomatic right pleural effusion.

glomerulosclerosis. Her PD prescription was two 2-L exchanges of icodextrin every 12 hours. The family had, for a few days before the presentation to the emergency department, noted decreased PD fluid drainage from the PD catheter. There was associated orthopnea without any other systemic symptoms. The patient's dry weight was approximately 183 lb, but she gained 3 to 4 lb in the past couple of days. Vital signs were a temperature of 97.5°F; heart rate, 107 beats/min, respiratory rate, up to 40 breaths/min; blood pressure, 150/98 mm Hg; and oxygen saturation, 95% on room air. She weighed 188.9 lb, with a body mass index of 34.57 (calculated as the weight in kilograms divided by the height in meters squared). There was right-sided dullness to percussion and absent breath sounds to the middle lung fields. The abdomen was distended, with a positive fluid wave, and a PD catheter was present, with no overt exit site infection. She had mild epigastric tenderness but without rebound or guarding. Pertinent laboratory test results were a normal complete blood cell count, albumin level of 0.45 g/dL (to convert to g/L, multiply by 10), lipase level of 498 U/L (to convert to μkat/L, multiply by 0.0167), and normal liver panel findings. A chest radiograph confirmed a new large right pleural effusion (Figure). Immediate thoracentesis revealed 1200 mL of clear-appearing fluid and provided immediate symptomatic relief. At this point in the emergency department, the daughter, the patient's caregiver, had astutely observed that the drained right pleural fluid appeared exactly as the icodextrin solution infused into the patient's abdomen during CAPD. The pleural aspirate fluid protein was less than 2 g/dL (to convert to g/L, multiply by 10), lactate dehydrogenase levels were undetectable, and it contained only 108 mg/dL of glucose (to convert to mmol/L, multiply by 0.0555). The blood glucose level determined in the emergency department earlier that night was, indeed, higher at 139 mg/dL. The use of iodinated contrast to investigate the presence of a pleuroperitoneal communication was contraindicated by a history of allergy to iodinated contrast. Therefore, we proceeded to perform a biochemical fingerprint analysis and comparison of the drained right pleural fluid and the drained peritoneal fluid. The biochemical fingerprint approach included testing for levels of electrolytes, creatinine, urea, and measured osmolality in the two simultaneously drained fluids. This innovative biochemical fingerprint evaluation of the two

TABLE. Biochemical Fingerprint Analysis of Simultaneous Right Pleural Fluid and Drained Peritoneal Fluid[a,b]

Variable	Pleural aspirate	Peritoneal dialysis effluent
Sodium (mEq/L)	133	135
Potassium (mEq/L)	4.2	3.9
Bicarbonate (mEq/L)	28	30
Chloride (mEq/L)	105	105
BUN (mg/dL)	69	68
Creatinine (mg/dL)	5.22	5.77
Glucose (mg/dL)	108	87
Calcium (mg/dL)	5.4	5.2
Measured osmolality (mOsm/kg)	319	318

[a]BUN = blood urea nitrogen.

[b]SI conversion factors: To convert sodium values to mmol/L, multiply by 1; to convert potassium values to mmol/L, multiply by 1; to convert bicarbonate values to mmol/L, multiply by 1; to convert chloride values to mmol/L, multiply by 1; to convert BUN values to mmol/L, multiply by 0.357; to convert creatinine values to μmol/L, multiply by 88.4; to convert glucose values to mmol/L, multiply by 0.0555; to convert calcium values to mmol/L, multiply by 0.25; to convert osmolality values to mmol/kg, multiply by 1.

drained fluids yielded a near perfect match (Table). Notably, calculated serum osmolality was 320 mOsm/kg (to convert to mmol/kg, multiply by 1), compared with pleural aspirate fluid osmolality of 319 mOsm/kg and drained peritoneal fluid osmolality of 318 mOsm/kg. Icodextrin is known to be iso-osmotic. This way, we confirmed the presence of a pleuroperitoneal communication. Use of CAPD was discontinued, and she has since been switched to hemodialysis via a newly placed tunneled dialysis catheter. The patient has persistently asked to return to PD, but she would require some form of a surgical diaphragmatic repair procedure before a return to PD would be entertained.[2,4,5]

DISCUSSION

We presented a case of symptomatic right-sided pleural effusion from a suspected pleuroperitoneal diaphragmatic communication complicating CAPD with icodextrin. Hydrothorax in a patient treated with PD sometimes poses a diagnostic dilemma.[6] Unlike most previous reports of this syndrome where the pleural aspirate has very high glucose concentrations relative to plasma, the so-called sweet hydrothorax, herein, the glucose content was only 108 mg/dL.[3,4] This is because she was using icodextrin as the dialysate for PD. Icodextrin is a starch-derived, water-soluble, glucose polymer (average molecular weight of 16.8 kDa) linked predominantly by α1,4 glucosidic bonds; does not contain high concentrations of glucose or dextrose; and is iso-osmotic with plasma. In the present patient, due to iodinated contrast allergy, iodinated contrast computed tomography to demonstrate the presence of a pleuroperitoneal diaphragmatic communication was contraindicated. Without prejudice to the use of isotopic scans or some colored dyes to show this pleuroperitoneal communication, as a novelty, we had decided on a new tactic. We, therefore, had devised a new innovative biochemical fingerprinting approach to analyze the simultaneously drained pleural and peritoneal fluids for levels of electrolytes, urea, creatinine, and measured osmolality to show concordance and, therefore, "confirm" the diagnosis of a pleuroperitoneal communication as the cause of the symptomatic right pleural effusion. The clear unilaterality of the right pleural effusion, the absence of edema on presentation, and no recurrence since PD was discontinued and she was switched to hemodialysis all argue against the right pleural effusion being simply a transudative fluid from volume overload. To our knowledge, this is the first time that biochemical fingerprint analysis of simultaneous pleural and peritoneal fluids has been reported in the literature.

Abbreviations and Acronyms: **CAPD** = continuous ambulatory peritoneal dialysis; **PD** = peritoneal dialysis

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