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Case Report

Acute appendicitis and secondary peritonitis in a patient with end-stage renal failure and a dormant peritoneal dialysis catheter

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ABSTRACT

Peritoneal dialysis (PD) is a common renal replacement therapy for patients with end-stage renal disease (ESRD). Despite its benefits, PD-related peritonitis remains a severe complication, often associated with significant morbidity and mortality. Although most cases of PD-related peritonitis are due to touch contamination, intra-abdominal infections, such as appendicitis, are less common but can result in severe outcomes. We present a case of severe peritonitis secondary to perforated appendicitis in a patient with a dormant PD catheter. A 41-year-old male with ESRD, previously on PD, presented with a 36-hour history of fever, chills, nausea, and abdominal pain. Despite transitioning to hemodialysis, the patient had retained his PD catheter, which had not been used for months. On admission, the patient was septic with evidence of peritonitis. Blood cultures were positive for Escherichia coli, while PD catheter cultures were negative. An abdominal CT scan revealed a gangrenous perforated appendix. The patient underwent an emergency laparoscopic appendectomy and PD catheter removal, resulting in significant clinical improvement. Perforated appendicitis in ESRD patients with a PD catheter can result in severe peritonitis with life-threatening complications, including sepsis and cardiac events. This case underscores the importance of maintaining a high index of suspicion for intra-abdominal causes of peritonitis in PD patients, even when the PD catheter is dormant. Timely diagnosis, empiric antibiotic therapy, and prompt surgical management are essential to reduce mortality in these patients.

Keywords: Peritoneal dialysis, End-stage renal disease, Peritonitis, Perforated appendicitis, Dormant PD catheter, Laparoscopic appendectomy

INTRODUCTION

Peritoneal dialysis (PD) is one of the options for renal replacement offered to 5%-10% of patients suffering from end-stage renal disease (ESRD) in addition to intermittent hemodialysis (IHD) and renal transplantation.[1,2] Hemodialysis has become the most common treatment modality in the U.S and Western Europe, where peritoneal dialysis (PD) is used in 5%-10% compared to 75% in countries such as Mexico.[1] Factors influencing the choice include the availability and access to hemodialysis and the patient's preference. PD is chosen for its convenience and improved quality of life compared to HD. In 2016, the International Society for Peritoneal Dialysis (ISPD) recommended a benchmark of 0.5 episodes of PD-related peritonitis per patient per year. Recent data report 0.26 episodes per patient per year in the U.S. PD-related peritonitis, however, is associated with hospitalization, contributing to death in approximately 15% of patients.[3] Most of the PD-related peritonitis is due to "touch contamination" by the patient, with Staphylococcus epidermidis and Staphylococcus aureus being culprits in 50% of cases. Intra-abdominal infections are the source in less than 10% of cases and are usually polymicrobial.[1,3-17] A small number of PD-related peritonitis cases have been reported of peritonitis

occurring in the context of emphysematous pyelitis, encapsulating peritoneal fibrosis (EPS), acute appendicitis, diverticulitis, cholecystitis, colonoscopy, and hysteroscopy.[1,5,7] The clinical presentation varies, but most patients present with diffuse abdominal pain, tenderness, and cloudy PD effluent, while others with anorexia, vomiting, diarrhea, and rarely fever.[7] Perforated appendicitis in PD patients is an uncommon diagnosis in published literature.

Operative mortality of PD patients with peritonitis ranges from 16%-50% to 33%, specifically in the case of perforated appendicitis.[7] In contrast, the predicted mortality for non-PD patients with perforated appendicitis was only 4%, with a significant increase in death rates after 32 hours of perforation.[7] We report a case of severe peritonitis secondary to perforated appendicitis in a patient with a dormant PD catheter presenting 36 hours after the onset of symptoms.

CASE REPORT

A 41-year-old male with a history of smoking, end-stage renal disease, hypertension, and diabetes mellitus type II was admitted with fever, chills, nausea, and abdominal pain. The patient was initially dialyzed through a peritoneal dialysis (PD) catheter; he had become non-compliant and was subsequently transitioned to hemodialysis but had refused the removal of the PD catheter. The patient's symptoms started at the dialysis center during his HD session 36 hours before admission. Blood cultures were drawn, empiric antibiotics were administered, and he was referred to the hospital on the same day but presented to the ED 24 hours later.

On admission, he was septic with a blood pressure (BP) of 149/83 mmHg, pulse 106 bpm, temperature 101.2 F, respiratory rate 20/min, and SpO2 97%. Physical examination revealed an ill-appearing patient with dry mucous membranes, diffuse moderate to severe abdominal tenderness, and purulent drainage from the peritoneal dialysis catheter. His blood work was significant for leukocytosis (14.0 K/ul WBC), elevated C-reactive protein (CRP) of 26.4 mg/dl, erythrocyte sedimentation rate (ESR) of 56 mm/hr, brain natriuretic peptide (BNP) of 175,000 pg/l, and troponin of 1.5 ng/dl, with a type 2 myocardial infarction.

An abdominal CT scan showed acute appendicitis. He was taken to the OR and was found to have a gangrenous perforated appendix with peritonitis for laparoscopic appendectomy and PD catheter removal. The HD center and ED blood cultures were concurrent for Escherichia coli types 1 and 2. The PD catheter cultures were negative. The patient improved clinically over the next 48 hours and signed out against medical advice (AMA), receiving oral levofloxacin and metronidazole prescriptions. One week later, the patient was seen doing well at the outpatient office visit, and the abdominal drain was removed.

DISCUSSION

Renal replacement therapy options for patients with ESRD vary between hemodialysis (HD), peritoneal dialysis (PD), and renal transplantation.[3] Patients can do PD at home, whereas HD often requires significantly more time and effort to arrange. PD catheters work by diffusion of uremic toxins from the blood through the peritoneal membrane and eventual elimination from this space.[9]

In 2016, the ISPD (Infectious Society for Peritoneal Dialysis) recommended a benchmark of 0.5 episodes of PD-related peritonitis per patient per year. Although PD-related primary peritonitis occurs in 0.26 episodes per patient/year in the US, it is associated with hospitalization, contributing directly to death in 5% or as a cofactor in 16% of patients.[1,17] Most of the PD-related peritonitis is due to "touch contamination" by the patient, with Staphylococcus epidermidis and aureus being culprits in 50% of cases. Intra-abdominal infections are the source in less than 10% of cases, such as in emphysematous pyelitis, encapsulating peritoneal fibrosis (EPS), acute appendicitis, diverticulitis, cholecystitis, colonoscopy, and hysteroscopy.[1,5,7] The clinical presentation of PD-related peritonitis due to gram-negative enteric bacteria is more severe, with fever, abdominal pain, vomiting, and diarrhea, *E coli* is the most common in 30%-50% of cases, followed by Klebsiella and Enterobacter species.[1]

Compared to exit and tunnel infections in which Gram-positive cocci in skin flora and organisms outside of the abdominal cavity gain entry into the peritoneal space causing peritonitis, Gram-negative bacteria such as *E. coli,* Klebsiella, Enterobacter, Citrobacter, and Proteus are more often associated with intra-abdominal sources such as intestinal perforations, cholecystitis, and ischemic bowel.[1,10] Candida may also be found, although fungal infections are less likely.[11] Secondary peritonitis can also result from cystitis or breaks in the continuity of the catheter.[1,7,14]

Purulent drainage from the exit site is typically sent for culture, and the patient is treated with oral antibiotics. More serious tunnel infections require intravenous antibiotics and possible catheter removal. PD-related peritonitis with intra-abdominal sources requires source control and appropriate initial broad-spectrum antibiotics against gram-negative bacteria, such as ceftazidime, cefepime, gentamicin, and tobramycin.[1]

The association between PD catheter use and peritonitis is still unclear, but increasingly, diverticulitis and appendicitis-related complications have been noted.[5,6] Fibrosis caused by increased mast cells, decreased defensin expression, progressive deterioration of catheter membrane, and direct peritoneal injury by matrix metalloproteinases have all been proposed as possible explanations.[4.11-13] There are no clear guidelines

regarding indications for and timing of PD catheter removal.[1,10] It is paramount to train patients to recognize symptoms of peritonitis, such as new onset abdominal pain, fever, and cloudy dialysate. Moreover, it is essential to emphasize the necessity of calling their dialysis center for prompt evaluation, fluid analysis, gram stain, and culture when any of the previously mentioned symptoms arise. The stain is often harmful, as seen in our patients, and culture results may take 24 to 72 hours.[1]

Delays in diagnosis of PD-related peritonitis can pose serious complications for patients, often rapidly progressing to sepsis and death if timely intervention is not implemented Ekart et al, documented a case of a 38-year-old male with ESRD undergoing PD with a diagnosis of appendicitis that was delayed by ten days.[5,15] This patient presented with acute abdominal pain with cloudy peritoneal dialysate, sepsis, elevated troponin T, and electrocardiogram (ECG) changes, resulting in a fatal outcome.[5]

Our patient presented with a 36-hour delay with localized abdominal pain, elevated troponin, type 2 MI, and sepsis, with blood culture positive for *E coli*, despite two negative peritoneal fluid cultures, and was promptly started on broad-spectrum antibiotics. Current recommendations for treatment include vancomycin or a first-generation cephalosporin to cover gram-positive organisms and a third-generation cephalosporin or aminoglycoside to cover gram-negative organisms. Antibiotic therapy can be narrowed down once the causative organism is identified.[1,10]

Our patient underwent an emergent laparoscopic appendectomy with marked improvement in symptoms within a few days. Mizuno et al, discussed a PD patient with perforated appendicitis, highlighting the significance of quick diagnosis and intervention and suggested abdominal exploration if the CT findings were inconclusive.[16] Operative mortality of PD patients with peritonitis ranges from 16%-50% to 33%, specifically in the case of perforated appendicitis.[15] In contrast, the predicted mortality for non-PD patients with perforated appendicitis was only 4%, although death rates increased significantly after 32 hours of perforation. Thom et al, also presented a case of acute appendicitis in a PD patient with possible loss of integrity of the catheter.[7]

Dialysate fluid drainage and abnormal abdominal imaging indicate that prompt laparoscopic intervention may be diagnostic and therapeutic.[7] Some studies suggested a 3-week PD interruption should be initiated if the infection is suspected. However, such a delay in dialysis requires an alternative dialysis route, likely HD, through a temporary central venous catheter.[15] Recurrent infections necessitate the permanent removal of the PD catheter and HD initiation.[10] It is important to note that in our patient, the peritonitis occurred while the PD catheter had not been used for months, suggesting that it may have served as an inert conduit that potentially disrupted mucosal surfaces and allowed bacterial translocation and propagation.

CONCLUSION

Acute appendicitis can be the cause of PD-related peritonitis secondary to intra-abdominal infections in ESRD patients with a PD catheter and can even occur in a dormant catheter. It can be associated with sepsis and significant cardiac events. While much less common than PD-related primary peritonitis, it can be linked to fatal outcomes, especially in delayed diagnosis. Early abdominal CT scans, resuscitative measures, initiation of empiric antibiotics, and prompt source control via expedited appendectomy are imperative to improve survival.

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