Patient with End-Stage Renal Disease (ESRD) Experienced a Malfunction of Continuous Ambulatory Peritoneal Dialysis (CAPD) Accompanied by Central Venous Stenosis (CVS) Complications: A Case Study

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Abstract
Peritoneal dialysis (PD) is a reliable treatment for end-stage renal disease (ESRD) users, accounting for around 8% of the chronic kidney disease (CKD) patient population globally. It can be done at home and is not prone to outflow disorders caused by infections. Common causes include constipation, kinked catheters, intraluminal catheter debris, and omental wrap. Technical failures are common during PD, with 18 out of 45 patients undergoing CAPD having non-infectious complications. Central venous stenosis (CVS) is a vascular access problem in CKD patients, with an incidence of 4.1-4.3%. we present a case of a 52-year-old man with abdominal pain, swollen hands and legs, and decreased appetite reported to the emergency department. The patient's CAPD drainage decreased and the patient's blood sugar level was low, requiring hospitalization. The CAPD process appears stagnant. The findings show that the patient experienced a CAPD malfunction due to catheter lumen plugging and central venous stenosis, requiring laparoscopic plugging evacuation and omentectomy. Other medical issues included stroke, anemia, hypoalbuminemia, and hypokalemia, which were managed during hospitalization. Post-repair CAPD response was good.

Introduction

With its simple technique, low cost, delayed use of vascular access, and lack of need for trained staff, peritoneal dialysis (PD) is still a reliable treatment for people with end-stage renal disease (ESRD) [(1)]. It can also be done at home. Globally, PD users make up around 8% of the chronic kidney disease (CKD) patient population [(2)]. The Indonesian Renal Registry (IRR) estimates that around 2700 people in Indonesia are PD users in 2020 [(3)].

Infections do not cause outflow disorders, which are common complications of continuous ambulatory peritoneal dialysis (CAPD). The most common causes are constipation, kinked catheters, intraluminal catheter debris, and omental wrap. Other reasons include high pressure inside the abdomen (leakage, hernia, and hydrothorax), PD waste that isn't working right or is cloudy, heart and metabolic issues, and issues with membrane dysfunction [(2)]. Out of 60 CAPD patients in Indonesia who transitioned to hemodialysis, 15 patients reported experiencing technical failure during PD [(3, 4)].

A study by Prakash et al. found 18 out of 45 patients undergoing CAPD had non-infectious complications. Most of the time (15.5%), ultrafiltration failed. Other common problems were an incisional hernia (6.6%), an exit site leak (4.4%), hydrothorax (4.4%), catheter malposition (4.4%), scrotal swelling (2.2%), and hemopitoneum (2.2%) [(5)]. Central venous stenosis (CVS) is a vascular access problem in

CKD patients, with an incidence of around 4.1-4.3% [6-9]. CVS is caused by using peripheral dialysis vascular access more than once, having a catheter dialysis line (CDL) for a long time, or having a pacemaker. Other factors, such as trauma, inflammation, and coagulation disorders, are thought to have other causes, although no further studies have been conducted [10].

In this paper, we will present an ESRD patient who was initially on routine hemodialysis, but CVS was detected along the way, and the patient was switched to peritoneal dialysis, where outflow disturbances occurred shortly after.

Case

A 52-year-old man came to the emergency department with a chief complaint of abdominal pain. Pain started 3 days ago, accompanied by complaints of swollen left hand and leg. The other complaint was decreased appetite in the last 6 days. There appears to be a decrease in CAPD drainage, and the CAPD process appears to be prolonged and stagnant. Patients with CAPD were installed from May 3, 2024, until July 11, 2024, when complaints appeared. Subsequently, the patient performed a lab examination and found low Hb (Hb 5.9), so the patient was recommended hospitalization through the emergency department.

Past Medical History: The patient has been taking dialysis for 2.5 years at the Naval Hospital in Surabaya, Indonesia. On May 3, 2024, the patient experienced issues with the CAPD, which Dr. Soetomo Hospital in Surabaya, Indonesia, repaired. The patient has a history of AV-shunt installation, which occurred up to five times. The patient's history includes a stroke infarction that occurred 10 years ago. The patient experienced a second stroke attack eight years ago and has been suffering from hepatitis C since December 2023. Last hemodialysis was June 14, 2024, before switching to CAPD. The patient presents with a history of right central venous stenosis. Two days ago, as part of the initial management, the patient visited the CAPD clinic for laxatives, heparin administration, and dialysis catheter tube flushing. However, the dialysate flow remained stuck and slow.

Previous medication history: carvedilol 2x12.5 mg, amlodipine 1x10 mg, candesartan 1x16 mg, furosemide 3x40 mg, folic acid 1x1. History of hemodialysis vascular access: CDL jugular dekstra, December 2021 at Naval Hospital. In March 2022, Jemursari Islamic Hospital in Indonesia used the AV shunt Radio-Cephalica sinistra, but it failed to mature. AV shunt Brachio Cephalica sinistra at Jemursari Islamic Hospital in March 2022 → 1.5 months ago, the procedure reached a dead end. The CDL subclavian sinistra was performed at Jemursari Islamic Hospital in May 2022. AV shunt Brachio Cephalica dextra at Jemursari Islamic Hospital June 2022 → The procedure lasted for a month, during which a peripheral vein punctured only the red and blue lines. Husada Utama (HU) Hospital, Indonesia, performed the CDL femoral dextra procedure in September 2022. AV shunt Brachio Basilica dextra at HU Hospital, Indonesia, in September 2022 → used for 4 months and then swollen. In August 2023, HU Hospital performed a CDL femoral dextra procedure. The Naval Hospital performed a CDL femoral sinusectomy in September 2023. Venography at Dr. Soetomo Hospital in December 2023. The patient received a Sinistra jugular CDL in January 2024. Takedown AV shunt, BB D, February 2024. CAPD May 3, 2024. We will rewire the CDL jugular vein sinus from April 7, 2024, to early July 2024.

On physical examination, it was found that the general condition was weak, with compos mentis awareness and GCS E4V5M6. The patient had a blood pressure of 123/67 mmHg, a pulse of 116 beats per minute, a respiration rate of 20 beats per minute, an axillary temperature of 37 ^{o}C, and an oxygen saturation of 98% free air. The head and neck examination revealed anemia, without any signs of jaundice, cyanosis, or dyspnea. The chest examination found a symmetrical chest shape with no lagging chest breath movement. On auscultation of the thorax, it was found that the cordis was difficult to evaluate; the heart sound was an S1-S2 regular rhythm; and no murmur or gallop was found. A vesicular type of pulmonary respiration was obtained; no rhonchi or wheezing was obtained. Upon examination of

the abdomen, we found it convex, not distended, with normal bowel sounds; however, evaluating the liver and spleen proved challenging. The extremities were warm, dry, and red. No edema was found. Height 160 cm, weight 63 kg (BMI: 24.61).

Laboratory examination results during the first day of treatment at Dr. Soetomo Hospital showed Hb 5.9 g/dl, hematocrit 17.9%, leukocytes 6,670 cells/mm³, platelets 246,000/mm³, neutrophils 86.6%, lymphocytes 3.4%, MCV 86.4 fL, MCH 28.4 pg, albumin 2.01 g/dl, BUN 48 mg/dl, creatinine 8.5 mg/dl, random blood glucose 149 mg/dl, sodium 135 mmol/L, and potassium 2.5 mmol/L.

The thorax X-ray examination revealed that the lungs were within normal limits, with aortosclerosis prominently present. The BOF photo obtained a normal intestinal gas shadow mixed with fecal material in the abdominal cavum, which is distributed to the pelvic cavum. The right femur received a femoral stem attachment. Based on the patient's history, physical exam, and other tests, the main diagnosis is ESRD with CAPD malfunction due to poor outflow, anemia, low albumin levels, and low potassium levels.

The patient's management plan during treatment in the room includes the following (1) Diet TKCPRG 2000 kcal/day, (2) PRC transfusion 1 kolf/day, target Hb > 8 g/dL (3) Albumin infusion 20% 100 ml used up in 4 hours (4) KCL premix infusion 50 mEq 500 cc / 24 hours (5) KSR 3x600 mg (6) Fluid Balance (7) Digestive Surgery Consult pro repair CAPD. On the 2nd day of treatment, the patient complained of abdominal pain, weakness, and reduced food intake due to nausea. The team found the patient's vital signs to be stable. This patient was supposed to have a triple lumen CDL inserted for hemodialysis access by colleagues in Thoracic, Cardiac, and Vascular Surgery (BTKV), but it didn't work. Instead, a 5Fr sheath was put through the right femoral artery as a temporary access. On the 4th day of treatment, the patient complained of abdominal pain, body aches all over, coughing, and decreased appetite. Vital signs were found to be stable. Laboratory results: Hb 6.7 g/dl, hematocrit 20.4%, leukocytes 6,670 cells/mm³, platelets 256,000/mm³, neutrophils 84.7%, lymphocytes 3.9%, MCV 86.4 fL, MCH 28.4 pg, albumin 2.25 g/dl, BUN 43 mg/dl, creatinine 8.3 mg/dl, random blood glucose 109 mg/dl, sodium 138 mmol/L, potassium 3.9 mmol/L. The patient was scheduled for laparoscopy for CAPD repair. On the 5th day of treatment, the patient complained of abdominal pain, cough, and decreased appetite. Vital signs were found to be stable. The lab test results were as follows: Hb 9.1 g/dl, hematocrit 28.7%, leukocytes 4,750 cells/mm³, platelets 215,000/mm³, neutrophils 81.9%, lymphocytes 6.9%, MCV 88.3 fL, MCH 28.0 pg, albumin 2.73 g/dl, BUN 36 mg/dl, creatinine 6.6 mg/dl, random blood glucose 109 mg/dl, sodium 137 mmol/L, potassium 4.0 mmol/L, calcium 8.4 mg/dL, and phosphate 4.01 mg/dL. The patient was scheduled for laparoscopic pro repair CAPD tomorrow morning. On the 7th day of treatment, the patient underwent CAPD repair. At the time of surgery, plugging was found on the inside of the catheter lumen, cleaned with a spanner, and then omentectomy was performed. The catheter patency check was performed, and it flowed well. On the 8th day of treatment, the patient was post-CAPD repair. The patient no longer complained of abdominal pain. Today, the patient can use the CAPD. The patient's vital signs were stable, and the left limb was moving to the side. Neurology was called because they thought the patient might be having a third attack of a thrombotic dd infarction stroke. On the 10th day of treatment, the CAPD tube was smooth, with no seepage and no bleeding. Vital signs were stable. Left extremity lateralization, the patient was scheduled for a CT scan via outpatient.

Discussion

One of the most common non-infectious problems that can happen to people undergoing CAPD is a problem with the PD catheter. This can be outflow or a mix of dialysate inflow and outflow. Constipation is a frequent cause of outflow disorders, followed by catheter tip migration and omental wrap. In the meantime, both conditions can be caused by a blockage of the catheter either inside (fibrin, clot) or outside (kingking, fibrin sheath). If we find a case of catheter malfunction, the first thing we do is make

sure that there is no constipation, where the administration of laxatives can solve the problem. If there is no improvement, the next step is to flush the intraluminal catheter using heparin or urokinase [4, 5].

In this patient, when complaints of dialysate flow disturbance were found, laxatives were given and flushing of the catheter lumen using heparin was observed for 2 days, but there was no change. Finally, we decided to perform a laparoscopy for further management.

Some cases of impaired outflow and inflow that do not respond to conservative measures require immediate intervention either by laparoscopy or open surgery. Especially in patients with poor vascular access, peritoneal dialysis is the main modality in addition to other options such as kidney transplantation [4, 5, 11].

While waiting for surgery, the patient underwent hemodialysis using temporary vascular access to the femoral artery using a 5fr sheath. During surgery, plugging was found in the distal lumen of the catheter. In addition, to prevent omental wrap in the future, it was decided to perform omentectomy.

Diagnosis of CVS is based on clinical symptoms and physical examination and confirmed by imaging. History of previous CVC and cardiac device insertion, complaints of arm swelling, pain or discomfort, skin ulceration, and access problems during dialysis may be important risk factors. Examination findings include ipsilateral arm edema and dilation of vessels in the neck or chest [12, 13]. Diagnostic methods include magnetic resonance (MR) angiography, computed tomography (CT) venography, and duplex ultrasound. However, conventional venography is considered the gold standard for diagnosis despite its invasive nature [14, 15].

The patient complained of swelling in the left hand and foot, more or less coinciding with the problem of reduced dialysate drainage flow. Prior to deciding on peritoneal dialysis, the patient experienced recurrent vascular access jams. In December 2023, a venography revealed total stenosis in the right subclavian vein, collateral azygos vein, and inferior vena cava.

If there is a persistent bilateral CVS that interferes with AV access in the upper extremities, several options are available when the patient needs hemodialysis access. Complete or tight CVS stenosis often has a high recurrence rate despite repeated and adequate endovascular interventions. PD should be considered if possible. AVF or upper femoral grafts are also viable options. As an alternative, one can use tunneled catheters, tunneled cuffed HD catheters, and the hemodialysis reliable outflow (HERO device) [16].

The patient had undergone several CDL and AV-shunt insertions, which had failed. Therefore, PD was the most preferred treatment modality compared to other options.

Hypokalemia is very common in PD patients [17, 18]. The etiology is multifactorial, including poor nutritional intake, diarrhea, and medications, as well as continuous dialysate loss [19, 20]. Treating hypokalemia in PD patients is challenging. Oral potassium supplements have gastrointestinal side effects. Intravenous potassium, usually administered in the emergency department, is inconvenient for patients. Alternative treatment options, such as eplerenone, are available, but they come at a significant cost [17].

At the initial examination, the serum potassium level was found to be 2.5 mmol/L, which was suspected to be due to less than optimal nutritional intake due to the patient's decreased appetite. The patient received treatment with KCL premix 50 mEq 500 cc/24 hours and KSR 3x600 mg orally. At the end of treatment, the serum potassium reached 4.0 mmol/L.

Protein energy wasting (PEW) is a common metabolic disorder in PD patients [20]; serum albumin is an important index to evaluate PEW. Complex causes of hypoalbuminemia in PD patients include protein loss during peritoneal dialysis, inflammation, decreased protein intake, chronic acidosis, and psychosocial factors [22]. There is strong proof that low albumin levels are linked to death from any cause and heart disease in people with Parkinson's disease [23].

The initial examination revealed a serum albumin level of 2.01 grams/L, likely a result of insufficient nutrition. The patient was given a 20% albumin infusion of 100 ml for 4 hours.

Anemia in CKD is a type of normocytic and normochromic anemia as well as hypoproliferative anemia, which is common in patients with kidney disease. Among other complications of CKD, it is often associated with poor outcomes, decreased quality of life, and increased mortality. As kidney disease progresses, the prevalence of anemia increases, affecting almost all patients with stage 5 CKD. Anemia in CKD is mostly caused by less erythropoietin being made, less iron being absorbed through the digestive tract because of ongoing inflammation, and shorter life spans for red blood cells [(24)].

The patient's hemoglobin level was 5.9 g/dL, prompting the planning of an operative procedure and subsequent transfusion. Additionally, we plan to conduct a serum iron and TIBC examination on the patient to assess their iron status and guide further management.

Conclusion

A 52-year-old male with CAPD malfunction due to catheter lumen plugging, complicated by central venous stenosis, was reported, and laparoscopic plugging evacuation and omentectomy were performed. In addition to mechanical problems, the patient had a stroke, anemia, hypoalbuminemia, and hypokalemia, which were successfully managed during the patient's hospitalization. The clinical response post-repair CAPD was good, so the patient was able to do outpatient care and control at the neurology clinic.

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