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Giant Right Atrial Thrombi Formation Associated with Hemodialysis Catheter Placement in a Dog

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Abstract : A Cocker spaniel (7-year-old, female) was presented with one week of anorexia, halitosis, oral ulcer, intermittent vomiting, acute weight loss and 3-day history of oliguria. The patient was diagnosed with acute on chronic kidney disease and pancreatitis. Hemodialysis was continued three times a week (total 7 sessions) with improved clinical signs and kidney panel, but presented with another episode of abdominal distention, respiratory distress, and large bowel diarrhea. Echocardiography revealed nearly totally occlusive thrombus in the cranial vena cava, as well as a right atrial mass of approximately 2 cm × 1 cm. The patient was treated with catheter removal, thrombolysis and anticoagulation therapy with recombinant tissue plasminogen activator. During anticoagulation therapy, size of atrial thrombus was not changed and heart function was not improved after treatment. Since clinical signs were deteriorated, the patient was euthanized by owner's request. Catheter-related giant thrombus in right atrium is a rare complication and treatment guideline for atrial thrombus does not exist. This case is first report of hemodialysis catheter-induced thrombus in Korea.

Key words **:** Acute-on-chronic kidney injury, Intermittent Hemodialysis (IHD), Catheter-related right atrium thrombus (CRAT).

Introduction

Intermittent hemodialysis (IHD) is an extracorporeal renal replacement therapy used primarily to manage the biochemical and fluid disorders of uremia (11). Despite the common choices of vascular access for hemodialysis include the arteriovenous fistula, artificial arteriovenous graft in human medicine, double-lumen central venous catheters are the predominant type of vascular access undergoing extracorporeal renal replacement therapy in dogs and cats (2).

Generally, an ideally functioning double-lumen catheter will provide rapid continuous blood flow, however catheter-related complications sometimes occur in dogs and cats, as well as in humans (4). The use of double-lumen catheter for hemodialysis is associated with a relatively high incidence of catheter-related complications including stenosis, catheter dysfunction, and infection (5). Thrombosis can have developed in response to inside of catheter lumen clot formation or endothelial damage in the right atrium occurred by the constant friction between catheter and right atrial wall. Both intraluminal and extraluminal thrombosis that formed around tip or in the right atrium, or attached to blood vessel interfere blood flow and can reduce effectiveness of hemodialysis (5). Intraluminal thrombosis occurs 17-33% of people with hemodialysis catheter placed (4).

Treatment of thrombus can be initiated as soon as detected. Delays in treatment may allow the thrombus to enlarge. Catheter-related right atrium thrombus (CRAT) is a rare complication that comes with or without catheter malfunctioning (4). We describe here about a case of giant right atrial thrombus formation associated with two-lumen hemodialysis catheter without catheter malfunctioning in a dog with acute kidney injury during intermittent hemodialysis.

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Case

A 7-year-old intact female English Cocker Spaniel dog was referred with one week of anorexia, halitosis, oral ulcer, intermittent vomiting, acute weight loss and 3-day of oliguria. On physical examination, the vital was normal, and the patient was mildly dehydrated (< 5%). Screening test was performed, and biochemical evaluation revealed increased BUN (198 mg/dL; reference range, 8.0-31 mg/dL), creatinine (6.8 mg/dL; reference range, 0.8-1.6 mg/dL), and phosphorus (25.8 U/L; reference rang, 3-6.2 U/L). Urinalysis revealed eusthenuria (USG; 1.025) on refractometer, proteinuria (300 mg/dL) on dipstick. The Canine pancreas-specific lipase kit (IDEXX SNAPP®, United States) test was positive. On abdominal ultrasonography, the edematous renal cortex and hypoechoic pancreas were detected. The patient was under severe oliguria as a urine output was only 0.25 ml/kg/hr. Based on these screening tests, history and clinical signs, the patient was tentatively diagnosed as acute-on-chronic kidney disease and acute pancreatitis. The patient was decided to treat with intermittent hemodialysis (IHD) and supportive treatment was initiated. Dual-lumen catheter (Arrow®, 14Fr, 15 cm) was placed into the jugular vein and the IHD was performed 3 times a week (Mon-Wed-Fri). On day 7, after

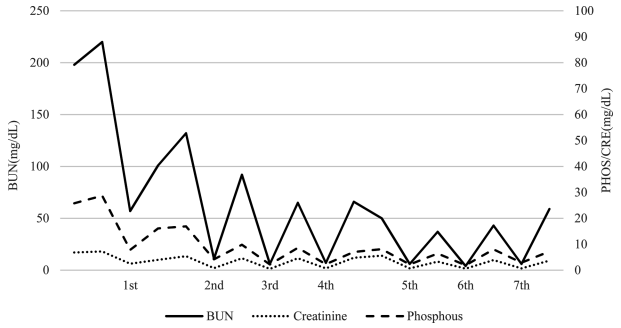

Fig 1. Serum BUN, creatinine, phosphorus curve during intermittent hemodialysis treatment. There were total 7 sessions of hemodialysis. Clinical signs with uremia were improved after 3rd hemodialysis.

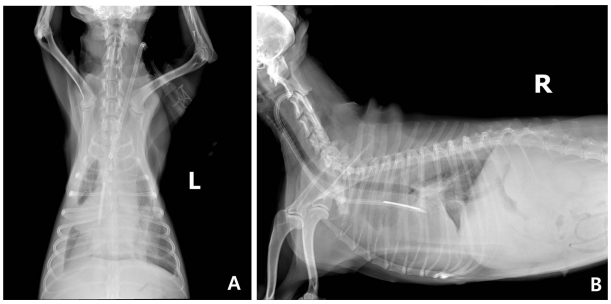

Fig 2. Thoracic radiographs. Pleural effusion is observed in the VD (A), and lateral view (B).

3rd session of hemodialysis, the patient's appetite and activity was markedly improved and other clinical signs were disappeared. Total 7 sessions of hemodialysis was accomplished, and her general condition was well managed for following 15 days. The serial changes of serum BUN, creatinine, and phosphorus are provided in Fig 1. However, on day 20, suddenly the patient's condition was deteriorated. The patient showed respiratory distress, complete anorexia and abdominal distension. In the serum biochemistry, decreased blood urea nitrogen (BUN, 6 mg/dL), decreased creatinine (0.7 mg/dL), decreased phosphous (2.9 mmol/L), and increased urine protein creatinine ratio (UPCR, > 45) were noted. Pleural effusion and peritoneal effusion was suspected on thoracic and abdominal radiographs (Fig 2). Pleural effusion was modified transudate, and peritoneal effusion was pure transudate. Echocardiography revealed mild to moderate tricuspid valve regurgitation and showed large mass that formed along with the dialysis catheter, and another mass of 2 × 1 cm was identified in the right atrium (Fig 3).

Giant thrombi associated with hemodialysis catheterization and secondary tricuspid valve regurgitation was strongly suspected. Therefore, the catheter was immediately removed, and the patient was treated with recombinant tissue plasminogen activator (rtPA) 24 hours after removal of catheter to wait for catheter insertion site to hemostasis. Treatment every 1 h with intravenous rtPA (0.4 mg/kg) was administered for a total of 4 doses. Despite thrombolysis therapy with rtPA was initiated, there was no change of atrial thrombus size, and clinical sign were not improved (Fig 4). The patient was euthanized by owner's request at the same day of diagnosis of giant thrombus and necropsy was refused.

Discussion

Catheter-related right atrial thrombus (CRAT) is rare, but potentially life threatening complication of central venous catheters (4). CRAT can have leading to pulmonary embolism, infection with septic emboli, arrhythmias, mechanical prob-

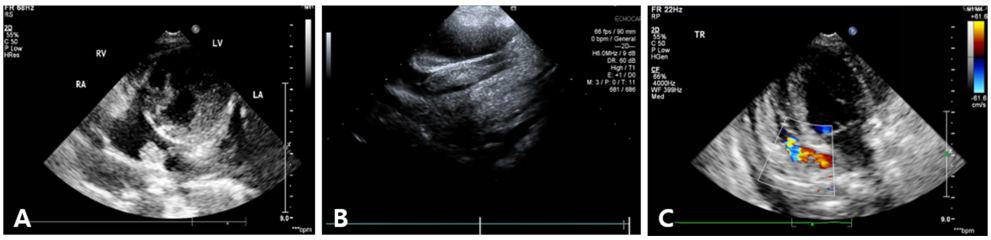

Fig 3. Echocardiography of the patient after 7th hemodialysis procedure. There was thrombus in right atrium, and giant thrombus along the IHD catheter (A, B). Mild to moderate tricuspid valve regurgitation secondary to the giant thrombi (C).

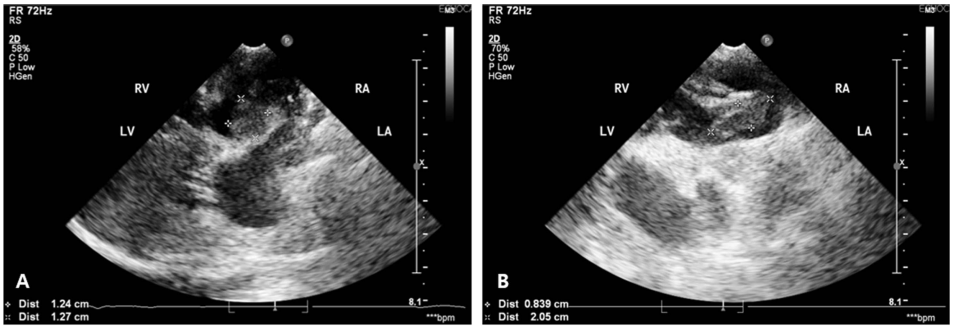

Fig 4. Echocardiography of the patient after rtPA treatment (A, B). There was no change of atrial thrombus size.

lems of cardiac function or even systemic embolization (10). Incidence rate of catheter-related right atrial thrombus is not reported in veterinary medicine, but relatively well-known complication and reported in human medicine. Recent studies were reported 1.9-42% incidence of thrombus in IHD patient and 5.4% incidence of CRAT in IHD patients with cuffed-central venous catheter (3,8).

There are a few things that are known about the cause of CRAT. First, the presence of the catheter in the right atrium may predispose the repeated mechanical trauma to the atrial wall by the movement of the catheter tip. Second, the endothelial damage results in activation of the coagulation cascade, platelet aggregation and eventually CRAT formation (11). Recent study, positioning the catheter tip in the right atrium is highly associated with CRAT (10). CRAT decreases catheter function gradually or abruptly over time if thrombosis or stenosis occurs (5). Initial sign of CRAT is inadequate blood flow during dialysis or a difficulty to aspirate the catheter. Because these thrombi may act as a ball valve, allowing infusion but occluding the catheter (5). However, in this case, there are no signs of catheter malfunction during 7 sessions of hemodialysis. On day 20, the patient's clinical signs were noticed without any evidence of catheter malfunctioning even though the thrombus in right atrium was found giant.

Size of thrombus is important when treat an intra-atrial thrombus. In human medicine, a thrombus of 2 cm or less is not clinically important (7). By comparison, a large intra-atrial thrombus can have serious consequences. The presence of a 2 cm or larger thrombus may be noticed by catheter dysfunction, symptom and signs of pulmonary embolism, and symptoms suggestive of endocarditis or syncope (3). In this case, the thrombus size was giant (2.0 × 1.0 cm) and located on the right atrium also founded surrounds the catheter.

Generally, the choice of therapy should be determined by clinical signs. Catheter removal should be the first step in the management of CRAT but removal alone seems to be inadequate therapy. The additional treatment options for CRAT include oral/systemic anticoagulation therapy, systemic thrombolysis and surgical thrombectomy (open heart, percutaneous) are reported in humans (10). Usually surgical thrombectomy is not superior to anticoagulation. However there have been no controlled study to define the optimal management of CRAT (9).

The goal to prevent thrombosis is to choose the largest bore catheter, and the proper length catheter positioned in the right atrium or vena cava (2). The suitable placement of the tip of the IHD catheter in human is anywhere between lower third of cranial vena cava and the upper region of the right atrium (6). Because partial or total thrombosis can cause late catheter dysfunction, it is necessary to regular check of catheter even there are no signs of catheter malfunction.

In conclusion, right atrial thrombus (RAT) is rare complication of hemodialysis catheter, as it was not reported in veterinary medicine. In this case, despite there was no catheter malfunction, CRAT occurred in right atrium. Therefore, routine echocardiographic screening in patients with long-term hemodialysis would be considered with or without catheter malfunction.

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