



KARDIOLOGIA POLSKA

Polish Heart Journal
The Official Peer-reviewed Journal
of the Polish Cardiac Society
since 1957

Online first

This is a provisional PDF only. Copyedited and fully
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ISSN 0022-9032

e-ISSN 1897-4279

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Article type: Clinical vignette

Received: November 7, 2022

Accepted: April 7, 2023

Early publication date: April 16, 2023

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Arteriovenous fistula in the right kidney as a cause of right ventricular heart failure

Short title: Arteriovenous fistula causing heart failure

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A 45-year-old female patient was hospitalized in January 2022 in another hospital and diagnosed with acute right ventricular heart failure, with dyspnea, ascites, and bilateral hydrothorax. Echocardiography then revealed, i.a., preserved left ventricular ejection fraction (LVEF: 57%), dilatation of both atria, moderate mitral valve insufficiency, severe tricuspid regurgitation pressure gradient (TRPG) with a peak of 51 mm Hg and a long pulmonary artery acceleration time (PA-AcT) of 152 ms. In March 2022, she was admitted to the Clinic of Gynecology at our hospital with suspected right ovarian cancer, based on elevated serum

cancer markers and an ovarian cyst found earlier in computed tomography (CT). The patient had a consultation with an angiologist to ascertain the presence of a systolic murmur detected in the umbilical region by a cardiologist. The angiologist used abdominal ultrasound and found, i.a., extension of the right renal vein and inferior cava vein, and fluidic spaces in the projection of the pelvicalyceal system of the right kidney (Figure 1A), in which low-resistance blood flow was detected using Doppler imaging. This suggested the presence of a renal arteriovenous fistula of non-traumatic origin, as the patient reported no history of abdominal or back trauma before hospitalization in January 2022. This hypothesis was confirmed during reanalysis of contrast-enhanced CT images from January 2022 (Figure 1B, C), in which we found, not described then, signs of a ruptured renal artery aneurysm into the renal vein. Our multidisciplinary team recognized the fistula as a cause of right ventricular heart failure with increased cardiac output, qualifying the patient for endovascular fistula closure. Angiography (Figure 1D) confirmed the presence of an arteriovenous fistula between the renal artery and vein. However, implantation of a stent-graft (BeGraft Peripheral, Bentley, 6.0) was complicated by the rupture of the renal artery (Figure 1E) and embolization of the distal part of the renal artery was necessary (Figure 1F). During a follow-up visit on July 15, 2022, the patient was asymptomatic. Ultrasound imaging showed that the right kidney was diminished (65 mm, cortex 12 mm). Blood creatinine (0.96→1.3→0.82 mg/dl; before and after the procedure in March and in July 2022, respectively), carbohydrate antigen 125 (CA-125) concentration (534.0→22.93 U/ml) and echocardiographic parameters (e.g., TRPG to 22 mm Hg) were normalized.

The presented case shows that heart failure may be caused by an arteriovenous fistula, the detection of which is possible during detailed physical examination (abdominal murmur) and abdominal ultrasound. An arteriovenous fistula should be considered as a cause of high-output right ventricular failure, not only in patients undergoing hemodialysis [1], but also in those with an unclear cause of right ventricular failure [2], especially when echocardiography reveals high TRPG resulting from volume overload accompanied by prolonged PA-AcT due to a low transpulmonary pressure gradient. Endovascular closure of the arteriovenous fistula healed the heart failure in this patient [3, 4]. Moreover, ovarian cancer serum markers, such as CA-125, can be elevated in the course of heart failure, what should be taken into account when considering a patient's qualification for surgery [5].

Article information

Conflict of interest: None declared.

Funding: None.

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Figure 1. **A.** Ultrasonographic imaging of the right kidney with fluidic spaces in the projection of the pelvicalyceal system (white arrow). **B.** Arteriovenous fistula in the hilus of the right kidney (white arrow) in CT done in January 2022 (white arrow). **C.** 3D reconstruction of arteriovenous fistula and the net of dilated veins in the hilus of the right kidney (horizontal white arrow) (right renal artery is marked with a vertical white arrow). **D.** Angiography done in March 2022 showing arteriovenous fistula and fast shunt of contrast medium to the inferior cava vein (white arrow). **E.** Implanted stent-graft, closed arteriovenous fistula, and contrast medium leak (white arrow) showing renal artery rupture and hemorrhage. **F.** Right renal artery embolized with coils (white arrow)