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The role of intraoperative transesophageal echocardiography in the management of renal cell carcinoma with atrial thrombus – case report

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Abstract

Renal cell carcinoma is a common disease, and clear cell renal cell carcinoma is the most common histological type. Renal cell carcinoma has a tendency to infiltrate the venous system including the inferior vena cava and the right atrium of the heart. We present the cases of two patients with renal cell carcinoma with stage IV tumor thrombus according to the Mayo classification, who underwent surgery under transesophageal echocardiography guidance. Apart from standard imaging methods used in renal cancer with tumor thrombus reaching the right atrium of the heart, we consider transesophageal echocardiography to be a very useful tool in the diagnostic work-up, patient monitoring, and selection of appropriate surgical technique.

Introduction

Renal cell carcinoma is a frequent disease, accounting for 3% of all cancers, with annually increasing incidence rates, with about 99,200 new cases recorded in the European Union in 2018[1,2]. According to the National Cancer Report from 2019, in Poland kidney cancer accounts for 3.8% of all malignancies in men and 2.3% in women, with a total of 5,214 new cases and 2,451 deaths in 2019.

There are three main types of renal cell carcinoma (RCC): clear cell (ccRCC), papillary (type I and II), and chromophobe RCC, with ccRCC being the most common type. A unique feature of RCC is the ability to infiltrate the venous system including the inferior vena cava (IVC) and the right atrium (RA) of the heart. On ultrasound imaging, tumor thrombus presents as an echogenic mass in the venous system. Vascular invasion above the diaphragm, including the RA, is described as stage IV in the Mayo classification[3].

IVC invasion occurs in 4% to 10% of cases, whereas about 1% to 3% of patients present with thrombus reaching the RA[4]. In cases of small, solid atrial tumor thrombus, treatment involves surgery through a transabdominal approach. In patients with fragile, large or adherent atrial thrombus, a transabdominal approach with sternotomy and cardiopulmonary bypass (CBP) is the preferred option. Extracorporeal circulation (ECC) with deep hypothermic circulatory arrest (DHCA) can be used in more challenging cases. Transesophageal echocardiography (TEE) is usually utilized to evaluate morphology and ensure intraoperative control of tumor thrombus.

We present the cases of two patients operated on RCC with tumor thrombus, who were intraoperatively monitored with the use of TEE. Transesophageal echocardiography was performed using GE Vivid S6 unit with a multiplane transesophageal probe with passing transducer into the esophagus through the oral cavity, using mid-esophageal imaging plane for the right atrium assessment. Endotracheal intubation was also performed through the mouth.

The first case involves a 67-year-old man diagnosed with stage IV kidney tumor, who underwent radical nephrectomy through the transabdominal approach only. The second case involved a 67-year old woman, also with stage IV kidney tumor, who underwent surgery through the transabdominal approach, also with intraoperative TEE that revealed detachment of the fragile tumor thrombus of the RA, which required immediate sternotomy and surgery performed with cardiac surgeon's assistance.

Case report

Case 1

A 67-year-old man was diagnosed with a right kidney tumor with atrial thrombus (Fig. 1, Fig. 2). TEE revealed a small, solid tumor thrombus in the RA (Fig. 3), therefore we decided to perform surgery through the transabdominal approach only. We used the surgical techniques described by Ciancio *et al.*[5]. The operation started with a chevron incision. The next step was mobilization of the kidney, followed by ligation of the renal artery, mobilization of the liver, and incising the diaphragm and pericardium to reach the RA. Under TEE guidance, the extent of atrial thrombus was precisely visualized and pulled from the right atrium below the level of the suprahepatic veins. Through this "milking maneuver", Satinsky clamp could be accurately applied above the thrombus. Next, the Pringle maneuver, clamping the contralateral renal vein and the IVC below the level of the thrombus was performed. The IVC was incised at the level of the

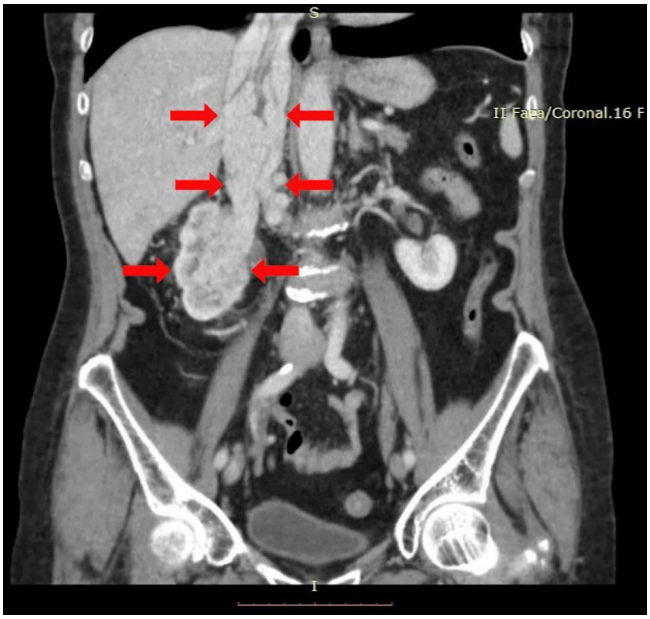

Fig. 1. *Right kidney tumor with tumor thrombus (CT scan)*

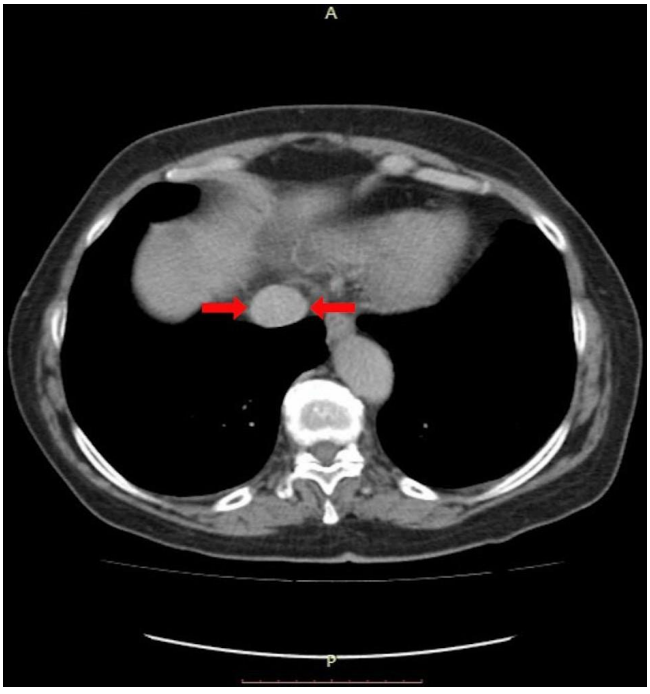

Fig. 2. Tumor thrombus in the right atrium of the heart (CT scan)

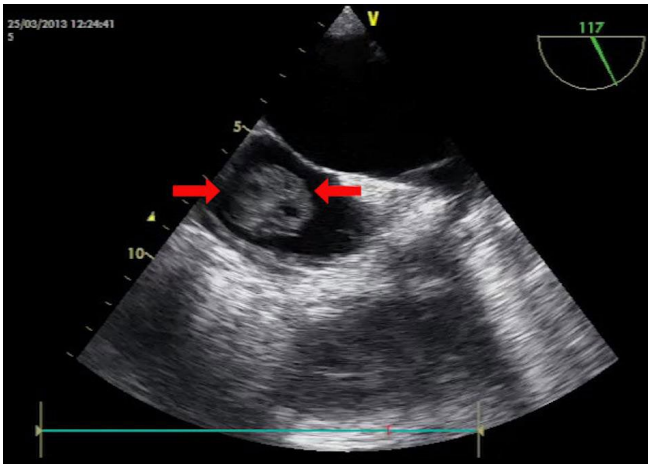

Fig. 3. *Tumor thrombus in the right atrium of the heart (TEE)*

Fig. 4. *Right kidney with tumor thrombus removed en bloc*

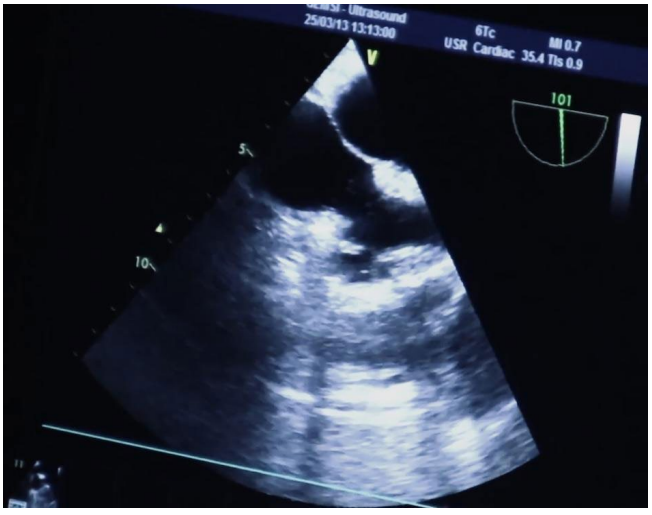

Fig. 5. *Right atrium of the heart after removal of the tumor thrombus (TEE)*

liver and the entire tumor thrombus was removed *en bloc* with the kidney (Fig. 4). Completeness of thrombus resection was confirmed by TEE (Fig. 5). The pericardial wall, diaphragm, and IVC were then closed with running sutures. After surgery, the patient was transferred to the intensive care unit (ICU), where respiratory support, medication for hypertension, and antibiotic therapy due to elevated inflammatory markers were administered. Three days later, the patient was transferred to the Urology Department and was then discharged from the hospital.

Case 2

A 67-year-old woman was diagnosed with a stage IV left kidney tumor – a CT scan revealed kidney tumor with tumor thrombus in the IVC reaching the RA (Fig. 6, Fig. 7). TEE showed large, fragile atrial tumor thrombus (Fig. 8), so we decided to start the procedure with an abdominal approach followed by cardiothoracic surgeons performing sternotomy and CPB with DHCA.

The operation started with a chevron incision; the left kidney and liver were mobilized under TEE guidance. Suddenly, TEE revealed detachment of tumor thrombus, which was followed by massive pulmonary embolism and cardiac arrest (Fig. 9). Immediate sternotomy was performed, followed by the administration of heparin bolus and direct cardiac massage. After performing CPB and DHCA, the pulmonary trunk was incised, and fragile thrombus was removed with forceps, suction and Fogarty catheter. Subsequently, the kidney and fragile tumor thrombus filling the IVC was removed. After surgery, the patient was transferred to the ICU, where she died of circulatory and respiratory failure two days later.

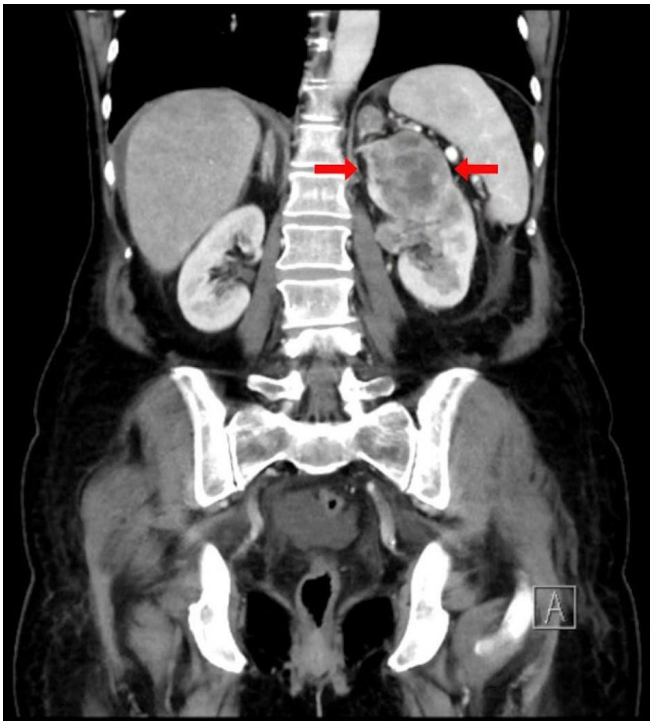

Fig. 6. *Left kidney with kidney tumor (CT scan)*

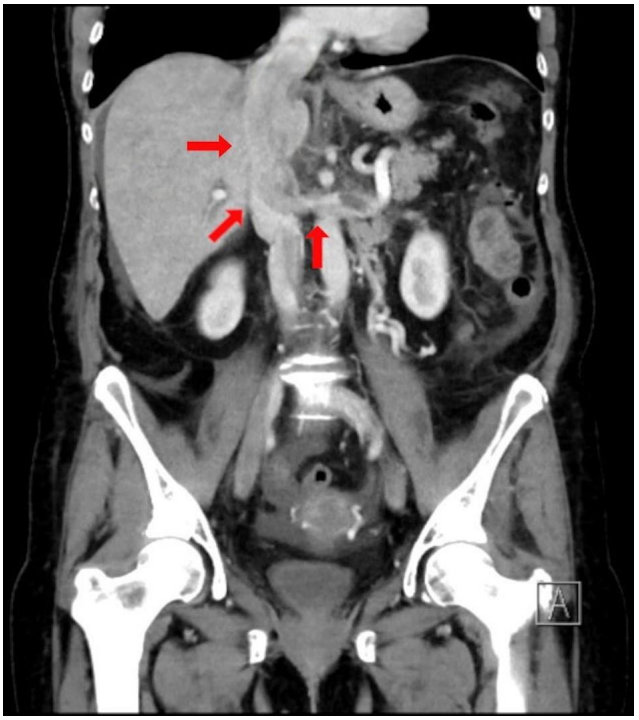

Fig. 7. *Tumor thrombus in the left renal vein and IVC (CT scan)*

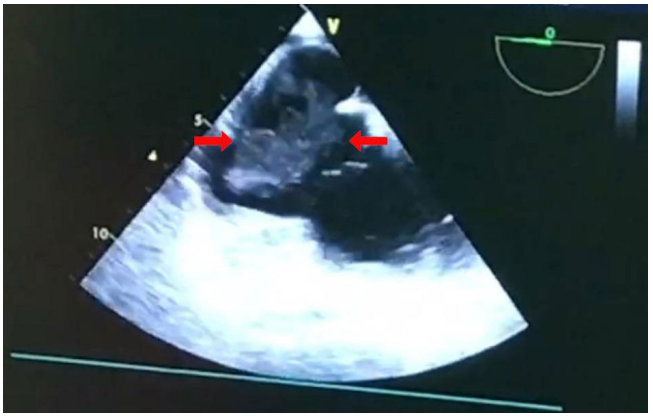

Fig. 8. *Large fragile tumor thrombus in the heart (TEE)*

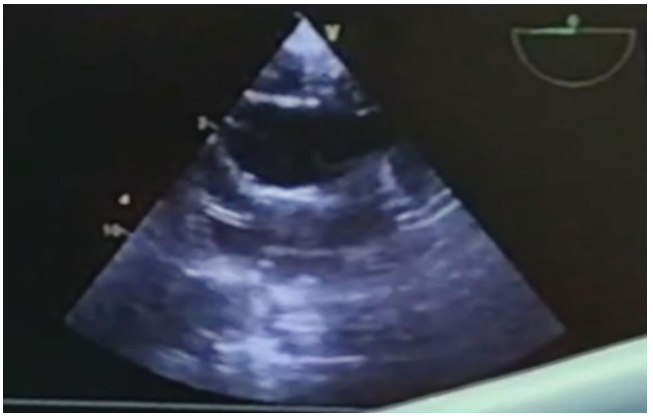

Fig. 9. *Pulmonary embolism after tumor thrombus detachment (TEE)*

Discussion

In preoperative imaging, CT is the most common imaging modality used in the preoperative setting, whereas three-dimensional breath-hold T1-weighted MRI performed after intravenous gadolinium contrast administration is the most sensitive method[6]. Nevertheless, TEE can accurately define the cranial extent of tumor thrombus, and its diagnostic utility increases with the level of tumor thrombus extension[7]. At the stage of surgical planning, it helps to assess the nature of tumor thrombus, which includes size, consistency, fragility, adherence, and mobility[8]. Two main types of tumor thrombi are distinguished: solid, small atrial thrombus (case 1) and fragile or adherent thrombus that fills a large capacity of the RA (case 2). Based on TEE imaging, one can choose or modify the surgical approach depending on the situation: transabdominal approach with the milking maneuver of the tumor thrombus (case 1) or transabdominal approach with CBP and DHCA (case 2). It provides continuous monitoring of cardiac function, and helps with central line placement[6]. In the transabdominal approach, it guides the surgeon and prevents applying the vascular clamp to a portion of the IVC with the thrombus, which can result in embolization. Furthermore, it helps to rule out or confirm the presence of residual tumor thrombus in the IVC or in the RA, thus providing evidence of complete resection[8].

Summary

TEE in the surgical treatment of RCC with stage IV tumor thrombus is an invaluable tool for the selection and modification of the surgical technique, as well as for performing and monitoring the surgical procedure. It helps to rule out residual tumor thrombus after surgery, and enables early detection of adverse events such as heart failure, or tumor thrombus embolism.

Conflict of interest

The authors do not report any financial or personal connections with other persons or organizations which might negatively affect the contents of this publication and/or claim authorship rights to this publication.

Author contributions

Original concept of study: MŁT. Writing of manuscript: MŁT, MT, KM, ML, JS. Analysis and interpretation of data: WB, MT, KM, ML, JS. Final approval of manuscript: MŁT, PK. Collection, recording and/or compilation of data: MT, KM, ML, JS. Critical review of manuscript: WB, PK.

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