

## CASE REPORTS

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### Combined Use of Transesophageal Echocardiography and Basket Catheter Can Prevent Tumor Embolism in a Patient with Renal Cell Carcinoma

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MASSIVE pulmonary tumor embolism is one of the serious complications that can occur during surgical treatment for renal cell carcinoma, especially tumors that extend into the inferior vena cava (IVC).<sup>1-5</sup> Therefore, the prevention of pulmonary embolism is important. We describe a case in which transesophageal echocardiography (TEE) and a basket catheter were used during thrombectomy and radical nephrectomy for renal carcinoma that invaded into the IVC to prevent massive tumor embolization.

#### Case Report

A 62-yr-old man with a history of recent episodes of minor pulmonary embolism was admitted to the hospital after the occurrence of chest pain and acute respiratory failure. Laboratory results at admission showed a hematocrit level of 29% and elevations in creatinine (1.2 mg/dl) and lactic acid dehydrogenase (1327 IU/l) levels. The chest roentgenogram showed an increasing shadow of the right pulmonary artery. Magnetic resonance imaging revealed a right renal mass with a tumor thrombus that extended the IVC below the hepatic veins without metastasis to the liver, lung, and brain. Thrombectomy and radical nephrectomy were scheduled.

After induction of anesthesia, monitoring included electrocardiography, arterial and central venous pressure, pulse oximetry, end-tidal carbon dioxide (ET<sub>CO<sub>2</sub></sub>), and rectal temperature measurement. A two-dimensional TEE (SDD870, Aloka, Tokyo, Japan) probe was placed to monitor the tumor thrombus. At this time, TEE showed the tumor thrombus extending into the IVC. There was no thrombus in the

cardiac chambers. A Swan-Gantz (Baxter) catheter was inserted under the fluoroscopy guide through the right jugular vein, and a basket catheter (Segura basket, Microvasive, Boston, MA) (fig. 1) was also inserted through the right jugular vein, through an 18-gauge sheath. A flatwire basket catheter was used and was made in a six-wire configuration. The precise location of the basket catheter was confirmed by TEE and chest and abdominal roentgenography.

The femoral artery and vein were exposed for possible use of cardiopulmonary bypass (CPB), and then right nephrectomy and thrombectomy were started. At this time, TEE showed the tumor thrombus extending into the IVC just below the hepatic vein (fig. 2A1, A2). Three and one half hours after the beginning of operation, movement of the tumor thrombus was observed by TEE during the manipulation of the IVC. Part of the tumor thrombus moved toward the right atrium and attached to the head of the basket catheter (figs. 2B1 and B2). At this time, no hemodynamic alterations were recognized, but some small thrombi were observed floating in the IVC. ET<sub>CO<sub>2</sub></sub> suddenly decreased from 29% to 22%, but 5 min later returned to baseline levels. Blood gas analysis showed that the pH level was 7.54; PaO<sub>2</sub> was 304 mmHg; PaCO<sub>2</sub> was 36 mmHg; and base excess was -0.3 (FiO<sub>2</sub> = 0.5). We suspected the occurrence of a minor pulmonary embolism, and intravenous heparin was administered at a dose of 400 units/h. One hour later, the IVC was clamped at the portion distal to the basket catheter with the tumor thrombus (fig. 3A), and the right kidney and thrombus were extracted from the incision of the IVC (fig. 3B). Then, the basket catheter with the tumor thrombus was pushed out from the same incision (fig. 3C), and the head of the basket catheter was cut off (fig. 3D). At this time, no residual tumor in the IVC was observed by TEE. The operation was completed without additional complications. Thirty minutes after completion of the operation, the patient was extubated without respiratory symptoms and neurologic complications. The hemodynamic variables were stable, and a tendency of hemorrhage was not recognized. The patient was transferred to the urology ward. Pulmonary scintigraphy performed 10 days after the operation showed no significant deterioration in pulmonary infarction. After that, the patient was administered interferone for antitumor therapy and was discharged from the hospital 2 months after the operation.

#### Discussion

The Mobin-Uddin umbrella, which was introduced in the 1960s, was the first widely used transvenous device for the prevention of pulmonary embolism.<sup>6-11</sup> Farrell *et al.*<sup>9</sup> reported a case in which the Mobin-Uddin umbrella was used successfully to prevent pulmonary embolism

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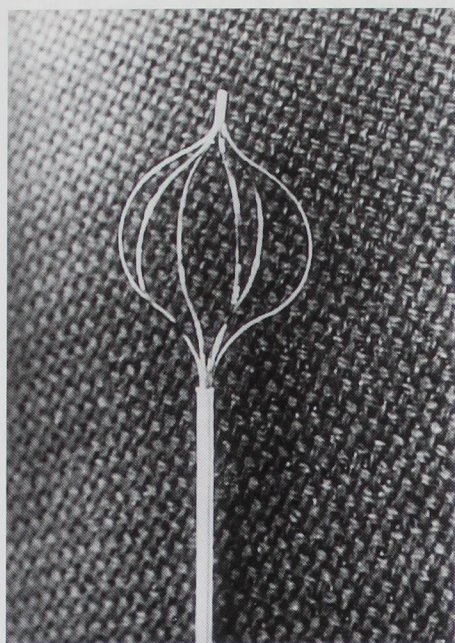


Fig. 1. The photograph of the head of the basket catheter.

during the operation of renal carcinoma invading the IVC. However, in this case, the right atrium must be opened during cardiopulmonary bypass to remove the umbrella filter with the trapped thrombus. Furthermore, it has been recognized that the use of the Mobin-Uddin umbrella might be accompanied with the risk of caval thrombosis and proximal migration.<sup>11</sup>

The Greenfield filter, first introduced in 1973, is the most frequently used filter because of its excellent late patency rates and minimal morbidity rate.<sup>11-13</sup> Rosenthal *et al.*<sup>12</sup> reported a case in which the Greenfield filter was inserted percutaneously before surgical removal of renal cell carcinoma invading the IVC to prevent tumor embolism. Brenner *et al.*<sup>13</sup> also reported six patients with renal cell carcinoma, in whom the Greenfield filter was inserted before the operation. In all patients, the Greenfield filters were left in the IVC after completion of surgical treatment. The struts on the Greenfield filter seem well suited to permanent attachment through the vena caval wall.<sup>14</sup>

In the current study, we used a basket catheter for the following reasons. First, the basket catheter has been widely used for removal of urethral stone, bile duct stone, and right atrial thrombus;<sup>15,16</sup> therefore, it is easily available. Second, dissimilar to the Greenfield filter, the basket catheter with the trapped thrombus can be easily pushed out and removed from the incision of the inferior vena cava. In the current patient,

the basket catheter was used effectively to prevent massive tumor embolism and was removed easily with the trapped thrombus. However, minor pulmonary embolism could not be prevented by the basket catheter, although hemodynamic and respiratory states were stable. Further investigation would be needed to clarify the effectiveness of the basket catheter for the prevention of pulmonary embolism.

Positioning the transvenous filtering device in a precise location above the tumor thrombus is an important factor for the prevention of pulmonary embolism.<sup>12,13</sup> In the current patient, TEE could be used successfully to position the basket catheter in a precise location above the tumor thrombus and to diagnose the location of tumor thrombus in the IVC. Furthermore, we could quickly detect a part of the tumor thrombus attaching to the head of the basket catheter. Transesophageal echocardiography also helps in the rapid diagnosis and man-

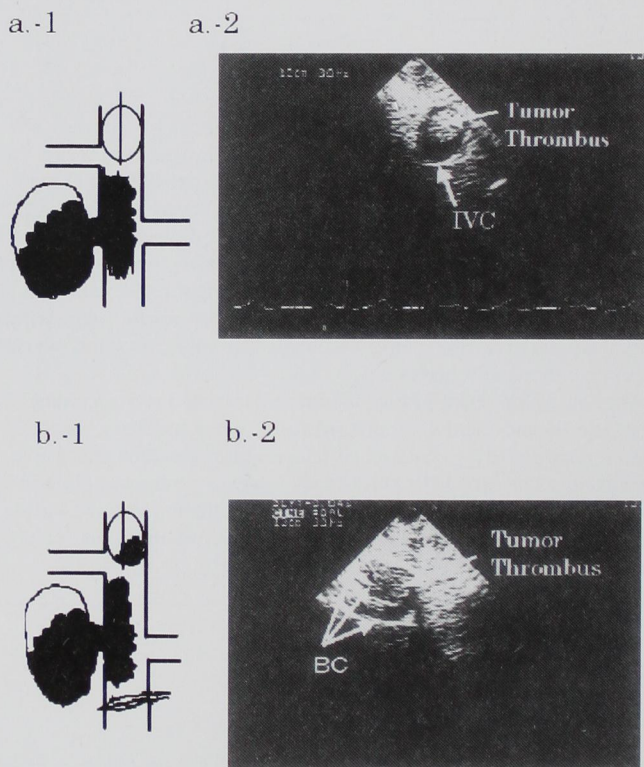


Fig. 2. (A1) The tumor thrombus extended into the inferior vena cava (IVC) just below the hepatic vein after the induction of anesthesia. (A2) Transesophageal echocardiography shows the tumor thrombus extending into the inferior vena cava (IVC). (B1) the part of tumor thrombus moved toward right atrium and attached to the head of the basket. (B2) Transesophageal echocardiography shows that the head of the basket catheter (BC) is catching the tumor thrombus moving toward the right atrium.



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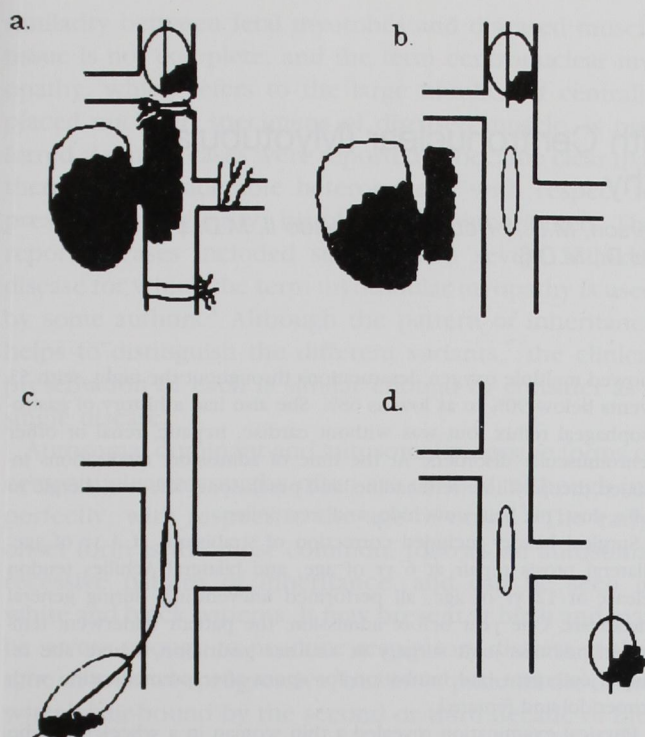


Fig. 3. Schema of the operative procedure. (A) The IVC was clamped at the portion distal to the basket catheter with the tumor thrombus; (B) the right kidney and thrombus were extracted from the incision of IVC; (C) the basket catheter with tumor thrombus was pushed out from the same incision; (D) the head of the basket catheter was cut off and an introducer of the basket catheter was removed *via* an 18-gauge sheath inserted through the right internal jugular vein.

agement of pulmonary embolism. Sasaoka *et al.*<sup>1</sup> reported a case of renal cell carcinoma extending into the IVC, in which TEE was used successfully to make an early diagnosis of massive tumor thrombus during radical nephrotomy. Mizoguchi *et al.* reported a case in which TEE guidance for removal of renal cell carcinoma in the IVC was very useful. Therefore, TEE is a prominent monitoring device for intraoperative monitoring of tumor events in patients with vena caval tumor thrombus.<sup>17</sup>

In conclusion, the basket catheter is a feasible alternative to prevention of massive tumor embolism during manipulation of vena caval tumor thrombus. Transesophageal echocardiography is useful to position the basket catheter in a precise location and to monitor tumor events in patients.

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