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Surgical treatment of renal cell carcinoma with right atrial thrombus: Early experience and description of a simplified technique

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Abstract Operative management of patients presenting renal cell carcinoma's (RCC) with right atrial tumor thrombus extension is a technical challenge. It requires the use of cardiopulmonary bypass (CPB). The aim of this study was to report our early experience and to describe a simplified CPB technique.

5 consecutive patients underwent surgical resection by a joint cardiovascular and urological team. The ascending aorta was canulated. The venous drainage was achieved using a proximal canula inserted in the superior vena cava and a distal canula inserted in the IVC below the renal veins. Right atrium thrombus extension was extracted under normothermic CPB without cross clamping or cardioplegic arrest. A cavotomy was performed at the ostium of the renal vein and an endoluminal occlusion catheter was introduced. The thrombectomy and the radical nephrectomy were then performed. The occurrence of gaseous or tumor embolism, operative time, perioperative bleeding, and post-operative complications were assessed.

Mean patients age was 62.9 years. Atrial and caval thrombectomy were achieved successfully in all patients. Mean operative time was 206 min. Mean CPB time was 62 min. Mean hospital stay was 18.8 days. One death occurred, due to respiratory failure. An asymptomatic early thrombosis of the IVC was diagnosed by CT scan in 1 patient. The four remaining patients were alive 6 months after the surgical procedure.

Minimally invasive CPB technique can be used to treat intra atrial thrombus tumor extension arising from renal cell carcinoma. It can be performed safely with acceptable complications rate.

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Introduction

Renal cell carcinoma (RCC) extends into the inferior vena cava (IVC) as a tumor thrombus in 4 to 10% of cases.[1,2] The presence of a tumor thrombus in the IVC associated with renal carcinoma does not modify survival when total excision of the thrombus is performed and in the absence of nodal or visceral metastases.[3,4] When not treated, poor survival rates have been reported.[5]

Early experiences using different techniques evolved to date with the aim to reduce per operative morbidity. Freed and Gliedman reported the use of a balloon catheter inserted in the vana cava, and Foster et al. reported the use of caval-atrial shunt to extract tumor thrombus with success.[6,7] The surgical management of renal tumors with thrombi in the IVC has therefore become the gold standard treatment, with reported perioperative mortality rate from 2.7 to 13%.[2,8] Survival at 5 years for patients operated without preoperative metastases varies between 30 and 72%.[2,8,9,10] The short and mid-term risks if no treatment is performed are massive pulmonary embolism, total obstruction of the tricuspid valve, and liver failure as a result of the Budd-Chiari syndrome. The level of tumoral extension is based on radiological examination and trans-esophageal echocardiography (TEE). When the thrombus extends into the right atrium (level IV) cardiopulmonary bypass (CPB) is usually required. The usual approach to perform thrombus excision is CPB using deep hypothermic circulatory arrest. CPB improves surgical visibility and allows complete tumor excision, but is associated with higher overall blood loss, greater coagulopathy, longer operative times with significant increase in morbidity and mortality.[11,12] To our knowledge the use of moderate hypothermic CPB without cardioplegic myocardial arrest and without aortic cross clamping on a routine basis was not reported in the literature.

We report our early experience of level (IV) IVC thrombus extraction using a simplified CPB approach.

Materials and methods

5 consecutive patients underwent surgery for RCC and tumor thrombus extension into the right atrium. The clinical and histological characteristics are listed in Table 1.

Table 1 Clinical and histological data

Variables	
Number of patients	5
Male/female	2/3
Age average (range)	62,9 ans (37 to 79 years)
BMI (range)	25.51 Kg/m^2 (21.2 to 33.3 Kg/m^2)
Left/right kidney	3/2
Thrombus level IV	5 cases
Fuhrman grade average (range)	3.4 (3 to 4)
Clear cell adenocarcinoma	4 cases
Primitive neuroectodermal tumor	1 case
Preoperative metastases	1 case

Preoperative workup

The staging evaluation included chest, abdomen and pelvis CT scan, abdominal ultrasound with color-Doppler, and Magnetic Resonance Angiography (MRA). The MRA localized the thrombus according to the suprahepatic veins and the caval atrial junction. It also evaluated thrombus adhesion to the vein wall. The position of the upper extremity of the tumor thrombus was defined in accordance with the 4 levels described by Neves and Zincke[13] (level IV = thrombus located in the right atrium). Locoregional and metastatic extension were evaluated in all cases by brain and chest CT-scan, bone scan and hepatic ultrasound.

Surgical techniques

TEE was performed at the beginning of the surgical procedure in all patients to confirm the level of the upper extremity of the thrombus. TEE was continued throughout the operation to detect air or tumor embolisms, to localize the occlusive balloon in the IVC, and to check complete extraction of the thrombus. In all patients median sternotomy-laparotomy was performed. The IVC was exposed at the level of the renal veins and in the infra-hepatic segment. The liver was not mobilized. After systemic heparinisation (300 UI/KG), ascending aorta was cannulated. An angled venous cannula was placed in the superior vena cava (SVC), and a second angled cannula was placed above the IVC bifurcation below the renal veins. Moderate hypothermia (33 °C) CPB was initiated without cross clamping neither cardioplegic cardiac arrest. Pump flow rate was 2.4 l/min/m^2. The SVC was occluded with a Rummel tourniquet proximally to the cannula. A longitudinal right atriotomy was performed allowing the introduction of an index finger to push the thrombus into the supra hepatic IVC under TEE control. Intra pericardial IVC was then clamped for a short time, using a tourniquet. Atrial closure was achieved and the patient weaned from CPB. The renal artery was ligated. Infra-renal IVC and contralateral renal vein were clamped using a tourniquet. The patient was placed in the Trendelenburg position to decrease the risk of air embolism. A short cavotomy was performed at the ostium of the renal vein. A balloon catheter (venous catheter, size 8/22F, 80 cm long, maximum volume maximum 43 cc, Syntel, Applied Medical, Nieuwegein, NL) was introduced through the cavotomy and was inflated above the thrombus using physiological saline solution, thus performing endoluminal occlusion of the IVC. Intrapericardial IVC was then unclamped to minimize hepatic congestion. The thrombus was removed en bloc through a large, longitudinal anterolateral cavotomy, either by direct extraction or by stripping with a second occlusion balloon. A lateral cavectomy around the ostium of the renal vein was performed in all cases (Fig. 1A,B). A segmental cavectomy was performed if (macroscopic or MRA) the IVC wall was invaded by the tumor. In this setting, a 19 mm diameter expanded polytetrafluoroethylene (PTFE) graft prosthesis was implanted; the contralateral renal vein was anastomosed laterally to the graft. Extended nephrectomy was then performed. When the lumen of the vena cava presented a normal diameter, the cavectomy was closed with a non-absorbable 5.0