

## Renal and Adrenal Tumors with Cardiac Invasion: Immediate Surgical Results in 14 Patients

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### Summary

**Background:** The resection of tumor thrombus of the inferior vena cava (IVC) and right atrium (RA) increases the survival rate of patients with renal/adrenal cancer.

**Objective:** To evaluate the surgical procedure in cases of IVC and RA in the treatment of renal and adrenal tumors.

**Methods:** Fourteen patients undergoing surgical intervention (during the period) between January 1997 and June 2007, for resection of IVC and/or RA thrombus due to renal or adrenal tumors, were retrospectively evaluated. The patients (64.2% male) presented with Wilms' tumor, clear cell carcinoma and adrenal adenocarcinoma, and had mean age of 4.5, 60.5 and 2.5 years, respectively. Epidemiological characteristics and intra- and postoperative parameters were evaluated.

**Results:** Suprahepatic IVC tumor thrombus were observed in all the patients, and in 62.4% of them the thrombus invaded the RA. Thrombectomy was performed with extracorporeal circulation with deep hypothermia and total circulatory arrest in 85.7%, with mild hypothermia in the remaining cases. The inferior vena cava was ligated in 7.1% of the cases, and reconstruction with suture was performed in 92.9% of the patients. The duration of orotracheal intubation and length of hospital stay were different, according to the tumor type. Two deaths, due to intraoperative cardiorespiratory arrest, were seen among patients with adrenal adenocarcinoma.

**Conclusion:** IVC and RA tumor thrombi are more frequent in patients with Wilms' tumor. More postoperative complications are seen in patients with adrenal adenocarcinoma, and the postoperative prognosis is better for patients with Wilms' tumor. (*Arq Bras Cardiol* 2009;92(3): 168-172)

**Key Words:** Vena cava, inferior; heart atria; thrombosis; kidney neoplasms; adrenocortical adenoma.

### Introduction

The total number of individuals diagnosed with renal parenchymal or pelvic tumor in the US in 2007 was estimated at over 50,000, with 25% of the patients progressing to death<sup>1,2</sup>. Furthermore, the incidence of these tumors in the US increased around 2% over the past two decades, and they now represent the third most frequent cause of death due to tumors of the urinary tract and the twentieth for tumors in general<sup>1,2</sup>.

In 4% to 10% of the cases, these tumors invade and/or compress the inferior vena cava (IVC) and develop venous tumor thrombus extensions that may extend cranially, reaching the right atrium of the heart in 1% of the cases<sup>3-5</sup>. Although rare, adrenal tumors may also evolve with invasion of the IVC and right atrium<sup>6</sup>. Even representing a relatively rare situation with reserved prognosis, surgical intervention with thrombectomy with tumor resection may increase the five-year survival rate to 47% - 68%<sup>7,8</sup>.

IVC tumor resection demands extracorporeal circulation (ECC), associated or not to deep hypothermia with total circulatory arrest (DHTCA), particularly when the tumor has invaded the right atrium<sup>8-11</sup>. Although deep hypothermia offers better hemodynamic control during surgery, in around 10% of the cases it may result in intra- and postoperative bleeding complicated by coagulopathy, neurological deficits and perioperative mortality<sup>12,13</sup>.

Since the incidence of cases is low, few studies have evaluated the efficiency of surgery and the incidence of perioperative complications after thrombectomy for renal or adrenal tumor, and the number of patients included in the sample is usually low<sup>4,14,15</sup>. The present study sought to investigate aspects of the surgical management of renal and adrenal tumors with inferior vena cava and right atrium thrombus.

### Methods

This study was conducted between January 1997 and June 2007. It included 14 patients, of both sexes and ages between nine months to 64 years, referred from the Urology and Cardiovascular Surgery Courses from Universidade Federal de São Paulo. The sample was composed of three subgroups, with mean age of 4.5, 60.5 and 2.5 years, presenting with Wilms'

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tumor, clear cell carcinoma and adrenal adenocarcinoma, respectively.

In all the patients, tumors invaded or compressed the IVC and/or the right atrium, resulting in thrombus formation. Thrombectomy was therefore needed in all cases during cytoreductive surgery.

All patients treated during that period were included in the study, independent of the presence of metastases. Demographic and clinical characteristics of the patients are presented in Table 1.

Cytoreductive surgeries were performed by surgeons of the Urology and Cardiovascular Surgery Courses. The surgical technique used consisted of a wide xiphopubic laparotomy followed by exploration of the peritoneal cavity and identification of structures. In sequence, renal and/or adrenal tumors were dissected for definition of cleavage planes relative to the adjacent structures. The cardiothoracic surgeon performed a median thoracotomy for implantation of the extracorporeal circulation circuit device, with cannulation of the superior vena cava or right atrium and ascending (portion of the) aorta. The patient was then submitted to deep hypothermia, at 18° C, with total circulatory arrest, undergoing atriotomy and cavotomy for total resection of the tumor thrombus. The atrial and IVC walls were then sutured with Prolene 4.0, along with procedures for removal of air from the vascular lumen. The temperature was raised to 37° C and the patient was weaned from extracorporeal circulation.

**Table 1 – Preoperative demographic characteristics of the patients**

Characteristic	N (%)	Variation
Male	9 (62.4)	
Female	6 (37.6)	
Median age	4.5 years	11 months – 64 years
Tumor		
Wilms'	6 (42.8)	
Clear cells	4 (28.5)	
Adrenal adenocarcinoma	4 (28.5)	
Local metastasis	0 (0)	
Distant metastasis	2 (14.2)	
Organ of metastasis		
Liver	2 (14.2)	
Lung	1 (7.1)	
Kidney	1 (7.1)	
Neoadjuvant chemotherapy	4 (28.5)	
Duration of extracorporeal circulation	83.2 minutes	37 – 165 minutes
Duration of total circulatory arrest	24.2 minutes	9 – 34 minutes
Thrombus extension		
Suprahepatic IVC	14 (100)	
Right atrium	9 (62.4)	

IVC - inferior vena cava

Surgical wounds were closed in layers. In case of extensive invasion of the inferior vena cava wall, and when primary reconstruction of the venous wall was not possible after tumor resection, a bovine pericardium conduit was implanted. When this procedure was not possible, the inferior vena cava was ligated. In this case, venous drainage of the lower half of the body is done through the azygos/hemiazygos system.

Data were collected retrospectively from hospital records, and are presented in a descriptive manner. Characteristics evaluated in this work include the surgical approach to thrombectomy, reconstruction of the inferior vena cava, transfusion of blood products and intra/postoperative complications, need for reoperations, length of hospital stay, orotracheal intubation and deaths.

## Results

Only patients with adrenal adenocarcinoma developed metastases before the surgical treatment. Metastases were localized in the liver and kidney in one patient, and in the liver and lung in the other. According to the clinical indication, patients with Wilms' tumor underwent neoadjuvant chemotherapy.

In all patients, thrombectomy was simultaneous to tumor resection. Two patients, presenting with clear cell carcinoma and adrenal adenocarcinoma, respectively, died during surgery due to cardiorespiratory arrest. Intraoperative transfusion of blood products was required in 10 cases, including 83.3% of the cases of Wilms' tumor, 75% of patients with clear cell carcinoma and 50% of patients with adrenal adenocarcinoma.

All patients underwent surgery with extracorporeal circulation. Deep hypothermia associated with total circulatory arrest was used in 85.7%, and mild hypothermia in 14.3% of the cases. The duration of extracorporeal circulation and anoxia is presented in Table 1. The inferior vena cava was ligated in 7.1% of the cases, and primary reconstruction with suture was performed in 92.9% of the patients. There were no cases of pericardial patch reconstruction.

Postoperative transfusion of blood products was conducted in 33.3% of the cases, in all subgroups. The volume transfused, however, was higher in patients with adrenal adenocarcinoma (21 bags), followed by patients with clear cell carcinoma (six bags) and Wilms' tumor (three bags). The statistical significance of the differences was not determined.

The duration of orotracheal intubation and length of hospital stay varied among the three subgroups (Figure 1). In one case, reoperation was required for drainage of cardiac tamponade.

No postoperative complications were seen in patients with clear cell carcinoma or Wilms' tumor. Non-fatal postoperative complications were observed in all the patients with adrenal adenocarcinoma. One of the patients presented acute renal failure, septic shock, mediastinitis, suture dehiscence and abscess of the surgical wound. The second patient presented acute renal failure and cardiac tamponade, and the third presented cardiorespiratory arrest that reverted in the intensive care unit. There were no deaths in the immediate postoperative period.

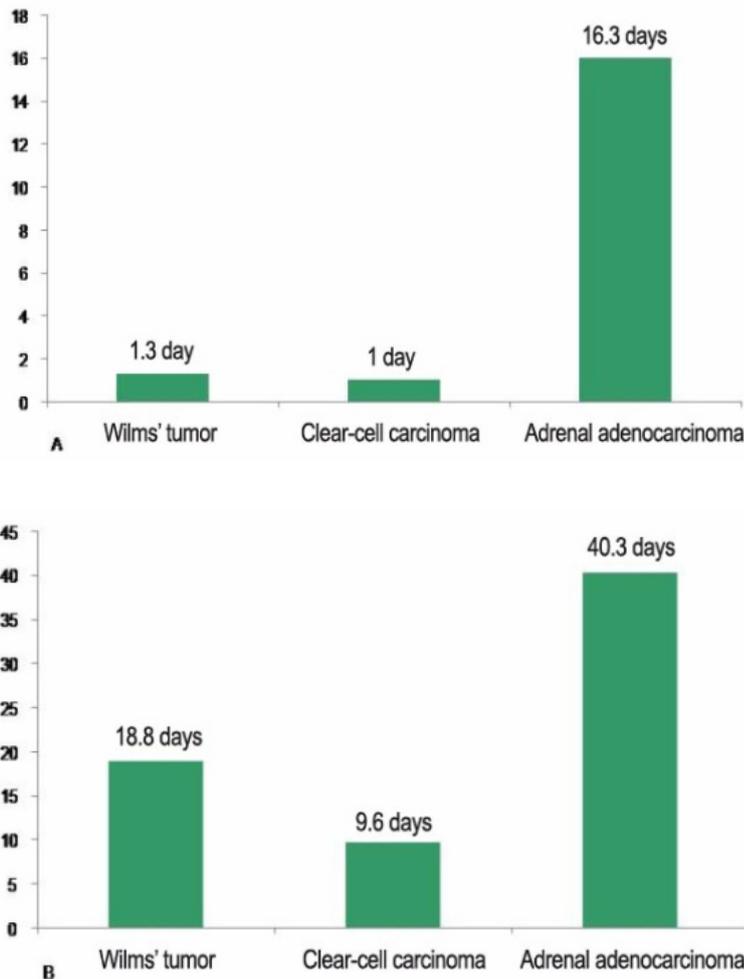


Chart 1 - A. Mean orotracheal intubation time according to tumor type; B. Mean hospital stay duration according to tumor type.

## Discussion

Thrombus formation in the inferior vena cava and/or right atrium by invasion of renal and adrenal tumors is relatively rare. Chemo- or radiotherapy are not efficient, and surgical resection is the choice treatment for these cases, resulting in improved survival rates<sup>7,16</sup>.

Treatment of these tumors is actually routine in urological surgery. These diseases, however, are important in the context of cardiovascular surgery due to possible complications with intracaval and/or intracardiac thrombi. It is thus extremely important for cardiovascular surgeons to be aware of recommended procedures and possible complications with the treatment, so that adequate care may be delivered to the patient.

Studies in this area, however, are mostly case reports or case series with small sample numbers, without great consistency<sup>4,14,15</sup>. Due mainly to the rarity of this complication,

few studies have been performed with larger case numbers, providing reliable conclusions<sup>10,16,17</sup>. In this context, having a large number of patients is of fundamental importance, even with lower power of evidence, since the studies may provide comparison between methods and results from different medical units and, eventually, lead to improved health care<sup>18</sup>.

Gender distribution among patients observed in the present study is similar to literature reports, independent from the histologic type of tumor<sup>10,17</sup>. The more prevalent histologic type in our study, however, was Wilms' tumor (42.8%), whereas other studies have shown higher prevalence of clear cell carcinoma<sup>10,17</sup>. This difference is possibly due to the fact that Urology and Pediatric Oncology Services are reference for the treatment of these tumors, receiving in consequence a higher number of patients in this category.

Metastases observed in this series derived from adrenal adenocarcinoma only, and localized to the lungs, liver and

kidneys. Nevertheless, with more prevalent metastases, similar results were reported by Haferkamp et al. in 2007<sup>10</sup>, with lung and liver metastases followed by infiltration in nonregional lymph nodes, bone and brain. Only patients with Wilms' tumor underwent neoadjuvant chemotherapy, which is mandatory for these patients and results in important cytorreduction of the tumor and venous thrombus, reducing the risks of the surgical procedure<sup>10</sup>.

In the present series, the cardiovascular surgeons performed median thoracotomy followed by pericardiectomy to reach the heart and implant the extracorporeal circulation system. A study by Wotkowicz et al<sup>16</sup>, in 2006, compared access pathways for ECC by median thoracotomy or minimal access surgery, i.e. parasternal thoracotomy between the third and fifth ribs with subclavian incision<sup>16</sup>. The results showed that the technique with minimal access, with deep hypothermia, reduced surgical time, duration of mechanical ventilation, the need for transfusion of blood products and length of hospital stay. Mortality rates, however, were not modified<sup>16</sup>.

ECC was used for all patients in this series, associated with DHTCA in most of the cases. In spite of increased risks of bleeding due to coagulopathies, and of neurological risks associated with prolonged reheating<sup>12,16</sup>, Chiappini et al. (2002)<sup>7</sup> reported greater safety and efficiency in the procedures when this method was used, as also shown more recently by Wotkowicz et al<sup>16</sup>. (2006)<sup>7,16</sup>. In addition, Ngaage et al. (2001)<sup>19</sup> used retrograde brain perfusion to minimize possible brain damage; the technique, however, was not used in any patient<sup>19</sup>. ECC and anoxia time were adequate, as compared to other studies<sup>16</sup>.

The tumor thrombus reached the suprahepatic region in all patients, and the right atrium in 62.4% of the cases. Klatte et al. (2007)<sup>17</sup> reported different results, with higher prevalence of tumor extension in the renal veins, followed by the infrahepatic, suprahepatic and intracardiac portions of the inferior vena cava<sup>17</sup>. The difference may be explained by the fact that all patients in our series underwent combined intervention of cardiovascular surgery, representing thus the minority of cases in which the thrombus reaches the most cranial portion of the inferior vena cava and right atrium.

Furthermore, the above study also showed that there is no correlation between the anatomical level of the thrombus and histologic characteristics of the tumor, although the lowest levels are presented by clear cell carcinomas<sup>17</sup>. Our study had different results, since all tumors, independent of the histologic type, reached at least the suprahepatic (portion of the) IVC.

The relationship between extension of the thrombus and

postoperative survival rates of the patients is controversial<sup>10,11,20</sup>. In a study with a large sample, however, Klatte et al. (2007)<sup>17</sup> observed that duration of surgery, intraoperative bleeding, and perioperative morbidity and mortality were proportional to the extension of the tumor thrombus<sup>17</sup>. Intra- and postoperative complications observed in the present study may be explained by this association, since in our patients the thrombi reached more cranial regions of the IVC and, as a consequence, they were exposed to higher surgical risks.

The complications observed in the present study are similar to those reported in the literature<sup>16</sup>. The longer periods of hospital stay and orotracheal intubation, required by patients with adrenal adenocarcinoma, as well as the need for transfusion of blood products, show the more severe condition of these patients. We observed a mortality rate of 14.2% in our study, a slightly lower value than that reported by Sweeney et al. (2003)<sup>21</sup> for patients undergoing thrombectomy of similar magnitude<sup>21</sup>.

Taken as a whole, the present study showed that tumor thrombi in the IVC and right atrium was more strongly with the presence of Wilms' tumor and young age; that cases of adrenal adenocarcinoma evolved with a higher frequency of postoperative complications, and a more favorable course in the postoperative period of patients with Wilms' tumor. These results stress the fact that, in spite of the large therapeutic arsenal available for the management of malignant tumors, surgical intervention is the best choice for cases of genitourinary tumors with invasion of the inferior vena cava<sup>7,17</sup>. The cardiologist and the cardiovascular surgeon are of fundamental importance in the process, but should have a harmonious and well-established interaction with the other members of the multiprofessional team, to adequately provide the cure of the disease and to improve the quality of life of the patient.

#### Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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#### Study Association

This study is not associated with any post-graduation program.

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