

Treatment options and outcomes for caval thrombectomy and resection for renal cell carcinoma



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ABSTRACT

Objective: Advanced renal cell carcinoma (RCC) has a significant predisposition to vascular invasion. Tumor vascular invasion and thrombus are found in the renal vein and the inferior vena cava (IVC) in up to 10% to 25% of patients. This study reviewed the current status of radical nephrectomy with IVC thrombectomy for advanced RCC.

Methods: A two-level search strategy of the literature (MEDLINE, PubMed, The Cochrane Library, and Google Scholar) for relevant articles listed between January 2000 and December 2015 was performed. The review was confined to patients with primary RCC associated with vascular invasion.

Results: Untreated RCC with intravascular thrombus has a median survival of 5 months. Surgical exposure and intervention are tailored to the level of tumor thrombus. The 30-day mortality for radical nephrectomy with IVC thrombectomy is low (1.5%-10%), and the complication rates have been reported to be 18%, 20%, 26%, and 47% for IVC tumor thrombus level I, II, III, and IV disease, respectively. Disease-specific survival ranges from 40% to 60% at 5 years after nephrectomy and removal of the intravascular tumor.

Conclusions: Radical nephrectomy with IVC thrombectomy is an effective cancer control operation that can be safely performed with acceptable mortality and morbidity. Preoperative imaging coupled with perioperative surgical management of the IVC is critical to procedural success and patient outcomes. (*J Vasc Surg: Venous and Lym Dis* 2017;5:430-6.)

The 2016 American Cancer Society estimates for the incidence of renal cell carcinoma (RCC) in the United States suggest that about 62,700 new cases of RCC (39,650 in men and 23,050 in women) will occur and that about 14,240 people (9240 men and 5000 women) will die of this disease.¹ RCC remains one of the 10 most common cancers found in both genders. The lifetime risk for development of RCC is 1 in 63 (1.6%). From a histologic perspective, there are three main RCC subtypes: clear cell (80%-90%), papillary cell (types I and II; 10%-15%, of which 60%-70% are type I), and chromophobe cell (4%-5%).^{2,3} RCC has a biologic predisposition for direct vascular invasion, with intravascular tumor thrombus being found in 10% to 25% of cases within the renal vein or within the inferior vena cava (IVC).^{4,5} Venous invasion is associated with the T3 stage of the TNM classification (Table I). The presence of

intravascular tumor thrombus within the IVC is considered a poor prognostic factor for patients with RCC. Patients with untreated RCC and an associated intravascular IVC thrombus have a median life expectancy of 5 months and a 1-year disease-specific survival of 29%.⁶ Radical nephrectomy with successful removal on intravascular IVC thrombus is considered the best approach to obtain local control of T3 RCC. Successful resection of an RCC with removal of associated intravascular thrombus is associated with good long-term control of the tumor in nearly 50% of cases that present with T3 disease. This summary examines the evidence for venous thrombectomy in the treatment of RCC.

METHODS

A two-level search strategy of the literature was performed. A search of MEDLINE, PubMed, The Cochrane Library, and Google Scholar electronic databases for relevant articles listed between January 2000 and December 2015 was performed. The searches were limited to the English language and humans and, in the case of Google Scholar, to the first 20 chronologically listed pages (~200 hits). The following were the search terms: *guidelines, recommendations, meta-analysis, review, renal cell carcinoma, caval thrombus, thrombectomy, clot removal, and caval resection*. After we identified relevant studies, we manually searched secondary sources, such as references, reviews, and commentaries, to identify additional materials. The review was confined to patients presenting with and diagnosed with primary RCC with venous invasion.

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Table I. TNM classification and staging

T
T1
T1a: limited to kidney ≤ 4 cm
T1b: limited to kidney >4 cm but ≤ 7 cm
T2: limited to kidney >7 cm
T2a: limited to kidney, >7 cm and ≤ 10 cm
T2b: limited to kidney, >10 cm
T3: tumor/tumor thrombus extension into major veins or perinephric tissues, but not into ipsilateral adrenal gland or beyond Gerota fascia
T3a: spread to renal vein
T3b: spread to infradiaphragmatic IVC
T3c: spread to supradiaphragmatic IVC or invades the wall of the IVC
T4: involves ipsilateral adrenal gland or invades beyond Gerota fascia
N
N0: no nodal involvement
N1: metastatic involvement of regional lymph node/s
M
M0: no distant metastases
M1: distant metastases
Stage groupings
Stage I: T1 N0 M0
Stage II: T2 N0 M0
Stage III: T3 or N1 with M0
Stage IV: T4 or M1
IVC, Inferior vena cava.

MANAGEMENT

The majority of patients with T3 disease (RCC and the presence of tumor thrombus within the IVC) are symptomatic on presentation. They require a multidisciplinary approach to allow surgical intervention. There are important features of the RCC that should be characterized before intervention is considered: the definition of renal vascular anatomy, the degree of tumor extension into the perirenal adipose tissue, the presence of direct invasion or metastatic disease within the ipsilateral adrenal gland, the identification of retroperitoneal or abdominal adenopathy or metastatic lesions, and the assessment of enlarged collateral vessels. In the presence of metastatic disease, cytoreductive intervention by radical nephrectomy is recommended in patients with a high Karnovsky performance status ($\geq 80\%$) and a large primary tumor mass with limited metastatic tumor burden and for patients with a symptomatic primary lesion. Nephrectomy for RCC is not recommended in patients with a poor score on the Karnovsky scale ($<80\%$) because there is no associated benefit.^{7,8}

STAGING

Whereas the TNM classification is the oncologic standard, several alternative staging systems have been

proposed to describe RCC tumor invasion and the severity of associated caval thrombus burden: Neves, Novick, and Hinman systems.⁹⁻¹¹ In both the Neves classification and the Novick system, renal vein thrombus extending <2 cm within the IVC is categorized as level I disease; the finding of infrahepatic IVC thrombus is considered level II disease; the identification of intrahepatic subdiaphragmatic IVC thrombus is defined as level III disease; and the presence of supradiaphragmatic thrombus is categorized as level IV disease (Fig). The Hinman staging system has only three staging levels of IVC tumor thrombus extension: level I, infrahepatic thrombus; level II, subdiaphragmatic thrombus above the hepatic veins; and level III, supradiaphragmatic thrombus. Ciancio et al¹² subsequently subcategorized Hinman level III disease into four subtypes: IIIa, retrohepatic thrombus below major hepatic veins; IIIb, retrohepatic thrombus at the level of the major hepatic veins; IIIc, retrohepatic thrombus found above the level of major hepatic veins but remaining subdiaphragmatic; and IIId, thrombus that is both suprahepatic and supradiaphragmatic extending into the intrapericardial portion of the IVC but outside the right atrium. In RCC, the incidence of pulmonary embolism is $\sim 2\%$,¹³ and two variants of pulmonary embolism with tumor thrombus have been categorized. The first type involves either the main pulmonary arteries or one or more of the large segmental arteries. The second type involves the small pulmonary arteries or arterioles. The latter may present as idiopathic pulmonary hypertension ante mortem.

IMAGING

Cross-sectional imaging with either computed tomography or magnetic resonance imaging (MRI) will accurately stage RCC and the level of the intravascular thrombus. A preoperative abdominal MRI study within 14 days of surgery is recommended, given the natural history for rapid intravascular thrombus progression (Table II). An IVC diameter >40 mm in cross section suggests invasion into the IVC.¹⁴ The finding of an anterior-posterior diameter of the IVC of 18 mm or anterior-posterior diameter of the renal vein of 14 mm at the level of the renal vein ostium on preoperative imaging is 90% sensitive for predicting IVC wall invasion.¹⁵ Complete occlusion of the IVC due to renal cell-associated thrombus has been independently associated with a greater risk of tumor invasion into the IVC wall.^{15,16} The finding of tumor signal on MRI on both the intraluminal and extraluminal sides of the IVC wall is considered a reliable sign of vessel wall invasion with a 92% accuracy rate.¹⁷

INFLUENCE OF PREOPERATIVE EMBOLIZATION

In a review of renal artery embolization, Kalman and Varenhorst found limited data to support the general

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