

Level III-IV Inferior Vena Caval Thrombectomy Without Cardiopulmonary Bypass: Long-Term Experience with Intrapericardial Control

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Abbreviations and Acronyms

CPB = cardiopulmonary bypass
ECOG = Eastern Cooperative Oncology Group
IVC = inferior vena cava
RCC = renal cell carcinoma

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Purpose: Inferior vena cava tumor thrombectomy requires experienced surgical teams due to complex hemodynamic considerations. The teams often use vascular bypass techniques that introduce additional risk. Inferior vena caval control in the pericardium obviates the need for cardiopulmonary bypass. We reviewed our experience with intrapericardial control during inferior vena caval tumor thrombectomy to evaluate perioperative outcomes and determine factors associated with overall survival.

Materials and Methods: We retrospectively reviewed the records of 87 patients who underwent nephrectomy with inferior vena caval tumor thrombectomy using intrapericardial inferior vena caval control from 1978 to 2012. This technique was performed in all 43 and 35 cases of intrahepatic and supradiaphragmatic thrombi, respectively, and in 9 select cases of intra-atrial thrombi. Patient demographics, operative variables and postoperative outcomes were examined. Multivariate regression analysis was used to determine associations between clinical variables and overall survival.

Results: Mortality 30 days perioperatively was 9.2% and the incidence of high grade complications was 19.5%. Median survival was 3.1 and 2.5 years in patients with pT3bN0 and pT3cN0, respectively. Extended regional lymphadenectomy, which was performed in all cases, revealed nodal metastasis in 38%. On multivariate analysis ECOG greater than 2 and pT3c stage were associated with worse survival. Histological grade, perinephric fat invasion and lymph node involvement were not associated with worse survival.

Conclusions: Intrapericardial control of the inferior vena cava enables a single surgical team to safely perform tumor thrombectomy for intrahepatic and supradiaphragmatic thrombi, eliminating the risk and morbidity related to cardiopulmonary bypass. Although supradiaphragmatic extent and ECOG greater than 2 are associated with worse survival, complete resection with lymphadenectomy can allow for long-term survival in patients with locally advanced disease.

Key Words: kidney; vena cava, inferior; carcinoma, renal cell; thrombosis; mortality

DESPITE the down staging of diagnosed renal masses since the advent of multidetector computerized tomography, locally advanced renal masses are still common. Venous system invasion develops in approximately 4% to 10% of cases, of which 22% to 70% show IVC invasion.¹ A recent population based study demonstrated 5-month median survival without surgical intervention.² With the imminent fatal progression of these tumors an aggressive surgical approach has been advocated, given the associated overall 5-year survival rate of 39% to 60%.^{3,4} The potential for long-term survival beyond 10 years was reported as early as 1956.⁵ With the evolution of targeted therapy and its use in the perioperative setting an increasing number of patients are potential candidates for surgical excision.

Many groups advocate vascular bypass techniques, including venovenous bypass and CPB with and without hypothermic circulatory arrest.^{1,6,7} Others recommend reserving bypass techniques exclusively for level IV thrombi because CPB carries additional intraoperative risk as well as significant potential for postoperative neurological and hematological complications.^{8,9} Hypothermic circulatory arrest in tumor thrombectomy series was also associated with a perioperative mortality rate of 3% to 16%.³ Level III/IV thrombi were associated with an increased rate of complications of 17.5% to 47% with perioperative mortality as high as 40%.^{1,6,10}

The thoracoabdominal incision has been used to resect advanced RCC for more than 6 decades.¹¹ The technique of intrapericardial control, which predates the introduction of highly sensitive abdominopelvic imaging and improvements in bypass techniques, assists in the prevention of intraoperative pulmonary embolism, minimizes hepatic ischemia time, avoids systemic heparinization and obviates the need for median sternotomy. By avoiding CPB a single surgical team can safely perform most IVC tumor thrombectomy cases.

We reviewed our experience with this surgical approach, which underwent minimal alteration during the study period, to determine perioperative outcomes and examine overall survival in patients with advanced IVC tumor thrombi.

MATERIALS AND METHODS

With approval from the institutional review board we identified patients in an existing nephrectomy database who underwent open radical nephrectomy and tumor thrombectomy between 1978 and December 2012. Of 210 patients with IVC tumor thrombus 87 with level III and IV thrombi treated with intrapericardial control were identified and included in analysis. All clinical information, including initial consultation, inpatient notes,

operative records, order sheets, pathology reports, hospital discharge summaries, outpatient encounters, readmission records and personal communication, was retrospectively reviewed. Karnofsky and ECOG status was determined from preoperative records. Operative time was determined from surgical incision to the completion of surgical closure. All complications within 30 days of surgery were considered related to surgery and graded by 2 independent reviewers according to the 2004 Clavien-Dindo grading system. Grading discrepancies prompted reexamination of the medical record until consensus was attained. All complications were further classified by organ system.

Before the introduction of computerized tomography and magnetic resonance imaging patients underwent venography and arteriography to determine the cranial extent of tumor thrombus. With the introduction of computerized tomography in the early 1980s patients underwent preoperative imaging at operating surgeon discretion. Since 2003, all patients have undergone intraoperative transesophageal echocardiography regardless of tumor level.

Surgical Approach

A right thoracoabdominal incision was made in all cases regardless of tumor laterality to allow for complete vascular exposure. The incision was extended from the midline to the left costochondral junction in select left cases. The intrapericardial IVC was isolated with a curved pedicle clamp and controlled with a Rummel tourniquet (fig. 1). Hepatic vascular isolation was performed via the Pringle maneuver, occluding the porta hepatis. Vascular control of the superior and inferior mesenteric arteries was performed concomitantly to limit portal vein inflow. After achieving complete vascular control longitudinal cavotomy was performed from the renal vein ostium toward the inferior (short) hepatic veins. Digital manipulation, balloon catheter withdrawal or tissue elevators were used to remove the tumor thrombus in

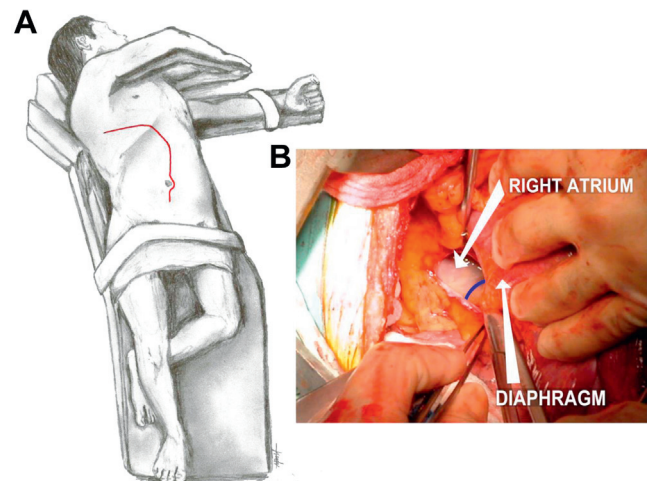


Figure 1. A, surgical position for right thoracoabdominal incision over 7th or 8th rib regardless of tumor laterality. B, cavoatrial junction exposed through thoracoabdominal incision. Blue line indicates intrapericardial IVC.

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