

## Ante Grade Balloon Occlusion for Treatment of Renal Cell Carcinoma with Inferior Vena Cava (IVC) Thrombus

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### Abstract

**Background:** RCC with venous tumour thrombi (VTT) is managed conventionally by radical nephrectomy with tumour thrombectomy; if needed, repair of IVC and metastasectomy may be necessary. Level I and II thrombi are managed with low complication rates by laparotomy alone. Level III and IV thrombi are managed surgically by standard technique i.e. thoracoabdominal tumour resection with cardiopulmonary bypass (CPB). However, it requires hepatic mobilization and is associated with complications based on high morbidity and hence less invasive techniques have been developed.

**Materials and Methods:** We present 11 cases of renal cell carcinoma with hepatic and sub hepatic IVC thrombus from 2015 to 2019. We have operated 64 cases of radical nephrectomy, out of which, there were 11 cases of RCC with IVC thrombus. The average age was 61 years. Out of 11 patients, 9 were males and 2 were females. Ten cases were on the right side and one case was on the left side.

**Results:** Of the eleven patients, nine patients needed observation in the intensive care unit (ICU) for one day only. The remaining 2 patients needed observation in ICU for 3 days as they developed pneumonia. 6 patients needed one unit of packed red blood cells (PRBC) transfusion and 5 patients needed 2 units of PRBC transfusion. The average post-operative creatinine was 1.8. The average days of hospitalisation were 10 - 12 days. There were no wound infections or mortality.

**Conclusion:** For the surgical treatment of RCC with retrohepatic IVC tumour extension, transjugular balloon occlusion of the suprahepatic IVC offers an alternative to extensive hepatic mobilization to obtain suprahepatic thrombus control. Advantages over traditional surgical methods may include decreased surgical time, lower risk of liver injury and tumour embolism. We suggest this method for further evaluation.

**Keywords:** Balloon Occlusion, Inferior Vena Cava, Venous Tumour Thrombus

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### Introduction

Approximately 4 % to 15 % cases of renal cell carcinoma are associated with venous tumour thrombus which commonly invades

into inferior vena cava (IVC) and renal vein. [1] Complications of IVC tumour thrombi are associated with life threatening

conditions such as pulmonary embolism, Budd-Chiari syndrome leading to hepatic failure and tricuspid valve obstruction, thus necessitating the gold standard surgical management. [2]

Therapeutic and prognostic decision making is aided by the staging system of VTT extension. [1] RCC with VTT is managed conventionally by radical nephrectomy with tumour thrombectomy. If needed, repair of IVC and metastasectomy may be necessary. Level I and II thrombi are managed with low complication rates by laparotomy alone. Level III and IV thrombi are managed surgically by standard technique i.e. thoracoabdominal tumour resection with cardiopulmonary bypass. [1,3] However, it requires hepatic mobilization and is associated with complications based high morbidity and hence less invasive techniques have been developed. [1]

### Materials and Methods

We present 11 cases of renal cell carcinoma with hepatic and sub hepatic IVC thrombus from 2015 to 2019. We have operated 64 cases of radical nephrectomy. Out of which, there were 11 cases of RCC with IVC thrombus. The average age was 61 years. Out of 11 patients, 9 were males and 2 were females. 10 cases were of right side and one case was of left side. Under general anaesthesia, a left subclavian central line was placed. The surgical site was prepared from the neck up to the mid-thigh including potential vascular access sites in the jugular, axillary and femoral regions. Under sterile conditions and ultrasound guidance, the right internal jugular vein was cannulated, and 14 F sheath was introduced. Using standard exchange techniques and fluoroscopic guidance, a 0.035-inch Rosen guide wire was placed at the level of the tip of the tumour thrombus, determined by pre-operative CT angiography imaging. Coda balloon catheter (30 mm diameter and 40 mm length) was introduced into the IVC.

Catheter angiography was done and the balloon was parked cranial to the thrombus.

Kidney and IVC were exposed through a subcostal incision of contralateral rectus muscle. Right renal artery was transected. Kidney was dissected circumferentially, leaving the kidney attached only by the right renal vein. Rummel tourniquets were placed around the infra-renal IVC (below the palpable thrombus), two large lumbar veins and the left renal vein. The plane posterior to the supra-renal IVC was developed to allow clamping on a later occasion. Mean arterial pressure was maintained between 50 - 60 mmHg. When performing left radical nephrectomy, we dissected the right renal artery and renal vein in one of the patients. Left renal artery was clamped using Hemlock clips and the left renal vein was holding the tumour thrombus with the specimen. The balloon was inflated prior to IVC clamp under fluoroscopic control. After a few minutes of trial inflation, the patient remained hemodynamically stable. Right renal vein was entered at its confluence to the IVC in 10 cases. In patients with left renal vein thrombus, an incision was made on the left renal vein extending up to IVC. The renal vein wall was detached circumferentially and the mobile retrohepatic thrombus was extracted en bloc with ring forceps. Balloon was moved caudally removing all the thrombus. Complete IVC thrombus extraction was done. A cavogram revealed no residual clot and the cavotomy was repaired using 4-0 Prolene double end needle (Table/Figure 4). All tributary veins were released after 20 minutes of IVC occlusion. Surgery was completed in around 3 - 4 hours. Post-operative recovery was unremarkable in 9 patients. Two patients had post-operative chest infection managed conservatively with intervention of a pulmonologist. All the patients were kept under observation in ICU. 2 units of PRBC were transfused in 6 patients and 1 unit of blood was transfused in the remaining 5 patients. Duplex ultrasound revealed no residual clot in the IVC, deep

femoral veins or iliac veins. The final pathology revealed a 12 cm RCC, clear cell type with Fuhrman nuclear grade 4.

**Results**

**Table/Figure 1: Baseline Characteristics of our Patients**

Parameter	Value
Median age of patients	62 years (58 - 64)
Median Hb	10.5 grams
Median operating time	4.5 hours (4 - 6.5 hours)
Blood loss	500 – 900 ml
Hospitalisation	10 – 14 days

**Table/Figure 2: Post-operative Course**

ICU Stay	9 Patients 1 Day 2 Patients 3 Days due to Pneumonia
Blood transfusion	6 patients needed 1 PRBC transfusion 5 patients needed 2 PRBC transfusion
Post operative creatinine	1.8 average
Duration of hospitalisation	10 - 12 days
Wound infection	Nil
Mortality	Nil

Of the eleven patients, nine patients needed observation in the intensive care unit (ICU) for one day only. The remaining 2 patients needed observation in ICU for 3 days as they developed pneumonia. 6 patients needed one unit of PRBC transfusion and 5

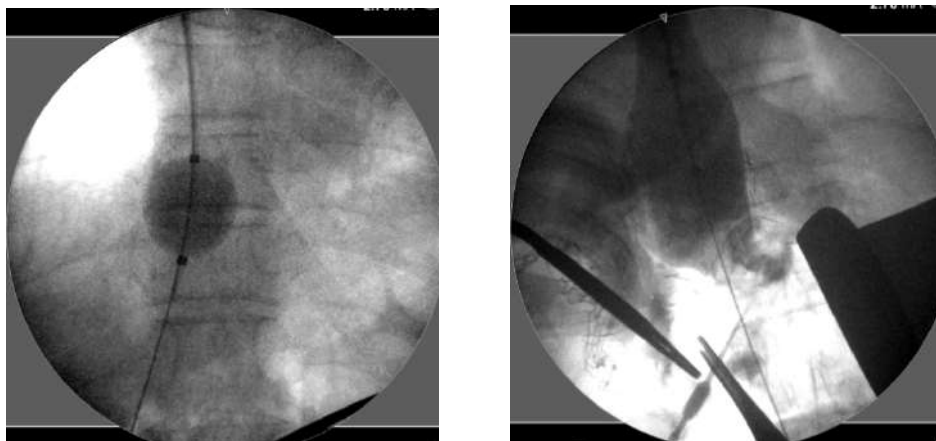
patients needed 2 units of PRBC transfusion. The average post-operative creatinine was 1.8 and the average days of hospitalisation was 10 - 12 days. There were no wound infections or mortality.



**Table/Figure 3: Computed Tomography of Abdomen Showing Right Renal Mass with IVC Thrombus**



**Table/Figure 4: Intra-operative Thrombus Removal**



**Table/Figure 5: Cavogarm After Thrombus Removal Showing Level of Balloon**

### Discussion

While performing nephrectomy with IVC thrombectomy, acceptable suprahepatic exposure and IVC control might be challenging and frequently needs complete mobilization of the liver or sternotomy with pericardiotomy needing a multidisciplinary participation of cardiac or vascular surgeons. [4] To tackle this problem, we employed endoluminal principles and techniques to have suprahepatic IVC control and noted that this technique works efficiently and without any difficulty. Some researchers have successfully applied endoluminal IVC occlusion to reduce morbidity. Yang et al. analysed the data of ten patients that underwent temporary balloon occlusion of IVC during resection of thrombus. Ninety percent of the cases tolerated the procedure with no major complications. At the last follow up visit i.e., at 6 - 18 months, eight patients were

alive and tumour-free. The technique of occlusion to achieve a bloodless field, was similar to our technique. [5] In a case series of RCC with thrombus (level II or III) treated with endoluminal occlusion of IVC, cranial occlusion balloon was introduced under trans-oesophageal endoscopy control through a cavotomy. Following this, thrombectomy and radical nephrectomy were done. This resulted in the decreased rates of complications. [2] AngioVac is another approach to open surgical resection for poor surgical candidates and may reduce the risk of embolization. But it was not a better approach to reduce the metastasis during the removal of tumour thrombi. [6]

Nagy Z et al. reported less invasive VTT pushing with balloon catheter (VTTP BC) technique for level III VTT and asserted that it requires less surgical time with reduced blood loss and complication rates



against the contemporary surgical methods. It can be accomplished without thoracotomy, cardiopulmonary bypass, hypothermic circulatory arrest and liver mobilization. [1] Transjugular suprahepatic balloon occlusion bypasses the liver mobilization and decreases the accompanied risk of liver and hepatic venous branches injury. [7] It permits accurate balloon positioning with decline in the risk of thrombus disruption as well as an intra-operative completion cavogram to ensure complete removal of the thrombus. Accurate balloon repositioning caudally after resection of the suprarenal thrombus should immediately reconstitute hepatic vein flow and thus, the risk of hepatic ischemia seen with IVC thrombectomy is avoided. However, balloon techniques have the potential of inadequate IVC occlusion and anatomical exposure to obtain surgical control. Balloon failure can be disastrous. Moreover, there is a very small risk of cardiac arrhythmia as a result of irritation of the right atrium by the wire or catheter. Despite the technique for subdiaphragmatic control of IVC, there is always a likelihood of patient intolerance to decreased venous return. While it may be a concern that endoluminal control will not allow rapid access to the heart for cardiopulmonary bypass, our planned strategy in this case would be veno-venous bypass from the femoral vein to the axillary vein without sternotomy. This was not needed in our series, but the involvement of expert vascular surgeons will make this surgical approach more achievable when required.

### Conclusion

For the surgical treatment of RCC with retrohepatic IVC tumour extension, transjugular balloon occlusion of the suprahepatic IVC offers an alternative to extensive hepatic mobilization to obtain

suprahepatic thrombus control. Advantages over traditional surgical methods may include decreased surgical time, lower risk of liver injury and tumour embolism. We suggest this method for further evaluation.

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