



# Renal Cell Carcinoma with Renal Vein and Inferior Vena Cava Tumour Thrombus Invasion: A Case Series

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## Abstract

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Conflicts of interest: None

**Introduction:** Renal Cell Carcinoma (RCC) with Inferior Vena Cava (IVC) involvement is rare, occurring in 4%–10% of cases with RCC. The IVC tumour removal is associated with a high mortality. There is no large series reporting such cases from Sri Lanka. This study is on a series of patients with RCC and IVC tumour thrombus, who underwent successful venous tumour removal.

**Methods:** This is a descriptive retrospective study of consecutive patients undergoing surgery over four years. The level of extension of RCC tumour thrombus was categorised into level I (renal vein), level II (infrahepatic IVC), level III (retro hepatic) and level IV (suprahepatic).

**Results:** 24 were included. 16 (66.7%) were males. Mean age was 60.7 years (37-79). 64.3% presented with a palpable mass while 17.9% had haematuria. Three (12.5%) had lung metastasis. There were three (12.5%) level I, six (25.0%) level II, 11 (45.8%) level III and four (16.7%) level IV tumours. The commonest histological type was clear cell carcinoma (85.0%). The mean follow up was 11.2 months (0.2 to 50.7). The one month and one year survival was 96.0 % and 72.0%.

**Discussion and Conclusions:** This is the largest case series of RCC with venous tumour thrombus extension from Sri Lanka. The one month and one year survival was 96.0 % and 72.0%. This is comparable to other such series. However a larger study with longer follow-up is required before drawing further conclusions.

**Keywords:** Renal cell carcinoma, Inferior vena cava, Tumour thrombus, Sri Lanka, Tumour excision

## Introduction:

Renal Cell Carcinoma (RCC) with renal vein and Inferior Vena Cava (IVC) tumour thrombus (IVTT) is relatively rare, occurring in 4%–10% of patients with RCC.<sup>1</sup> RCC with IVTT removal is technically challenging, with a high mortality of 5% -18% and a morbidity in excess of 15%, especially in higher level IVTT.<sup>2</sup>

In Sri Lanka there is minimal data about the RCC and IVTT. In this case series, we report the outcome of patients with RCC and IVTT who have undergone successful resection of the IVTT. This study is expected to fill the gaps in the local data.

## Methods:

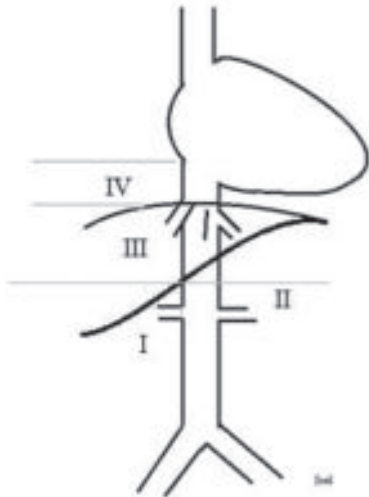
The aim of our study is to assess the clinical presentation, patient characteristics, histology subtypes, perioperative complications and the outcome of the patients with RCC and IVTT who underwent surgical excision.

This is a descriptive retrospective study. Data of consecutive patients undergoing radical nephrectomy and renal vein or IVC tumour thrombus removal were collected from February 2021 to February 2025. Data were maintained on a computerised database. Data on basic demographics, imaging findings, histopathological findings, surgical interventions and

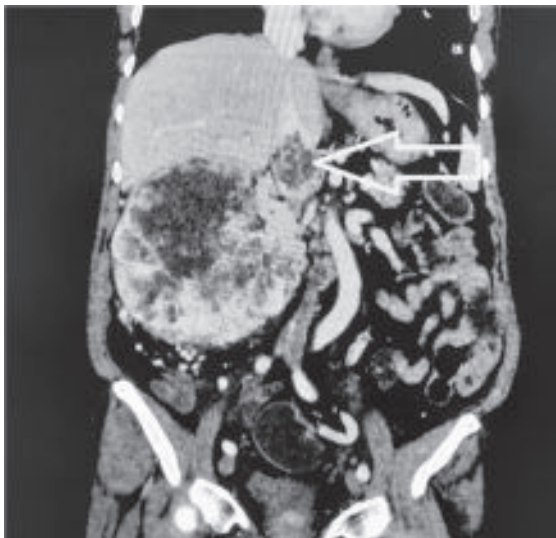
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outcomes were considered. Depending on the computed tomographic (CT) imaging findings, the level of the extension of the IVTT was categorised into level I (in renal vein only), level II (infrahepatic level in the IVC), level III (up to the superior border of the hepatic veins) and level IV (suprahepatic IVC and atrial) (Figure 1, figure 2).



**Figure 1** The level of the inferior vena cava (IVC) extension (Mayo Classification) of the tumour thrombus



**Figure 2** Computed tomographic image showing level 3 tumour (yellow arrow)

During the surgery, for the level I tumour thrombus, control of the renal vein with the adjacent IVC (sufficient to apply a side biting Satinsky clamp) was achieved. Control of the contralateral renal veins, and control of the infra renal IVC and infra hepatic IVC were carried out for the level II tumour thrombus. Whereas for the tumour thrombus in the retro hepatic IVC (level III), control of the infra renal IVC, bilateral renal veins, supra

hepatic IVC and the hepatic hilar vessels were achieved along with complete mobilisation of the liver (total hepatic vascular isolation). For the level IV tumour thrombus (IVTT extending above the hepatic venous level), sternotomy and / or cardiopulmonary bypass were done.

For the intra luminal IVTT that had not infiltrated the IVC wall, the IVTT was simply removed out from the lumen. For the IVTT that have infiltrated the venous wall, the IVTT was excised with a cuff of the venous wall.

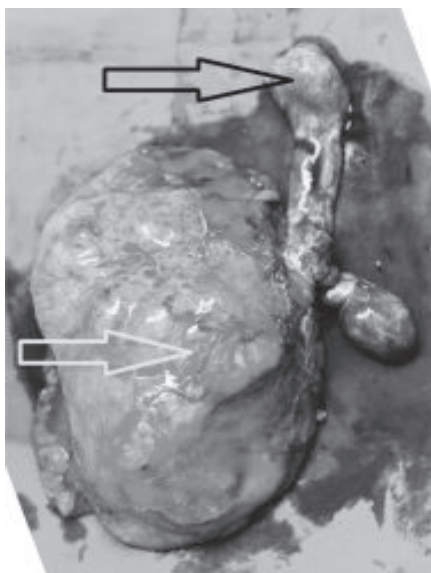
### Results:

A total of 24 patients with RCC with tumour thrombus extension into the vein were included. There were 16 (66.7%) males and 08 (33.3%) females. The mean age of the patients was 60.7 years (37-79). 64.3% patients with RCC presented with a palpable mass. While 17.9% presented with haematuria. Other presenting features were, varicocele (3.6%), lower limb oedema (3.6%), visible anterior abdominal wall collateral veins (3.6%), anaemia (3.6%) and pathological fractures (3.6%). Three (12.5%) had lung metastasis at the time of presentation. Three (12.5%) were level I tumour thrombus, six (25.0%) were level II tumour thrombus, 11 (45.8%) were level III tumour thrombus and four (16.7%) were level IV tumour thrombus (Figure 3). (The table 1 gives the summary of the level of the IVTT extension). 16 (66.7 %) RCC were from the right kidneys and eight (33.3 %) were from the left kidneys.

**Table I:** Table showing the summary of the level of the intravenous tumour extension

Level of the intravenous tumour extension	Number	Percentage (%)
1	3	12.5
2	6	25.0
3	11	45.8
4	4	16.7
Total	24	100.0

The laparotomy for the IVTT excision was done through the upper abdominal midline incision with a transverse extension beginning approximately one inch above the umbilicus. 22 (91.7%) patients underwent only laparotomy, while two patients (8.3%) with supra diaphragmatic extension of the IVTT, also underwent a sternotomy to facilitate IVTT removal and cardiopulmonary bypass. The table 2 gives the summary of all the cases in this series. All the IVTT were removed with a cuff of the healthy IVC wall to accomplish tumour thrombus clearance.



**Figure 3** Image showing level 4 tumour Thrombus (black arrow) and the renal cell carcinoma (blue arrow)

**Table II**

Table showing the summary the summary of the cases

Case number	Age	Sex	side	level	Surgical Access
1	53	Male	Left	3	Laparotomy
2	52	Male	Left	3	Laparotomy
3	71	Female	Right	2	Laparotomy
4	59	Female	Right	3	Laparotomy
5	72	Female	Left	3	Laparotomy
6	59	Male	Right	3	Laparotomy
7	51	Male	Right	2	Laparotomy
8	62	Male	Left	4	Laparotomy
9	70	Female	Left	4	Laparotomy
10	45	Female	Right	3	Laparotomy
11	79	Female	Right	3	Laparotomy
12	44	Male	Right	1	Laparotomy
13	37	Male	Right	3	Laparotomy
14	55	Male	Left	1	Laparotomy
15	62	Female	Right	2	Laparotomy
16	70	Female	Right	2	Laparotomy
17	62	Male	Left	4	Laparotomy and sternotomy
18	69	Male	Right	3	Laparotomy
19	75	Male	Right	3	Laparotomy
20	71	Male	Left	1	Laparotomy
21	73	Male	Right	4	Laparotomy and sternotomy
22	63	Male	Right	2	Laparotomy
23	48	Male	Right	2	Laparotomy
24	54	Male	Right	3	Laparotomy

After IVTT removal, the IVC was repaired with primary lateral repair (lateral venorrhaphy) in all cases (Figure 4). Patients were started on prophylactic low molecular weight heparin from the day of the surgery.



**Figure 4** Image showing primary lateral repair (lateral venorrhaphy) of the inferior vena cava

The commonest histological type was clear cell carcinoma (85.0%), whereas collecting duct type (5.0%), eosinophilic variant (5.0%) and papillary renal cell carcinoma (5.0%) were found in the rest of the cases.

The mean follow up of patients in this series is 11.2 months (0.2 - 50.7). on the Kaplan-Meier survival analysis, the one month and one year survival was 96.0% and 72.0% respectively. When the survival was compared with the level of intravenous extension of the IVTT, there was no difference ( $p > 0.05$ ) this is probably due to the small number of cases in various levels. During this period, six patients (25.0%) were lost to follow-up.

**Discussion and Conclusions**

About 4%-10% of patients with RCC have IVTT at presentation. Of these, in 2%-16%, the IVTT extends into the right atrium<sup>3</sup>.

According to the TNM classification, RCC extending into the major veins and the perinephric fat is classified as T3. Of these, the renal vein invasion is classified as T3a. While the IVTT extending into the IVC but below the diaphragm is T3b and the T3c is the IVTT extending above the diaphragm<sup>3</sup>.

The right renal vein is about an inch long, whereas the left renal vein is about three inches long. Therefore, right sided RCC invade the IVC more than the left sided tumours. In the above series, 66.7% of the RCC were from the right side.

The imaging modalities for the diagnosis and staging are the ultrasound scan (USS), CT scan and magnetic resonance imaging (MRI) scan. The USS is useful in the initial diagnosis of the RCC and in detection of IVTT. Ultrasound scan however, has a lower sensitivity for the assessment of the IVTT, especially if the IVTT is in the infrarenal segment of the IVC. Therefore, a CT or MRI scan should be done for a complete evaluation.

CT scan shows better details of the venous invasion, the local spread, regional lymph node involvement and metastasis. CT is also a good modality to differentiate the tumour thrombus from the bland thrombus. Tumour thrombus demonstrates intra thrombus vascular enhancement (due to neo-vascularisation). Whereas the bland thrombus does not demonstrate such enhancement. The sensitivity and the specificity of CT scans for detecting venous invasion are 85% and 98%, respectively. However, CT scan is not an effective method for detecting venous wall invasion. In addition, the true extent of the IVTT may become difficult to determine in the presence of flow artefacts.

MRI is a useful imaging technique for the assessment of the IVTT invasion. MRI has a specificity and sensitivity of almost 100%. MRI is also sensitive in the detection of venous wall infiltration by the tumour thrombus. It is also a better for the demonstration of the tissue planes<sup>4</sup>. The 2D and trans oesophageal echocardiogram are used to assess the intra-atrial extension of the IVTT.

Radical nephrectomy is a complex surgery with a perioperative mortality of 1.5% to 10%<sup>5</sup>. The surgical complexity further increases with the level of the IVTT extension. In the current series, the perioperative mortality was 4.0%.

The only option for improving the long-term survival in RCC with IVTT, is the en bloc radical nephrectomy with the IVTT clearance. A study reported that the 5 year survival of non operated patients with IVTT was 26.0%. This improved to 57.0% after radical excision<sup>6</sup>.

Following IVTT resection, The options for the IVC reconstruction depends on; the extent of the defect on the IVC wall, presence of collaterals and the pressure in the lower IVC stump.<sup>7</sup> For less than 50% defect on the IVC wall, a primary lateral repair (Lateral venorrhaphy) is done. After the removal of the IVTT with the IVC wall, if the defect on the venous wall is more than 50%, repair with a patch (venous or

synthetic) is done to avoid narrowing of the IVC. If a segment of the IVC is excised with the IVTT, reconstruction with a synthetic interposition graft is done. After excision, ligation of the ends of the IVC can be done if the IVC is already occluded, provided there is adequate collateral flow. However, the distal stump pressure is measured. If the stump pressure exceeds 30 mmHg, reconstruction of the IVC is recommended to prevent venous hypertension. In case of ligation of the IVC, the left renal vein can also be ligated without reconstruction. However, the gonadal and the adrenal veins must be preserved to improve the venous drainage. It is preferable to measure the stump pressure within the left renal vein. If it is more than 37 - 44 mmHg, reconstruction needs to be done. The right renal venous drainage should always be reconstructed in case of IVC ligation<sup>8</sup>.

A multicentre study showed that IVTT extension level (T3b, T3c), infiltration of fat, lymph node metastasis, tumour size and distant metastasis are poor prognostic factors (9). In addition venous wall infiltration by the IVTT and positive resection margins of the vein are also associated with poor prognosis (6), (9), (10).

About 28% of patients have lung metastasis at presentation. in the above series there lung metastasis was detected in 12.5%. The reported median survival of patients with lung metastasis is 13 months and 2-year survival is 26%<sup>11</sup>.

However, two randomised trials have shown that nephrectomy with combination (e.g. interferon) treatment, in patients with metastasis results in improved survival compared to the patients followed up without nephrectomy. In addition, the studies have shown that nephrectomy can be done without additional morbidity in patients with metastasis<sup>12</sup>.

Adjuvant therapies for RCC include both the targeted therapy (interferon alfa-2b, sunitinib, sorafenib, and Temsirolimus) and immunotherapy.

The mean follow up of patients in this series is 11.2 months (0.2 to 50.7). On the Kaplan-Meier survival analysis, the one month and one year survival was 96.0 % and 72.0% respectively.

other studies have reported almost similar one year survival rates i.e. 70%<sup>13</sup>. However a larger study with longer follow-up is required before drawing further conclusions.

However, 25% of the patients were lost to follow up in this series. This is because most of the patients do not

wish to follow up with the surgeon after starting the adjuvant treatment. Establishing a web-based database system and better communication among multidisciplinary team members (oncologist and surgeon) will help to address this problem in the future.

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