

## ORIGINAL RESEARCH

# CT scan versus colour flow doppler in finding venous tumour thrombosis among patients with renal cell carcinoma

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### ABSTRACT

**Introduction:** Renal cell carcinoma is observed to be the most common primary tumour affecting the renal cells that constitute 2.5 – 3% of all the neoplastic problems. In some patients affected with renal cell carcinoma, the major involvement of the renal veins and inferior vena cava by that tumour thrombus comprises in almost 21 – 35% of the cases and thereby reaching up to the major organs like heart. The purpose of this study was to compare the sensitivity of CT scan and colour flow Doppler ultrasound in detecting tumour thrombus in renal vein and inferior vena cava in cases of renal cell carcinoma so that it can be used as a complementary investigation. **Materials and Methodology:** All patients reported with renal cell carcinoma were included in the study after consent. Patients with previous history of DVT, advanced renal tumours, sensitivity to contrast media for CT scan and those unfit for surgery due to co-morbidities were relatively excluded from the study. The data was collected on structured proforma. Patients' demographic data, results of investigations and intra-operative findings were entered in proforma in each case. All the data collected were than analysed with the aid of SPSS v12. **Results:** A total of 45 patients with renal cell carcinoma were evaluated. There were 30 (66.6%) male and 15 (33.4%) females with male to female ratio of 2:1. The age range was 25–70 years with mean age of 56. The tumour involved right side in 27 (60%) cases and left side in 18 (40%) cases. It has been identified that almost 19 (43.3%) of 45 renal veins to be observed with tumour thrombus extension through surgical and pathological findings. 12 cases (44%) out of the 27 cases with right renal veins and 7 (41.6%) out of 18 left renal veins had seen with tumour thrombus extension. **Conclusion:** Colour Doppler sonography seems to be accurate in detecting the tumour thrombus extension into renal veins and inferior vena cava in patients with renal cell carcinoma.

**Keywords:** renal cell carcinoma, Doppler, CT scan, tumour thrombus

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### INTRODUCTION

Renal cell carcinoma is observed to be the most common primary tumour affecting the renal cells that constitute 2.5 – 3% of all the neoplastic problems. This renal cell carcinoma has a great propensity in spreading through the venous system. In some patients affected with renal cell carcinoma, the major involvement of the renal veins and inferior vena cava by that tumour thrombus comprises in almost 21 – 35% of the cases and thereby reaching up to the major organs like heart.<sup>1</sup> The frequency of the tumour thrombus that extends into the heart majorly the right side happens in much lower percentage (0.5 – 2%). The treatment modality in such cases remains ultimately the surgery in those patients affecting with venous extension. The surgery options for such

modality has improved survival and healing rates when compared with patients with not undergone surgery.<sup>2</sup>

Imaging plays a major vital role in determining the management of the radical surgery which is the only options in cases with localized and advanced tumours.<sup>3</sup> The extent of the tumour will do not have any authority over prognosis but it does affect the ideal surgical approach. CT scan, colour flow Doppler ultrasound, venacavography and MRI have been used in detecting tumour thrombus. CT scan is the primary imaging technique due to the very high overall accuracy of up to 90%, colour flow Doppler ultrasound can be used as a complementary technique for assessing venous spread of renal tumour.<sup>3,4</sup> Doppler ultrasound is at least as accurate as CT in

staging of RCC and may improve the CT findings.<sup>5</sup> The venous spread may look like on ultrasound as intra luminal echogenic nodules or thrombi. It can also be manifested as generalized caval dilatation with innumerable diffuse low amplitude echoes emanating from the lumen and partial or complete absence of flow.<sup>6</sup>

The purpose of this study was to compare the sensitivity of CT scan and colour flow Doppler ultrasound in detecting tumour thrombus in renal vein and inferior vena cava in cases of renal cell carcinoma so that it can be used as a complementary investigation.

**MATERIALS AND METHODOLOGY**

After obtaining approval from the institutional ethical committee, this study was adopted as a cross sectional study. In this study, almost around 45 adult patients who were reported to the Urology Department included as the study population. The stipulated time period for this study was from Jan 2019 to June 2020. All patients reported with renal cell carcinoma were included in the study after consent. Patients with previous history of DVT, advanced renal tumours, sensitivity to contrast media for CT scan and those unfit for surgery due to co-morbidities were relatively excluded from the study. All patients were subjected to colour flow Doppler ultrasound and CT scan with contrast to assess the renal vein and inferior vena cava involvement by tumour thrombus. The results were confirmed by intra operative findings and histopathology. The data was collected on structured proforma. Patients’ demographic data, results of investigations and intra-operative findings were entered in proforma in each case. All the data collected were than analysed with the aid of SPSS

v12. Frequencies were calculated for the side of tumour and involvement of renal vein and inferior vena cava by tumour thrombus. Depending upon the surgical pathologic findings, the sensitivity, specificity, accuracy, positive and negative predictive values of CT scan and Doppler ultrasound were calculated for tumour thrombus extension into renal veins and inferior vena cava.

**RESULTS**

A total of 45 patients with renal cell carcinoma were evaluated. There were 30 (66.6%) male and 15 (33.4%) females with male to female ratio of 2:1. The age range was 25–70 years with mean age of 56. The tumour involved right side in 27 (60%) cases and left side in 18 (40%) cases.

It has been identified that almost 19 (43.3%) of 45 renal veins to be observed with tumour thrombus extension through surgical and pathological findings. 12 cases (44%) out of the 27 cases with right renal veins and 7 (41.6%) out of 18 left renal veins had seen with tumour thrombus extension.

All the true and false positive as well as negative results for tumour thrombus extension into renal veins and inferior vena cava were seemed to be showcased by using doppler ultrasound and CT scan. In 19 cases of the right renal involvement, colour Doppler revealed almost in all the cases except one with false negative finding. 7 cases of left renal vein, CT scan revealed 13 cases of false negative and 5 cases of false positive out of 18 cases. The sensitivity, specificity, accuracy, PPV and NPV of CT scan and Doppler for tumour extension into renal veins and inferior vena cava were studied which showed that the sensitivity of Doppler was 100% whereas CT scan showed 76% in inferior vena caval extension.

**Table 1: Percentage distribution with respect to gender and site of involvement**

Parameters	Percentage
<b>Gender</b>	
• Male	66.66%
• Female	33.4%
<b>SITE</b>	
• Right	60%
• Left	40%

**Table 2: Sensitivity, specificity, accuracy, positive and negative predictive values of CT scan and colour Doppler sonography for tumour thrombus extension into renal vein and inferior vena cava**

Variables	Right renal vein (%)		Left renal vein (%)		IVC (%)	
	CT scan	Doppler	CT scan	Doppler	CT scan	Doppler
<b>Sensitivity</b>	64	87	61	100	76	100
<b>Specificity</b>	91	100	72	86	100	100
<b>PPV</b>	83	100	62	85	100	100
<b>NPV</b>	76	92	73	100	97	100
<b>Accuracy</b>	79	95	68	93	97	100

**DISCUSSION**

The renal cell carcinoma mostly denoted the fifth most common cancer in men with a increasing rate of incidence.<sup>1</sup> It has the most marked propensity in order

to spread into renal vein, inferior vena cava and finally to the right side of heart.<sup>2</sup> There are two school of thoughts reported in the literature based on the effects of venous involvement on prognosis with

certain studies showing poor prognosis, while other studies reportedly showing no effect.<sup>7</sup> The pre-operative imaging is observed to be an essential tool for planning the surgical management as the venous tumour extension will eventually change the surgical approach.<sup>4</sup> The tumours seen with venous thrombus in right renal vein or lateral segment of left renal vein do not necessarily require any approach modification. If tumour thrombus seen to be involving the medial segment of left renal vein or inferior vena cava below the hepatic venous confluence, a chevron or rooftop incision is mandatorily required. A combined thoraco-abdominal approach is required for effective venous tumour thrombus extension above the hepatic venous confluence, while involvement of right side of heart necessitates the cardiopulmonary bypass. Hence a reliable and readily available technique is mandatory for venous tumour thrombus diagnosis.<sup>5</sup>

We observed that the tumour had major predilection for right side with 27 cases (60%) and was predominant observed in males (66%). The tumour thrombus involving the renal vein has seemed to be more on the right side (44%). These findings were observed to be in similar with the study conducted by *Habboub et al.*<sup>3</sup> *London NJM et al*<sup>8</sup> reported that 79% overall accuracy of CT scan in detecting renal vein thrombus. But in our study, the overall accuracy of CT scan was low (73%) for renal vein thrombus. In this study, it has been observed that Doppler had higher overall accuracy (93%) than CT scan (73%) in renal vein assessment. In our study, all cases of inferior vena caval involvement were detected by Doppler ultrasound but CT scan missed one case eventually. In this case of right sided tumour, the cephalic extent of tumour thrombus was observed to be 2 cm in the infra-hepatic vena cava. The tumour was actually compressing the inferior vena cava which was clearly represented and noted by the Doppler ultrasound. Therefore the sensitivity of colour doppler sonography in recognising tumour thrombus in compressed veins is reportedly higher than CT scan. *McGahan et al*<sup>9</sup> found that 89% sensitivity of colour doppler sonography in inferior venal caval involvement and 100% for renal vein involvement in 19 patients. Our results match more or less with those of *McGahan et al*<sup>9</sup> therefore this series includes higher number of patients (45) and shows higher accuracy for inferior vena caval involvement than renal vein.

*HUbsch P et al*<sup>6</sup> in their study represented that colour doppler ultrasound can be readily used to differentiate bland from tumour thrombus. Doppler sonography also has the capability to differentiate inferior vena caval encasement from thrombus. Our data and that of *McGahan et al*<sup>9</sup> indicate that accuracy of colour Doppler ultrasound is superior to the CT scan and is comparable to MRI. It has advantages over CT is that it is less expensive, readily available and has multi-planar capabilities. Venous thrombus extension

generally does not affect prognosis, however venous wall invasion by thrombus has poor prognosis.<sup>10</sup>

## CONCLUSION

Colour Doppler sonography seems to be accurate in detecting the tumour thrombus extension into renal veins and inferior vena cava in patients with renal cell carcinoma. But CT scan is considered as the primary imaging modality in order to stage the renal cell carcinoma and colour doppler sonography can be used as complementary tool in order to asses venous extension in equivocal cases.

## REFERENCES

1. Davits RJAM, Blom JHM, Schrhder FH. Surgical management of renal carcinoma with extensive involvement of the vena cava and right atrium. *Br J Urol* 1992;70:591-593.
2. Waters WB, Richie JP. Aggressive surgical approach to renal cell carcinoma: review of 130 cases. *J Urn!* 1979; 122:306-309.
3. HK Habboub, MM Abu-Yousef, RD Williams, WA See, GD Schweiger. Accuracy of color Doppler sonography in assessing venous thrombus extension in renal cell carcinoma. *Am J Roentgenol* 1996;168:267-71.
4. Welch TJ, LeRoy AJ. Helical and electron beam CT scanning in the evaluation of renal vein involvement in patients with renal cell carcinoma. *J Comput Assist Tomogr* 1997;21:467-71. 10.
5. Scoutt LM, Zawin ML, Taylor KJW. Doppler US: Clinical applications. *Radiology* 1990;174:309-19.
6. HUbsch P, Schurawitzki H, Susani M, Theyer G, Trainol O, Polzleitner D, et al. Color Doppler imaging of inferior vena cava: identification of tumor thrombus. *J Ultrasound Med* 1992;11:639-45. 12.
7. Hatcher PA, Anderson EE, Paulson DF, Carson CC, Robertson JE. Surgical management and prognosis of renal cell carcinoma invading the vena cava. *J Urol* 1991;145:20-4.
8. London NJM, Messios N, Kinder RB, Smart JG, Osborn DE, Watkin EM, et al. A prospective study of the value of conventional CT, dynamic CT, ultrasonography and arteriography for staging renal carcinoma. *Br J Urol* 1989;64:209-17.
9. McGahan JP, Blake LC, White RV, Gerscovich EO. Brant WE. Color flow sonographic mapping of intravascular extension of malignant renal tumors. *J Ultrasound Med* 1993;12:403-9.
10. Viridi JS, Kelly DG. Prognostic value of renal venous involvement in renal carcinoma. *Br J Urol* 1992;69:481-5.