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DUAL CT ANGIOGRAPHY IN IDENTIFICATION OF VASCULAR ANAMOLIES IN LIVE KIDNEY DONORS

***Alok Mazumdar., Manikantha Suresh A and Murali Krishna K**

Department of General surgery, Sevenhills Hospital, Visakhapatnam, Andhra Pradesh

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ABSTRACT

Live kidney donor evaluation mandates anatomical and functional assessment of the donor kidney. Dual CT angiography provides description of vascular, parenchymal, and collecting system. We compared the accuracy of Dual CT angiography with intra-operative findings in 62 donors at our hospital. In 62 patients, single renal artery and vein was present in 83.8%. Double arteries on unilateral kidney were more on the left side (8.06%) *vs* the right side (0%). Double renal arteries on both kidneys were seen in 8.06% on the left side and the right side. Double renal veins were seen in 8.06% in CT and 11.2% intra-operatively. Single renal vein seen in 88.7% in CT and 83.8% intra-operatively. Late confluence of veins seen in 3.2% through CT and 4.8% intra-operatively. Therefore CT renal angiography can be adopted as the standard preoperative imaging modality for identification of vascular anomalies in live kidney donors.

INTRODUCTION

Renal transplantation is the treatment of choice for any end-stage renal disease (ESRD). Due to longer survival rate of grafts, living donors are preferred to cadaveric donors in renal transplantation.

In living donor renal transplantation, precise evaluation of the renal vessels, the parenchyma, and the urinary tract is necessary to determine whether potential donor kidneys are suitable for transplantation or not. The presence of accessory arteries, early branching arteries, anomalous venous anatomy and ureteric abnormalities influence the choice of side of kidney to be transplanted. This information is required before donor nephrectomy and helpful during surgery (Snyder J, Foley R, Collins A, *et al* 2009).

In the past, Urography or Ultrasonography were used to evaluate for renal and ureteral anatomy. Intra-arterial Digital Subtraction Angiography (DSA) was done to identify the number, postion, and patency of the renal arteries. It was also used to determine the presence of proximal branches of the main renal artery. This technique requires arterial catheterization, injection of iodine containing contrast material and ionizing radiation. The technique is relatively expensive and time consuming too. It requires patient hospitalization for at least 6hours. Nowadays these imaging techniques have been replaced largely by computed tomography angiography (CTA) or magnetic resonance angiography (MRA). Replacing both Arteriography and Urography or US with single CT or MR angiography examination provides not only better but also less costly and less invasive evaluation of donor kidney (Halpern EJ, Mitchell DG, *et al* 2003).

Several studies have demonstrated usefullnes of CT angiography for preoperative evaluation of renal donors (*Platt JF, Ellis JH et al1996, Kaynan AM, Rozenblit AM, Figueroa KI, et al 1999)*. Reports with regard to non-Gadolonium-enhanced MR angiography suggested that accessory arteries are inadequately duplicated with time-of-flight and phase-contrast techniques (*Gourlay WA, Yucel EK, Hakaim AG, et al 1995, Meyers SP, Talagala SL, Totterman S, et al 1995)*.

Investigators in one study compared helical CT with contrast MR angiography and concluded that CT is more accurate (*Tsuda K, Murakami T, Kim T, et al 1998)*.

More recent clinical data suggested that Gadolinium-enhanced MR angiography is superior to the non enhanced MR techniques (Low RN, Martinez AG, Steinberg SM, *et al* 1998).

The present study is aimed at the accuracy and usefulness of Dual CT angiography in evaluation of living donors as compared with the inta operative findings.

**Corresponding author: Alok Mazumdar*
Department of General surgery, Sevenhills Hospital, Visakhapatnam, Andhra Pradesh

MATERIAL AND METHODS

This is prospective study and the subjects include those undergoing donor nephrectomy at our institute Seven Hills Hospital, Visakhapatnam from March 2010 to March 2012. The study population includes a total of 62 potential kidney donors. All these were healthy living donors.

After approval from the Ethical committee a written informed consent was obtained from above group of patients and were evaluated clinically and by Labaratory investigations, ultrasound, IVP and Dual CT angiography

After obtaining the CTA data the radiologist give a standard report on number of renal arteries and veins on each side. The relationship between the sites of origin of any accessory renal arteries and the origin of main renal artery. The presence of early or extra hilar branching is noted. In case of multiple renal arteries the dominant artery and the caliber of accessory and branch arteries were noted. The anatomy of polar and capsular arteries is documented if present. Normal venous structures such as lumbar, adrenal and gonadal vein were noted. Any renal and extra renal abnormalities also noted.

The reports for 2D reformed images and 3D reconstructed images are limited. They are created only for surgical assistance in case of multiple arteries and are available for review.

Surgical Correlation

All 62 patients underwent donor nephrectomy using an open extraperitoneal approach. The surgeons were aware of the image findings prior to performing surgery.

The donor kidneys were selected on the basis of the CT findings. If the vascular anatomy is simple and urinary tract was normal the left kidney was preferred for donation because of geater length of renal vein.

Operative findings were recorded in the operating room. The number of arteries, early branching of arteries and veins in donated kidney were recorded. Any abnormalities in urinary tract if present were also noted.

The above operative findings were later correlated with CTA findings. If there was any discrepancy we reevaluated the CTA findings retrospectively to look for any additional information which could have been overlooked.

OBSERVATION AND RESULTS

CT Angiography

In patients who had undergone nephrectomy 42 were female patients and 20 were male patients. Age of patients ranges from 20 to 70 years.

The CT angiographic findings of 62 patients were recorded. Out of the 62 patients, according to CT angiography findings there were single arteries in 52 patients on both left and right side. Hence in these patients the decision was made to go for left nephrectomy.

Out of the 10 remaining patients, in 5 patients CT angiography findings showed two arteries on both left and right side. In this group of patients decision was made to go for left nephrectomy because on left side there will be a longer renal vein that facilitates for speedy anastamosis.

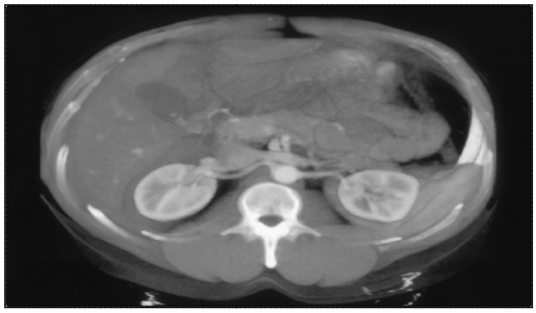

Fig-1 Normal CT angiography film showing B/L single renal artery

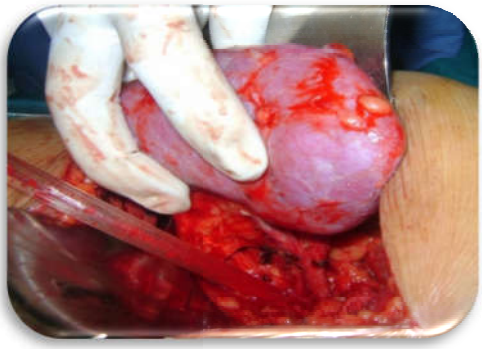

Fig 2 Intra-operative image showing single renal artery

Out of the 5 remaining patients it was found that there are two arteries on left side and single artery on right side. Hence decision was made to perform right donor nephrectomy as single arterial anastamosis will reduce the cold ischemic time.

Intraoperative Findings

Out of the 52 patients who were taken for left donor nephrectomy based on CT angiography findings, it was found intraoperatively that only 46 patients were having single artery and the findings correlated with CT findings.

Number of arteries	Ct findings No of patients	Operative findings	Correlation %	Missed %
SINGLE	52	46	88.46	11.5
DOUBLE	0	5	NO	9.61
TRIPLE	0	1	NO	1.92

In the above mentioned group of patients the CT angiography findings and Intra-operative findings are same. The sensitivity and specificity in found to be 100%.

Fig- 3 Intra-operative image showing two renal arteries

Fig- 4 Intra-operative image showing three renal arteries

In the remaining 6 patients, five patients were found to have double renal arteries and one was found to have triple renal arteries. These findings were not mentioned in the CT angiography and were missed.

In our study the correlation is 88.46% that is out of the 52 patients 46 had correlation while in the remaining 6 it was not correlating.

In 5 patients there were double arteries on both sides. Intra-operatively (all had left donor nephrectomy) we found double arteries. 3 of them were having accessory arteries supplying nearer to hilum. One patient had a polar artery supplying the upper pole and the other supplying to the lower pole. The artery supplying to the upper pole was small in size. However, it was dissected and given to the recipient team.

The remaining five patients underwent right donor nephrectomy (Based on CT findings, right single artery and left double artery). According to the CT angiography findings these five patients were having single artery. Intra-operatively we found that only 4 of them were having single artery and was in concordance with the CT angiography findings. In one patient we found two arteries, one main artery was entering into the hilum where as the other artery was a polar artery supplying a significant portion of the kidney. Hence the accessory artery was dissected separately and taken for anastamosis by the recipient team.

In the above group of patients there is 80% correlation between the CT angiography and intraoperative findings.

In seven out of 62 patients there were no correlation between the CT findings and intra operative findings. The overall correlation in our study was 91.93%.

On overall analysis of the above findings the sensitivity and specificity of CT angiography findings in identifying the vascular anamolies is calculated and is found to have 86% and 93% respectively.

On reconstruction of the images and after doing again 3D processing retrospectively we could identify the missed arteries in 5 members. In the remaining two members the polar, accessory arteries were not identified even on reconstruction of images.

Renal veins

In the CT angiography of these 62 patients it is reported that 55 members had single vein, 5 members are having two veins and two members had veins with late confluence.

Intra-operatively out of the 62 patients who underwent donor nephrectomy (57 Left + 5 Right) it is found that 52 members have single vein, seven members had two veins and three members had veins with late confluence.

The sensitivity and specificity of CT angiography in depicting the branching veins is 72% (5 of 7) and 100% (52 of 52).

DISCUSSION

Advances in imaging technology allow quicker and safer evaluation of potential donors. The first applications of CT angiography were reported in 1991 (Buzzas GR, Shield CF *et al,* 1997). In 1993, Rubin *et al*, reported that helical CT angiography with dynamic intravenous bolus administration of contrast material made it possible to visualize abdominal vasculature, specifically the aorta, renal arteries, and splanchnic circulation. Excellent anatomic detail of the aorta and its main branches could be visualized with this technique. The authors also reported CT angiographic depiction of pathologic conditions such as renal artery stenosis, abdominal aortic aneurysm and dissection, and celiac bypass graft occlusion. This opinion has been supported by others (*Low RN, Martinez AG, et al 1998,* Bakker J, *et al,* 1999).

The performance of CT angiography in our study seems to be similar to that in previous studies. According to our data, CT angiographic findings agreed with surgical findings regarding the number of arteries in 86% of donated kidneys, in comparison with previously reported values of 90%–95% (Kawamoto S, Montgomery *RA, et al*, 2003, *Desmond Yat Hin Yap et al, 2010,* Patil UD, Ragavan A, *et al* 2001).

In our study including a total of 62 patients we missed the accessory arteries in 7 patients. Six of them are those who are taken for left nephrectomy. One is in a patient taken for right nephrectomy.

Out of the 6 patients who were taken for left donor nephrectony based on the CT angiography findings, we found that in four patients apart from the main renal artery also had one accessory artery and was found supplying near to the hilum. All the four accessory arteries which were identified was dissected and appropriate length was given to the Transplant Surgeon to facilitate proper anastamosis.

In one patient we found an accessory artery supplying to the lower pole of the kidney. As the artery supplying to the lower pole also give branches to the ureter, it cannot be sacrificed. The artery was dissected and appropriate length was given for anastamosis.

In one patient we found two accessory arteries besides the main renal artery. One supplying the upper pole and the other entering near to hilum. Both the accessory arteries are separately dissected and enough length was given for anastamosis. In this patient the accessory artery at the hilum was anastamosed with the main renal artery and a common stump was achieved (Bench surgery done). This later was

anastamosed with the external iliac artery. The upper polar artery was separately anastamosed to the Internal iliac artery.

In the patient who was taken for Right donor nephrectomy, we found two arteries one supplying near the hilum and the other supplying to the upper pole. Both the arteries were separately anastamosed to the External and Internal iliac arteries respectively.

Regarding the missed findings a retrospective study was done. The intraoperative findings was discussed with the Radiologist. With the help of image reconstruction and 3D processing and reviewing the images repeatedly the radiologists could make out 6 arteries out of the 8 arteries missed.

This emphasizes the point that the reporting of CT angiogram is very important. It might change the decision to choose right or left kidney.

Both sensitivity and specificity for detecting accessory arteries in our study are 86% and 93% respectively as compared with a study in a large population with 77% and 89%, respectively (Kawamoto S, Montgomery RA *et al,* 2003). In retrospectively reconstructed images we could identify 95% of the arteries, only two are missed out of 62. This brings into conclusion that sensitivity is similar to that of other studies after retrospective reconstruction of images.

The results of our study indicate that CT angiography is very accurate in demonstrating the main renal arteries and veins in the preoperative evaluation of renal donors.

It is evident from our study that the reporting of the CT angiography is important in planning for donor nephrectomy. A proper evaluation and image reconstruction should be done in order to avoid missing of accessory renal arteries.

Variations in the anatomy of the minor vasculature can complicate the harvesting procedure. By knowing the location of an anomalous minor vessel as revealed by CT angiography allows more cautious surgical dissection in proximity to the vessel. This is particularly true for small polar arteries, more so when the polar artery is supplying the lower pole as it may be supplying to the ureter also. Prior to CT angiography, small vessels were typically clamped and dissected. We now make a genuine effort to preserve the small polar arteries if they supply a significant portion of renal parenchyma. We are also more careful if there is a accessory artery on one side and we are operating on the other side. It is evident that despite the best reporting there can still be a missed artery in less than 5% of cases.

With CT angiography, the radiologist is able to provide the surgeon with valuable information for preoperative planning of organ harvesting. This helps to reduce the risks and complications associated with the surgery. This also improves the chances for a successful outcome.

A potential limitation of this study is that the surgeons preferentially removed the kidney that had less complicated vascular anatomy. Therefore, the kidneys with more complex vessels had no pathologic proof, and the sensitivity and specificity values were given only for the less complicated kidneys.

Recently, a 16-channel system has been developed, which can surprisingly increase the scanning speed without requiring additional output from the x-ray tube. With this system, abdomen and pelvis could be scanned in 7 or 8 seconds, with a 2.5-mm nominal section thickness and a table speed of 120 mm/sec (detector array of 1.5 _ 16 mm, pitch of 2.0, gantry rotation time of 0.4 second). With the help of this even arteries with smaller diameter can be detected and the scan time is also reduced. This may further help the operating surgeon and improves the outcome.

CONCLUSION

Preoperative CT renal angiography is helpful in depiction of the main renal arteries and veins and is associated with minimal risk of contrast nephropathy. With CT angiography, the radiologist is able to provide the surgeon with valuable information for preoperative planning of organ harvesting. This helps to reduce the risks and complications associated with the surgery.

Therefore CT renal angiography can be adopted as the standard preoperative imaging modality for identification of vascular anamolies in live kidney donors. However accurate radiologic interpretation depends on the radiologist's experience level, attention to detail and commitment to careful evaluation of the axial source image at the independent console.

References

Bakker J, Lightenberg G, Beek FJA, van Reedt Dortland RWH, Hene RJ. Preoperative evaluation of living renal donors with Gadolinium-enhanced magnetic resonance angiography. Transplantation 1999; 67: 1167 -1172.

Buzzas GR, Shield CF, Pay NT, Neuman MJ, Smith JL. Use of gadolinium-enhanced, ultrafast, three-dimensional, spoiled gradient-echo magnetic resonance angiography in the preoperative evaluation of living renal allograft donors. Transplantation 1997; 27: 1734 -1737.

Desmond Yat Hin Yap, Ferdinand Siu Kay Chu, Sai Man Chu, Po Chor Tam, Sidney Tam, Sydney Chi Wai Tang, CT angiography versus conventional digital angiography in preoperative assessment for Chinese living kidney donors. JNEPHROL 2010; 23 (06): 711-716.

Gourlay WA, Yucel EK, Hakaim AG, *et al*. Magnetic resonance angiography in the evaluation of living-related renal donors. Transplantation1995; 60:1363-1366.

Halpern EJ, Mitchell DG, Wechsler RJ, Outwater EK, Moritz MJ, Wilson GA.Preoperative evaluation of living renal donors: comparison of CT angiography and MR angiography. Radiology 2000; 216: 434 -439.

Kawamoto S, Montgomery RA, Lawler LP, Horton KM, Fishman EK.Multidetector CT angiography for preoperative evaluation of living laparoscopic renal donors. AJR Roentgenol 2003; 180:1633-1638.

Kaynan AM, Rozenblit AM, Figueroa KI, *et al*. Use of spiral computerized tomography in lieu of angiography for

preoperative assessment of living renal donors. J Urol 1999; 161:1769-1775.

Low RN, Martinez AG, Steinberg SM, *et al*. Potential renal transplant donors: evaluation with gadolinium-enhanced MR angiography and MR urography. Radiology 1998; 207: 165 -172.

Meyers SP, Talagala SL, Totterman S, *et al*. Evaluation of the renal arteries in kidney donors: value of three-dimensional phase-contrast MR angiography with maximum-intensity-projection or surface rendering. AJR Am J Roentgenol 1995; 164:117-121.

Patil UD, Ragavan A, Nadaraj, *et al*. Helical CT angiography in evaluation of live kidney donors. NephrolDial Transplant 2001; 16:1900-1904.

Platt JF, Ellis JH, Korobkin M, Reige KA, Konnak JW, Leichtman AB. Potential renal donors: comparison of conventional imaging with helical CT.Radiology 1996*;* 198*:*419-423.

Snyder J, Foley R, Collins A, *et al*. Prevalence of CKD in the United States: a sensitivity analysis using the National Health and Nutrition Examination Survey (NHANES) 1999-2004. Am J Kidney Dis 2009; 53: 218-228.

Tsuda K, Murakami T, Kim T, *et al*. Helical CT angiography of living renal donors: comparison with 3D Fourier transformation phase contrast MRA. J Comput Assist Tomogr 1998; 22:186-193.

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