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LIVE RENAL DONORS;
COMPARISON OF CT ANGIOGRAPHY AND PER OPERATIVE FINDINGS

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ABSTRACT: Objectives: To compare the findings of helical computed tomographic angiography and intra-operative findings in live related donors. To evaluate the accuracy of helical computed tomography with advanced 3D techniques in depicting the renal vasculature, parenchymal and anatomy of collecting system. **Setting:** Sheikh Zayed Post Graduate Medical Institute and National Institute of kidney diseases Lahore**. Material and Method:** Between June 2006 to May 2009 eighty potential donors underwent CT angiogram as a part of their preoperative workup. We retrospectively studied the CT angiogram and compared the finding with the surgical findings. The results were reviewed with radiologists to determine the discrepancy in discordant cases. **Results:** The accuracy of CT angiography was 93.40% to predict number of vessels. Five arteries and one vein was missed, this disconcordant comprised 7.59% during initial CT interpretation. The overall concordance between CT angiography and operative findings in delineating the arterial anatomy was found in 74(93.67%) and venous in 78 (98.73%) donors. All CT scans demonstrated normal collecting system except one, which showed a dilated right pelvicalical system and ureter. Simple renal cysts about the size of 2-4 cm were found in the four left kidneys. CT scan supplied additional important anatomical information including kidney size and the presence of nephrolithiasis. **Conclusion:** Helical CT angiography is very specific for arterial and venous anatomy as well as other anatomical and functional details. It provides all the information required by a surgeon. It can become the single imaging modality for preoperative assessment of potential donors in place of conventional angiography and intravenous urography. CT angiography is minimally invasive and cost effective.

Key words: Donor evaluation; Renal angiography; Surgical findings.

INTRODUCTION

Renal transplantation leads to better survival and quality of life for patients with renal failure. It has become the treatment of choice for the end stage renal disease[1]. Kidney donation by living related donors is becoming an increasingly common surgical procedure in an attempt to overcome the shortage of kidney donors. Live related transplantation has shown better graft survival than cadaveric donor renal transplantation. However adequate preoperative living kidney donor elevation including detailed medical history, laboratory testing and

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radiological imaging which is mandatory so as to minimize the surgical complications that can threaten the graft and sometime survival of recipients[2].The radiological imaging studies chosen must provide information regarding vascular, parenchymal and ureteral anatomy, in addition it must give status of renal function. The preoperative information provided by the imaging studies also helps in deciding the side of donor nephrectomy[3,4].

The traditional imaging included ultrasound abdomen and pelvis, renal scan, excretory urography and conventional renal arteriography. Arteriography requires one day hospital admission for post procedure observation of 12 hours. This causes inconvenience to the potential donors and increases the cost of renal transplant programme[5,6].

The usefulness of single section helical computed tomography for preoperative evaluation of living kidney donors has been well established[7,8]. Several investigators have described the use of multi-detector row CT (MDCT) for the preoperative evaluation of donors kidney[9,10].

It provides essential anatomical information and can be an alternative to standard urography and arteriography. Helical CT is an out patient procedure which reduces the cost of imaging and eliminates the morbidity associated with conventional angiography.

The purpose of this study was to evaluate the accuracy of helical CT angiography in depicting bilateral renal vascular, parenchymal and ureteral anatomy as well as excretory patterns through a single imaging modality and to compare the results of the CT with the anatomy at operation.

PATIENTS AND METHOD

Eighty two donor candidates under went helical CT angiogram evaluation at Sheikh Zayed Post Graduate Medical Institute and National Institute of kidney diseases Lahore, June 2006 to May 2009. Among these, seventy nine kidneys were donated.

The donors, 13 women and 66 men in the age range of 20-60 years (mean age 34.38) were screened clinically and with laboratory investigations to rule out any medical contraindication for kidney donation. Ultrasonography of entire abdomen and pelvis was performed in all subjects.

Helical CT angiogram was evaluated for the number and location of arteries, early branching (within 1.5 cm of origin) and arterial stenosis, venous anomalies, non vascular abnormalities including parenchymal and collecting system abnormality, calculus and non renal abnormalities. Two or more than two renal arteries that arose from aorta with multiple ostia, regardless of size, were defined as multiple renal arteries. Two or more than two renal veins that drain into the vena cava with multiple ostia, again regardless of size, were defined as multiple renal veins. All the images were interpreted by a single radiologist at our institution and reviewed by the operating surgeon before harvesting the allograft. The findings on helical CT angiogram were used to select the side of the donor kidneys and CT angiogram findings were correlated with operative findings.

RESULTS

Open donor nephrectomy was performed in all 79 donors. Left kidney was selected in 76 patients and right kidney in 3 candidates, in one due to unexplained left sided hydroueretronephrosis and in two others due to more than two renal arteries. Among all the harvested kidneys, a single renal artery was found in right kidney and fifty left kidneys (64.55 % total 51 out of seventy nine kidneys).Multiple renal arteries were found in twenty eight (35.44%) patients. Twenty six left and two right kidneys had multiple renal arteries, (a total 28 kidneys out of 79).Early branching of renal artery and late confluence of renal vein was observed in four and three donors respectively.

A single vein was present in seventy six left kidneys and in two right kidneys (98.73% a total of seventy eight out of seventy nine kidneys), one kidney on right side had two renal veins (1.26% one out of seventy nine kidneys).Retroaortal renal vein was found in one left kidney Non vascular renal abnormalities were also

identified in five (6.32%) donors. Simple renal cysts were noted in four donors and hydrouretronephrosis in one kidney.

The overall concordance between CT angiogram and preoperative finding in delineating the renal arterial anatomy was found in 74 (93.67%) donors. In five patients in whom CT angiogram revealed single renal artery were found to have double renal artery at operation. Four lower polar arteries, one upper polar artery were missed on CT angiogram. Four arteries could not be identified and one was taken as early branching of main renal artery.

The accuracy of prediction of renal vein was 98.73 %(seventy eight donors out of seventy nine donors).Five arteries and one vein was missed during initial CT interpretation. On second look of CT scan without the knowledge of surgical findings, two missed arteries and one vein was detected. The sizes of detected arteries were 2.6mm and 2.5mm respectively while the caliber of renal vein was 2.7mm. The accuracy of second look interpretation session were 40% (two arteries out of five) for renal arteries and 100% for renal vein (one out of one vein was detected).

Final reading session was carried out with the knowledge of surgical findings, which revealed one upper polar artery with caliber of 2.1mm was also missed in both the initial and second look sessions. The accuracy of final look interpretation session was 33.33%, one out of three arteries was detected in this session. However two missed arteries were not detected with careful and repeated session of re- evaluation of CT images, even with the knowledge of surgical findings. Figure no 1 and 2 showing CT Angiogram with multiple renal arteries.

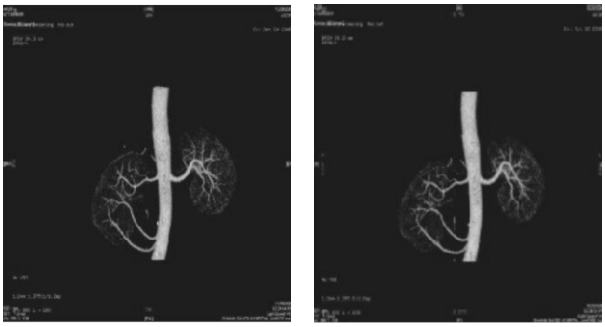

Fig-1. CT Angiogram showing three renal arteries on the right side

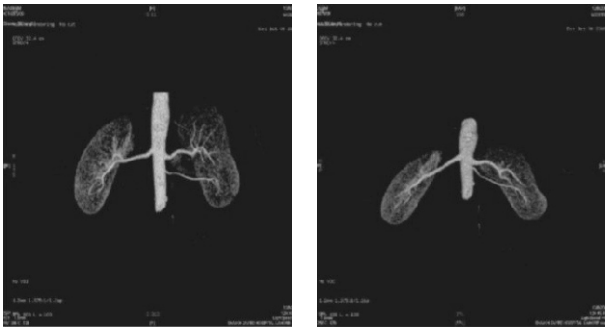

Fig-2. CT Angiogram showing two renal arteries on the left side

DISCUSSION

Accurate assessment of renal vascular anatomy is essential to ensure safe surgery of the donors and to optimize the results of living transplantation. Although arteriography is the accepted gold standard for the assessment of renal arterial anatomy, but it has several disadvantages. It is invasive, has a risk of bleeding, arterial injury, thromboembolization and requires post procedure observation.

In addition it does not provide the parenchymal and venous anatomy and does not provide 3-Dimentional images.

With the advent of helical CT scanning and 3-Dimensional reconstruction, imaging of arterial and venous anatomy in three dimensions can be obtained. In addition, helical CT angiogram provides renal parenchymal anatomy and can therefore identify renal cysts and tumors. The amount of contrast used in both the procedures are also similar. No complications from 3-Dimensional CT scanning were observed, and no rise in serum creatinine was observed seven days after helical imaging.

This study was carried out to evaluate the accuracy of renal CT angiography preformed by the use of MD CT for

the prediction of renal vascular anatomy.

In our study, CT angiographic anatomies with respect to renal arterial and venous anatomy precisely matched the surgical findings in seventy three out of seventy nine donors with the accuracy of 92.40%. The accuracy of renal arterial anatomy was 93.67% and the accuracy of predicting renal vein was 98.73%. The result of our study corresponds with other studies that have reported that MD CT showed high sensitivity in the assessment of renal vasculature[11,12,13,14].

Saravanan et al reported CT scan findings corresponded with surgical findings, the accuracy of renal arteries and venous anomalies was 94% and 98% respectively[15].

Johnson J.E[16] et al also reported 96% results that are similar to our study.

Out of five renal arteries which were not detected on initial evaluation, two of these arteries were not identified on retrospective reviews even with the knowledge of surgical findings and were thus attributed to technical limitations. Villablaca et al[17] have reported that MD CT cannot be a reliable tool for the measurement of vessels below 7mm in diameter, and the range of size for accessory renal artery described by Satyaprl et al[18] was 0.2-3.0cm. The majority of accessory renal arteries must be demonstrated by MD CT. Clavis et al[19] emphasized that contrast enhancement is also critical for detecting small arteries. Therefore an acceptable quality of CT scan and optimal scan timing for adequate contrast enhancement could reduce the technical limitations of MD CT[20].

Three renal arteries and one renal vein was retrospectively detected in repeat evaluation, these cases were attributed to an interpretational limitations. The sizes of missed arteries and veins ranged between 2.5-2.7mm and sizes of most of the missed arteries and vein were not difficult to detect in the repeated interpretational session. MD CT has been shown to be reliable even when the images are interpreted by different readers with varied level of expertise, as a study reported by Saheni et al[12]. Therefore, when the images are obtained in adequate scan protocol, and with adequate contrast enhancement, human errors can be reduced by careful image interpretation[21].

CONCLUSION

Helical CT angiography is a minimally invasive, cost effective and very specific for arterial and venous anatomy as well as other anatomical and functional details. It provides all the information required by a surgeon and can become the single imaging modality for preoperative evaluation of potential kidney donors in place of conventional angiography and intravenous urography.

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