A 64-slice CT angiographic study of morphologic and morphometric analysis of healthy kidney donors

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ABSTRACT

The kidneys are bilaterally paired organs and serve several essential functions required to maintain a normal human physiological function. The renal size was conventionally determined on x-ray or urography by measuring the renal length distance of first lumbar vertebrae to third or fourth lumbar vertebrae. Ectopic position of the kidney can be associated with ureteric stone, vesicoureteric reflux and can predispose to iatrogenic trauma during interventional radiological and laparoscopic procedures and any surgeries. Therefore, it is important to know the variations between individuals in the level of kidney relative to the spinal column. The study aimed to analyse the morphometric and morphologic measurements of the kidney using CT angiogram in kidney donors. In this study, the length and breadth of kidney and different level of location of kidney in 100 renal donors were analysed. The study was conducted in specialised scan centres located in Chennai. Out of 100 kidney donors, 61% of them were male & 39% of them were female. The right kidney length was found to be 10.59 ± 1.14 cms, and left kidney length was found to be 10.72 ± 1.22 cms. This report will be useful for transplant surgeries, as well as clinicians and radiologist who perform various techniques.

INTRODUCTION

The kidneys are bilaterally paired organs and serve many essential functions required to maintain a normal human physiological function. They are the primary organs for maintaining fluid and electrolyte balance. And they play an important role in maintaining acid-base balance and also part of the endocrine system (Borley and Standring, 2008). The renal size was conventionally determined on x-ray or urography by measuring the renal length distance of first lumbar vertebrae to third or fourth lumbar vertebrae. These methods obtain the measurements were associated with various drawbacks. With the advent of a newer modality of investigation, CT has been effectively used for estimating kidney size. Computed tomography of the kidneys has replaced standard radiography for evaluation of renal morphometry. Because abnormalities of kidney size are present in many renal diseases, it is valuable to have a set of standard computed tomographic measurements. Only a few reports have described the use of CT to obtain renal measure-
ments in adults. The same technique was used in the present study to measure renal length and width. A change in kidney dimensions from one examination to next may be an important indicator for the presence of disease (Raza et al., 2011). The kidney generally measures 10-12cms vertically, 5-7 cms transversely. In this paper, we have analysed the length and breadth of the kidney in 100 kidney donors. The renal size was conventionally determined on renal angiograms by measuring the renal length from the distance of the upper pole to lower pole and breadth by the distance between medial and lateral borders.

The position of kidney within the retroperitoneum varies significantly by a degree of inspiration, body position and anatomic anomalies. When the kidney lies outside the renal fossa is said to be ectopic kidney (Arena et al., 2007). Ectopic kidney poses a problem for any planned surgical intervention given their abnormal blood supply. Ectopic position can be associated with ureteric stone, vesicoureteric reflux and can predispose to iatrogenic trauma during interventional radiological and laparoscopic procedures and any surgeries (van den Bosch et al., 2010; Polak-Jonkisz et al., 2012). So it is important to know the variations between individuals in the level of kidney relative to the spinal column. Only very few studies were demonstrated the level of kidney relative to the spinal column. (Bhatnagar et al., 2013; Guarino et al., 2004) Only a few studies have done using CT angiogram in donors. This report will be useful for transplant surgeries, as well as clinicians and radiologist who perform various techniques. (Glodny et al., 2009) The position of kidney within the retro-peritoneum varies significantly by a degree of inspiration, body position and anatomic anomalies. The right kidney sits 1-2 cms lower than the left due to displacement of the liver. Generally, the right kidney resides in the space between L1 — L3. Left kidney Reside in the space between T12 — L3 vertebrae. (Datta, 2004)

MATERIALS AND METHODS

For this study, a total of 100 kidney donors were included. The study was conducted in specialised scan centres located in Chennai. The centres are Precision, Aarthi, and Bharath after getting appropriate permission from the medical director of the respective centres. The study group was drawn from healthy kidney donors who attended the radiology department of those centres, who had no diseases related to kidney. The study group was drawn from both sexes of age between 25 – 50 years. The study spanned for six months.

RESULTS

Out of 100 kidney donors, 61 of them were male & 39 of them were female. The morphometric result of the length of the kidney on the right and the left side is given in Table 1. Overall comparison of length of the kidney between the gender is given in Figure 1. Comparison of length of the kidney between the genders on the same sides is given in Table 2. Morphometric result of breadth of kidney on sides is given in Table 3. Overall comparison of the breadth of kidney between the gender is given in Figure 2. Comparison of the breadth of kidney between the gender on
DISCUSSION

In this study, the left kidney is longer (i.e.) 0.13cms than the right kidney. In breadthwise, the right kidney is 0.11 cm bigger than the left kidney. The current study is similar to the study conducted by Sayeed and Barton et al. in 1993 and 2006 (Emamian et al., 1993; Barton et al., 2000). He is reported that the length of the left kidney is longer than the right kidney.

The similar morphometric study had been conducted by (Kang et al., 2007) by computed tomography abdomen, and his findings were correlated with the study conducted in this work. He also conducted a sexual dimorphic study in the kidney where he reported male kidney is 0.2cms greater in length than female. Difference between mean values for women and men on the right side kidney length was measured with a two-tailed student’s t-test, which is statistically significant in this study. The renal dimensions might also differ among the population of different geographical origin (Sampanio and Mandarim-De-Lacerda, 1989).

The same side is given in Table 4. Different level of location of the kidney is observed, and distribution of level of location of the kidney for the right and the left side is given in Figures 3 and 4, respectively.

| S.No | Length of kidney | Mean ± SD |
|------|------------------|-----------|
| 1.   | Right kidney length | 10.59 ± 1.14 cms |
| 2.   | Left kidney length  | 10.72 ± 1.22 cms |
that the left kidney was longer than the right and the mean kidney length was more significant in men than in women (Gebrehiwot and Atnafu, 1998) which is similar to this current study. The morphometry of the kidney could be useful to differentiate the normal from abnormal like hydronephrosis and renal disease. This finding would be useful for transplant surgeons. The morphometry of the kidney is shown in Figure 6. Out of 100 donors, 72% of kidneys were situated in the level ranging from T11 to L3, and 28% were ranging from L1 to L5 on the right side. On the left side, 89% ranging from T11 to L3, and 11% were ranging from L1 to L5. This shows variations in the level of location of the kidney is more on the right side than on the left side. The embryological reason may be due to failure of elongation of the ureteric bud, and its growth is misdirected. This could have been more on the right side than on the left side. The average level of kidney on the right side is L1 — L3 shown in Figure 5. In this study, only 26% of the population falls under this group. On the left side, the normal level of the kidney is T12 — L3 and only 43% of the population fall under this group.

It is surprising to see on the right side that 39% of the population falls under T12 — L3 position. Instead of falling under L1 — L3. This is due to the development of suprarenal gland at the T12 level. This would have stopped the further migration of the kidney on the right side. Fifteen studied the computed tomography angiography in 50 patients. He found an ectopic kidney in 1 individual which lies at the level of the intervertebral disc between L3 and L4. This study shows the other possible location of the kidney. This brings an idea to clinicians who perform clinical examination and ultrasonography for diagnosing kidney.

CONCLUSIONS

Our study has revealed that there is a significant difference in the morphometry of length of the kidney on the right side between gender. The length and width of kidneys are considered a very important parameter for clinical assessment of patients with diabetes mellitus, renal artery stenosis and assessment of renal transplant candidates.

Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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