



Analysis of Morphometry of Calyceal Pattern in Kidney Donors Using CT Angiogram Images

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ABSTRACT

The advent of more conservative methods of treatment for renal pathologies has necessitated a precise knowledge of renal pelvicalyceal system. Knowledge on the patterns of pelvicalyceal system and its relation to the renal segmental arteries is of importance in procedures in kidney. The aim is to analyze the morphometry of calyceal system in kidney donors using 64- Slice Computed Tomography Angiography. The study was conducted in specialized scan center located in Chennai after getting appropriate permission from medical director of the center. The study group was drawn from kidney donors who approached the scan center who had no diseases related to kidney. In this study, a total of 99 kidney donors were included. This was a prospective cross-sectional study conducted from June 2014 to September 2017. The statistical analysis and plotting of graphs were carried out using Sigma stat 13.0 (Systat software, USA). Various patterns of the pelvicalyceal system along with morphometric dimensions of the infundibulum, which leads from the major calyces to the renal pelvis were studied. The result was then correlated with clinically significant parameters.

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INTRODUCTION

Each kidney has two or three or even multicalyceal pattern. Each major calyx is formed by the minor calyces and these major calyces' drains into the renal pelvis. When renal stones are formed in the kid-

ney it deposits in renal calyx. These renal stones are usually smaller stones and will be passed in the urine. When the stones are larger in size it will be located in any of the major calyx which leads to obstruction in the urinary pathway. This may cause hydronephrosis, hydrouretronephrosis and even renal failure. Hence the best method for renal stone treatment is broadly accepted by urologist is extracorporeal shockwave lithotripsy (ESWL), which is the treatment of choice for renal stones with a maximal length of 2 cm or less. Various literatures have explained the correlation of lower pole calyceal system anatomy and ESWL (Sampaio and Passos, 1992). After the measurement of lower calyceal anatomy in intravenous urography (IVU) initially demonstrated by a researcher and later many authors raised different viewpoints about the measurement of the lower calyceal anatomy (Elbah-nasy *et al.*, 1998). The clearance rate of stone frag-

ments is worse over the lower calyces than over the middle or upper calyces (Lingeman *et al.*, 1994). Calculi in the lower calyceal group represent 24%-44% of all calculi requiring treatment (Sampaio *et al.*, 1997). Detailed anatomy of calyceal pattern will help in kidney stone treatment (Sampaio, 2001).

MATERIALS AND METHODS

The present study was carried out after getting approval from Institutional Human Ethics Committee, Saveetha Medical College and Hospital. The study was conducted in specialized scan center located in Chennai after getting appropriate permission from medical director of the center. The study group was drawn from kidney donors who approached the scan center had no diseases related to kidney. The study spanned a period of 3 years, 2 months. In this study, a total of 99 kidney donors, CT Angiogram images were included. This was a prospective cross-sectional study conducted from June 2014 to September 2017.

Sample size was estimated by SigmaStat 13.0 (Systat software, USA). The kidney donors who approach Specialized Scan Center, Chennai were included for the proposed study. The donors were subjected to CT angiogram. The CT machine used was light speed VCTXe, ADW4.5 Version. 64 slice Computed Tomography Angiography.

RESULTS AND DISCUSSION

Gender differences in the infundibular length of lower calyx

In this study, the lower infundibular length and width of calyx were measured and also compared with types of calyceal pattern, side and gender Figure 3.

Morphometrical changes in the infundibular length of lower calyx

The mean and standard deviation of lower infundibular length of male and female on right and left side are given in Table 1. Comparison of lower infundibular length between right and left side and between male and female were done. *p* and *t* Values are given in Figure 1. Figure 1 shows that, The values of mean \pm SD (*n* - male=54; female=45). The *t*' and *P*' Values are by student *t*' test is significantly different from male. The respective right and left lower infundibular length of calyx of male and female are also compared by student *t*' test. For the male the *t*' and *P*' Value are 0.234 and 0.815 respectively. For the female the *t*' and *P*' Values are 0.092 and 0.927 respectively. significantly different from significantly different from the respective side.

Comparison of lower infundibular length of different calyceal pattern

In this study we also compared the lower infundibular length of different calyceal pattern by one way ANOVA. Right side *F*=1.407, *p*=0.250; left side *F*=2.472, *p*=0.090. Mean and standard deviation are given in Table 1. Student *t* test values, one way ANOVA values are given in Figure 1. Lower infundibular length of tricalyceal pattern on right and left side shows statistically significant *t* = 2.068 *p* = 0.043.

Comparison of lower infundibular width of different calyceal pattern

We compared the lower Infundibular width of different calyceal pattern by one way ANOVA. Right side *F*= 4.554, *p*=0.013; left side *F* = 0.334, *p*=0.717. Mean and standard deviation are given in Table 2. Student *t* test values, one way ANOVA values are given in Figure 2. Figure 2 Shows that, Different calyceal pattern are compared by one way ANOVA right side *F*=4.554, *p*=0.013; left side *F*=0.334, *p*=0.717. Comparison was also made between right and left. significantly different from bicalyx. Student *t* test values are given in Table 1.

The measurement of lower infundibular length is very essential for selection for the best method of kidney stone treatment for a specific patient. There is no statistical association between sides and gender. In our study lower infundibular length on right side 1.87 cm; on left side it was 1.5 cm which is slightly lower than the study conducted by (Pankaj and Wadekar, 2014). The measurement of lower infundibular length is essential for indicating and predicting the outcome of extracorporeal shock wave lithotripsy for treating lower pole nephrolithiasis and also for the retrograde flexible ureteronephroscopy in treatment of lower pole calyx stones. Lower infundibular width is also a reliable factor for predicting the success of extracorporeal shock wave lithotripsy in lower pole kidney stone. The lower infundibular width less than 0.4 cm is clinically important. In this study we found 13 kidney shows less than 0.4 cm. Despite the fact that most of them studied the lower pole anatomy using intravenous urogram pre-treatment examinations to measure anatomic factors, it has been discussed that some of these factors like infundibular width or infundibular height should not be used because its measurement can change with different urography phases, respiration and/or postural movements or poor quality images (Ghoneim *et al.*, 2005; Gallagher and Tolley, 2000; Pace *et al.*, 2003). Although there have been some groups that evaluated the possibility of using

Table 1: Comparison of lower infundibular length of calyx

Gender	Right	Left	Statistical value
Male (cm)	1.89 ± 0.43	1.87 ± 0.45	t = 0.234 p = 0.815
Female (cm)	1.85 ± 0.53	1.84 ± 0.49	t = 0.092 p = 0.927
Statistical value	t = 0.413 p = 0.681	t = 0.313 p = 0.755	Values given in Figure 1

Table 2: Comparison of lower infundibular width of different calyceal pattern

Gender	Right	Left	Student t test
Bicalyceal (cm)	0.83 ± 0.36	0.73 ± 0.32	t = 1.483 p = 0.141
Tricalyceal (cm)	0.70 ± 0.14	0.68 ± 0.28	t = 0.342 p = 0.733
Multicalyceal (cm)	0.58 ± 0.21	0.69 ± 0.15	t = 1.780 p = 0.084
One way ANOVA	f = 4.554 p = 0.013	f = 0.334 p = 0.717	Values given in Figure 2

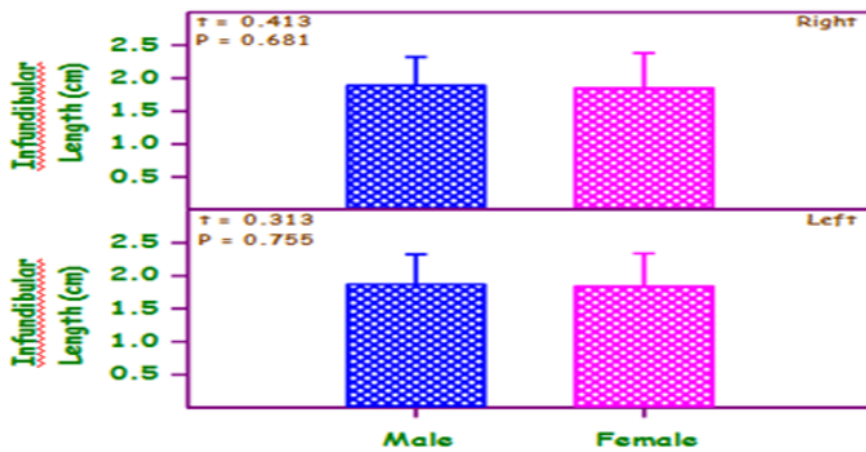


Figure 1: Comparison of lower infundibular length of calyx in right and left side of male and female

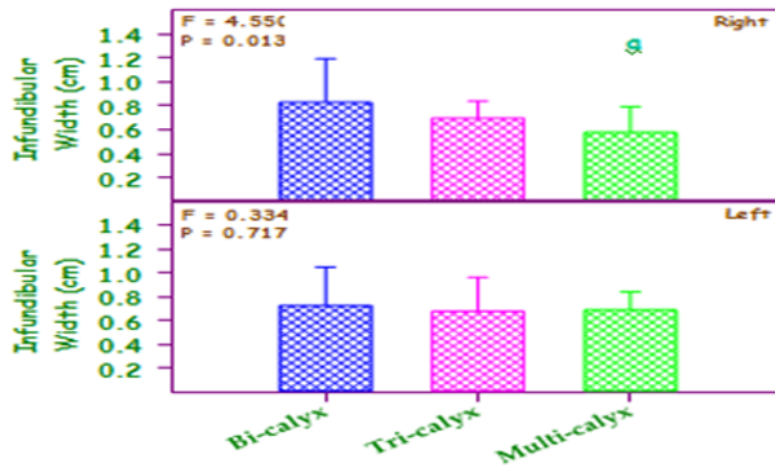


Figure 2: Comparison of lower infundibular width of different calyceal pattern

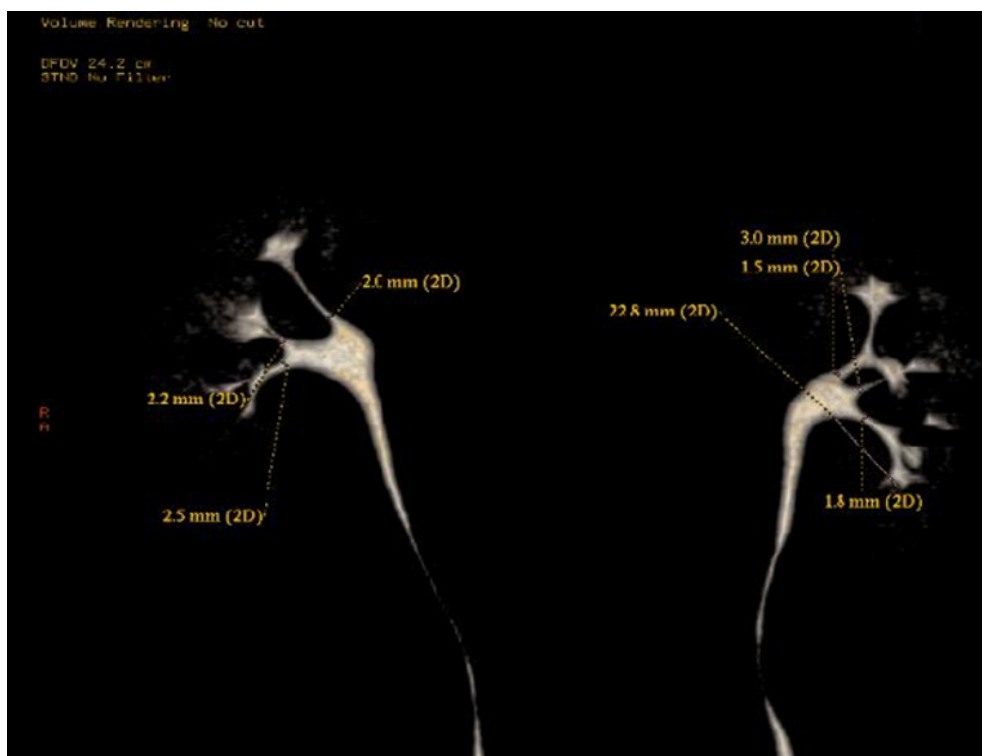


Figure 3: Morphometry of length and width of calyceal pattern of kidney

a three dimensional helical computed tomography to measure the anatomy of the collecting system to avoid potential bias as described above instead of using an urography some authors did not find any statistical difference which concluded that IVU remains a good method to analyze renal collecting system (Gallagher and Tolley, 2000; Filho et al., 2007). To perform these endourologic procedures safely and efficiently it is essential to have a clear understanding of pelvicalyceal anatomy and its variations. Thus, the in-depth knowledge of pelvicalyceal anatomy will be of immense value to the clinicians of related specialties.

CONCLUSION

To conclude, this study suggests that apart from detailed clinical history and examination, a thorough and depth anatomical knowledge of renal morphometry of calyceal pattern is also important for donor selection. Regional anatomy is evaluated in detail to decide the precise surgical approach which will avoid donor complication and to ensure good recipient graft function.

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