Original Article

Optimum patient position for sonographic examination of the kidneys

Lina F. Hammad

ABSTRACT

Objective: Sonography is a widely used imaging modality for examination of the kidneys utilized to evaluate dimension of the kidneys during the progression of a renal disease. The aim of the study was to investigate the optimum patient position for sonographic examination of the kidneys which will reduce scanning time and hence increase cost effectiveness.

Methodology: In 93 subjects, renal sonography was performed in the three positions (supine, oblique and prone) for the right and the left kidneys. Longitudinal and transverse images of both kidneys were obtained when possible and measurements of renal dimensions (renal length, width, thickness and cortical thickness) was extracted. Measurements were conducted at the Department of Radiological sciences, King Saud University.

Results: The right kidney was more accessible with subjects in the supine position compared to oblique subject position for the left kidney. Prone subjects position was the second more accessible position to image both kidneys. No statistical differences in kidney dimensions were found between the three positions.

Conclusions: We suggest that the sonographic examining protocol for the right and left kidneys could begin at the supine position and oblique position respectively. Subject position does not affect renal dimensions obtained sonogeaphically.

KEY WORDS: Patient position kidney sonography.

Pak J Med Sci October - December 2012 Vol. 28 No. 5 823-826

How to cite this article:

Hammad LF. Optimum patient position for sonographic examination of the kidneys. Pak J Med Sci 2012;28(5):823-826

INTRODUCTION

Several imaging modalities can be used to examine the kidneys to rule out obstruction, abnormalities, and diseases and to obtain anatomical and blood flow information. Although, the most accurate measurement of renal size requires expensive, highly complex studies using modalities such as axial tomography and magnetic resonance imaging, the use of these imaging methods are restricted due to radiation hazards and toxicity due to contrast agent adminstration.[1,2] Ultrasound is a useful, accessible, non-invasive, portable and inexpensive method to reliably investigate different renal abnormalities.[3]

Renal dimensions estimation by ultrasound is an important parameter in clinical evaluation of adult patient kidney disease and healthy adult donors and had replaced radiography as the common standard.[4,5] Renal length obtained sonographically has been shown to be a reliable parameter[5] with a high level of inter and intra-observer reproducibility in comparison to volumetric renal estimation, which correlates with anthropometric variables.[6]

1. Lina F. Hammad, PhD,
Department of Radiological Science,
College of Applied Medical Sciences,
King Saud University, Riyadh, Saudi Arabia.

Correspondence:

Dr. Lina F. Hammad, PhD,
Assistant Professor,
Department of Radiological Sciences,
College of Applied Medical Sciences,
P.O. Box 300126, Riyadh 11732,
Kingdom of Saudi Arabia.
E-mail: lhammad@ksu.edu.sa
LFH2@hotmail.com

* Received for Publication: July 6, 2012
* Revision Received: August 15, 2012
* Revision Accepted: August 16, 2012

Estimating renal size by ultrasound can be done from measurements of length, width and thickness, which are useful parameters in differentiating acute from chronic kidney diseases.[7] In addition to that, it was suggested that the inclusion of abdominal sonography (which include renal imaging) with other laboratory tests in the lower urinary tract symptoms clinic can help to diagnose potentially life-threatening conditions.[8] Furthermore, ultrasound was found able to detect most structural abnormalities in infants.[9,10]

The revised practice guideline for the performance of an ultrasound examination of the abdomen and retro-peritoneum published by the American Institute of Ultrasound in Medicine (AIUM) in 2008 stated that "The examination should include long-axis and transverse views of the upper poles, mid-portions, and lower poles of the kidneys. The cortex and renal pelvises should be assessed. A maximum measurement of renal length should be recorded for both kidneys. Decubitus, prone, or upright positioning may provide better images of the kidneys",[11] It is not documented in the literature which position yielded clearer details of the kidney, and the sonographer could scan the patient at various positions (supine, prone, decubitus or upright) until acceptable views and measurements are obtained. In a busy radiology department, reducing the time of scanning can increase number of patients imaged and improve cost effectiveness.

The aim of this study was to evaluate the most accessible patient position for the examination of the kidneys sonographically which will reduce scanning time and hence increase cost effectiveness.

METHODOLOGY

Experimental Design: One hundred asymptomatic young adult male (age range 28-22 years, mean age 22.23 years) were recruited. Informed consent was obtained from all subjects, and the study was approved by local research ethics committee.

Statistical Analysis: Using SPSS software, Cochran's test was applied to examine the ability to obtain both kidneys largest longitudinal and widest transverse sections in the three subject positions. Friedman test was used to examine differences in kidney dimensions between the three positions.

Kidney Measurement: Subjects enrolled in the study had the followings measurements after signing the consent form: height and body weight using a measuring scale, kidney sonography performed by a sonographer with an experience of more than 5years using a Convex type probe 2 - 5 MHz and a Phased array probe 6 -13 MHz Hitachi EUB- 6500 (Hitachi, Japan). A build- in kidney protocol was used which provided automatic adjustment for the gain and other parameters. The scanning room temperature was maintained at 21-24^{o} C, with normal ventilation. Measurements were conducted at the Department of Radiological sciences, King Saud University

All participants emptied their bladders prior to the examination, to avoid an increase in renal length caused by oral hydration.[12] Both kidneys were examined with the subject in the supine, oblique and prone positions. Maximum renal length and cortical thickness were measured in a section visually estimated to represent the largest longitudinal section; renal width and thickness were measured in the plane orthogonal to longitudinal axis of the kidney at the level of the renal hilum. Longitudinal and transverse images of the kidneys were obtained with the subjects holding their breath after deep inspiration.

RESULTS

Of the 100 volunteers enrolled in the study, 7 subjects dropped due to inability to continue the measurements sessions. The mean and standard deviation (SD) for age, height, weight and BMI calculated for 93 asymptomatic controls are tabulated in Table-I.

Results demonstrated that it was not possible to image optimally the kidneys at some positions. Number of measurements in each position for each kidney is tabulated in Table-II. When the accessibility to obtain longitudinal and transverse measurements of the kidneys at the three positions were tested, number of measurements at each position were found to exhibit statistical differences (P=0.000). Supine position was the most accessible to image the right kidney (N_{Long}=93 & N_{Trans}= 92), whereas oblique subject position provided the most accessible site for measuring the left kidney dimensions (N_{long}=86 & N_{trans}= 89). Prone position

Table-I: Descriptive measures mean and (SD) for age, height, weight and BMI.

No of subjects	*Age (yr)*	*Height(m)*	*Weight (kg)*	*BMI*
93	22.23 (1.39)	1.71 (0.06)	64.28 (9.54)	21.9 (3.12)

Table-II: Number of data obtained for each kidney in each position.

N=93	Longitudinal			P value	Transverse			P value
	Supine	Oblique	Prone		Supine	Oblique	Prone	
Right Kidney	93	71	91	0.000	92	77	90	0.000
Left Kidney	70	86	75	0.000	71	89	88	0.000

was found to be the second best position for viewing both kidneys ($N_{\text{right kidney long}}$ =91 and $N_{\text{left kidney long}}$= 75) and ($N_{\text{right kidney Trans}}$ =75 and $N_{\text{left kidney trans}}$= 88).

The mean and standard deviation (SD) for the measurements for each kidney in all positions are tabulated in Table-III and statistical analysis demonstrate insignificant differences in kidney dimensions between the three positions used in the study (P> 0.05).

DISCUSSION

Renal imaging, texture and dimensions are important parameters for the diagnosis and the prognosis of many renal diseases, as reduced renal length is considered an indicator of irreversible chronic renal disease.[4] Furthermore, ultrasound is the technique of choice to evaluate these parameters due to its safety and the ability for the measurements to be conducted quickly and easily without the use of injected contrast medium[13] and its reproducibility and accuracy.[6] Although CT and MRI can be used to measure renal volume accurately with voxel count–based methods[1,14], these techniques present problems of cost, radiation exposure, and toxicity associated with renal contrast agents.[2]

Although the AIUM guidelines suggested scanning subject at different positions to image the kidneys optimally,[11] recommendations for the most optimum position to examine the kidneys were not found in the literature. It was felt that identifying the optimum examination position instead of scanning at different positions will reduce examination time which will be reflected on number of patients scanned and improve productivity of the department.

Although previous studies did not investigate the most accessible patient positions to image the kidneys and hence reducing scanning time, examining the kidneys in the three locations (supine, oblique and prone) until optimum position is found would increase scanning time and reduce cost effectiveness in a busy ultrasound department. Emamian and colleagues suggested that the supine position were sufficient to image the kidneys, but measurement of the renal dimensions were done with the patients in the prone position.[15] Other studies scanned until optimal visualization were found and used the longest measurements obtained from the three positions in adults[16-18] and in pediatrics.[10]

The first finding of the present study confirmed that both supine and prone positions were the most accessible to image the right kidney, whereas oblique subject position provided the most accessible site for measuring the left kidney dimensions (Table-II). Causes for inability to image the kidneys vary; the presence of gases in the colon and anatomically elevated kidneys with interference from the costal arches are the most contributors. In contrast to that, the presence of the liver provides a large acoustical window for right kidney imaging in the supine position, and the presence of the kidneys in the retro-peritoneal area seems to contribute to the prone position being the second best position for viewing both kidneys, whereas gases from the colon appears to contribute to the supine patient position for imaging the left kidney being the worst position (Table-II).

While the practice of patient being fasting for eight hours prior to abdominal sonography was not followed in this study we speculate that such preparation may improve even further the ability to visualize both kidneys especially the left kidneys in the supine position due to the reduction in the amount of gases within the colon. Such practice is not part of the recommendation of the American

Table-III: Mean cm and (SD) for data obtained for each kidney in each position.

N=93	Kidney Length			P value	Kidney Width			P value	Kidney thickness			P value	Kidney cortex thickness			P value
	Supine	Oblique	Prone		Supine	Oblique	Prone		Supine	Oblique	Prone		Supine	Oblique	Prone	
Right Kidney	10.37 (0.65)	10.36 (0.66)	10.37 (0.74)	0.086	5.27 (0.81)	5.22 (0.81)	5.28 (0.67)	0.066	5.25 (0.72)	5.23 (0.73)	5.16 (0.72)	0.054	1.25 (0.15)	1.26 (0.16)	1.24 (0.14)	0.554
Left Kidney	10.73 (0.85)	10.62 (0.93)	10.68 (0.93)	0.186	5.15 (0.67)	5.17 (0.7)	5.08 (0.53)	0.594	4.69 (0.66)	4.77 (0.59)	4.63 (0.57)	0.315	1.35 (0.19)	1.37 (0.2)	1.38 (0.22)	0.851

Institute of Ultrasound for examining the kidneys and hence was not applied in the study protocol.[11]

The second finding of this study demonstrated the insignificant differences in kidney dimensions between the three positions used in the study (Table-III). The insignificant difference suggests that measurements obtained in any position could be used for assessing the kidney size and for patient follow up.

Our results are in agreement with previous study where insignificant differences in renal length were found between supine (occasional oblique) position and prone positions for both kidneys.[15] The present study have included the oblique position as a separate parameter and found insignificant differences not only in length but in all parameter measured.

From both findings, it is recommended to start the examination in the supine position for the right kidney and in the oblique position for the left kidney with no effect on renal dimensions from the position of patients.

ACKNOWLEDGMENT

This research project was supported by a grant from The Research Center of the College of Applied Medical Science, Deanship of Scientific Research, King Saud University. The author would like to thank Dr Diana F. Hammad for statistical advice.

Declaration of interest: The Author reports no conflicts of interest and is responsible for the content and writing of the paper.

Source of funding: The Research Center of the College of Applied Medical Science, Deanship of Scientific Research, King Saud University.

REFERENCES

1. Van den Dool SW, Wasser MN, de Fijter JW, Hoekstra J, van der Geest RJ. Functional renal volume: quantitative analysis at gadolinium-enhanced MR angiography—feasibility study in healthy potential kidney donors. Radiology. 2005;236:189–195.
2. Thomsen HS. Nephrogenic systemic fibrosis: a serious late adverse reaction to gadodiamide. Eur Radiol. 2006;16:2619–2621.
3. Gavela T, Sánchez Bayle M, Gómez Mardones G, Gallego S, Martínez-Pérez J, Moya MT. Ecographic study of kidney size in children. Nefrologia. 2006;26(3):325-329.
4. Ablett MJ, Coulthard A, Lee RE, Richardson DL, Bellas T, Owen JP, et al. How reliable are ultrasound measurements of renal length in adults? Br J Radiol. 1995;68(814):1087-1089.
5. Kang KY, Lee YJ, Park SC, Yang CW, Kim YS, Moom IS, et al. A comparative study of methods of estimating kidney length in kidney transplantation donors. Nephrol Dial Transplant. 2007;22(8):2322-2327.
6. Emamian SA, Nielsen MB, Pedersen JF. Intraobserver and interobserver variations in sonographic measurements of kidney size in adults volunteers. A comparison of linear measurements and volumetric estimates. Acta Radiol. 1995;36(4):399-401.
7. Kalantarinia K. Novel imaging techniques in acute kidney injury. Curr Drug Targets. 2009;10(12):1184-1189. Review
8. Patel NS, Blick C, Kumar PV, Malone PR. The diagnostic value of abdominal ultrasound, urine cytology and prostate-specific antigen testing in the lower urinary tract symptoms clinic. Int J Clin Pract. 2009;63(12):1734-1738.
9. Preda I, Jodal U, Sixt R, Stokland E, Hansson S. Value of ultrasound in evaluation of infants with first urinary tract infection. J Urol. 2010;183(5):1984-1988.
10. Kadioglu A. Renal measurements, including length, parenchymal thickness, and medullary pyramid thickness, in healthy children: what are the normative ultrasound values? AJR Am J Roentgenol. 2010;194(2):509-515.
11. American Institute of Ultrasound in Medicine Practice Guideline for the Performance of an Ultrasound Examination of the Abdomen and/or Retroperitoneum 2008. http://www.aium.org/publications/guidelines/abdominal.pdf
12. Kantarci F, Mihmanli I, Adaleti I, Ozer H, Gulsen F, Kadioglu A, et al. The effect of fluid on renal length measurement in adults. J Clinical Ultrasound. 2006;34(3):128-133.
13. Brandt TD, Neiman HL, Dragowski MJ, Bulawa W, Claykamp G. Ultrasound assessment of normal renal dimensions. J Ultrasound Med. 1982;1:49-52.
14. Widjaja E, Oxtoby JW, Hale TL. Ultrasound measured renal length versus low dose CT volume in predicting single kidney glomerular filtration rate. Br J Radiol. 2004;77:759–764.
15. Emamian SA, Nielsen MB, Pedersen JF. Kidney dimensions at sonography: correlation with age, sex, and habitus in 665 adult volunteers. Am J Roentgenol. 1993;160:83.
16. Carrasco JO, Castellanos FR, Kimura E, Delgado RE, Herrera-Felix JP. Renal length by ultrasound in Mexican adults. Nefrologia. 2009;29(1):30-34.
17. Kim HC, Yang DM, Jin W, Lee SH. Relation between total renal volume and renal function: Usefulness of 3D sonographic measurements with a matrix array transducer. AJR Am J Roentgenol. 2010;194(2):W186-192.
18. Hammad LF. A sonographic study of kidney dimensions in Saudi's University Students. Pak J Med Sci. 2012;28(3):395-399.