

THE ROLE OF ULTRASOUND'S SENSITIVITY, SPECIFICITY AND DOPPLER TWINKLING ARTIFACT IN THE DETECTION OF URINARY STONE AND HYDRONEPHROSIS

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Abstract: The low back ache is a quiet common illness in our general public. It is generally connected with urinary system diseases like its infection, calculi formation and obstruction. Renal stone often causes outrageous lumbar distress, which is likewise called renal colic. Quick recognition for its appropriate treatment frequently ensured by medical imaging modalities. The goal behind this investigation was to estimate the efficacy % of ultrasound's, sensitivity, specificity and Doppler twinkling artifact in detection of hydro nephrosis and urinary tract stone formation. **Objective:** To determine the level of "significance of ultrasound's, sensitivity, specificity and Doppler's twinkling artifact", for diagnosing a urinary tract stone and hydronephrosis on basis of systematic review and data analysis of relevant research articles. **Methodology:** Ultrasound's, sensitivity, specificity and Doppler twinkling artifact of 3253 cases derived from 35 articles satisfying the selected criteria from journals of 2000-2017 were incorporated for this precise audit. These articles were recovered from American Journal Radiology (AJR), J Med Ultrasound, ACTA Radiological, Springer Science, Business Media LLC, J Med Ultrasonic,, Biomedical Engineering, NDT Plus, Elsevier, American Institute of Ultrasound in Medicine, Ultrasound in Medicine and science, Saudi Journal of Kidney ailments and Interpretation, Clinical Urology, Journal of Radiology and Nuclear Medicine, Journal of End urology and RSNA from Medline, Embase, Cochrane Library, Cinahl and Google. The pursuit criteria of this examination dependent on eleven imaging modalities. **Result:** Ultrasound sensitivity / specificity for renal stones is 81% /100%; and for hydronephrosis is 93% / 100% respectively. Its sensitivity to pick ureteric stone is 46% and to identify hydro ureteric is 50%. The color Doppler twinkling artefact is seen of the calculi only and otherwise this sign is absent. **Conclusion:** The diagnostic percentage efficacy of Ultrasound sensitivity is more for hydro nephrosis (93%) and gradually decrease for renal stone (81%), hydro ureteric stone (50%), and ureteric stone (46%). The ultrasound's specificity diagnostic weightage for hydronephrosis and renal stone is equal and maximum (100 %.) The color Doppler twinkling artefact is diagnosing only to urinary tract calculi. The utilization of shading Doppler does not increase the examination time.

Key words: Ultrasound's Sensitivity, Doppler Twinkling Artifact

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INTRODUCTION

Excretion of urinary system contains many metabolic wastes in form of minerals and salts. When these contents are at high levels, it lead to stone formation in this system. At start, Kidney stones are tiny, yet with time, become bigger in size, filling the inward hollow structures of the kidney.1 A couple of stones stay in the kidney, and don't cause any symptoms, remain unfamiliar and normally found, when a skiagram is taken during a wellbeing examination of the individual.2 Sometimes, the kidney stone goes down the ureter, the bladder and leaves the body. Should the stone stuck in the ureter, it upsets the parenchyma of that kidney and causes hydronephrosis.3 Such stone routinely causing a sharp, cramping torment in the back and side, often moving to the lower paunch or crotch. Moreover such pain begins sudden and peristaltic. Quick recognition for its appropriate treatment frequently ensured by medical imaging modalities like ultrasound or a CT scan.4 These imaging tests not only give knowledge

how massive the stone but also inform their site of lodging in the system, CT machine has more cost, so it is not available at all emergency health centers of developing countries.^{5,6} In view of above scenario, in the public health interest and to update the information of sonographer working at peripheral health centres, facilitated with only ultrasound machines, in the present investigation, it was decided to assess the significance of ultrasound's sensitivity, specificity and Doppler's twinkling artifact, for diagnosing a urinary tract stone and hydronephrosis.

METHODS:

Pre-endorsement for this survey was acquired from the institutional audit board (IRB) and moral advisory group of UOL

- The American Journal Radiology (AJR), J Med Ultrasound, ACTA Radiological, Springer Science, Business Media LLC, J Med Ultrasonic, Biomedical Engineering, NDT Plus, Elsevier, American Institute of Ultrasound in Medicine, Ultrasound in Medicine and science, Saudi Journal of Kidney sicknesses and Transplantation, Clinical Urology, the Egyptian Journal of Radiology and Nuclear Medicine, Journal of End urology and RSNA with publication date (2000-2017) were searched on eleven imaging modalities and language restriction English.
- The 35 articles from above mentioned journals were shortlisted for this study.
- Total 3253 cases of these articles was reviewed systematically and analysed during the present study.
- The phrases: urinary tract stone, hydronephrosis, ultrasound specificity, sensitivity and Doppler twinkling artifact with urinary tract defects were used as key words for searching of these articles.
- In this study, analysis of the sensitivity, specificity, predictive values and accuracy ultrasound data were selected of only those patients who:
 1. Were non hefty, young and old of both sex.
 2. came in the emergency setting with Lumbar or Flank pain suspected of renal colic
 3. and underwent both flanks ultrasound examination in a supine position, looking in kidney (for hydronephrosis, lithiasis, perirenal fluid) and the ureter from the renal pelvis down to the ureterovesical junction both with longitudinal and transverse section, first Gray-scale pictures and after that shading, colour Doppler pictures acquired with B-mode ultrasound.
 4. Were performed Sonographic examinations with a 3.5-5-MHz curvilinear staged exhibit test.
 5. Had images analysed also for the presence, appearance, and intensity of the artefacts.
 6. The % of genuine positive, genuine negative, false-positive, false-negative figures of the gathered information were also extracted.
- The relevant biochemical (Creatinine, Oxalate citrate, phosphate and cysteine) radiological and clinical records of all these patients were analysed also.
- The extent of patients experienced medical procedure and their span and methods for clinical subsequent meet-ups records were additionally be explored in this.
- The data of mean size of stones visualized by ultrasound was 3.43 mm to 8.88 was excluded in this study as it was in the standard deviation (3-32 mm).
- The data of five years experienced

sinologist, radiologist and supervised residents of surgery/medicine were entertained in this study.

STATISTICAL ANALYSIS:

- All factual examination were performed with an electronic spreadsheet program (Excel, Microsoft office 2003, Microsoft Redmond Wash) and measurable programming (SAS, form 9.2; SAS establishment, Cary NC).
- The percentage values of diagnostic efficacy regarding sensitivity, specificity, predictive positive / negative, twinkling artefact, accuracy of CD/ Gray scale ultrasound of Hydronephrosis, Renal stone Hydroureteric stone and ureteric stone of all cases taken under the present audit were tabulated in Table -1.
- The Bar chart (table-2) was drawn to determine the positive and negative predictive values and the table-3 (Bar chart) for Accuracy value of Gray scale & Doppler ultrasound of studied diseases of all shortlisted cases.
- Pie Chart (Table-4) was drawn to estimate the twinkling artifacts finding in studied diseases of all cases taken in the present investigation.

RESULTS

RESULT IN INFERENCE TO TABLE -1

Out of total 3253 cases, there were 745 cases of hydro nephrosis and have 93, 100, 95, 94 and 100 percentage value of sensitive diagnostic efficacy, specific diagnostic efficacy, positive predictive value, negative predictive value and gray scale accuracy respectively. Their CD efficacy was not significant & twinkling artifact were absent.

Out of the total studied cases, the cases

of Renal stone were 799 and possess 81, 100, 93, 89, 98, 97 and 93 percentage value of sensitive diagnostic efficacy, specific diagnostic efficacy, positive analytical assessment, negative analytical assessment, CD usefulness, gray scale correctness and twinkling artifact respectively.

Out of total studied cases, the cases of Hydroureteric stone were 886 and retain 51, 45, 95, 93, 99, 98 and 95 percent values of sensitive diagnostic efficacy, specific diagnostic efficacy, positive analytical assessment, negative analytical assessment, CD efficacy, gray scale accuracy & twinkling artifact respectively.

Out of 3253 cases, the cases of Ureteric stone were 823 and hold 46, 56, 98, 94, 100, 99 and 95 percent values of sensitive diagnostic efficacy, specific diagnostic efficacy, positive analytical assessment was, negative analytical assessment, CD usefulness, gray scale accuracy & twinkling artifact.

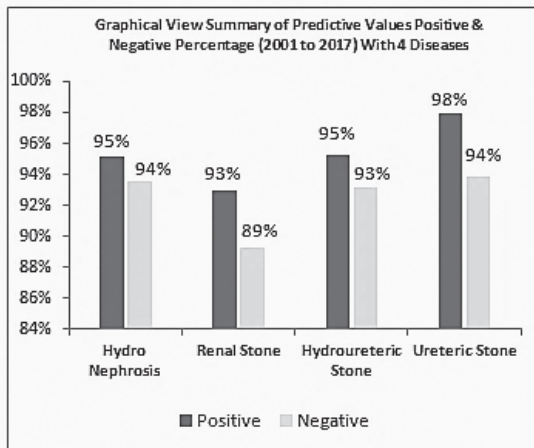
CONCLUSION:

The diagnostic percentage efficacy of Ultrasound sensitivity is maximum (93%) for hydro-nephrosis. The Specificity assessment was 100% for hydronephrosis and renal stone positive analytic usefulness was highest (98%) for ureteric stone; the negative positive analytic usefulness was lowest (89%) for renal stone; the uppermost (100%) colour Doppler usefulness was of ureteric stone; gray scale accuracy was top most (100%) for hydronephrosis among all reviewed and analysed cases. The color Doppler twinkling artefact is diagnosing only to urinary tract calculi. The utilization of shading Doppler does not increase the examination time.

Sr.#	Years	Diseases	Total Patients	No. of Patients	Sensitivity	Specificity	Predictive Values		Accuracy		Twinkling Artifact
							Positive	Negative	CD	Gray-scale	
10	2010	Hydro Nephrosis	832	62	90%	100%	94%	95%	N/A	99%	N/A
		Renal Stone		122	82%	100%	90%	88%	99%	96%	92%
		Hydroureteric Stone		364	54%	48%	96%	92%	99%	99%	95%
		Ureteric Stone		284	44%	53%	100%	90%	100%	99%	96%
11	2011	Hydro Nephrosis	444	115	92%	100%	100%	97%	N/A	100%	N/A
		Renal Stone		143	80%	100%	93%	89%	99%	97%	94%
		Hydroureteric Stone		86	52%	46%	95%	95%	98%	99%	95%
		Ureteric Stone		100	44%	53%	98%	98%	99%	99%	92%
12	2012	Hydro Nephrosis	408	120	94%	99%	94%	91%	N/A	100%	N/A
		Renal Stone		101	83%	100%	92%	87%	98%	96%	92%
		Hydroureteric Stone		64	50%	45%	96%	97%	99%	98%	96%
		Ureteric Stone		123	45%	55%	100%	98%	100%	99%	96%
13	2013	Hydro Nephrosis	379	98	94%	99%	96%	90%	N/A	99%	N/A
		Renal Stone		93	82%	99%	93%	86%	99%	97%	95%
		Hydroureteric Stone		123	53%	47%	97%	93%	97%	98%	96%
		Ureteric Stone		65	48%	57%	99%	92%	99%	98%	95%
14	2014	Hydro Nephrosis	351	71	94%	100%	96%	91%	N/A	100%	N/A
		Renal Stone		96	80%	100%	93%	87%	99%	98%	94%
		Hydroureteric Stone		84	51%	44%	95%	93%	98%	98%	96%
		Ureteric Stone		100	45%	54%	98%	95%	100%	97%	97%
15	2015	Hydro Nephrosis	273	92	94%	100%	95%	92%	N/A	100%	N/A
		Renal Stone		84	83%	99%	96%	89%	97%	97%	92%
		Hydroureteric Stone		44	56%	47%	98%	91%	99%	99%	96%
		Ureteric Stone		53	45%	57%	98%	89%	100%	98%	94%
16	2016	Hydro Nephrosis	263	104	92%	99%	94%	90%	N/A	99%	N/A
		Renal Stone		60	80%	100%	93%	85%	98%	97%	94%
		Hydroureteric Stone		66	53%	44%	90%	90%	100%	98%	93%
		Ureteric Stone		33	48%	52%	97%	92%	99%	99%	96%
17	2017	Hydro Nephrosis	303	83	92%	100%	93%	91%	N/A	100%	N/A
		Renal Stone		100	82%	100%	94%	88%	98%	98%	98%
		Hydroureteric Stone		55	51%	46%	92%	93%	99%	98%	96%
		Ureteric Stone		65	46%	56%	99%	94%	100%	99%	92%

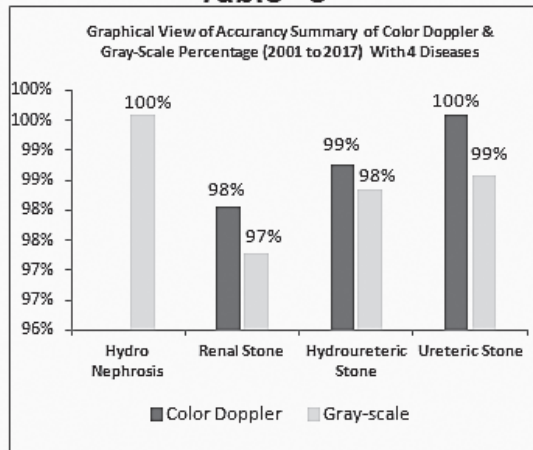
TABLE - 1: PERCENTAGE VALUES OF CHARACTERISED FEATURES OF 6078 CASES (2010-2017)

Table-2



Result in interpretation to Table - 2
 The percentage of positive / negative analytical assessment of Hydronephrosis, Renal stones, Hydro-ureteric stone and ureteric stone were 95/94, 93/89, 95/93 and 98/94 respectively among all reviewed cases.

Table - 3



Result in analysis of Table - 3
 The percentage assessment of Gray scale / colour Doppler of Renal stone, Hydroureteric stone, ureteric stone and Hydronephrosis, were 97/98, 98/99, 99/100 and 100/0 respectively among all analyzed cases.

Table - 4

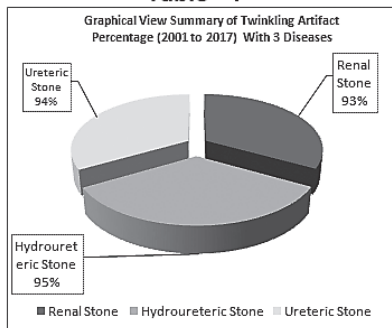
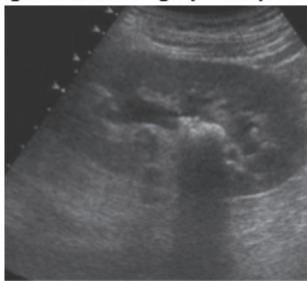


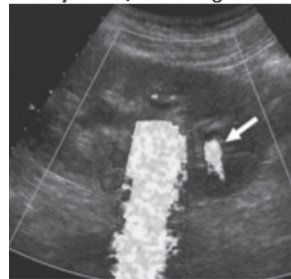
Image No. 1
 Large stone causing hydronephrosis



Presence of Posterior shadowing

Image No.2

Kidney stone / Twinkling artifact



Twinkling sign from large stone

Result in review of Table - 4, image -1 & image -2
 The percentage value of twinkling artifacts of Hydro-ureteric stone, ureteric stone and Renal stone, were 95, 94 and 93 respectively among all reviewed cases.

DISCUSSION

Ultrasound presently represents the first line imaging strategy for the detection of diseases such as urolithiasis, due to its accessibility for being a radiation free method and also because of the advancement in spatial resolution.7,8 Calculi are easily detected when their echogenicity is different from that

of the nearby tissues and cast a posterior acoustic shadowing.9,10 However, many of these stones are nearby echogenic tissue, e.g. in the renal sinus, and no posterior shadowing is produced due to their small size.11,12 The present systematic review and data analysis of 3253 cases prove that Diagnostic imaging efficacy particularly of

ultrasound's, sensitivity, specificity, positive analytic assessment, negative analytic assessment and gray scale accuracy are very useful to the patient management process of Hydronephrosis, Renal stones, Hydronephrotic stone and ureteric stone while assaying the relevant biochemical Creatinine, Oxalate citrate, phosphate and cysteine and clinical records of all these patients was the least sensitive diagnostic alternative.^{13,14,15} The data of mean size of stones visualized by ultrasound was 3.43 mm to 8.88 mm was excluded in this study as it was in the standard deviation (3-32 mm).^{16,17}

Shading Doppler is a stand out amongst the most regularly utilized Doppler practice.^{26, 27} Color Doppler methodology's essential use is to survey a moderately extensive zone to determine direction of blood stream. Color Doppler ultrasound is intense quickly changing of red and blue mixture behind every hyperechoic focus despite the high color velocity scale setting.^{18, 19, 20} This indicates color Doppler twinkling artefact. Power Doppler is a relatively new method for mapping blood flow with color.^{21, 22} It has some similarity to conventional color Doppler, but also has significant differences.^{23, 24, 25} The twinkling artefact was first described in 1996 by Rahmouni et al.⁵ Twinkling artefact is a shading appearance seen behind a strongly shiny interface such as urinary tract stone, parenchymal calcification or bones during color Doppler investigation. The twinkling artefact is also known as "color comet tail" sign. It is recognizable on color Doppler ultrasound.^{26, 27} This artefact is known as good image sign because it is beneficial for abnormal detection. It is also determined on power Doppler ultrasound.^{28, 29} Twinkling artefact is highly dependent on machine setting and its appearance is dependent on color-write priority and grey scale gain.³⁰

The twinkling artifact becomes a useful assessing imaging tool to have a thorough comprehension and appreciation. This sign allows the radiologist to its appropriate use in order to increase the test sensitivity. In the present investigation, the systematic review and data analysis of total cases (3253) revealed that the color Doppler twinkling artefact was found diagnosing only to urinary tract calculi than simple hydronephrosis.

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