Diagnostic Accuracy of Sonographic Twinkling Artefact in Localization of Ureteric Stones Keeping Low Dose Computed Tomography as the Gold Standard

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Abstract

Objectives: To determine the diagnostic accuracy of color Doppler twinkling artifact in conjunction with grey-scale ultrasound for diagnosis and localization of ureteric stones, keeping low dose computed tomography findings as the gold standard in adult patients presenting with lumbar pain.

Materials & Methods: In this cross-sectional study, a group of 190 adult patients were enrolled for the diagnosis of ureteric calculi. Each subject was examined using greyscale ultrasound, followed by color Doppler ultrasound for twinkling artifacts. The effectiveness of ultrasound in identifying calculi was evaluated by comparing it to the low-dose computed tomography. Density of the stones in computed tomography was correlated with the outcome of shock wave lithotripsy. All the collected data was entered and analyzed on SPSS version 25.0.

Results: The mean age of the patients was 48.41±16.69 years. For diagnosing ureter calculi the sensitivity, specificity, negative predictive value , positive predictive value, and diagnostic accuracy of Doppler ultrasound were 90.4%, 73.9%, 77.2%, 88.7% & 85.3% respectively taking computed tomography findings as gold standard.

Conclusion: Twinkling artifacts in conjunction with grey-scale ultrasound demonstrate considerable sensitivity and relatively low specificity in diagnosing ureteric calculi.

Keywords: Doppler ultrasound, Twinkling artifact, computed tomography, ureteric calculi.

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Introduction

Ureteric stones are recognized as one of the most painful disorders of the urogenital system causing obstructive uropathy. Such patients usually present with severe flank pain, nausea and vomiting. It affects 20% of the general population worldwide.[1] Ultrasound Urine Ketone Body (KUB) has been established as the cost-effective, non-ionizing, easily available investigation modality for the diagnosis of urolithiasis.[2] Sonographic detection of ureteric stones is often a challenging subject due to their location behind the beam-attenuating tissues e.g. fat & bowel. Twinkling artifacts on color Doppler ultrasound can detect these small calculi in conjunction with grey-scale ultrasound since its intensity is dependent on the architecture of the stone.[3] The "Twinkling artifact" also known as the "color comet tail artifact" was first described in 1996.[4] It is operator-dependent & requires a probe with a scale setting at high color velocity to differentiate from renal vessels. Spectral Doppler spectrum shows close vertical bands with saturated amplitude.[5] Low-dose CT KUB is a promising CT technique with reduced radiation dose to the patient and with the added benefit of high sensitivity and specificity for urinary stone detection.[6,7]

Materials & Methods

This study is a descriptive cross-sectional analysis

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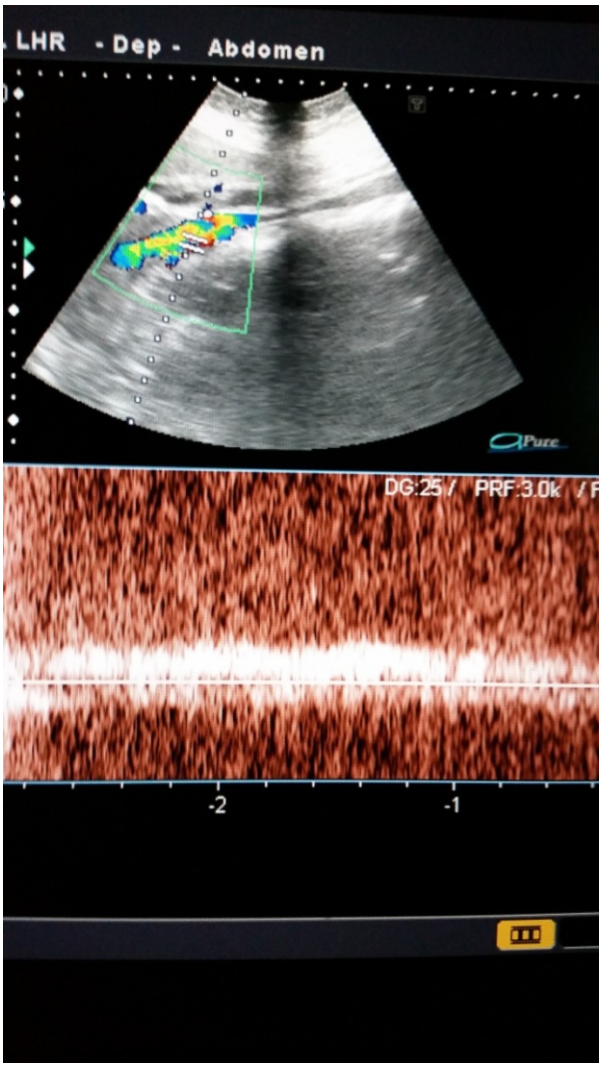
carried out at the Radiology Department of Services Hospital in Lahore from June 10, 2021, to December 10, 2021. The Institutional Review Board approved the research, and all the participants provided written informed consent. The study included 190 cases. They were selected based on a 95% confidence interval and a 5% margin of error, with the expected sensitivity being 97% & specificity 70%. The recruitment of participants was done using a non-probability consecutive sampling technique. For the diagnosis of ureteric calculi, the primary indicator was the presence of an acoustic shadowing on greyscale ultrasound & twinkling artifact on color Doppler ultrasound.

Presence of ureteric colic in patients 18-60 years of age both males and females. Ureteric stones (5-20mm size)causing hydronephrosis on grey-scale imaging. Denial to undergo CT. contra-indications to CT e.g. Pregnancy. Presence of alternate diagnosis e.g. Appendicitis, Gastroenteritis, Ovarian Pathology, Renal mass, fever, and UTI. Obese patient (BMI >30). Patients clinically suspected of ureteric colic and referred for CT scanning were examined after informed consent. The Sonographic study was performed using Xario-200 (Toshiba)with a convex 3–6 MHz probe by a consultant Radiologist. Both flanks were scanned in a supine position with grey scale ultrasound looking for hydronephrosis & nephrolithiasis. If hydronephrosis was observed then the ureter was traced from the renal pelvis up to the ureterovesical junction in a lateral position. Stone measurement was done in the longest dimension. Colordoppler was used to generate twinkling artifact. The twinkling artifact was analyzed & patients were further examined with low dose CT KUB to determine sensitivity, specificity, Positive predictive value and Negative predictive value. CT KUB was performed with a 16 slice- Toshiba Aquilion 2007 machine using our standard protocol for renal colic (120 kV, 200 mAs, and 3mm reconstruction in Sagittal and coronal planes).

Results

Data was analyzed by SPSS software, version 25.0. Qualitative variables, including the diagnosis of twinkling artifact via grey scale & Doppler USG, as well as CT KUB, were expressed using frequencies and percentages. Quantitative variables, such as age and BMI, were expressed as through means and standard deviations. In this study total of 190 patients were enrolled with a mean age of 48.41±16.69 years. Male patients were 77% and females were 23%. Mean value of the BMI of the patients was 22.97±4 kg/m^2 with minimum and maximum values of 16.50±29.82 kg/m^2 respectively. Our study results showed the



sensitivity, specificity, PPV, NPV, and diagnostic accuracy of Doppler USG were 90.4%, 73.9%, 77.2%, 88.7% & 85.3% respectively.

Table 1: *Comparison of diagnosing ureteric stone by Doppler USG taking CT finding as Gold standard*

		CTKUB Findings		Total
		Positive	Negative	
Doppler USG twinkling artefact	Positive	85	25	110
	Negative	9	71	80
Total		94	96	190
Sensitivity			90.4%	
Specificity			73.9%	
Positive predictive value			77.2%	
Negative predictive value			88.7%	
Diagnostic accuracy			85.3%	

Greyscale Ultrasound of ureter in conjunction with color Doppler demonstrating Twinkling artifact and its spectral pattern

Discussion

Twinkling artifact on color Doppler USG is seen on or behind the stone in collaboration with grey scale imaging at the site of ureteric stones. Krakhotkin et al results matched with our study & concluded high sensitivity (90%) and lower specificity for stones greater than 5 mm 8. Twinkling artefact is more valuable for stones greater than 5mm in size.[9-13] Few other studies including Hanafi et al also concluded the high false-positive value of using twinkling artifacts for stones less than 5mm.[14-16] Stones with rough surfaces produced more intense twinkling artifacts than those with smooth surfaces showing an interesting relationship between twinkling artifacts & stone composition.[17,18] CT density value also plays a role in the success of ESWL, with the value of <1180 HU favoring a successful outcome.[19,20] Twinkling artefact is highly operator dependent with a small risk of high false positive rates.[21,22] Low-dose CT KUB reduces the radiation burden while maintaining high sensitivity and specificity for ureteric stone detection.[23,24]

Conclusion

High sensitivity & good diagnostic value of color Doppler twinkling artifact makes it a reliable method for the diagnosis of urolithiasis and its efficacy is proven by correlation with the findings of low dose computed tomography.

Conflict of interest *None*

Funding Source *None*

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Authors Contribution

AR, II: Conceptualization of Project
AR: Data Collection
AK, HSA: Literature Search
SS, MAO: Statistical Analysis
II: Drafting, Revision
AK, MAO: Writing of Manuscript