H. Rokni Yazdi MD[1]
M. Mirjalili MD[2]
M.R. Noroozi MD[3]

Twinkling Artifact in Patients with Urinary Stones

Background/Objective: To determine the usefulness of twinkling artifact in detecting urinary stones by sonography according to stone characteristics and sonographic features.

Patients and Methods: A prospective study was conducted on 60 urinary stones which had been detected by KUB, IVP or CT scan. First of all, gray scale sonography was performed using 3.5-5 MHz phased array and data including stone size, location and posterior shadow were registered. Then, presence or absence of twinkling artifact and its intensity with respect to different filters (0-3), pulse repetition frequencies (PRF) (244, 1563, and 4864 Hz), and focal zones (at the level of the stone, lower and higher) was assessed using color Doppler sonography. Finally and in the case of artifact presence, spectral Doppler sonographywas performed. For data analysis, $\chi 2$ and independent t test was used .

Results: The prevalence of twinkling artifact was 78.3%. Artifact presence in a PRF value of 1563 Hz was significantly related to the echo difference between stone and adjacent tissues ($p= 0.001$).

Conclusion: The above findings together with the fact that twinkling artifact was strongly present in more than half the cases, indicates the sufficiency in detecting urinary stones.

Keywords: Twinkling Artifact, Urinary Stones, Doppler Sonography

Introduction

Detection of urinary stones on sonography may encounter some problems especially when these stones are surrounded by sonic beam-attenuating tissue (e.g. renal sinus or mesenteric fat and intestines) or when they do not have a desirable posterior acoustic shadow. In spite of recent advancement in sonography, radiologists are not able to confirm or exclude the presence of urinary stones under the mentioned circumstances.[1]

If there is an additional frequent sonographic feature, it may be helpful to make decision in obscured cases. In 1996, “twinkling artifact” was described by Rahmouni et al.[2] as an artifact generated by a strongly reflecting medium composed of individual reflectors. Its appearance is dependent on color-write priority and gray-scale gain. As color write priority decreases, the amount of twinkling artifact decreases behind the stone.[3]

This study was conducted to determine the frequency of twinkling artifact according to the stone characteristics and sonographic features, whether it could be considered as an additional sonographic feature of urinary stones.

Patients and Methods

In a prospective study, 60 urinary stones of 53 patients that had been confirmed by kidney ureter bladder x-ray (KUB), intravenous pyelogram (IVP) or CT scan were included in a nonrandomized sequential manner. In those patients with several urinary stones, we included thesmallest and largest stones.

Exclusion criteria were being so agitated or ill to tolerate the procedure. Gray

1-Associate Professor of Radiology, Advanced Diagnostic and Interventional radiology Research Center (ADIR), Tehran University of Medical Sciences, Tehran, Iran.
2-Senior Resident of Radiology,Advanced Diagnostic and Interventional Radiology Research Center (ADIR).Tehran University of Medical Sciences, Tehran, Iran.
3-Associate Professor, Department of Urology, Faculty of Medicine, Tehran University of Medical Sciences, Tehran, Iran.

Corresponding Author:
Maryam Mirjalili
Address: Advanced Diagnostic and Interventional Radiology Research Center (ADIR).
Tel: +9821 6658 1578
Fax: +9821 6658 1579
Email: mmirjalili@irimc.org
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scale, color Doppler and spectral Doppler sonographywere performed for all the cases using Sonoline G-40 (Siemens AG, Erlangen, Germany).

Initially, all of our cases underwent gray scale sonography using 3.5-5 MHz curvilinear phased array probe. Data regarding size, echo difference between stone and adjacent tissue, location of the urinary stones and presence of a posterior acoustic shadow were registered. The focal zone was set at the level of the stone or lower, subsequently color Doppler sonographywas performed. Color box was adjusted to encompass the stone and its posterior acoustic shadow. Color gain was set in the point lower than noise threshold and the presence of twinkling artifact and the intensity was deliberated according to different filters (0-3), pulse repetition frequencies (PRF) (224, 1563, and 4864 Hz) and focal zone (at the level of the stone, lower and higher). Therefore, we initially looked for twinkling artifact according to PRF changes with filter 2 and focal zone placed at the depth of the urinary stone and consequently with respect to filter and focal zone changes with a PRF value of 1563 Hz. An artifact with a length of more than 1 cm was classified as having strong intensity. Finally, spectral Doppler sonographywas performed if twinkling artifact was observed.

Written informed consent was obtained from all the patients at the beginning of the study. The gathered data were analyzed using SPSS 13.0 for windows (SPSS Inc., Chicago, IL). Assessment of significant difference was performed by chi-square and independent t tests.

A multivariate logistic regression model was also performed to assess the effect of different variables on the presence of artifact.

Results

Sixty cases of urinary stones were studied. IVP and KUB were the method of confirmation in 5 and 55 cases, respectively. The median of stone diameter was 10 mm (range 4.5-29 mm). Inferior calyx was the most common location of urinary stones (35%), whereas the bladder with only one single case was the most uncommon location. The characteristics of urinary stones have been summarized in Table 1.

Approximately, in three fourths of the cases, urinary stones showed marked echo differences. Sonographic examinations revealed 55 urinary stones with discrete posterior shadowing. Twinkling artifacts were generated from different cases of urinary stones according to PRF changes in filter 2 and focal zone at the depth of the urinary stone (Fig. 1).

Generally, the artifact was observed in 78.3% of urinary stones, of which 5% belonged to urinary stones without posterior shadowing (Fig. 2). In addition, approximately 13% of the artifacts were seen in

Table 1. The Characteristics of Urinary Stones

Characteristics	Value
Size; mm	
Mean (Range)	10.9 (4.5-29)
Location; n (%)	
Inferior Calyces	21 (35.0)
Middle Calyces	14 (23.3)
Ureter	13 (21.7)
Superior Calyces	6 (10.0)
Pelvis	5 (8.3)
Bladder	1 (1.7)

Table 2. Relationship Between the Presence of Twinkling Artifact and Other Studied Variables

Variable	Artifact		P Value
	Present [n(%)]	Absent [n(%)]	
Echo-difference			0.001
Marked	39 (88.6)	5 (11.4)	
Slight	8 (50)	8 (50)	
Posterior Acoustic Shadow			0.295
Present	44 (80)	11 (20)	
Absent	3 (60)	2 (40)	
PRF			0.998
244 Hz	38 (63.3)	22 (36.7)	
1563 Hz	47 (78.3)	13 (21.7)	
4864 Hz	47 (78.3)	13 (21.7)	
Focal Zone			0.998
Above	47(78.3)	13 (21.7)	
Level	47 (78.3)	13 (21.7)	
Below	47 (78.3)	13 (21.7)	
Filter			0.998
0	47 (78.3)	13 (21.7)	
1	47 (78.3)	13 (21.7)	
2	47 (78.3)	13 (21.7)	
3	47 (78.3)	13 (21.7)	
Stone Size [mean (SD)]	11.4(5.9)	8.8(3.8)	0.144

CI: Confidence Interval

urinary stones with slight echo differences (Fig. 3).

There was no significant relation between the size of the stone and presence of twinkling artifact (p=0.144). Half of the urinary stones smaller than 5 mm in diameter (two of four cases) showed twinkling artifact. The results of statistical tests applied to assess the relationship between the presence of twinkling artifact and other studied variables are demonstrated in Table 2. A multivariate logistic regression model analysis was also performed between the presence of artifact as dependent variable and size, location, echo difference and posterior acoustic shadow as independent variables. The results indicated that only echo difference had a significant association with the presence of artifact (Table 3).

Discussion

Urinary stones are detected easily by sonography if they have distinct echogenicity and marked posterior shadowing. However, radiologists may practically experience difficulty in detecting urinary stones with

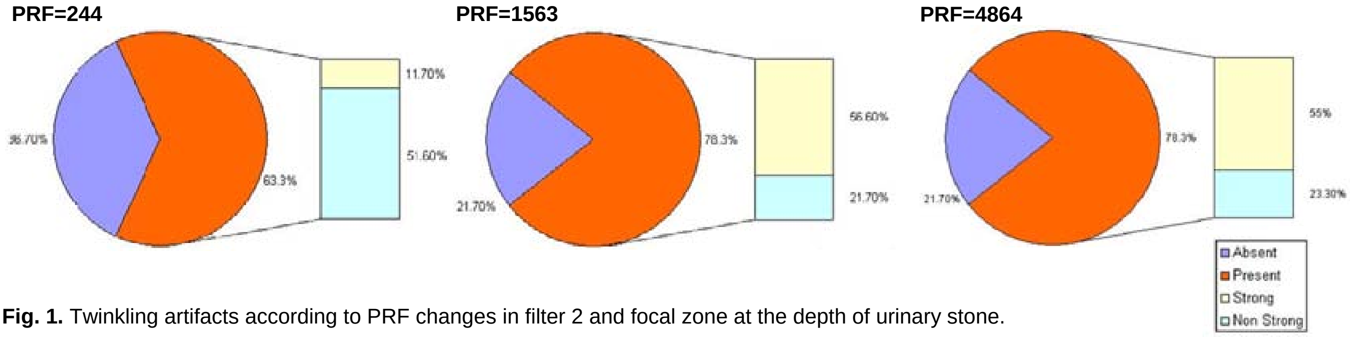

Fig. 1. Twinkling artifacts according to PRF changes in filter 2 and focal zone at the depth of urinary stone.

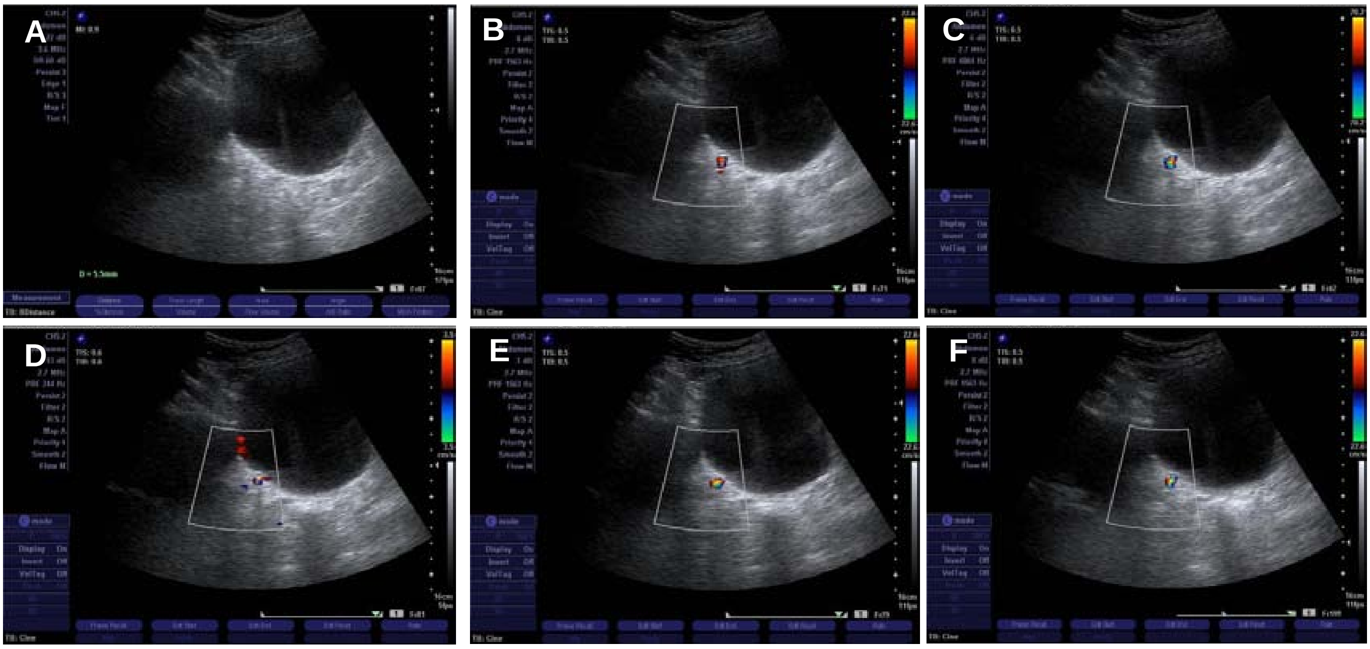

Fig. 2.A 51-year-old man with a 5.5 mm ureteral stone.

A. Sonogram shows echogenic lesion in distal right ureter. It is poorly distinguished from adjacent echogenic tissue and does not show discrete posterior shadow.

B-D. Color Doppler sonogram shows twinkling artifact from echogenic lesion.PRF changes the effect on twinkling artifact intensity.

E-F. Change in focal zone position does not affect twinkling artifact intensity.

G. On spectral sonogram, spectrum is composed of close vertical bands without definable waveforms.

Table 3. Results of Multivariate Logistic Regression Analysis Showing the Correlation of Artifact Presence with Anatomical and Sonographical Characteristics of the Stone

Variable	Odds Ratio	95% CI*s for Odds Ratio	P Value
Size	0.93	0.81-1.1	0.38
Location	0.52	0.25-1.1	0.086
Echo Difference	10.7	2-57.1	0.005
Posterior Shadow	0.27	0.02-3.3	0.31
Constant	0.56	-----	0.76

*CI: Confidence Interval

indistinct echogenicity or indiscrete posterior shadowing.

Indistinct echogenicity of urinary stones may be due to surrounding sonic beam-attenuating tissue. For example, it is too difficult to detect a kidney stone by sonography without marked posterior shadowing in a field of similar echogenicity to renal sinus fat.

In a study by Kimme-Smith et al., it was revealed that real time sonography had a sensitivity of 81% and specificity of 86% for detecting renal stones.[4] Thus, it is clear that if an additional characteristic is found in association with urinary stones, it will be possible to eliminate the rate of false positive and negative findings moreover to avoiding unnecessary imaging such as CT scanning.

Rahmouni and his colleagues stated that they observed twinkling artifact in hyperechoic regions of 42 out of 140 cases (30%) with calcification of the prostate, testis, kidney, liver, gall bladder and breast. They also expressed that the generation of this artifact was not affected by velocity, wall filter, probe frequency and focal depth.[2] Similarly, unlike Lee et al.,[1] we were not able to find a significant relationship between the generation of twinkling artifact in a PRF value of 1563 Hz and different filters or even focal zones. However, the artifact was observed in 78.3% of the urinary stones. The difference in the frequencies of the artifacts was probably related to the more advanced generation of sonography instrument we applied in our study.

Chelfouh et al. indicated the sensitivity and specificity of the absence of twinkling artifact—a marker of calcium oxalate monohydrate urinary stone—as 60% and 83%, respectively.[5]

In conclusion, according to the high frequency of twinkling artifact, which was strong in more than half the cases, it is useful in detecting urinary stones, therefore we recommend paying more attention to this artifact in order not to miss the diagnosis.

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Fig. 3. A 48-year-old man with a 9.8 mm stone in the lower calyce of the left kidney.

A. Sonogram shows an echogenic lesion with slight echo difference between the lesion and adjacent tissues and a discrete posterior shadow.

B-D. Color Doppler sonogram shows twinkling artifact from stone. PRF changes do not affect the artifact intensity significantly.

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