

Color doppler twinkling artifact: A misunderstood yet useful sign

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Abstract: Color Doppler scintillation or twinkling artifact represents a phenomenon with unclear underlying causes that appears as a rapid alternation of color immediately behind a stationary echogenic object, giving it a false appearance of movement. This sign has proved useful in detecting certain clinical conditions, especially in urolithiasis, since it enhances diagnostic accuracy and sensitivity; therefore, every radiologist should be fully acquainted with this radiologic sign.

Keywords: Artifact, Lithiasis, Radiology, Color Doppler ultrasound.

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Imaging Appearance

The “twinkling artifact”, also called “color comet-tail artifact” is visible on Color Doppler Ultrasound (US) examinations as a rapid alternation of color immediately behind a stationary echogenic object, acquiring a false appearance of movement. (Figure 1). It may also manifest when power Doppler and Spectral Doppler scanings are performed, appearing as a sign of heterogeneous spectral expansion composed of adjacent vertical lines with no waveform at all^(1,2). Some authors have considered this artifact as an imaging sign, because of its effectiveness and usefulness in promoting pathology detection, especially lithiasis.

Brief History

The twinkling artifact was first described in 1996 by Rahmouni et al., as a sign generated by a highly reflective object that, despite being stationary, would generate a rapid alternation between red and blue when interrogated with colour Doppler sonography⁽³⁾.

Meaning

Nature of the scintillation remains poorly understood. The presence of a narrow-band noise due to fluctuations in the circuits of Doppler ultrasound equipment has been proposed as the underlying cause of this sign⁽¹⁾. It is mainly observed on rough,

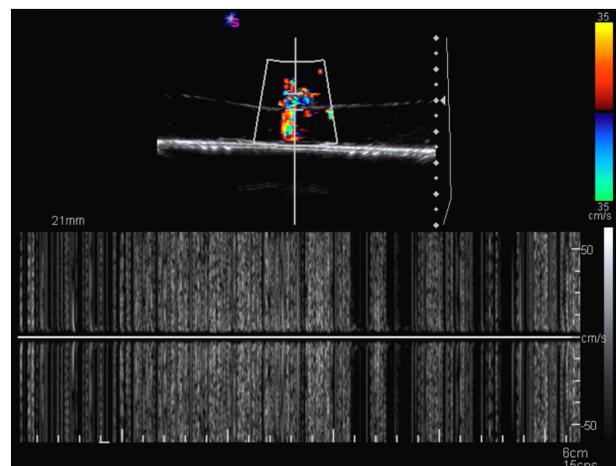


Figure 1. We used a small stone under water placed on a gelatin substrate to demonstrate the twinkling artifact and its representation on spectral Doppler analysis, appearing as a typical sign of heterogeneous spectral expansion composed of adjacent vertical lines with no waveform at all.

hyperechoic, irregular surfaces with multiple cracks which cause a strong reflection of incident ultrasound waves and multiple internal reflections which widen the spectrum. The greater the surface roughness, the greater the artifact^(1,2). It represents a phenomenon

highly dependent on equipment used as well as on machine parameters such as transducer frequency, pulse repetition frequency (PRF), gray-scale gain, color-write priority and the position of focal zone. In some cases, nonlinear and complex relations may be observed^(1,4). Some authors recommend to increase both wall filter and PRF so as to reach a diminished representation of normal vascular flows, thus having the artifact highlighted⁽²⁾. It has also been shown that focal zone position improves artifact visualization (i.e., when placed at the same level or posterior to the target structure)⁽⁴⁾. The twinkling artifact can be detected in calcified areas of various tissues, thus representing a remarkably useful tool in the diagnosis and monitoring of diverse clinical entities⁽⁴⁾.

Differential Diagnosis

Since its initial description, this artifact has proven useful, particularly in uro- and nephrolithiasis (Figure 2a). However, it can be found in other diseases such as choledocholithiasis and foreign bodies, among other entities (Table I)^(1,2,4). In the study by Mos C et al., a US sensitivity of 73.27% is reported in diagnosing urolithiasis in a comparative study with radiography, urography and CT examinations⁽⁵⁾, whereas Park SJ et al., have documented the usefulness of the scintillation artifact in confirming the presence of small stones (86% of cases)⁽⁶⁾. The twinkling artifact can be found in 95.5% of patients with nephrolithiasis versus 9% of controls (patients with no history of urolithiasis referred for abdominal ultrasound, without kidney or urinary pathologies); therefore, this ultrasonographic sign has proved helpful in the diagnosis of calculus not observed on B mode sonography⁽⁷⁾. This capacity is especially useful in ureterovesical junction stones,

when the ureter may not appear distended, even with ureteral jet presence on color Doppler sequences, and the small stone is difficult to be visualized on B-mode due to the existence of adjacent echogenic tissue (Figures 2b and 3)⁽²⁾.

Table I. Entities that may present ultrasound scintillation artifact.

Biliar tract	Intra- and extrahepatic biliary lithiasis.
Kidneys and urinary tract	Renal and ureteral lithiasis Nephrocalcinosis
Pancreas	Ductal and parenchymal calcifications in chronic pancreatitis
Liver and Spleen	Granulomatous Diseases
Gallbladder	Adenomyomatosis Biliary sludge
Others	Small calcifications in the cyst wall Vascular calcification Appendicoliths Surgical Clips Foreign bodies

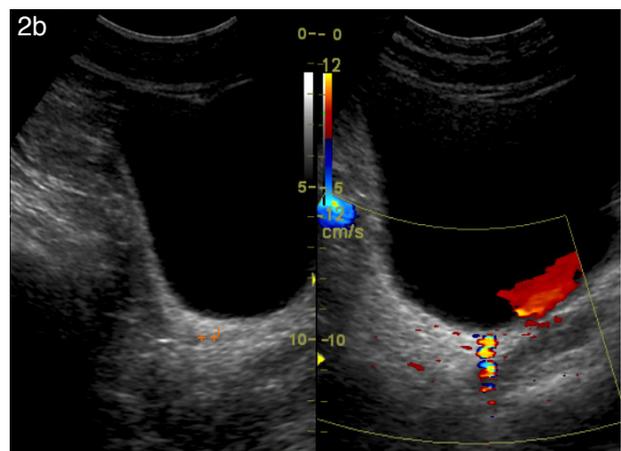
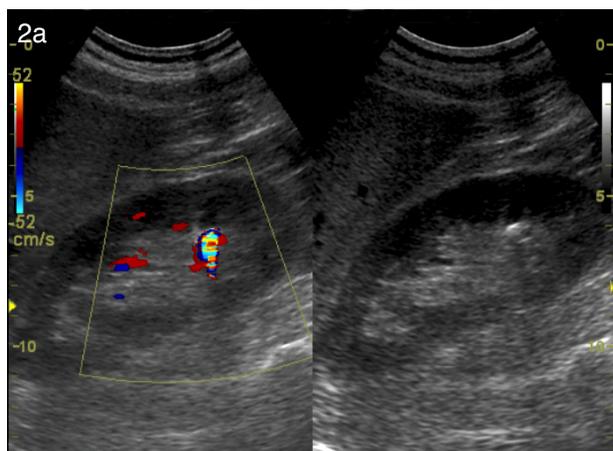


Figure 2. Scintillation artifact in nephrolithiasis (a). Echogenic mass is observed in right renal sinus with low-level posterior shadowing artifact, evidenced by color Doppler imaging. In the same patient, ureteral jet without dilatation of ureter may be observed, b) findings are not indicative of urolithiasis. However, a twinkling artifact is demonstrated on color Doppler sonography, thus providing an easy diagnosis. Calculi may be observed between calipers.



Figure 3. US sequence showing echogenic mass in the right renal sinus without posterior shadowing artifact. The twinkling artifact becomes evident on colour Doppler sonography, and remains visible despite an increased PRF, unlike the renal vasculature, whose representation has already disappeared.

Discussion

Ultrasound (US) currently represents the first-line imaging technique for the diagnosis of diseases such as urolithiasis, due to its availability, for being a radiation-free method and also because of the improvements in spatial resolution that ultrasound machines have achieved with the introduction of new technologies. Calculi are easily diagnosed when their echogenicity is different from that of the surrounding tissues, and cast a posterior acoustic shadowing. Nevertheless, many of these stones are surrounded by echogenic tissue, e.g., in the renal sinus, and no posterior shadowing is generated due to their small size; in this case, the twinkling artifact becomes a useful diagnostic imaging tool. To have a thorough knowledge and understanding of this sign allows the radiologist to properly use it in order to increase the test sensitivity.

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