Twinkling Artifact in Color Doppler Imaging of the Orbit

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Objective. To show an artifact related to color Doppler flow imaging of the orbit. Methods. Three patients with strongly reflective structures in the orbit were selected from those routinely referred by clinicians for color Doppler ultrasonography of the orbit. Gray scale and color flow images were obtained with a 7.5-MHz linear array probe for a region with strongly reflective structures. A spectral display was acquired to confirm the presence of blood flow. Results. One patient had a metallic foreign body just behind the bulb; another had calcification within the irregular mass of phthisis bulbi; and the third had hyperechoic drusen in the periphery of the intraocular melanoma. The color mosaic, suggesting the presence of blood flow, was detected beyond all hyperechoic structures. Close vertical bands with no outer wrapping were detected in the spectrum display, obtained by placing the sample volume on the region of color flow. The artificial color flow was recognized as a color Doppler twinkling artifact. Conclusions. The color flow beyond the strongly reflecting structures in the orbit might be mistakenly interpreted as real blood flow if an examiner is not familiar with the artifact. It should prompt further imaging with spectral Doppler ultrasonography. Key words: color Doppler ultrasonography; artifact; orbit; blood flow.

Case Reports

Case 1
A 44-year-old man had an injury to the left eye from a filing of metal. Plain radiography and computed tomography at admission (Fig. 1A) showed a foreign body...
within the orbit, just behind the bulb. Gray scale and color Doppler ultrasonography was subsequently performed to evaluate blood flow in the orbital vessels of the injured side. The foreign body located in the central part of the optic nerve was shown as a hyperechoic area with an anechoic acoustic shadow extending along the course of the optic nerve (Fig. 1B). The color flow was detected on color Doppler imaging in the ophthalmic and central retinal arteries as well as in the short posterior ciliary arteries. The Doppler sample volume was placed on the color image of the examined vessels for measurement of flow velocities. In all arteries except the central retinal artery, the velocity waveform appeared normal. In the region of the central retinal artery, the spectrum was shown as close vertical bands with no outer wrapping (Fig. 1C). Additionally, treble squeaks were detected in the audio mode.

Case 2
A 24-year-old woman was admitted to the hospital because of acute pain in the right orbit. She had undergone right optic nerve glioma resection 6 years before. An ultrasonographic examination was ordered for exploration of the orbital space. Polycyclic masses with a few hyperechoic calcifications and acoustic shadows beyond them were found in the right eye, which was smaller than the left eye. Color Doppler ultrasonography showed mixed color dots within and just beyond the hyperechoic calcifications (Fig. 2A). The sample volume was placed on the color dots to confirm the presence of blood flow. Close vertical bands with no outer wrapping were noticed in the spectrum mode (Fig. 2B). Additionally, treble
squeaks were detected in the audio mode, which enabled the sonographer to recognize artificial color flow. The mass was diagnosed as phthisis bulbi with a calcified lens inside.

**Case 3**

In a 73-year-old woman thought to have choroidal melanoma, color Doppler ultrasonography and computed tomography were performed. The tumor was detected with both techniques. Additionally, a small, hyperdense calcification was shown in the optic disc. A hyperechoic area was also found within the optic disc on ultrasonography (Fig. 3A). It was recognized as optic disc drusen. With Doppler imaging, color dots were shown just beyond the drusen (Fig. 3). Spectral Doppler imaging showed the same findings as in cases 1 and 2 (Fig. 3B).

**Discussion**

Our cases show that echoes received by the transducer and imaged by an ultrasonographic machine as color flow are not always related to moving objects such as red cells in the vessels. It is commonly known that artifactual colors can originate from slow tissue motion imperfectly eliminated by the clutter rejection filter, from motion caused by the probe, or from erroneous velocity estimates from Doppler signals with low signal-noise ratios.8–12

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**Figure 2.** A, Color Doppler sonogram showing color dots behind calcifications within the irregular hyperechoic mass (M) of phthisis bulbi (arrowheads). The color suggests the presence of blood flow. B, Sample volume placed on the color flow showing the spectrum consisting of close vertical stripes with no outer wrapping. This confirms that the color flow is an example of a twinkling artifact.

**Figure 3.** A, Color Doppler sonogram showing hyperechoic drusen (thin arrow) and intraocular melanoma lateral to the optic nerve disc (thick arrow). The color flow is shown behind the drusen and in the periphery of the tumor (arrowheads). B, Twinkling artifact shown seen behind the drusen. The Doppler spectrum shows vertical bands without outer wrapping. The real blood flow was detected at the base of the tumor (spectrum not shown).
This series, however, enlarges the body of evidence that artifactual color may also appear behind strongly reflecting structures with rough surfaces. This phenomenon was first described as a "twinkling artifact" by Rahmouni et al. They observed that parenchymal calcifications and bladder or gallbladder calculi were sources of a rapidly changing mixture of red and blue. They used spectral Doppler ultrasonography to confirm the presence of flow. The sample volume, placed on that color mosaic, displayed parallel vertical bands on both sides of the baseline with no outer wrapping in the velocity-time base. They also reported that treble squeaks could be heard in the audio mode. Additionally, Rahmouni et al performed several experiments, which showed the twinkling artifact behind granular structures such as sodium chloride, iron filings, emery paper, and ground chalk. The artifact was also shown behind a neurosurgical coil within a cerebral aneurysm, encrusted ureteral stents, and urinary calculi. To our knowledge, however, this color pattern had not been observed during orbital examination.

The time of ultrasonographic examination of the orbit should be kept as short as possible, because ultrasound-induced temperature increases within the ocular tissue are of important clinical and ethical concern. The acoustic outputs from ultrasonic scanners in clinical use have continued to increase, placing greater responsibility on the user for exposure control and risk-benefit assessment. Therefore, the sonographer usually quickly performs ultrasonographic imaging of the orbit, and blood flow is frequently evaluated only by means of color Doppler imaging. However, if only color imaging is used, the investigator should be aware that the twinkling artifact can be misinterpreted as blood flow. Detection of a color mosaic, when strongly reflecting structures in the orbit are present or suspected, should prompt further imaging with spectral Doppler ultrasonography, particularly if therapeutic decisions hinge on criteria based on the presence of blood flow within the tissue.

References


