

## Detection of Normal Intratesticular Perfusion Using Color Coded Duplex Sonography Obviates Need for Scrotal Exploration in Patients with Suspected Testicular Torsion

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**Purpose:** Although color coded duplex sonography is useful for visualizing testicular perfusion in patients with clinical suspicion of testicular torsion, fear of overlooking the condition itself remains. Thus, routine scrotal exploration in every patient with acute scrotal pain is common at many centers. We assessed the efficacy of color coded duplex sonography in predicting the need for scrotal exploration in patients with clinical suspicion of testicular torsion.

**Materials and Methods:** We prospectively assessed the diagnostic value of color coded duplex sonography in 236 patients (median age 13 years, range 0 to 53) with clinical suspicion of testicular torsion between 1995 and 2012. All patients were evaluated by sonography and subsequently underwent exploration, whereby the surgeon was blinded to the ultrasound results. The sensitivity, specificity, and positive and negative predictive values of color coded duplex sonography for diagnosing testicular torsion were calculated based on preoperative ultrasound findings, and compared to the final diagnosis after surgical exploration.

**Results:** Testicular torsion was the most common cause of impaired intratesticular blood flow (119 cases, 50.4%), followed by torsion of the testicular appendages (82, 34.8%), epididymo-orchitis (18, 7.6%) and various other conditions (17, 7.2%). The sensitivity, specificity, and positive and negative predictive values of color coded duplex sonography for detecting testicular torsion were 100%, 75.2%, 80.4% and 100%, respectively.

**Conclusions:** Our data provide evidence that routine surgical exploration is no longer justified in patients with clinical suspicion of testicular torsion if color coded duplex sonography has revealed normal intratesticular perfusion.

**Key Words:** scrotum, sensitivity and specificity, spermatic cord torsion, ultrasonography

DIFFERENTIAL diagnosis of acute scrotum is still a challenge, especially in children. Although clinical features may differ between the most common acute scrotal pathologies, several authors have reported similar findings in testicular torsion and its differential diagnoses.<sup>1-10</sup> Since color coded duplex sonography became available, a large number of mainly retrospective studies have been carried out to investigate the

reliability of this method as a noninvasive diagnostic tool in assessing scrotal pathology with a focus on testicular torsion.<sup>1-3,6,8,9,11-24</sup> However, the findings have been controversial, with some authors claiming that color coded duplex sonography is a useful tool for decreasing the number of patients undergoing scrotal exploration, and others—despite using modern color coded duplex sonogra-

### Abbreviations and Acronyms

CCDS = color coded duplex sonography

EO = epididymo-orchitis

NPV = negative predictive value

PPV = positive predictive value

TT = testicular torsion

TTA = torsion of testicular appendage

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phy—performing surgical exploration in every case of acute scrotum.

In the largest multicenter study carried out so far 919 boys with acute scrotum were investigated prospectively.<sup>17</sup> Of these patients 208 were suffering from testicular torsion, although intratesticular perfusion was missing in only 76% of these patients. This finding appears to be a weak point concerning the use of CCDS. In some cases sustained testicular perfusion has been wrongly assumed in the early phase of torsion or partial torsion, resulting in a misdiagnosis of false-positive intratesticular flow.<sup>13,17</sup> It is true that modern CCDS offers the possibility of identifying low velocity vascular flow in certain anatomical structures. However, its sensitivity and specificity are not 100%. In previous series a sensitivity of 50% to 100% and a specificity of 0% to 100% were reported for CCDS in patients with testicular torsion.<sup>9,13,15,18,20–22</sup> However, an essential factor in calculating sensitivity and specificity is the final determination of the underlying diagnosis. In this respect only some studies have been based on scrotal exploration.<sup>3,7,9,16,24</sup> Other authors have used clinical classification of the etiology.<sup>4,23,25,26</sup>

We prospectively evaluated the diagnostic accuracy of CCDS in assessing suspected testicular torsion in 236 patients. The surgeon was blinded to the preoperative CCDS results, which were compared to the intraoperative findings after subsequent surgical exploration.

## MATERIALS AND METHODS

### Study Design and Participants

The study was performed as a prospective diagnostic study and conducted at a tertiary care university hospital. Our study fulfilled all ethical considerations and was approved at the beginning of patient enrollment in 1995. Due to imminent ethical requirements, the study was reviewed once more and approved by the local university ethics committee in 2011.

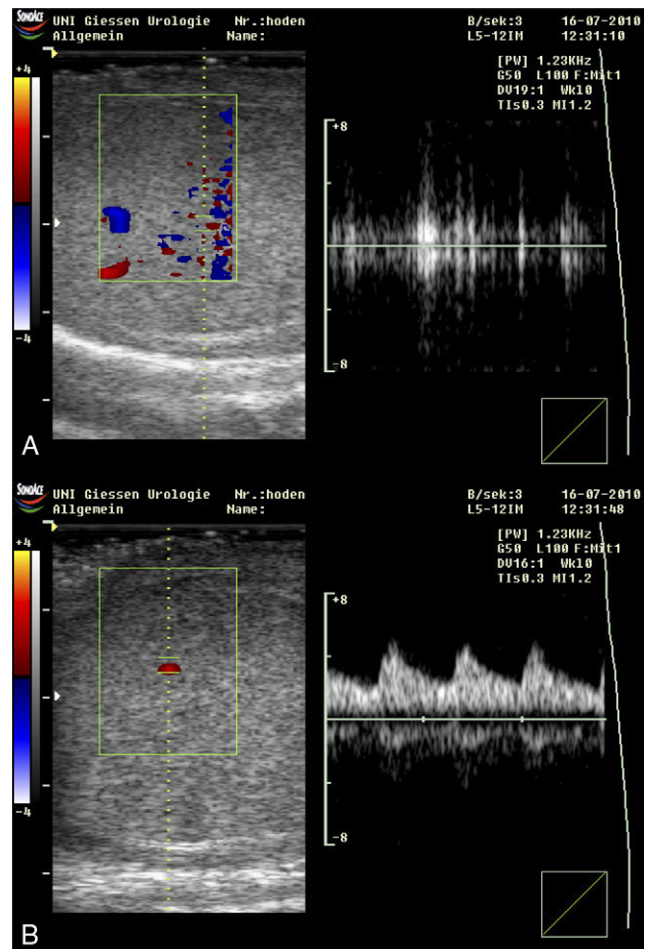
A total of 236 patients (median age 13 years, range 0 to 53) were prospectively enrolled from 1995 to 2012. All patients were referred to us with suspicion of testicular torsion by urologists, pediatricians, general practitioners or emergency physicians. Thus, surgical exploration was indicated. Standardized forms were used to document patient history and CCDS examination. A senior urologist who was experienced in scrotal ultrasound performed CCDS during the initial triage.<sup>23,26</sup> This evaluation was done parallel to ongoing preparations for surgery, whereby the estimated time needed for additional investigation was less than 15 minutes in each case.<sup>16,19</sup> All patients/parents signed a written informed consent document, and all patients underwent subsequent scrotal exploration.

### CCDS Measurements

CCDS imaging was performed on the affected and unaffected testis using a high-frequency (7.5 to 10 MHz) linear transducer (Combison® 420, Kretz Medical, Kraichtal, Germany, Pro Focus™, BK Medical, Quickborn, Germany or SA 8800 MT, Sonoace GmbH, Marl, Germany).<sup>16,21</sup> Spermatic cord perfusion and intratesticular perfusion were recorded. Power and threshold settings were adjusted to optimize detection of low volume and low velocity flow, including the detection of diastolic flow.<sup>15</sup> For small children a special filter setting was used to detect flow speeds less than 3 cm per second. Color gain was decreased to just below the noise level to minimize the number of artifacts that might cause misinterpretation (fig. 1). Central arterial and venous flow intensity, especially the systolic peak velocity, was detected in both testes and compared. Only an absent or diminished intratesticular flow signal in comparison to the healthy contralateral testis was considered impaired and thus pathological.<sup>16,21</sup> Before surgical exploration the examiner classified the findings as “normal” or “impaired” intratesticular perfusion.

### Outcomes and Data Analysis

All patients subsequently underwent scrotal exploration by the urologist on duty, who was blinded to the CCDS



**Figure 1.** A, high color noise with irregular signals. B, successful detection of intratesticular perfusion after decrease of color noise.

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