# The Relative Merits of Doppler Sonography in the Evaluation of Patients with Clinically and Scintigraphically Suspected Testicular Torsion*

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## Abstract

**Background:** Since the early 1970s testicular scintigraphy has been used to diagnose the cause of acute scrotal pain. The advent of Doppler sonography further enhances diagnosis by providing simultaneous real-time scrotal imaging with superimposed testicular blood flow information.

**Objectives:** To assess the diagnostic value of Doppler sonography in patients with acute scrotal pain and scintigraphic findings suggestive of testicular torsion.

**Methods:** Seventy-five patients with acute scrotal pain underwent testicular scintigraphy and Doppler sonography. All patients who had scintigraphic findings suggestive of testicular torsion were included in the study and their files were retrospectively reviewed.

**Results:** Twenty-seven patients had scintigraphic findings suggestive of testicular torsion. Radionuclide scintigraphy accurately detected all cases of testicular torsion. However, abscess, hematoma, hydrocele and other conditions simulated testicular torsion on scintigraphy, lowering the test specificity. These pathologies were clarified by Doppler sonography that was 95% specific and 86% sensitive for testicular torsion.

**Conclusions:** Doppler sonography should be used as the first-line modality in the evaluation of patients with suspected testicular torsion. Scintigraphy should be performed only in certain settings of equivocal sonographic findings to prevent false negative sonographic diagnosis.

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Testicular torsion is one of the most common urologic emergencies, with a reported incidence of one in 4,000 males under the age of 25 years [1]. Testicular torsion requires early diagnosis and prompt surgical treatment for testicular survival, and unless managed aggressively it may result in testicular necrosis after as little as 4 hours of ischemia. To avoid delay in diagnosis, immediate surgical exploration based on the clinical history and physical examination has been advocated in order to maximize testicular salvage. However, the clinical presentation of various disease states may overlap and this approach comes at the expense of unnecessary surgery in many patients. Therefore, an early differential diagnosis of acute testicular torsion from epididymitis or orchitis is crucial since the latter conditions can be treated conservatively. Several imaging modalites are used for the diagnosis of testicular torsion. Testicular scintigraphy with Tc-99m pertechnetate has traditionally been used to diagnose the cause of acute scrotal pain. This method is a rapid, non-invasive and highly accurate technique with a reported sensitivity approaching 100% [2–7]. The common hallmark of testicular torsion on scintigraphy is decreased perfusion to the symptomatic ischemic testicle and the appearance of an intrascrotal photopenic lesion. However, when recognized on radionuclide scintigraphy, a photopenic intrascrotal lesion is not pathognomonic for testicular torsion and may also be seen with various other intrascrotal pathologies, thereby lowering the specificity of the test [7–9]. In some cases it may falsely lead to unnecessary emergency surgical exploration.

Sonography is increasingly used to evaluate patients with acute scrotal pain, and in many cases it can directly visualize the pathologic changes suspected on clinical examination. The emergence of Doppler sonography in the last decade further enhances the diagnostic role of sonography since it provides simultaneous real-time scrotal imaging with superimposed blood flow information to assess testicular perfusion [10–16]. The aim of this retrospective study was to evaluate the relative merits of Doppler sonography in the differentiation of testicular torsion from other intrascrotal pathologies that simulate testicular torsion on scintigraphy, in order to prevent unnecessary surgical exploration in this group of patients.

## Patients and Methods

From January 1994 to November 2001, radionuclide scintigraphy and Doppler sonography were concurrently performed in 75 male patients with acute scrotal pain. The study group comprised 27 patients (age range 1–49 years) with an intrascrotal photopenic lesion on testicular scintigraphy, indicating the possibility of testicular torsion. The diagnosis of testicular torsion was made at surgery. Negative diagnosis of testicular torsion was verified after hospital discharge by outpatient follow-up that indicated the clinical absence of torsion.

Testicular scintigraphy was performed with the patient lying supine after an intravenous injection of 10–15 mCi of Tc-99m pertechnetate in adults, and proportional fractionation for pediatric patients. A gamma-camera with 15% window set at 140 kev, with a low energy parallel-hole collimator positioned over the scrotum was used. Sequential 2 second flow images were obtained for the first 60 seconds, followed by immediate static images (600 kc/image). Each scan was interpreted by two experienced physicians. The scans included in the study were those interpreted as having an abnormal pattern suggestive of testicular torsion or in which testicular torsion could not be excluded. The scintigraphic patterns included decreased perfusion to the symptomatic testicle, which was confirmed on the static images and was thought to represent

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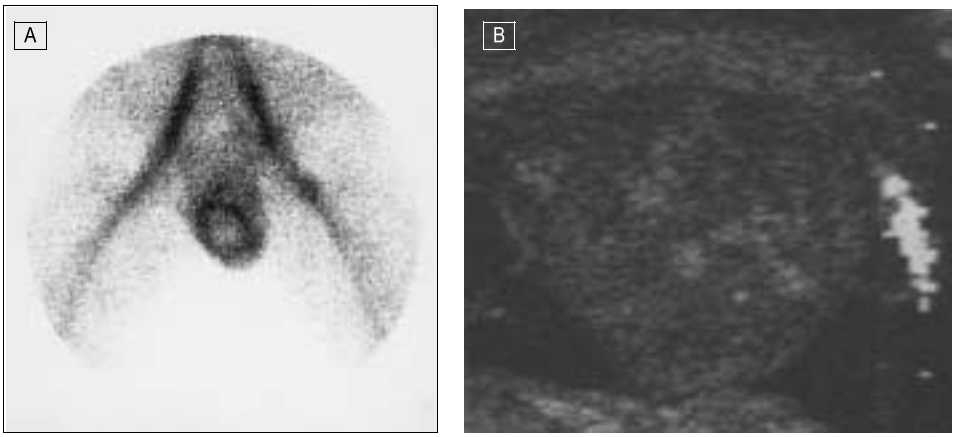


**Figure 1** **[A]** Scintigraphy of a patient with testicular torsion shows increased uptake around a photopenic area of the necrotic testicle ("bull's eye" sign). **[B]** Doppler sonography shows complete absence of testicular blood flow in a patient with testicular torsion.

acute testicular torsion, or a hyperemic response seen as a hot rim around a photopenic lesion that was assumed to represent a late phase ("missed") testicular torsion [Figure 1A].

Within a few hours, either before or following scintigraphy, Doppler sonography was also performed using a 7–10 MHz linear transducer for both imaging and Doppler analysis. Each patient was examined in a supine position and the scrotum was coated with a copious amount of aqueous gel. Longitudinal and transverse scans were obtained. Intratesticular, epididymal and peritesticular blood flow were assessed and compared to the contralateral asymptomatic testis. Each sonographic examination was interpreted by two experienced physicians. The sonographic pattern of testicular torsion demonstrated absent testicular blood flow in the symptomatic testis [Figure 1B].

## Results

Twenty-seven patients had an intrascrotal photopenic lesion on testicular scintigraphy indicating the possibility of testicular torsion. Surgery was performed in 11 of the 27 patients and the final diagnosis was made based on histopathologic results, which revealed testicular torsion in 7 patients, intrascrotal abscess in 2, torsion of the appendix testis with reactive hydrocele in 1 and testicular embryonal cell carcinoma in 1 patient. Sixteen patients were managed conservatively and their final diagnosis was based on the clinical findings, sonographic features and follow-up as follows: epididymo-orchitis with or without reactive hydrocele in 4, atrophic but viable testis in 1, post-hernioplasty intrascrotal hematoma in 1, post-traumatic intrascrotal hematoma in 1 and cryptorchidisim in 2; in 7 patients there was no explanation for the scintigraphic findings.

**Table 1.** Results of Doppler sonography

| Sonographic findings | Testicular torsion | |
|---|---|---|
| | Present | Absent |
| Testicular torsion | True positive=6 | False positive=1 |
| No testicular torsion | False negative=1 | True negative=19 |
| Total | 7 | 20 |

Scintigraphy accurately identified all seven patients with testicular torsion (seven true positive cases). However, 20 of the 27 patients who were suspected of having testicular torsion on scintigraphy had other causes (or no explanation) for the area of decreased relative vascularity which was mistaken for an avascular testicle (20 false positive cases). In contrast, Doppler sonography accurately identified 19 of the 20 patients without testicular torsion (19 true negative cases) and was found to be 95% specific for testicular torsion in this group of patients. In all 19 patients, Doppler sonography easily depicted intratesticular blood flow. Only one patient who was suspected of having testicular torsion on scintigraphy was also falsely diagnosed by sonography as having testicular torsion. Surgical exploration in this patient found an intrascrotal abscess as well as a viable testicle. Furthermore, sonography accurately prevented unnecessary surgery in 16 of the 27 patients (59%) who were suspected of having testicular torsion on scintigraphy, including all patients with inflammatory diseases or other conditions that were managed conservatively. One patient was operated on despite negative sonography because of clinical deterioration and uncertain diagnosis and was found to have torsion of the appendix testis with unusually large and loculated reactive hydrocele. However, the testicle was viable and well perfused, and this patient was considered as a true negative by sonography. All other patients had surgical conditions, including testicular torsion, abscess and tumor, and they underwent surgery. On the other hand, Doppler sonography was only 86% sensitive for testicular torsion, identifying 6 of 7 patients with torsion. One patient with testicular torsion was falsely interpreted as having acute orchitis [Table 1].

## Discussion

Acute scrotal pain presents a major diagnostic and therapeutic clinical challenge. The early differentiation of acute testicular torsion, which is a surgical emergency, from other diseases such as epididymitis or orchitis, which require conservative medical treatment, is most important.

Since the early 1970s scrotal radionuclide imaging with Tc-99m pertechnetate has been used to diagnose the cause of acute scrotal pain. Its utility lies in its ability to differentiate acute testicular torsion from inflammation, with a reported sensitivity and specificity exceeding 95% for detecting testicular torsion, especially if the examination is performed within 24 hours of onset of symptoms [2–7]. Inflammation and infection produce increased flow and hyperemia on the involved side. In contrast, testicular torsion with obstruction of spermatic vessels and testicular ischemia within a few hours of onset results in decreased delivery of radiotracer, producing a photopenic lesion. In late ("missed") torsion, increased perfusion is demonstrated on the periphery of

the photopenic testicle as a result of increased scrotal blood flow from the pudendal arteries [7]. Although the intrascrotal photopenic area is a characteristic scintigraphic feature of testicular torsion, either in the early or late phase, it is not a pathognomonic sign. Intrascrotal photopenic lesions have also been reported in cases of hematocele, hydrocele, spermatocele, scrotal hernia, testicular prosthesis and post-orchiectomy [2–7]. In cases of late-phase ("missed") testicular torsion, abscess, hematoma, necrotic testicular tumor or testicular infarction due to infection or vascular disease, a photopenic intrascrotal area is usually surrounded by a hyperemic rim producing the "bull's eye" sign on radionuclide scintigraphy [8,9].

More recently, Doppler sonography of the scrotum has gained acceptance for the diagnosis of testicular torsion, combining morphologic imaging with the ability to assess testicular blood flow [10–16]. The purpose of performing Doppler sonography is not solely to exclude an ischemic testis but to search for another cause for testicular pain, which is where sonography is superior to scintigraphy [16].

Previous comparative studies have shown that both methods are sufficiently accurate to evaluate patients with suspected testicular torsion [17,18]. The specific purpose of the present study was to assess the diagnostic value of Doppler sonography in patients with acute scrotal pain and scintigraphic findings suggestive of testicular torsion. Because scintigraphy is limited by its poor resolution, we assumed that Doppler sonography would be a useful imaging technique to differentiate testicular torsion from other intrascrotal diseases that simulate testicular torsion on scintigraphy, thereby preventing or minimizing unnecessary surgical explorations in this group of patients.

In accordance with previous reports [2–7], we found that Tc-99m pertechnetate radionuclide scintigraphy accurately detected all patients with testicular torsion. In contrast, scintigraphy was not specific for this diagnosis. In the patients studied we found that Doppler sonography was 95% specific for testicular torsion, dramatically reducing the number of unnecessary surgical explorations in many patients with inflammatory diseases such as epididymitis or in patients with normal studies. Another advantage of sonography lies in clearly differentiating testicular diseases such as tumor from extratesticular pathologies such as hydrocele, abscess or hematoma. We found one patient with testicular torsion detected by scintigraphy and proven by surgical exploration that was missed by sonography. This concurs with the reported range of sensitivities of 82–100% for sonographic detection [16–18]. As previously reported [10–19], operator skill is an important factor during sonographic examination, and accurate results often depend on a high degree of experience of the technician or physician performing the study. However, there are several pitfalls, including inappropriate setting of the Doppler control [15,19]. Color Doppler noise or motion artifacts can erroneously be interpreted as blood flow within the testis and not all sonographic units are sensitive enough to detect the low volume and low velocity flow in testes, especially in infants. In these equivocal cases scintigraphy can be performed to improve the diagnosis and prevent the consequences of wrong diagnosis.

In conclusion, sonography should be used as the first-line investigation due to its high sensitivity and better specificity as compared to scintigraphy. In addition, sonography is often more available than scintigraphy, especially at night. By providing morphologic and blood flow information, it can differentiate testicular torsion from other testicular or paratesticular causes for the acute scrotum, thereby preventing or minimizing unnecessary surgery in patients with conditions that can be managed conservatively. However, testicular scintigraphy should not be abandoned and should be used in patients with a strong clinical suspicion of testicular torsion despite a negative sonogram, or in cases where sonography is equivocal or technically inadequate.

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