Sonographic Differential Diagnosis of Acute Scrotum

Real-time Whirlpool Sign, a Key Sign of Torsion

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Objective. The purpose of this study was to prospectively investigate the role of high-resolution and color Doppler sonography in the differential diagnosis of acute scrotum and testicular torsion in particular. ***Methods.*** Patients who underwent sonography for acute scrotum between April 2000 and September 2005 were included in the study. Gray scale and color Doppler sonography of the scrotum was performed. The spermatic cord was studied on longitudinal and transverse scans from the inguinal region up to the testis, and the whirlpool sign was looked for. ***Results.*** During this period, 221 patients underwent sonography for acute scrotum. Sixty-five had epididymo-orchitis with a straight spermatic cord, a swollen epididymis, testis, or both, an absent focal lesion in the testis, and increased flow on color Doppler studies along with the clinical features of infection. Three had testicular abscesses. Sonography revealed features of torsion of testicular appendages in 23 patients and acute idiopathic scrotal edema in 19. Complete torsion was seen in 61 patients who had the whirlpool sign on gray scale imaging and absent flow distal to the whirlpool. There was incomplete torsion in 4 patients in whom the whirlpool sign was seen on both gray scale and color Doppler imaging. Nine patients had segmental testicular infarction, and 1 had a torsion-detorsion sequence revealing testicular hyperemia. In 14 patients, the findings were equivocal. There was a complicated hydrocele, mumps orchitis, and vasculitis of Henoch-Schönlein purpura in 1 patient each. Five patients had normal findings. Fourteen were lost for follow-up. ***Conclusions.*** Sonography of acute scrotum should include study of the spermatic cord. The sonographic real-time whirlpool sign is the most specific and sensitive sign of torsion, both complete and incomplete. Intermittent testicular torsion is a challenging clinical condition with a spectrum of clinical and sonographic features. ***Key words:*** acute scrotum; color Doppler sonography; segmental infarction; sonography; testicular torsion; whirlpool sign.

Abbreviations
ITT, intermittent testicular torsion

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Video online at www.jultrasoundmed.org.

Acute scrotal pain may have many causes. The more common causes are testicular torsion, epididymo-orchitis, torsion of the testicular appendages, and acute idiopathic scrotal edema. The most important aim of imaging in these patients is to rule in or out testicular torsion, which warrants emergency surgery to avoid testicular impairment. At the same time, the investigation should be specific enough to avoid unnecessary surgery. Testicular torsion can be extravaginal, intravaginal, or mesorchial. Intravaginal torsion, the most common type, occurs between 3 and 20 years of age, with an incidence of 65% between 12 and 18 years.[1] It is generally associated with a preexisting anomaly of fixation of the testis, termed "bell and clapper testis." Here the intrascrotal portion of the spermatic cord lacks posterior adhesion to the scrotum and remains surrounded by the tunica vaginalis, thus predisposing to rotation of the

testis and cord. A 12% incidence of bell clapper deformity was found in one autopsy series.[2] The horizontal lie of the testis has been linked with the bell clapper deformity in 100% of patients who have had surgery.[3–5] In most people, this anomaly is bilateral,[5] which warrants orchidopexy of the contralateral testis in cases of torsion of the testis. This procedure is necessary to avoid the risk of metachronous torsion of the contralateral testis and anorchia, the reported incidence of which is 30% to 43% of cases.[6–8] Hence, a definitive diagnosis of testicular torsion is essential even in cases with late appearance, partial torsion, or intermittent testicular torsion (ITT). Even though there are clinical signs of differentiation between the various conditions causing acute scrotum, they are not accurate. There are gray scale sonographic features of the testis and its environment in differentiating these conditions, but they fail in accuracy. High-resolution color Doppler sonography has been shown to be the most accurate and important modality in the differential diagnosis of acute scrotal pain,[9–12] but there are some difficulties encountered. Arce et al[13] and Baud et al[14] described rotation of the cord as a very useful sign of acute spermatic cord torsion. More recently, the incidence of ITT or the torsion-detorsion sequence with a varying spectrum of clinical and sonographic features has been reported by many authors.[3,4,15–18] Intermittent testicular torsion is a clinical syndrome defined by a history of unilateral scrotal pain of sudden onset and of short duration that resolves spontaneously.[15] The intensity of pain may or may not be as severe as that seen with acute torsion. The mean number of painful episodes reported is 4.3, and the range is 1 to 30 over 2 to 48 months.[3,5,16] The mean age of initial appearance is reportedly 12 years (range, 1.7 to 58 years).[3,5,17] The objective of this study was to prospectively investigate the role of high-resolution and color Doppler sonography in the differential diagnosis of acute scrotum and testicular torsion in particular, with a real-time technical modification of the sign of rotation of the cord in the form of the whirlpool sign.

Materials and Methods

All patients who had acute pain with or without swelling of the scrotum between April 2000 and September 2005 were included in the study. The ages of the patients and the clinical features were recorded. There were no laboratory investigations available at the time of sonography. High-resolution sonography and color Doppler sonography were done on all the patients with a Linear 5- to 12-MHz probe (HDI 3500 and HDI 5000; Philips Medical Systems, Bothell, WA). Gray scale imaging started in the inguinal region of the symptomatic side and extended along the spermatic cord to end in the scrotum. Both longitudinal and transverse scans were done. The following features were looked for: (1) tortuosity of the cord, (2) an acute change in the direction of the cord, and (3) the presence of the whirlpool sign. The whirlpool sign was elicited in the following manner. When tortuosity of the spermatic cord was seen, a short axis scan of the cord above the level of tortuosity was obtained. Then the transducer was moved down along the cord, and a rotation of the cord structures was looked for. If an acute rotation was seen, it was taken as a positive whirlpool sign. The location of the whirlpool sign and the axis of rotation were noted. If it was not seen, the same maneuver was repeated in all possible angles of the tortuous cord. The gray scale features of the testis and epididymis were studied. If a hydrocele was present, its nature was noted. Then the same technique was repeated with color Doppler sonography. Spectral tracing was done in appropriate situations. The same procedure was repeated on the opposite side. Those patients who did not have surgery underwent laboratory investigations.

Results

During the study period, there were 221 patients with acute scrotal pain. An overview of the diagnoses and the numbers of the cases is given in Table 1.

There were features characteristic of epididymo-orchitis in 65 patients, including a straight spermatic cord, a swollen epididymis, testis, or both, an absent focal lesion in the testis, with or without a hydrocele, and increased flow on color Doppler studies in the epididymis and testis or epididymis alone associated with clinical and laboratory features of infection or urinary tract infection, such as fever, dysuria, and leukocytosis. The disease involved the right testis in 39 (60%) patients and the left testis in 26 (40%). The age of the patients ranged from 5 months to 76 years. Four of the 65 patients underwent surgical exploration and were confirmed to have epididymo-orchitis. The rest were treated appropriately.

They were followed with clinical examination or sonography or by telephone conversation with the patient or his parents after a minimum of 8 weeks in patients with a good response and as required by clinical condition in others. During follow-up, there were testicular or epididymal abscesses in 18 patients, which were treated appropriately. All the other patients were confirmed to have normal-sized testis after 8 weeks.

Three patients in this series with scrotal pain and high fever had testicular abscesses. The testis was swollen with a large hypoechoic area. On color Doppler imaging, there was lack of flow in the hypoechoic area, whereas there was increased flow in the rest of the testis and epididymis. They underwent orchidectomy, which confirmed the diagnosis.

The sonographic diagnosis was torsion of the testicular appendage in 23 patients. These patients had a straight spermatic cord and a normal testis. There was a mass of varying size and echo pattern in relation to the head of the epididymis and upper pole of the testis. A minimal hydrocele was present in 16 (76%) patients. On color Doppler study, there was increased flow seen in the testis and epididymis in 8 patients and in the epididymis only in 15 patients. There was no flow seen in the masses in all the patients. The age of the patients ranged from 4.5 to 15 years. Five of them underwent surgical exploration, which revealed torsion of the testicular appendage in 4 and the epididymal appendage in 1. The rest of the patients were treated conservatively and followed clinically or sonographically and were confirmed to have an uneventful recovery.

Table 1. Sonographic Diagnoses

Diagnosis	No. of patients
Acute epididymo-orchitis	65
Testicular abscess	3
Torsion of appendage of testis	23
Acute idiopathic scrotal edema	19
Complete torsion of testis	61
Incomplete torsion of testis	4
Segmental infarction of testis	9
Torsion-detorsion with hyperemia	1
Equivocal features	14
Complicated hydrocele	1
Mumps orchitis	1
Henoch-Schönlein purpura vasculitis	1
Normal	5
Lost for follow-up	14
Total	221

Nineteen patients had features of acute idiopathic scrotal edema, which revealed a normal testis and edema of the scrotal wall. The age of these patients ranged from 3 days to 10 years.

Complete testicular torsion was seen in 61 patients who had the whirlpool sign in the spermatic cord on real-time gray scale imaging (Video 1) and absent intratesticular flow on color Doppler studies. On a static image, the mass of the whirlpool had the appearance of a doughnut, a target with concentric rings, a snail shell, or a storm on a weather map (Figure 1). The appearance was best seen with the transducer at different angles. The whirlpool sign was seen in a longitudinal scan of the spermatic cord in 12 (20%) patients and in a transverse scan in 20 (32%) patients. The axis was oblique of varying degrees in 29 (48%) patients. The mass of the whirlpool was seen just outside the external ring (Figure 1B), at a varying distance above the testis (Figure 1, C and D), or posterior to the testis (Figure 2 and Table 2). In 1 child of 3 months, the testis was undescended and seen in the inguinal canal. A whirlpool sign was seen close to it (Figure 3). The maximum width of the mass of the whirlpool was 20 mm. The testis and its environment had varying features on the gray scale imaging of the testis, which are summarized in Table 3. On color Doppler studies, there was no flow in the cord distal to the whirlpool and within the testis (Video 2) in 56 patients. In 5 patients, there was flow seen in the proximal part of the mass of the whirlpool and no flow in the distal part and the testis (Figure 4 and Video 3). Ages of these patients were between 3 months and 57 years. The interval between the onset of acute scrotal pain and sonography ranged from 3 hours to 5 days. A history of a previous episode of testicular pain was present in 24 (40%) patients. Eight of these 24 patients had a sonographic diagnosis of epididymo-orchitis during the previous episode. The condition involved the right testis in 14 (23%) patients and the left testis in 47 (77%). Surgical exploration was done in 48 of these patients and confirmed testicular torsion in all of them. In 40, the testis was gangrenous; therefore, ipsilateral orchidectomy and contralateral orchidopexy were done. In 8 patients, the condition of the testis improved on derotation of the cord; therefore, bilateral orchidopexy was done. Contralateral orchidopexy alone was done in 13 patients who reported late. These 13 patients were followed

clinically or sonographically and were confirmed to have a decrease in the size of the symptomatic testis, a feature taken as confirmative of torsion.

In 4 patients, the whirlpool sign was seen in the mass of the spermatic cord on both gray scale and color Doppler imaging (Figure 5 and Video 4). On color Doppler studies, the visualized vessels were seen to rotate around the central axis. Blood flow was seen in the distal cord, too. In 1 of these patients, the whirlpool sign was seen only on a dynamic real-time study, and a whirlpool mass was not seen on a static image. In these patients, the appearance of the testis was variable. In 1 patient, the testis was swollen and hypoechoic without any focal changes. On a color Doppler study, there were sparse vessels seen in the testis. In the other 3 patients, the testis

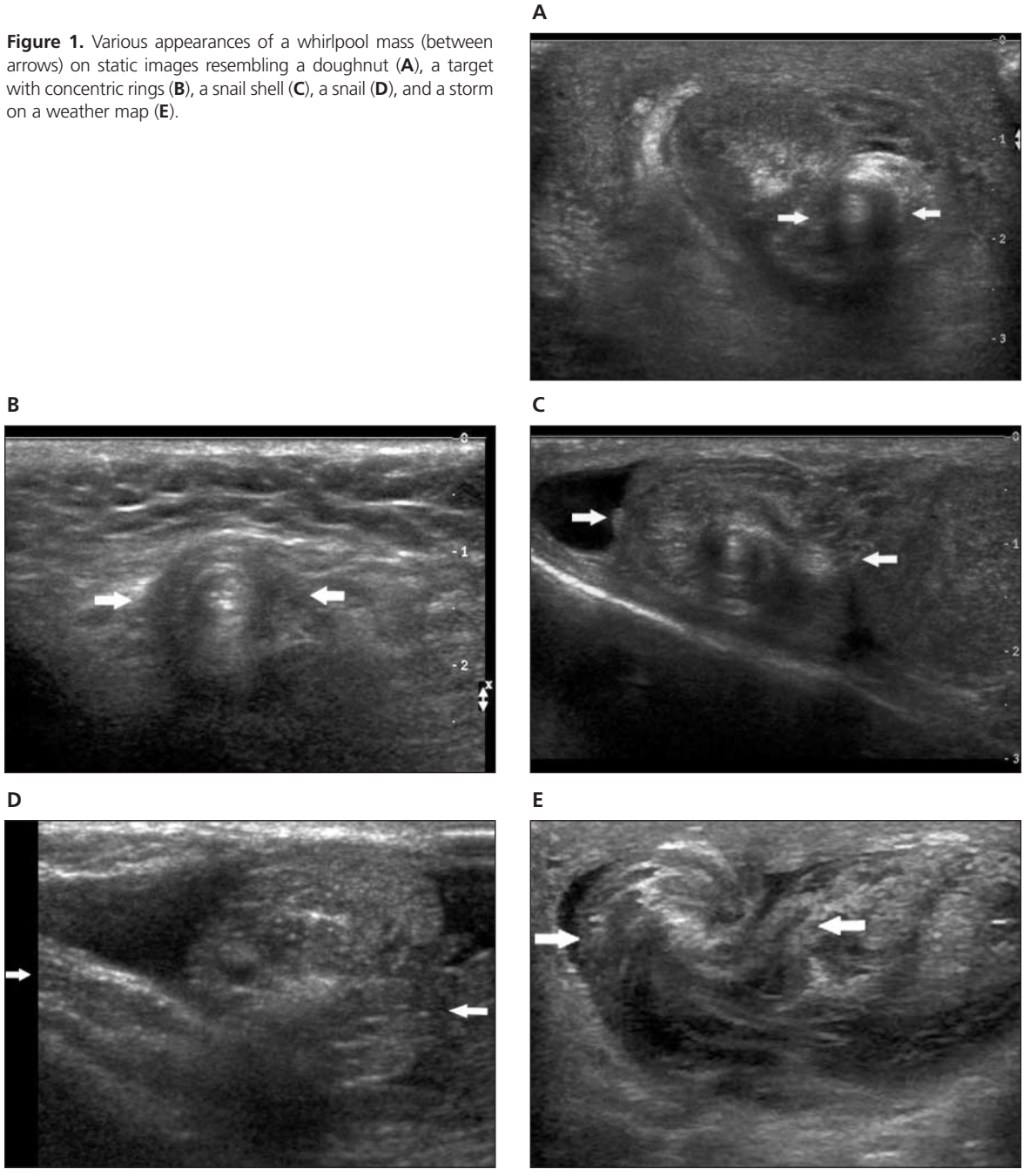


Figure 1. Various appearances of a whirlpool mass (between arrows) on static images resembling a doughnut (**A**), a target with concentric rings (**B**), a snail shell (**C**), a snail (**D**), and a storm on a weather map (**E**).

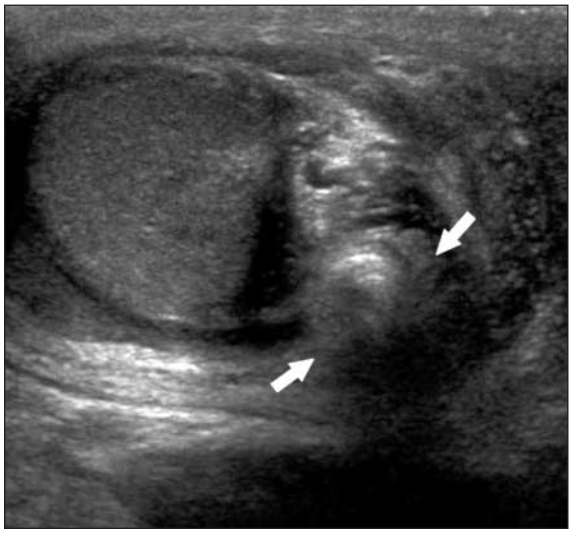


Figure 2. Longitudinal scan of a testis in complete torsion showing the testis in the horizontal axis and the whirlpool mass (arrows) posteroinferior to the testis.

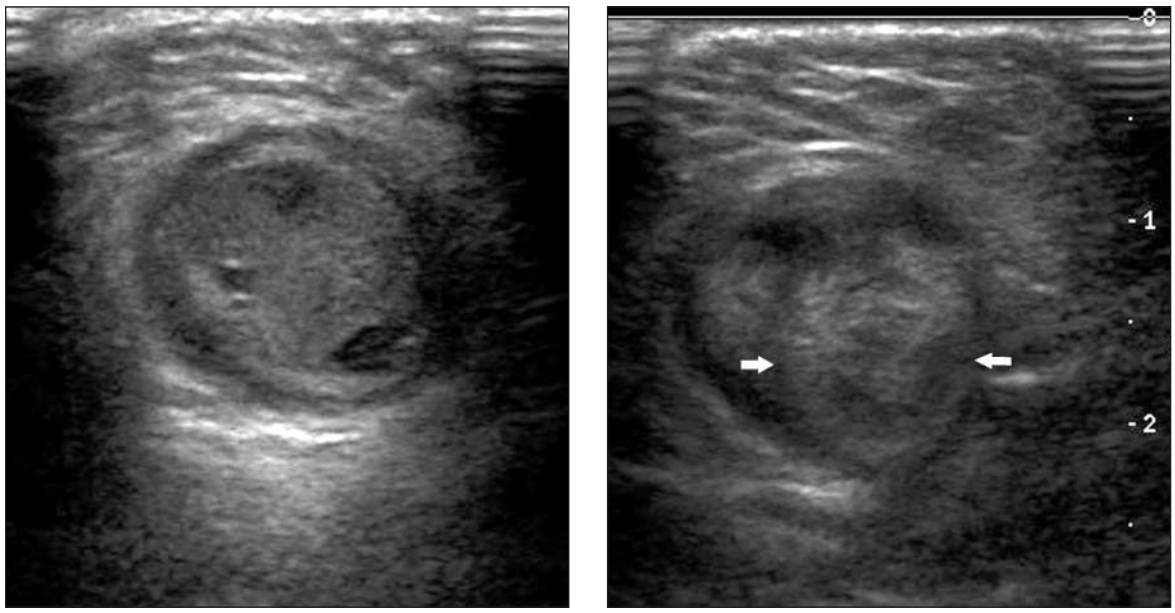
was swollen and revealed focal hypoechoic areas of varying size. On color Doppler studies, there was no flow seen in the hypoechoic areas, suggestive of segmental infarction. The rest of the testis with a normal echo pattern showed a normal flow pattern in 2 patients and hyperemia in 1. The visualized intratesticular vessels revealed a normal flow pattern on spectral tracing in all 4 patients. These 4 patients underwent surgical exploration. There was torsion of the cord (Figure 5D) in all of them. The testis was swollen with features of ischemia or segmental infarction. After detorsion of the cord, there was improvement in the appearance of the testis; therefore, bilateral orchidopexy was done. In 2 patients, the testis was normal in appearance on follow-up sonography performed 8 weeks later and also on color Doppler studies. On the initial scan, 1 of these 2 patients did not show focal changes, and the other showed hyperemia. In the other 2 patients, the testes had atrophied. These 4 patients were concluded to have partial or incomplete torsion.

Table 2. Features of the Whirlpool Sign

Feature	Complete Torsion	Incomplete Torsion
Total, n	61	4
Axis, n		
Longitudinal	12	0
Transverse	20	2
Oblique	29	2
Location, n		
Outside external ring	6	0
Above testis	43	4
Posterior to testis	11	0
Inguinal canal in undescended testis	1	0

In 9 patients, the spermatic cord was straight, and the axis of the testis was horizontal. The testis was swollen in 8 of them and smaller in 1. The testis revealed hypoechoic lesions of varying size. On color Doppler studies, there was no detectable flow in these hypoechoic areas. The area of the testis with the normal echo pattern revealed a normal arterial flow pattern in 7 patients and hyperemia in 2 (Figure 6). The epididymis was either normal or increased in size and showed increased flow on color Doppler studies in all these patients. In 1 patient, there was wide separation of testis and epididymis, suggestive of a long mesorchium. All these patients gave a history of acute testicular pain of varying but short durations, which was spontaneously relieved. They were free of symptoms for 5 hours to 10 days before scanning. None of them had fever or evidence of conditions associated with vasculitis. All these patients underwent surgical exploration, and the testis was swollen in 8 and normal in size in 1. All the testes revealed ischemic regions of various sizes suggestive of segmental infarction of the testis (Figure 6D). In 1 patient, a long mesorchium was confirmed. On needle prick, there was a subnormal bleeding response. Orchidectomy with contralateral orchidopexy was done in 7 patients. Histopathologic examination confirmed segmental hemorrhagic infarction in all of them. In 2 patients, bilateral orchidopexy was done. On follow-up, both of them had a decrease in the size of the testis. In all these patients, the features seen in the testis were suggestive of segmental infarction of the testis. None of them proved to have a preexisting vascular disease to explain the infarction. All the patients gave a history of acute testicular pain of short duration with spontaneous relief. The testis was placed horizontally in all of them. Because of all these features, the patients in this group were concluded to have segmental testicular infarction due to a torsion-spontaneous detorsion sequence or ITT.

One patient aged 23 years gave a history of 3 attacks of acute left testicular pain lasting for 5 to 10 minutes with spontaneous relief of pain starting from the age of 8 years. He sought care



A B

Figure 3. Scans of the left inguinal region showing a swollen and hypoechoic undescended testis in the inguinal canal secondary to torsion (**A**) and a whirlpool mass (arrows) just lateral to the testis (**B**).

6 hours after the most recent episode. He did not have a fever. On sonography, the spermatic cord was straight. The testis was placed along the horizontal axis. The testis and epididymis showed subtle increases in size with decreased echogenicity, which could be recognized only on meticulous comparison with the contralateral testis. On a color Doppler study, there was unequivocal increased flow seen in the left testis and epididymis (Figure 7). It was concluded to be a torsion-detorsion sequence. Bilateral orchidopexy was done after 1 month, at which time both the testes were normal.

Fourteen children had acute scrotum without fever. Sonography revealed a straight spermatic cord and a swollen testis and epididymis. On color Doppler studies, there was unequivocal increased flow in the testis and epididymis. They did not have evidence of infection or urinary tract infection. They were treated with antibiotics. Twelve of them had a normal-sized testis after 8 weeks. These patients could have had either epididymo-orchitis or ITT. In 2 of these 14 patients, the testis had atrophied, indicating that they most probably had ITT.

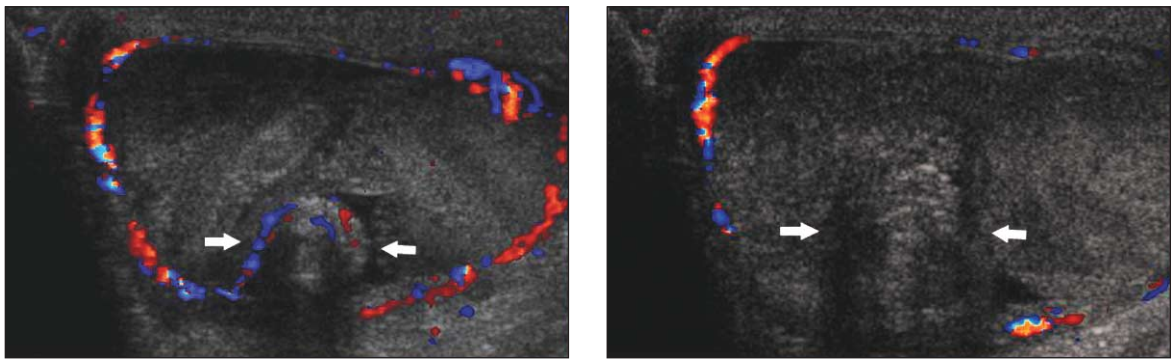
There was a complicated hydrocele alone in 1 patient. In 2 patients, there were preceding illnesses of mumps and Henoch-Schönlein purpura. In both patients, sonography showed a swollen, hypoechoic testis with hyperemia, suggestive of orchitis due to these etiologies. Sonographic findings were normal in 5 patients. Fourteen patients were lost for follow-up.

Table 3. Gray Scale Features of Torsion

Feature	Complete Torsion	Incomplete Torsion
Total, n	61	4
Whirlpool sign, n	61	4
Size of testis, n		
Swollen	58	4
Smaller	3	0
Echo texture, n		
Uniformly hypoechoic	30	1
Uniformly hypoechoic with echogenic septa	3	0
Uniform echo pattern with hypoechoic septa	5	0
Focal hypoechoic areas	23	3
Axis, n		
Longitudinal	10	0
Transverse	51	4
Hydrocele, n		
Simple	31	2
Septated	5	0

Discussion

Acute scrotal pain can have diverse causes. The most important objective of treatment of these patients is to rule in or rule out testicular torsion.

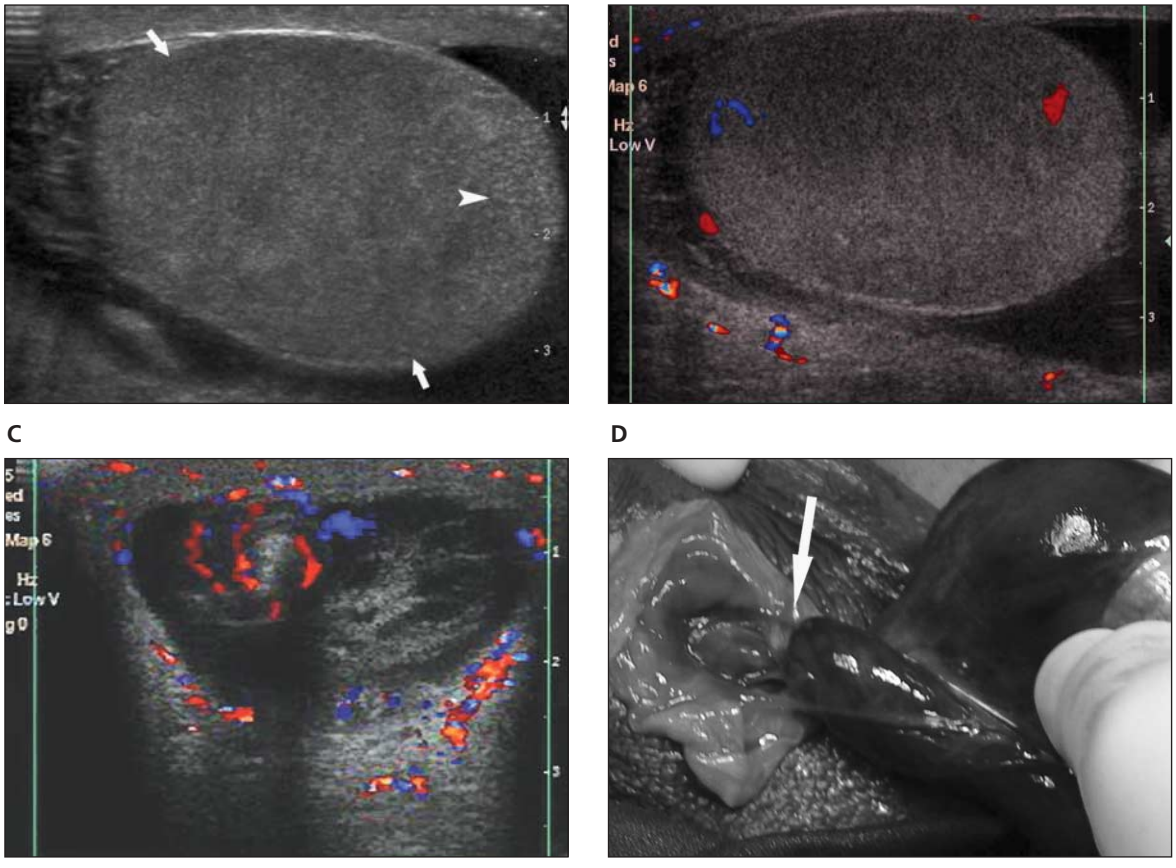


A B

Figure 4. A, Color Doppler image showing the vessels in the proximal part of a whirlpool mass (arrows). **B**, Flow is absent in the distal part of the whirlpool (arrows).

Figure 5. Incomplete torsion of the testis. **A**, Longitudinal scan of a horizontally placed testis showing a large hypoechoic area (arrows) in the upper two thirds of the testis and a normal echo pattern (arrowhead) in the lower third. **B**, Color Doppler image showing no flow in the hypoechoic area with a few vessels seen in the poles. **C**, Color Doppler image of the whirlpool mass showing the visualized vessels going around the central axis. **D**, Ischemic testis with the segmental infarction of the upper two thirds and torsion of the spermatic cord (arrow).

A B

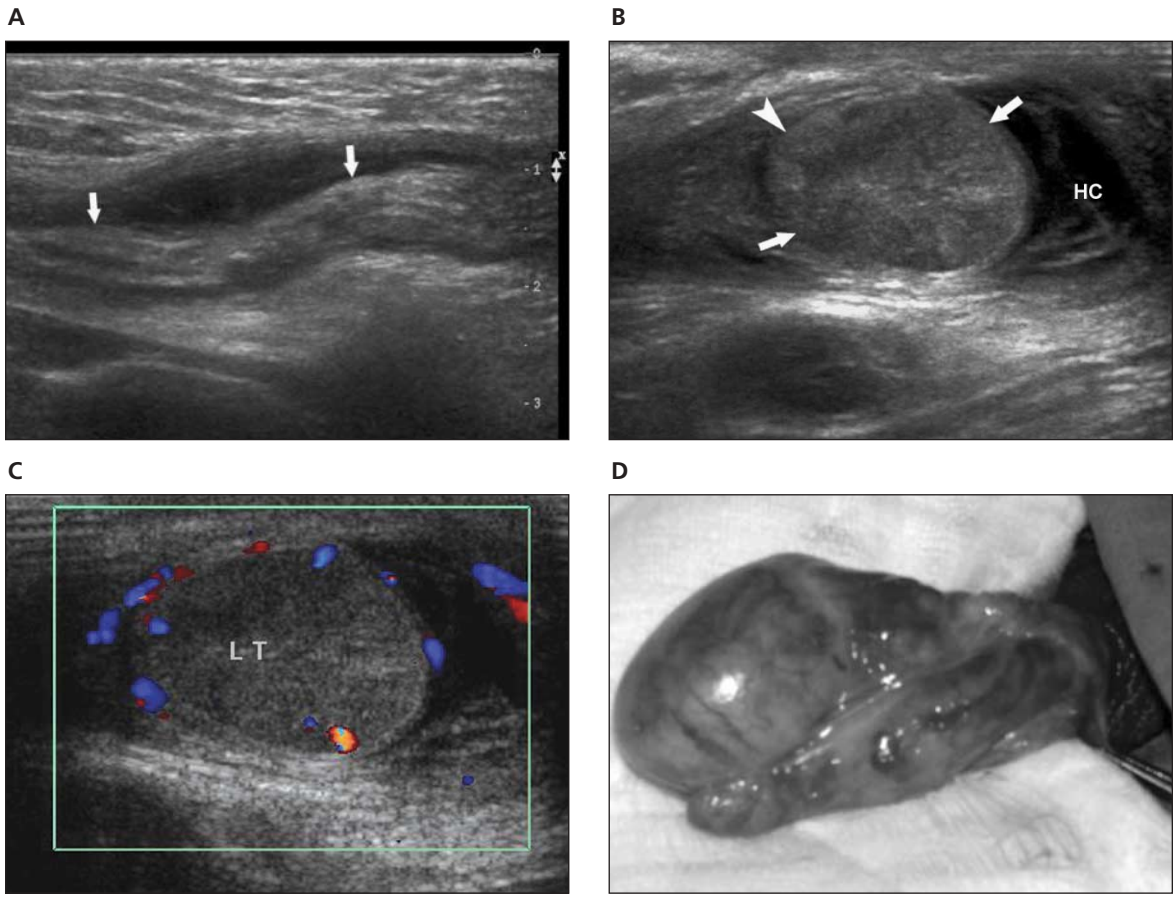


C D

It requires immediate intervention to avoid infarction of the affected testis.[19] Conversely, if torsion can be confidently ruled out, unnecessary surgical intervention can be avoided. Intermittent testicular torsion or a torsion-detorsion sequence is a clinical syndrome defined by a history of unilateral scrotal pain of sudden onset and of short duration that resolves spontaneously.[15] The natural history of ITT varies. Some patients may have acute torsion at a later date. This is evidenced by the observation that up to half of patients with acute torsion report previous episodes of testicular pain.[3] In this series, the incidence of previous episodes was 40%. Some patients have continued attacks, which, if lasting enough, can result in ischemic damage to the testis, although definite evidence of this is lacking.[4,16,18]

Currently, a sonographic study of acute scrotum is focused on evaluation of the testis, epididymis, and scrotal wall on gray scale sonography and study of the intratesticular vascular flow by color Doppler imaging.[9–12,14,20–23] However, there are situations that may show inconclusive results on color Doppler studies. The torsion-detorsion phenomenon may show testicular hyperemia, mimicking an inflammatory process.[23,24] There are reports of spermatic cord torsion with preserved testis perfusion on color Doppler studies.[11,25–28] Arce et al[13] and Baud et al[14] concluded that all these pitfalls occur because of indirect evaluation of a condition that is caused elsewhere, and they proposed to study the spermatic cord directly because actual torsion occurs there. Baud et al[14] and Kalfa et al[29] studied the spermatic cord in its entire length, including the inguinal canal, and described a spiral twist of the cord at the external inguinal ring diagnostic of torsion, irrespective of the color Doppler findings

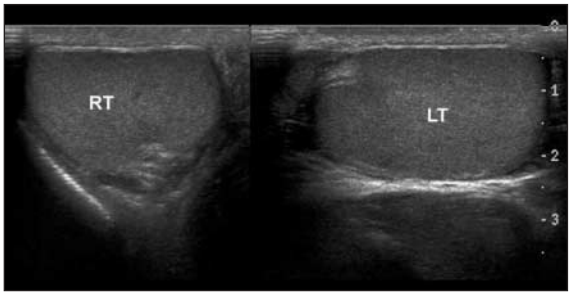
Figure 6. Segmental testicular infarction. **A**, Longitudinal scan of the straight spermatic cord (arrows). **B**, Longitudinal scan showing a transverse section of a swollen testis with a large hypoechoic area (arrows) in the lower part and a normal echo pattern (arrowhead) in the upper part. There is a septated hydrocele (HC). **C**, Color Doppler image showing lack of flow in the hypoechoic area with a few vessels in the periphery of the left testis (LT). **D**, Ischemic testis with segmental infarction.



in the testis. They described high sensitivity and specificity of this sign. The rate of unnecessary surgery was 0%. The same sign was elicited in this series with a real-time modification in the form of downward movement of the transducer along the spermatic cord to look for the whirlpool sign. The mass of torsion of the cord had the appearance of a doughnut, a target, a snail shell, or a storm on a weather map. The movement of the transducer in a downward direction perpendicular to the axis of this mass brought on the whirlpool sign. The whirlpool mass is seen in various locations: just distal to the external ring, above the testis or posterior to the testis, and in the inguinal canal if the testis is undescended. The angle at which it is best seen also varies. This sign was seen in 65 patients in this series, all of whom were proved to have testicular torsion, complete in 61 and incomplete in 4. In complete torsion, the whirlpool sign is seen only on gray scale sonography with absent intratesticular flow on color Doppler imaging. In incomplete torsion, there is flow in the vessels of the whirlpool mass, distal to it, and in the testis. The whirlpool sign is seen on gray scale as well as color Doppler imaging. The incomplete torsion probably explains the cases reported in earlier reports as missed torsion or torsion with preserved testicular perfusion, and the whirlpool sign helps in diagnosis of torsion in such patients. Hence, the real-time whirlpool sign is the most definitive sign of torsion because it has 100% specificity and sensitivity; there were no false-positive or -negative findings of torsion in this series.

Figure 7. Intermittent testicular torsion. **A**, Transverse scan of a scrotum showing the short axis of the right testis (RT) and long axis of the left testis (LT) indicating the horizontally placed left testis. The left testis is slightly hypoechoic compared with the right testis. **B**, Color Doppler image of the right testis showing a normal flow pattern. **C**, Color Doppler image showing increased flow in the left testis.

A



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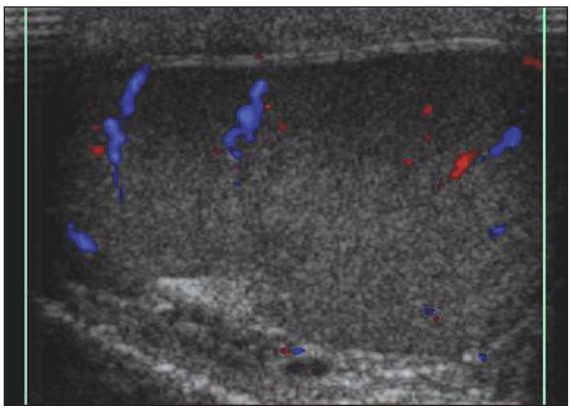

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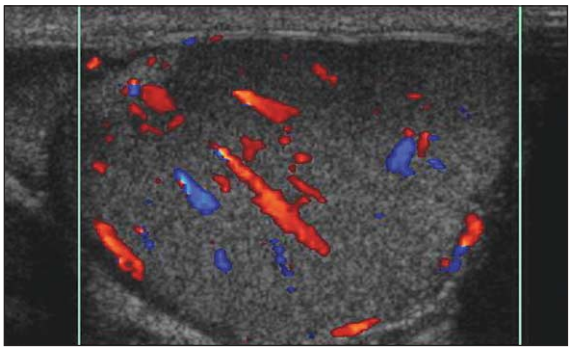

The second group of patients has a straight spermatic cord, a swollen testis, epididymis, or both, absent focal changes in the testis, and unequivocal increased flow in the testis and epididymis. Sometimes the flow may be increased in the epididymis alone with normal flow in the testis. These features may be seen in either acute epididymo-orchitis or ITT,[5] and the differentiation is based on the presence or absence of clinical or laboratory evidence of infection.[5] Patients with acute epididymo-orchitis have some clinical features suggestive of epididymo-orchitis, such as fever, dysuria, and laboratory evidence of leukocytosis or urinary tract infection, seen in 65 patients in this series. The patients with ITT lack these clinical features of epididymo-orchitis, and instead they may give a typical history of acute pain of short duration with spontaneous relief, which is usually associated with vomiting. The axis of the testis is horizontal. We had 1 patient with this diagnosis. The finding of epididymal or testicular hyperemia or both in ITT is indicative of reactive hyperemia and is seen in 17% of patients with ITT. A consistent sonographic sign described in ITT is the horizontal lie of the testis.[5]

In 14 children in this series, who had a straight spermatic cord and hyperemia, a diagnosis could not be offered because there was lack of any differentiating clinical or laboratory features. The usefulness of the horizontal testicular axis in ITT[5] was not yet known during that period of study; hence, the observation was not looked for in those patients. This observation may be a useful sonographic sign in such patients.

The fourth group has a straight spermatic cord, a horizontally oriented testis, a swollen testis and epididymis, focal changes in the testis, and increased flow in the spermatic cord and epididymis with decreased or increased flow in the testis. The focal hypoechoic areas in the testis lack blood flow on color Doppler imaging. The possible diagnoses in these patients are segmental infarction (due to ITT or vasculitis) and epididymo-orchitis with suppuration of the testis. The differentiation is by clinical or laboratory evidence of infection for a testicular abscess and the lack of such evidence with a horizontal axis of the testis for ITT.[30] In this series, there were 12 patients with these features, and 9 of them turned out to have ITT with segmental infarction and 3 to have testicular abscesses.

There was no case of unnecessary surgery in this series (0%). There were only 2 cases of missed torsion in this series of 207 patients (1%) who were followed for at least 8 weeks, which included all forms of torsion. These 2 patients had equivocal sonographic features with testicular hyperemia. The limitation of the study is that the patients with acute epididymo-orchitis (65 cases) and those with testicular or epididymal hyperemia who were not given a sonographic diagnosis (14 cases) were followed for a period of 8 weeks only, which is short considering the possibility of ITT occurring after a gap of even years. Follow-up extending for more time is not possible in the health care system existing in this country. The length of follow-up, however, would form a good subject of study in a society with a closed health care system, where patients could be followed for many years; that would give the true incidence of ITT versus acute epididymo-orchitis in the presence of testicular or epididymal hyperemia.

From the data of this series and those of recent publications, one can draw the following conclusions about ITT. The sonographic features of this syndrome will depend on the time between sonography and the event, the severity of the torsion, and the duration of the event. If the patient reports after a few days of a mild event, the sonographic findings may be normal. If he reports within a few hours after severe torsion and complete detorsion, the testis would be slightly swollen and hypoechoic, and the spermatic cord would be straight. There would be hyperemia of the testis on color Doppler imaging. The same features are also seen in acute epididymo-orchitis. The differentiation of ITT and epididymo-orchitis in this situation is only clinical. One useful and consistent sonographic finding in ITT is the horizontal lie of the testis.[3,5] Some of these patients with a torsion-detorsion sequence showing testicular hyperemia and mimicking epididymo-orchitis have testicular atrophy later, which is well documented.[16] It was seen in 2 patients in this series. Eight patients in this series who had classic features of acute torsion had reports of an earlier sonographic diagnosis of acute epididymo-orchitis because of testicular hyperemia, indicating that they had a torsion-detorsion sequence on the previous occasion, which also corroborates this phenomenon.

The third group of the patients with ITT, who have severe torsion with complete detorsion and report early, reveal sonographic features of segmental testicular infarction.[30] The horizontally placed testis reveals focal hypoechoic areas that lack blood flow, with the rest of the testis showing a normal echo pattern. These areas with a normal echo pattern either show normal blood flow in sparse arteries or show hyperemia. The epididymis may show increased blood flow. Although polycythemia, sickle cell anemia, and acute angitis have been linked to segmental infarction, the cause of most reported cases is unknown,[30–33] and these were probably in fact cases of ITT. The differential diagnosis of this condition can be severe orchitis with suppuration. The differentiation of these conditions is by the clinical features of infection seen in epididymo-orchitis and the history of acute pain with spontaneous relief, a history of a previous episode, and a horizontal testicular axis in ITT.

In conclusion, testicular torsion is a complex condition with a spectrum of clinical and sonographic features. In complete torsion, there is a whirlpool sign on gray scale sonography and absence of flow in the distal cord, testis, and epididymis. In incomplete torsion, there is a whirlpool sign on gray scale and color Doppler sonography and varying amounts of vessels

within the testis. The sonographic real-time whirlpool sign is the most specific sign of torsion, either complete or incomplete, because it reveals the actual anomaly. Alternatively, the torsion may present a challenging spectrum of clinical features that may be due to ITT. The symptoms are acute onset of severe scrotal pain with spontaneous relief after a short time. The sonographic spectrum of this condition varies depending on the severity and duration of the event and the time between the event and sonography. There may be features of segmental testicular infarction, testicular hyperemia, or a normal testis.

The following algorithm is suggested for sonography in a case of acute scrotal pain:

1. When the clinical history and physical examination are sufficiently alarming and unequivocal for testicular torsion and sonography is not possible immediately, surgical exploration is done without any imaging.
2. When there are unequivocal sonographic features of the following conditions, the patient is treated accordingly: testicular torsion showing total absence of intratesticular blood flow, torsion of the testicular appendage, and acute idiopathic scrotal edema.
3. When there is symmetric or asymmetric arterial flow seen in the testis, the spermatic cord is studied in detail to look for the whirlpool sign. The real-time whirlpool sign is the most specific sign of both complete and incomplete testicular torsion.
4. Features of segmental testicular infarction and a horizontal lie of the testis in a patient without features of systemic vascular disease or infection are diagnostic of ITT. Prophylactic contralateral orchidopexy should be performed to preserve the normal testis because of the high association of future contralateral torsion.
5. In a case with features of a straight cord and a swollen testis and epididymis with hyperemia, acute epididymo-orchitis and ITT are both possible. The diagnosis of acute epididymo-orchitis is made when there are clinical or laboratory features of infection or urinary tract infection. A history of pain with spontaneous relief and a horizontal testicular axis indicate ITT. When these differentiating features are absent, the patients need active follow-up. This is essential because ITT is a possibility. The challenges of clinical decision making in these patients lie in the recognition that there is no definitive diagnostic test to confirm ITT. Only by halting the pattern of recurrent pain can the diagnosis be made, albeit retrospectively.[18] When there is a clinical history typical of ITT and a horizontal testicular axis, bilateral orchidopexy is done immediately.

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