

Role of Ultrasound with Color Doppler in Acute Scrotum Management

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ABSTRACT

Background and Objective: An acute scrotum is defined as acute pain with or without scrotal swelling, may be accompanied by local signs or general symptoms. Acute scrotal pain is a medical emergency. Depending on cause, the management is entirely different. Torsion of testis and strangulated hernia are surgical emergency; whereas, epididymo-orchitis is treated by medicines. Testicular trauma and obstructed hernia can be differentiated by taking history from patient. Physical examination adds only a little information. Color Doppler ultrasound (US) is the modality of choice to differentiate testicular torsion from inflammatory conditions and can thus help in avoiding unnecessary surgical explorations. **Subjects and Methods:** A study on 50 patients was conducted who were referred with history of acute scrotal pain to our department between January 2013 and January 2014. Trauma and scrotal mass were excluded from the study. The clinical presentation, outcome, and US results were analyzed. **Results:** Color Doppler sonography yielded a positive and negative predictive value (PPV and NPV) of 100% each for torsion, whereas, 93.9 and 70.6% for epididymo-orchitis, respectively; a sensitivity and specificity of 100% for torsion, whereas, for epididymo-orchitis it was found to be 86.1 and 85.7%, respectively. In cases of incomplete or early torsion, some residual perfusion may be detected leading to false-negative results. **Conclusion:** We therefore conclude that color Doppler sonography can reliably rule out testicular torsion and can thus help in avoiding unnecessary surgical explorations. Hence, it can significantly improve outcome and decrease morbidity of patient. It is an accurate, rapid, nonexpensive, nonionizing, important adjunct to clinical assessment of scrotum.

Keywords: Color Doppler in acute scrotum, sonographic evaluation of acute scrotum, torsion of testis

Introduction

The ability to confidently establish a surgical versus a nonsurgical diagnosis for acute scrotal pain is important. The benefits of early surgery for testicular salvage in ischemic disease, primarily torsion of the testis, are well-known; but must be balanced against the costs of operating unnecessarily on a large number of patients with nonsurgical disease, primarily acute epididymo-orchitis. Acute scrotum is defined as acute pain with or without scrotal swelling, may be accompanied by local signs or general symptoms. The most common differential diagnoses of the acute scrotum include: i) Torsion of the spermatic cord and ii) acute epididymitis or epididymo-orchitis. Less common diagnoses include: Strangulated hernia, segmental testicular infarction, testicular tumor, and idiopathic scrotal edema.^[1] This appropriate discussion, however, will be limited

to patients with acute pain who have no history of trauma and no history of a mass before the onset of pain. There is, however, overlap in the clinical presentation of the different causes of acute scrotal pain. Imaging in clinically equivocal cases may lead to an early diagnosis of testicular torsion, and thus, decrease the number of unnecessary surgeries. There is no definite protocol of acute scrotum screening for the primary care physicians to follow. Early detection of testicular torsion through color Doppler is the only means to reduce the burden of morbidity. This article emphasizes the importance and protocol of screening of patient with acute scrotal pain to create awareness among primary healthcare providers so as to detect testicular torsion at the earliest, so immediate surgery can be performed to salvage the testis as well as to rule out testicular torsion so that unnecessary surgery can be avoided. A study comparing primary scrotal exploration and initial ultrasound (US) examination with exploration for positive US results or a high clinical suspicion of torsion, showed that US obviated the need for exploration in many patients and thus shortened hospital stays.^[2]

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Subjects and Methods

We did a prospective study on 50 patients who were referred to our Department of Radiodiagnosis, Maharaja Yashwantha Rao Hospital and MGM Medical College, Indore between January 2013 and January 2014 presenting with acute scrotal pain. Patients with history of trauma and scrotal mass were excluded from the study. These patients were subjected to high frequency ultrasonography and color Doppler using standard machine (Philips HD7 XE) equipped with high resolution and color Doppler linear probe (7.5–12 MHz). Serial transverse and sagittal images of each scrotum are obtained and both testis are compared for echotexture and color flow. The study included both the scrotum and inguinal area. The clinical presentation, outcome, and US results were analyzed.

Discussion and Results

Acute scrotal pain is a medical emergency. Depending on cause, the management is entirely different. Torsion of testis and strangulated hernia are surgical emergency; whereas, epididymo-orchitis is treated by medicines. Testicular trauma and obstructed hernia can be differentiated by mere taking history from patient. Although, scrotal contents are the most accessible to clinical examination, serious dilemmas occur. Physical examination adds only a little information and limited by acute pain and discomfort for patient which further limits the proper physical examination. In these situations, US with color Doppler is valuable in differentiating between medically treatable and surgical emergency of scrotum and avoiding unnecessary disastrous surgical exploration.^[3] Now, US with high frequency transducer in combination with color Doppler has become the imaging modality of choice for evaluation of acute scrotum.

In our study, we evaluated 50 patients presenting with acute scrotal pain by color Doppler ultrasonography. The results of these imaging studies were correlated with final diagnosis established by means of surgery or clinical follow-up [Table 1].

Testicular torsion is most common in males of age group 10–25 years, but it can occur at any age. Prompt diagnosis is necessary because torsion requires immediate surgery to preserve the testis. The spermatic cord undergoes rotation between 90° and 720°. This initially results in testicular venous outflow obstruction, subsequent engorgement, arterial obstruction, and rapid irreversible testicular infarction, normally within 6 h of onset.^[4] The testicular

salvage rate is 80–100% if surgery is performed within 5–6 h of the onset of pain, 70% if surgery is performed within 6–12 h, and only 20% if surgery is delayed for more than 12 h. There are two types of testicular torsion: Intravaginal and extravaginal. Intravaginal torsion is the more common type, occurring most frequently at puberty. It results from anomalous suspension of the testis by a long stalk of spermatic cord, resulting in complete investment of the testis and epididymis by the tunica vaginalis. This anomaly has been likened to a bell-clapper. Anomalous testicular suspension is bilateral in 50–80% of patients. Extravaginal torsion most often occurs in newborns without the “bell clapper” deformity. It is thought to result from a poor or absent attachment of the testis to the scrotal wall, allowing rotation of the testis, epididymis, and tunica vaginalis as a unit and causing torsion of the cord at the level of the external ring.^[5]

Classically, testicular torsion presents with sudden onset, severe scrotal pain with associated swelling, nausea, and vomiting. Atypical presentations are also common.^[6] The physician needs to be aware that an embarrassed child may state that he has lower abdominal or inguinal pain rather than scrotal pain. A child may also minimize his symptoms out of fear. On examination, high lying, transverse testis may be seen. In addition, there may be loss of the cremasteric reflex; lifting the testis does not abolish the pain (Prehn's sign).^[4,6] This can be a difficult clinical sign to elicit and has shown significant clinician variance. This large inconsistency makes it unsuitable as an adequate screening or diagnostic test.^[7]

On gray-scale sonography, in acute phase of torsion, within 1–6 h, testis appears enlarged, with normal echogenicity, and later it becomes heterogeneous and hypoechoic compared with the contralateral normal testis, as shown in Figure 1a. A hypoechoic or heterogeneous echogenicity may indicate nonviability. Reactive hydrocele and scrotal skin thickening are often seen with torsion. The gray-scale findings of acute and subacute torsion are not specific and may be seen in testicular infarction caused by epididymitis, epididymo-orchitis, and traumatic testicular rupture or infarction.^[5] Color Doppler sonography shows absent blood flow in the affected testicle^[8] or significantly less than in the normal, contralateral testicle as shown in Figure 1b. The spermatic cord immediately cranial to the testis and epididymis is twisted and intrascrotal portion of the cord appears as edematous, round, ovoid or curled echogenic extra-testicular mass, with the epididymal head wrapped around it as shown in Figure 1c, causing a characteristic torsion knot or "whirlpool pattern" on color doppler as shown in Figure 1d.^[4,5,9] Torsion of at least 540° is necessary for complete arterial occlusion. With partial torsion of 360°, or less, arterial flow may still occur, but venous outflow is often obstructed, causing diminished diastolic arterial flow on spectral Doppler examination.^[10] If spontaneous detorsion occurs, flow within the affected testis may be normal, or it may be increased and mimic orchitis^[5,11] [Tables 2 and 3].

In our study, out of 50 patients presenting with acute scrotal pain, eight were diagnosed to be having torsion testis by color

Table 1: US diagnosis of acute scrotum

	Number of cases	US diagnosis
Epididymo-orchitis, epididymitis, funiculitis	36	33
Torsion	8	8
Obstructed/strangulated hernia	1	1
Others like torsion of testicular appendage, hydrocele, varicocele	5	8

US: Ultrasound

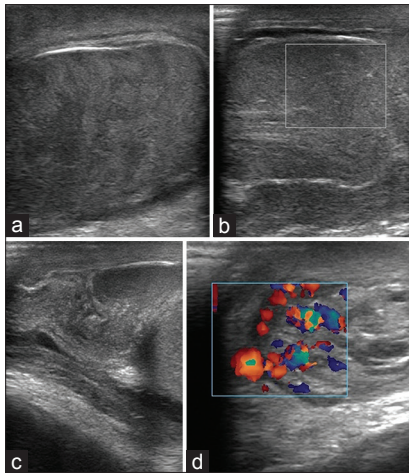


Figure 1: (a) Testis enlarged and appears heterogeneously hypoechoic. (b) Complete absence of detectable flow in the symptomatic testis. (c) Intrascrotal portion of the cord appears as edematous, round, ovoid, or curled echogenic extra testicular mass; with the epididymal head wrapped around it. (d) Whirlpool sign - color Doppler (CD) shows spiral twisting of vessels (arrow) proximal to the torsion knot

Table 2: US diagnosis in testicular torsion

Torsion	
True positive	8
True negative	42
False positive	0
False negative	0

Table 3: Accuracy of US in diagnosing testicular torsion

Torsion	
Positive predictive value	100%
Negative predictive value	100%
Specificity	100%
Sensitivity	100%

Doppler. Findings from surgery confirmed testicular torsion in these eight patients. All cases were correctly diagnosed with color Doppler ultrasonography. There was no false positive diagnosis of testicular torsion. The study demonstrated 100% specificity and sensitivity for testicular torsion. Positive and negative predictive value (PPV and NPV) for testicular torsion was found to be 100%. The most common age group in our study were between 14 and 18 years of age. Depending on the duration of the process, the morphologic appearance of torsion on follow-up by surgery and histopathology were intense congestion to widespread extravasation of blood into the interstitial tissue to hemorrhagic testicular infarction.

Epididymo-orchitis is the most common cause of acute scrotal pain in postpubertal men. The age of peak incidence is 40–50 years. It usually results from a lower urinary tract infection and is less often hematogenous or traumatic in origin.^[5] Typically, patients present with the insidious onset of scrotal pain and swelling with associated fever, rigors, and lower urinary tract symptoms such

as increased frequency, dysuria, and urgency.^[5,6] The pathogen is linked with age, the most prevalent age group is sexually active individuals and the commonest pathogens are *Chlamydia trachomatis* or *Neisseria gonorrhoeae*. At the extremes of age, *Escherichia coli* tend to be the commonest cause and are often linked to urinary tract infections.^[4] In acute epididymitis, sonography characteristically shows thickening and enlargement of the epididymis, involving the tail initially and frequently spreading to the entire epididymis. The echogenicity of the epididymis is usually decreased, and its echotexture is often coarse and heterogeneous as shown in Figure 2a. Testicular involvement usually diffuse and in 10% focal (adjacent to enlarged portion of epididymis) and they appear hypoechoic. Reactive hydrocele formation is common, and associated skin thickening may be seen. Colorflow Doppler sonography usually shows increased blood flow in the epididymis or testis, or both, compared with the asymptomatic side as shown in Figure 2b. When vascular disruption is severe, resulting in complete testicular infarction, the changes are indistinguishable from those seen in testicular torsion. The important distinction is on spectral Doppler, in epididymitis there is high flow and low resistive index in comparison to high resistive flow found in torsion of the spermatic cord.^[5,12] Diastolic flow reversal in the arterial waveforms of the testis is an ominous finding, associated with testicular infarction in severe epididymo-orchitis^[5,13] [Tables 4 and 5].

In our study, we diagnosed 33 cases as epididymo-orchitis by color Doppler ultrasonography who had findings 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. Out of 33 positive diagnosis made by US, two were found to be false positive on clinical follow-up, of which one being diagnosed as omental hernia and other being varicocele limited to inguinal region, which were misdiagnosed as funiculitis. A middle-aged male patient presented with scrotal pain and nodular mass on the left side. Gray scale B-mode US image showed a mildly hyperechoic oval, inhomogeneous mass in the region of the left spermatic cord. The mass was located just above the left epididymis and showed marked vascularity on power and color Doppler imaging. We misdiagnosed it as funiculitis. Hence, valsalva maneuver should be done to differentiate funiculitis from varicocele^[12] in case of doubt. On clinical follow-up of 50 patients, 36 patients are found to be having epididymo-orchitis/funiculitis. The study demonstrated 85.7% specificity and 86.1% sensitivity for epididymo-orchitis. PPV and NPV for epididymo-orchitis was found to be 93.9 and 70%, respectively.

An acute inguinal hernia may also present as an acute scrotum. In this case, pain and swelling involve both the scrotal contents and the groin area. On US:

- The hernial sac most commonly contains bowel, while its next most common contents are omentum
- Gray-scale US findings include a fluid- or air-filled loop of bowel in the scrotum. The presence of real-time peristalsis is diagnostic for the presence of bowel

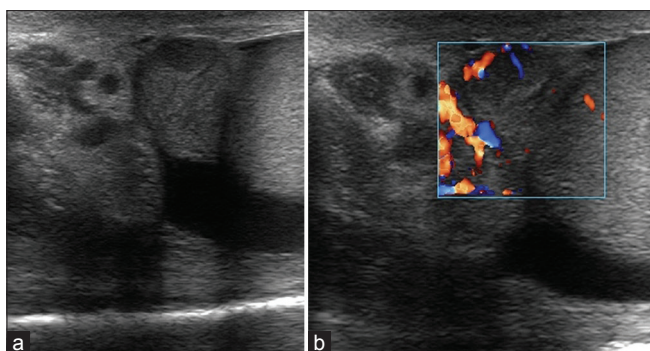


Figure 2: (a) Grey scale shows enlarged heterogeneously hypoechoic left epididymis with reactive hydrocele and associated thickened spermatic cord/funiculitis is seen. (b) On CD, shows increased vascularity in left epididymis, and its adjoining spermatic cord

Table 4: US diagnosis in epididymo-orchitis

Epididymo-orchitis, funiculitis	
True positive	31
True negative	12
False positive	2
False negative	5

Table 5: Accuracy of US in diagnosing epididymo-orchitis

Epididymo-orchitis, funiculitis	
Positive predictive value	93.9%
Negative predictive value	70.6%
Specificity	85.7%
Sensitivity	86.1%

- If the omentum has herniated, hyperechoic areas are present and correspond to omental fat
- Bowel strangulation is more common in indirect than in direct inguinal hernia. An akinetic dilated loop of bowel observed at US in the hernial sac is reported to have high sensitivity and specificity for the recognition of bowel strangulation.^[12,14] Hyperemia of scrotal soft tissue and bowel wall are suggestive of strangulation.

In our study, we found one case of obstructive inguinoscrotal hernia diagnosed by US, which was later confirmed by follow-up.

Conclusion

In our study, we found 100% specificity and sensitivity for testicular torsion. The common age group for torsion of testis was 14–18 years and for epididymo-orchitis it is quite a wide range between 30 and 45 years. We therefore conclude, color Doppler of scrotum is must in a patient presenting in emergency department with acute scrotal pain. It can reliably rule out testicular torsion and helps in clearing clinical dilemma between torsion testis and epididymo-orchitis, and thus help in avoiding unnecessary surgical explorations. Hence, it can significantly

improve outcome and decrease morbidity of patient. It is an accurate, rapid, nonexpensive, nonionizing, important adjunct to clinical assessment of scrotum.

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