Section: Radiodiagnosis

Original Research Article

FIRST-LINE IMAGING IN SCROTAL PATHOLOGY: THE ULTRASOUND ADVANTAGE

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ABSTRACT

Background and Objective: Acute scrotal pain is a common clinical problem, requiring accurate diagnosis to differentiate between surgical emergencies and other etiologies. This study aimed to analyze the distribution of different causes of acute scrotal conditions in a cohort of patients presenting with this complaint, as well as their age and laterality. **Subjects and Methods:** This study retrospectively reviewed data from 50 patients who presented with acute scrotal pain. The analyzed variables included age in years, affected side, and the etiology of the acute scrotal condition. The frequency and percentage of each category within these variables were recorded and analyzed. **Results:** The age distribution of the 50 patients ranged from 0 to over 60 years, with the most frequent age groups being 21-30 years (24%) and 0-10 years (22%). The acute scrotal pain was most commonly on the right side (21 cases), followed by the left side (18 cases), with bilateral involvement in 8 cases. The most frequent etiologies identified were hydrocele (36%), scrotal wall edema (24%), and funiculitis (24%). Less frequent causes included epididymo-orchitis (20%), varicocele (18%), hernia (18%), epididymitis (12%), spermatic cord hydrocele (10%), epididymal cyst (8%), Fournier's gangrene (4%), pyocele (4%), orchitis (2%), emphysematous epididymo-orchitis (2%), intratesticular abscess (2%), torsion (2%), infarct (2%), and fracture (2%). In 3 cases (6%), the findings were normal or showed no involvement. **Conclusion:** This analysis of 50 patients presenting with acute scrotal pain reveals a diverse range of underlying etiologies, with hydrocele being the most common. The age distribution shows a broad representation across different life stages. While testicular torsion is a critical concern in acute scrotum, it represented a small percentage in this specific cohort. These findings highlight the importance of considering a wide differential diagnosis in patients with acute scrotal pain.

INTRODUCTION

Due to its ease of use, lack of ionising radiation exposure, non-invasive nature, reproducibility, low cost and accessibility ultrasound is the preferred modality for evaluating scrotal disease. Pain and swelling in the scrotum is a common complaint in the emergency department (ED) and can be indicative of a wide range of underlying conditions. The differential diagnosis includes surgical emergencies such as testicular torsion, incarcerated hernia, testicular rupture, and Fournier's gangrene, as well as non-surgical conditions like epididymitis, orchitis, and hydrocele. Timely and accurate diagnosis is crucial, particularly to identify and manage surgical emergencies to preserve testicular viability and prevent significant morbidity.

Traditional reliance on medical history and physical examination can be challenging due to overlapping signs and symptoms among various etiologies of acute scrotal pain. Emergency medicine textbooks may sometimes overstate the reliability of history and physical examination alone. Urology and radiology literature, however, highlight the significant overlap in clinical findings, especially in cases of testicular torsion, epididymitis, and orchitis. Even specific features like the time of onset, dysuria, urethral

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discharge, and fever do not consistently differentiate these conditions.

In this context, ultrasound (US), particularly with color Doppler capability, has emerged as a pivotal imaging modality for the evaluation of acute scrotal pain. US allows for rapid and accurate assessment of scrotal anatomy and vascularity, aiding in the differentiation between surgical and non-surgical causes of acute scrotum. Bedside ultrasonography performed by emergency physicians (EPs) has shown promising accuracy in diagnosing these conditions.

Objectives

This article aims to provide a comprehensive review of the role of ultrasound in the evaluation of acute scrotal pain, based on the current literature. The objectives include:

- To discuss the utility of ultrasound in differentiating various etiologies of acute scrotal pain.
- To outline the characteristic sonographic findings associated with common acute scrotal conditions.
- To highlight the role of color and power Doppler in assessing scrotal perfusion.
- To emphasize the potential for emergency physician-performed bedside ultrasound in the management of acute scrotum.

MATERIALS AND METHODS

This review article is based on a comprehensive analysis of the provided sources, including retrospective studies, review articles, and clinical observations focusing on the use of ultrasound in the evaluation of acute scrotal pain. The literature was examined for information regarding the accuracy, techniques, and characteristic findings of scrotal ultrasonography in various pathological conditions presenting with acute scrotal symptoms.

RESULTS

Ultrasound, particularly with color and power Doppler, plays a crucial role in the diagnosis of various causes of acute scrotal pain.

Testicular Torsion

Testicular torsion, a surgical emergency involving the twisting of the spermatic cord, leads to obstruction of venous and lymphatic outflow, eventually compromising arterial blood flow. Ultrasound with color Doppler is the primary imaging modality for diagnosing torsion.

- **Gray-scale findings:** In the early stages (within 1-6 hours), the testis may appear normal or slightly enlarged with normal echogenicity. As torsion progresses (mid-stage), the testis may become enlarged with a striated pattern of edema, and later (late-stage, >24 hours), it can become heterogeneous and hypoechoic due to congestion, infarction, and hemorrhage. Reactive hydrocele and scrotal skin thickening may also be present. The spermatic cord may appear twisted, forming a characteristic "whirlpool" or "target sign" on ultrasound.
- **Doppler findings:** The hallmark of testicular torsion is the absence or marked decrease of blood flow in the affected testicle compared to the contralateral side on color and power Doppler. Power Doppler is more sensitive in detecting low-flow states, including venous flow, which may be the earliest sign of torsion. In incomplete or early torsion, some residual perfusion may be detected, leading to false-negative results. Spectral Doppler may show a decrease in arterial flow with an elevated resistive index (RI) in the mid-stage. In late torsion, arterial flow is typically absent. Spontaneous detorsion may result in normal or increased flow, mimicking orchitis.
- **Accuracy:** Color and power Doppler ultrasonography have reported sensitivities ranging from 86% to 98%, specificity up to 100%, and accuracy up to 97% for diagnosing testicular torsion. A study by Blaivas et al. reported a sensitivity of 95% and a specificity of 94% for EPs using bedside ultrasound to diagnose testicular torsion and differentiate it from other etiologies. Another study showed 100% sensitivity and specificity for testicular torsion using color Doppler.

Epididymitis and Orchitis

Epididymitis, inflammation of the epididymis, and orchitis, inflammation of the testis, are common causes of acute scrotal pain. They are typically treated with medical management rather than surgery.

- **Gray-scale findings:** Epididymitis usually presents with enlargement and a heterogeneous appearance of the epididymis, particularly the head. Orchitis may show testicular enlargement with altered echogenicity (heterogeneous or hypoechoic) and poorly defined borders. Scrotal wall thickening and reactive hydrocele are frequently associated with both conditions.
- **Doppler findings:** Color and power Doppler typically reveal increased blood flow (hyperemia) in the affected epididymis and/or testis compared to the contralateral side. Spectral Doppler may show a low resistive index (RI < 0.5) with increased diastolic flow due to increased vascularity.
- **Accuracy:** Color Doppler sonography has shown high sensitivity (up to 100%) for detecting increased flow in epididymitis and orchitis. However, differentiating orchitis from testicular tumors with poor vascularity can be challenging. One study reported a sensitivity of 86.1% and specificity of 85.7% for epididymo-orchitis using color Doppler.
- Testicular Trauma

Blunt or penetrating trauma to the scrotum can result in a spectrum of injuries, including testicular rupture, fracture, hematoma, and hematocele. Ultrasound is essential for evaluating the extent of damage.

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- **Gray-scale findings:** Testicular rupture is characterized by a disruption of the tunica albuginea, which may be difficult to visualize directly due to surrounding hematoma. Supportive findings include a large testicular hematocele, contour abnormality of the testis, and heterogeneous echotexture of the testicular parenchyma. Testicular fracture appears as a linear hypoechoic band within the testicular parenchyma. Intratesticular hematomas appear as echogenic collections that may become cystic over time. Hematoceles, collections of blood in the scrotal sac, can be echogenic in the acute phase and may contain septations in the subacute phase.
- **Doppler findings:** Rupture of the tunica albuginea is often associated with disruption of the tunica vasculosa, potentially leading to a loss of vascularity in a portion of the testis. Intratesticular hematomas should be avascular; the presence of blood flow may suggest active bleeding or a neoplasm. Acute large hematoceles may reduce blood flow to the testis, mimicking torsion.
- **Accuracy:** Ultrasound has reported high sensitivity (100%) and specificity (65-93.5%) for the detection of testicular rupture when compared with surgical findings.

Hernia

Inguinal hernias can present as acute scrotal pain and swelling when incarcerated. Ultrasound can help identify herniated bowel loops or omental fat in the scrotum or inguinal canal.

- **Gray-scale findings:** Ultrasound may reveal an elongated heterogeneous lesion extending into the inguinal canal and/or scrotum. Incarcerated bowel loops may show signs of dilatation and lack of peristalsis. The testicles and epididymides typically appear normal unless there is secondary involvement.
- **Doppler findings:** Doppler evaluation is usually not the primary diagnostic tool for hernias but can help assess the vascularity of the herniated contents and rule out strangulation (absence of flow).

Other Conditions

- **Hydrocele:** A hydrocele, a collection of serous fluid within the tunica vaginalis, typically presents as painless scrotal swelling but can be associated with acute pain in certain circumstances. Ultrasound shows an anechoic fluid collection surrounding the testis.
- **Spermatocele and Epididymal Cysts:** These are cystic lesions within the epididymis and are usually asymptomatic but can occasionally cause pain. Spermatoceles typically occur in the head of the epididymis, while epididymal cysts can occur anywhere along its length. Ultrasound reveals anechoic cysts, possibly with internal echoes or septations.
- **Testicular Tumors:** While usually painless, testicular tumors can occasionally present with acute pain due to hemorrhage or infarction. Ultrasound typically shows a solid parenchymal mass with variable echogenicity and internal flow on Doppler.
- **Fournier's Gangrene:** This is a severe necrotizing fasciitis of the perineum and scrotum, presenting with pain, swelling, erythema, and often crepitus. Ultrasound can be a useful adjunct to clinical diagnosis, showing subcutaneous gas (reverberation artifact), fluid collections, and thickening of the scrotal wall.
- **Torsion of Testicular Appendages:** Torsion of the appendix testis or appendix epididymis can mimic testicular torsion clinically. Ultrasound may reveal enlargement and increased flow around these small structures.

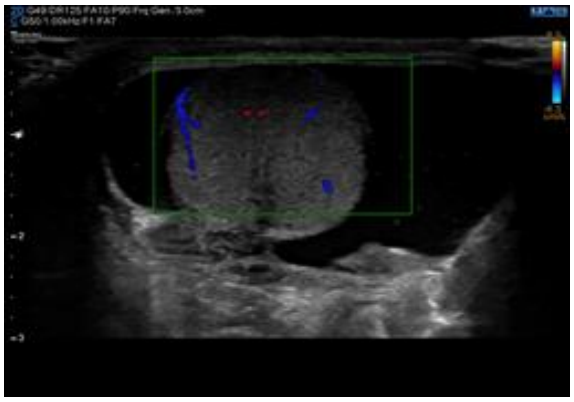

Figure 1: Hydrocele

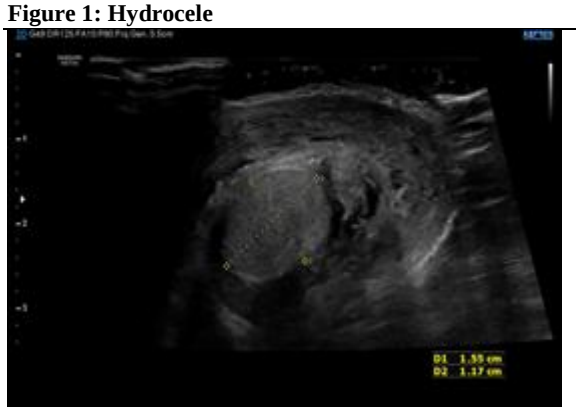

Figure 2: Scrotal Wall Edema

Figure 3: Funiclitis

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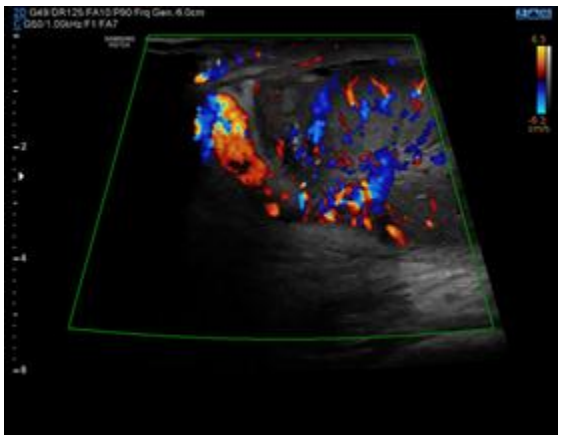

Figure 4: Epididymo-Orchitis

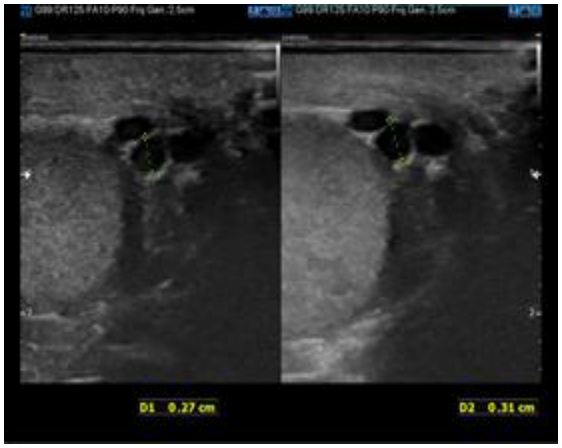

Figure 5: Varicocele

Figure 6: Hernia

Figure 7: Spermatic Cord Hydrocele

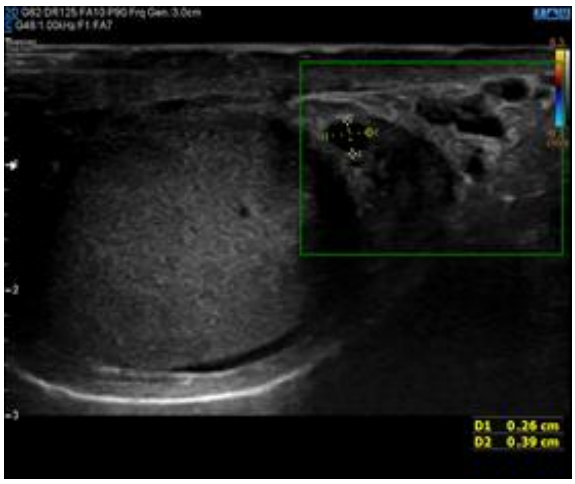

Figure 8: Epididymal Cyst

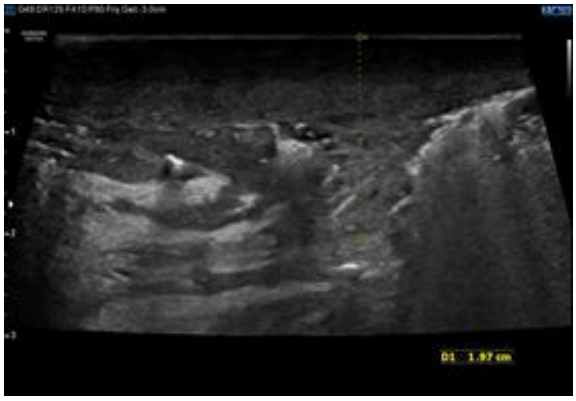

Figure 9: Fournier's Gangrene

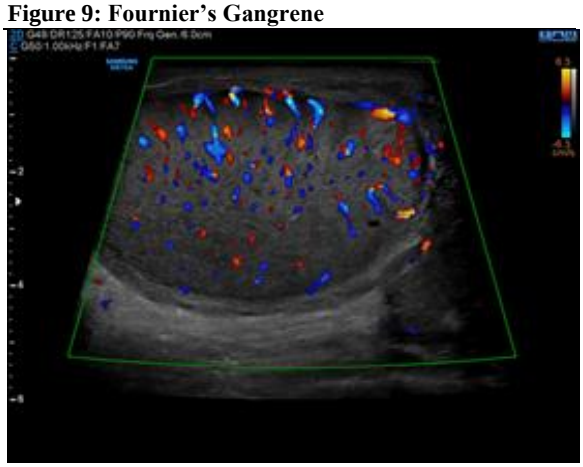

Figure 10: Orchitis

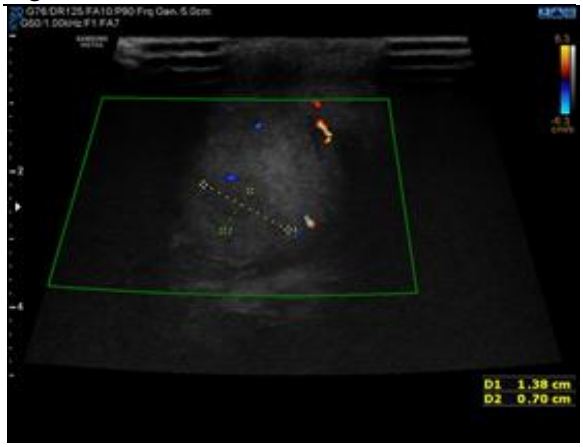

Figure 11: Intratesticular Abscess

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Figure 12: Testicular Infarct

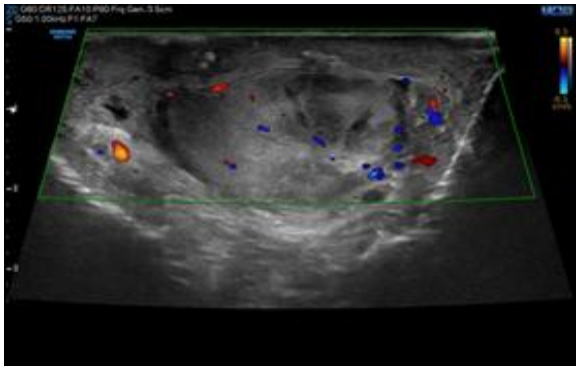

Figure 13: Testicular Fracture

Table 1

AGE IN YEARS	FREQUENCY	PERCENTAGE
0-10	11	22
11-20	5	10
21-30	12	24
31-40	7	14
41-50	6	12
51-60	1	2
>60	8	16
TOTAL	50	100

Table 2

SIDE	FREQUENCY	PERCENTAGE
Right	21	42
Left	18	36
Bilateral	8	16
Normal / No involvement	3	6
TOTAL	50	100

Table 3

ETIOLOGY	FREQUENCY	PERCENTAGE
Hydrocele	18	36
Scrotal wall edema	12	24
Funiculitis	12	24
Epididymo-Orchitis	10	20
Varicocele	9	18
Hernia	9	18
Epididymitis	6	12
Spermatic cord Hydrocele	5	10
Epididymal Cyst	4	8
Normal	3	6

Table 4

ETIOLOGY	FREQUENCY	PERCENTAGE
Fournier's Gangrene	2	4
Pyocele	2	4
Orchitis	1	2
Emphysematous Epididymo-Orchitis	1	2
Intratesticular Abscess	1	2
Torsion	1	2
Infarct	1	2
Fracture	1	2
Hematocele	1	2

DISCUSSION

Ultrasound, especially when combined with color Doppler, has become an indispensable tool in the evaluation of patients presenting with acute scrotal pain. Its ability to rapidly differentiate between surgical emergencies, such as testicular torsion and testicular rupture, from other more benign conditions like epididymitis and hydrocele is crucial for timely management and improved patient outcomes.[1]

The limitations of physical examination alone in accurately diagnosing the etiology of acute scrotal pain are well-documented. Ultrasound overcomes many of these limitations by providing objective anatomical and vascular information. The non-invasive and rapid nature of ultrasound, along with the absence of ionizing radiation, makes it the preferred imaging modality in this setting, applicable to both adult and pediatric populations.[2]

Emergency physicians are increasingly utilizing bedside ultrasound for the initial evaluation of acute scrotum. Studies have demonstrated that with appropriate training, EPs can achieve high accuracy in diagnosing various scrotal pathologies, including the critical differentiation of testicular torsion. Bedside ultrasound can expedite diagnosis and management, potentially reducing delays associated with radiology department-based studies, especially during off-hours.[3]

However, it is important to be aware of potential pitfalls in ultrasound diagnosis. For instance, intermittent torsion or spontaneous detorsion may present with normal or even increased blood flow, potentially leading to false negatives. Motion artifact

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can also mimic flow on Doppler. Therefore, a high index of clinical suspicion should always override normal ultrasound findings in cases where torsion is strongly suspected. Repeat examinations may be helpful in equivocal cases.[4]

The data from the "Untitled presentation" provide a snapshot of the various etiologies of acute scrotal pain encountered in a specific cohort of 50 patients. The predominance of hydrocele, scrotal wall edema, and funiculitis highlights the frequency of non-surgical causes. The occurrence of testicular torsion in this series (2%) underscores its importance as a critical differential diagnosis that necessitates prompt recognition via imaging, typically ultrasound. The age distribution suggests that acute scrotal pain affects a wide range of age groups, reinforcing the need for a consistent and reliable diagnostic approach like ultrasound across all age demographics. The laterality data indicate a slight predilection for right-sided issues in this specific group.[5,6]

CONCLUSION

Ultrasound with color Doppler is an invaluable tool in the diagnostic algorithm for acute scrotal pain. It allows for rapid, non-invasive, and accurate assessment of scrotal pathology, aiding in the crucial differentiation of surgical emergencies from other conditions. The increasing utilization of bedside ultrasound by emergency physicians has the potential to further enhance the timely and appropriate management of patients presenting with this common and potentially serious complaint.

REFERENCES

1. Connolly JA, Dean AJ, Hoffmann B, Jarman RD, editors. Emergency point-of-care ultrasound. John Wiley & Sons; 2017 Oct 23.
2. Wright S, Hoffmann B. Emergency ultrasound of acute scrotal pain. European Journal of Emergency Medicine. 2015 Feb 1;22(1):2-9.
3. Agrawal AM, Tripathi PS, Shankhwar A, Naveen C. Role of ultrasound with color Doppler in acute scrotum management. Journal of family medicine and primary care. 2014 Oct 1;3(4):409-12.
4. Cokkinos DD, Antypa E, Tserotas P, Kratimenou E, Kyratzi E, Deligiannis I, Kachrimanis G, Piperopoulos PN. Emergency ultrasound of the scrotum: a review of the commonest pathologic conditions. Current problems in diagnostic radiology. 2011 Jan 1;40(1):1-4.
5. Heller MT, Fargiano A, Rudzinski S, Johnson N. Acute scrotal ultrasound: a practical guide. Critical Ultrasound Journal. 2010 Nov;2:65-73.
6. Blaivas M, Sierzenski P, Lambert M. Emergency evaluation of patients presenting with acute scrotum using bedside ultrasonography. Academic Emergency Medicine. 2001 Jan;8(1):90-3.

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