Original Article

Epididymo-orchitis: Diagnostic utility of gray-scale sonography, and color Doppler sonography

Kan Radeesri*, Kaan Tangtiang**

Abstract

Introduction: Combination of gray-scale and color Doppler sonography has a high degree of accuracy and sensitivity in the detection, characterization, and localization of various scrotal abnormalities. Many of these disease processes produce overlap symptoms. Accurate diagnoses are crucial for prompt treatments and prevention of complications. Objective was to evaluate the capability of gray-scale sonography and color Doppler sonography for diagnosis of epididymo-orchitis.

Method: One hundred and seventy-one studies of scrotal sonography at the Department of Radiology, Thammasat University Hospital, from 1 January 2009 to 31 January 2014, were retrospectively reviewed.

Result: The sensitivity, specificity, accuracy, negative predictive value (NPV), and positive predictive value (PPV) of gray-scale sonography and color Doppler sonography for diagnosis of epididymo-orchitis were 97.9%, 99.2%, 98.8 %, 99.2%, and 97.9% respectively.

Discussion and Conclusion: Enlarged epididymis/testis, increased internal flow, and thickened scrotal skin were the top three findings that had the highest predictive value and were suggestive of epididymo-orchitis.

Key words: Epididymo-orchitis, Scrotal sonography, Gray-scale sonography, and color Doppler sonography

Received: 10 October 2016 **Accepted: 24 October 2017**

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Introduction

Combination of high-resolution gray-scale sonography and color Doppler sonography has a high degree of accuracy and sensitivity in the detection, characterization, and localization of various scrotal abnormalities, which makes it the modality of choice for imaging the scrotum[1-6]. Many of these disease processes, including testicular torsion, epididymo-orchitis, and intratesticular tumor produce overlap symptoms (e.g., pain, swelling, or presence of mass)[6]. A thorough understanding of the usual findings to aid in differentiating surgical from medical condition is required to accurately guide patient care[1, 6]. Epididymo-orchitis and epididymitis are among the common causes of scrotal infection[3, 6]. Complications of acute epididymitis include infarction, abscess, gangrene, pyocele and infertility[6]. Accurate diagnoses are crucial for prompt treatments and prevention of complications. This study was undertaken to evaluate the capability of gray-scale sonography and color Doppler sonography for diagnosis of epididymo-orchitis.

Method

This study received prior approval from Thammasat University Ethics Committee. The informed consent procedure was waived for this retrospective study.

Data collection

Data of 305 patients who underwent scrotal sonography at the Department of Radiology, Thammasat University Hospital, from 1 January 2009 to 31 January 2014, were collected. One hundred and thirty-four studies were excluded owing to unavailable medical records, insufficient clinical information, having history of scrotal trauma, and no demonstrable sonographic abnormality. One hundred and seventy-one studies were enrolled in this study.

Epididymo-orchitis is defined as a clinical presence of inflammation and/or pain and/or swelling of the epididymis and/or testis, and the patient shows improved symptoms after an antimicrobial treatment on at least one follow-up visit. The specific gray-scale and color Doppler sonographic findings for epididymo-orchitis are hyperemia of the epididymis/testis (increased internal flow, Figure 1), enlarged epididymis/testis (Figure 2), abnormal echogenicity of epididymis/testis (Figure 3), presence of hydrocele (Figure 4), scrotal wall thickening (Figure 5), intrascrotal calcification, and scrotal abscess (Figure 6)[6]. Other diagnoses of scrotal disorder are retrieved from pathological diagnosis or final clinical diagnosis in medical record.

All sonographic findings and diagnosis were reviewed from the PACS system at Thammasat University Hospital. Clinical data including age, duration of symptoms, clinical diagnosis, and follow-up of all cases were sought by a review of all available medical records.

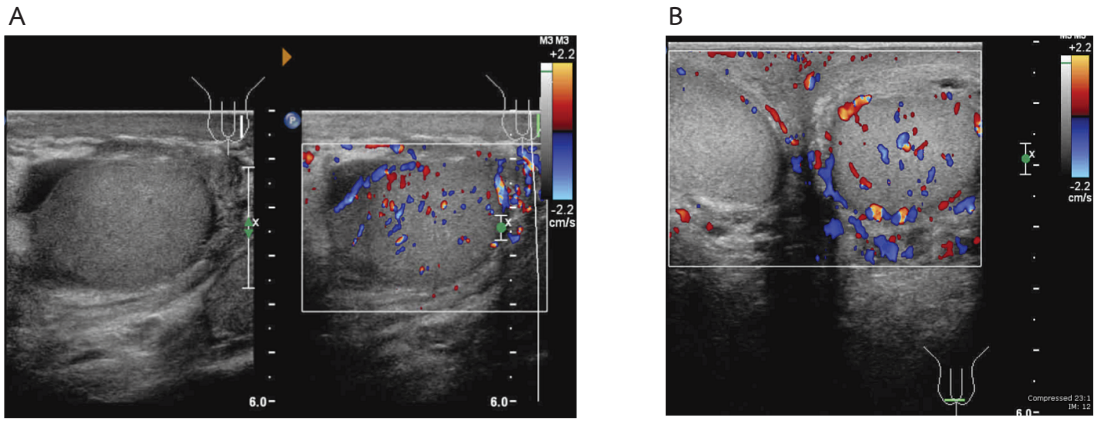

Figure 1 Left epididymo-orchitis. (A) Gray-scale and color Doppler sonography show normal echogenicity with increased flow of left testis. (B) Color Doppler sonography shows increased flow of left testis as compared to the normal right side. Left scrotal skin thickening is also shown.

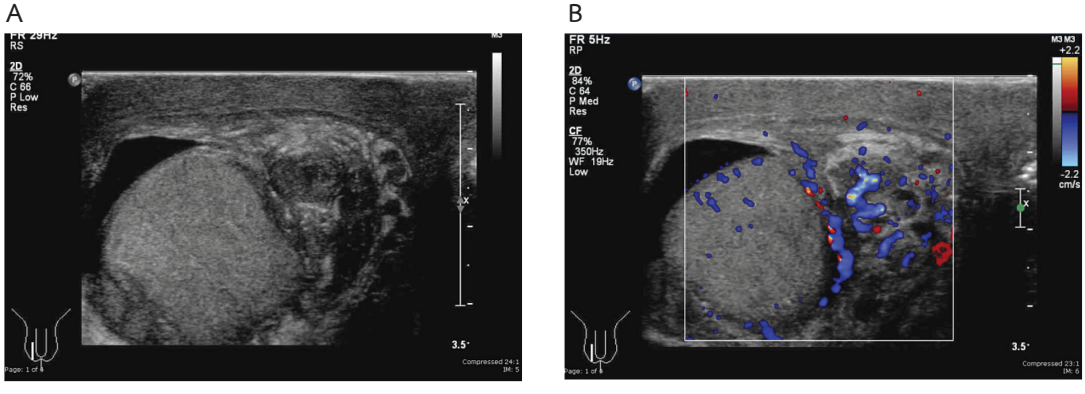

Figure 2 Gray-scale (A) and color Doppler (B) sonography of patient with right epididymo-orchitis show enlarged and heterogeneous echogenicity with increased flow of the epididymis.

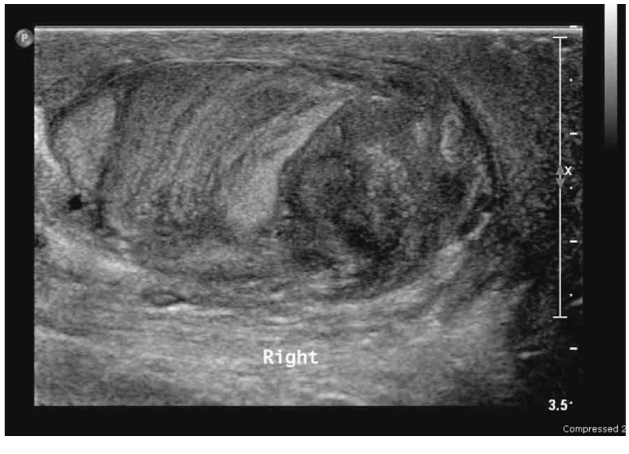

Figure 3 Gray-scale sonography of patient with right epididymo-orchitis shows heterogeneous echogenicity of right testis.

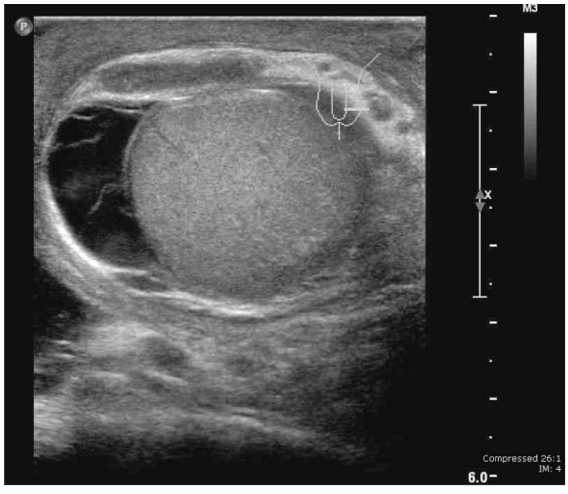

Figure 4 Complicated hydrocele. The gray-scale sonography shows heterogeneous echoic fluid with internal septa, representing pyocele.

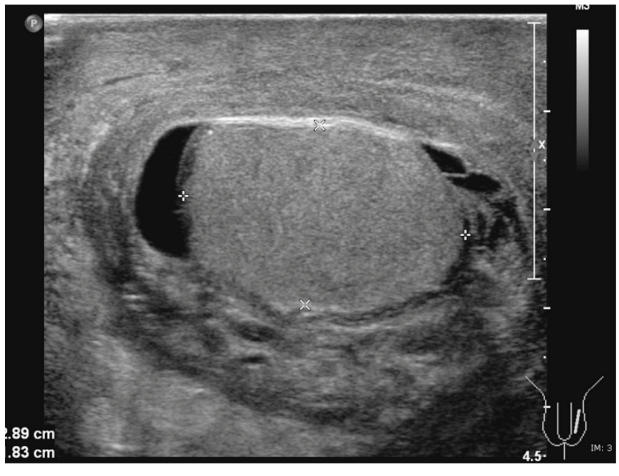

Figure 5 Gray-scale scrotal sonography shows markedly thickened scrotal skin in patient with left epididymo-orchitis. Pyocele is also seen in this case.

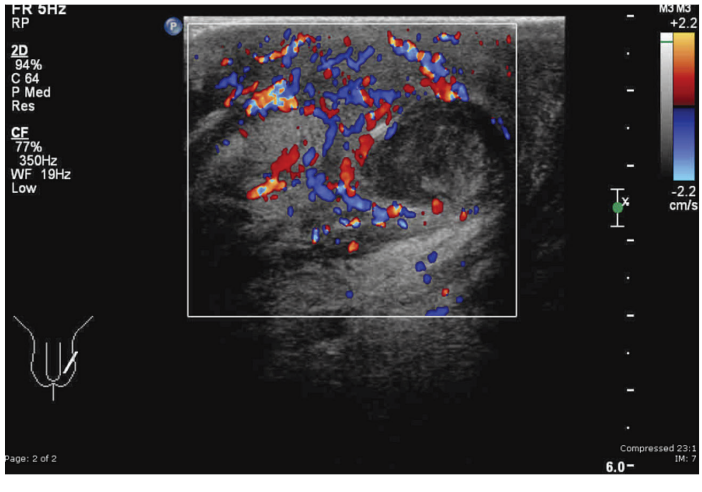

Figure 6 Left epididymo-orchitis with abscess formation. The color Doppler sonography shows focal heterogeneous low echoic lesion in the inflamed left testis with absence of color flow, representing abscess formation.

Sonographic techniques

Gray-scale and color Doppler US were performed in all the patients, using sonography machine PHILIPS iU22 with a 12-5 MHz linear transducer.

Statistical analysis

The sensitivity, specificity, accuracy, negative predictive value (NPV), and positive predictive value (PPV) of gray-scale sonography and color Doppler sonography for diagnosis of epididymo-orchitis were calculated. The sensitivity, specificity, and accuracy of diagnosing epididymo-orchitis were also calculated for each specific sonography finding of epididymo-orchitis, which consisted of enlarged epididymis/testis, abnormal echogenicity of epididymis/testis, hyperemia of the epididymis/testis (increased internal flow), presence of hydrocele, scrotal wall thickening, intrascrotal calcification, and scrotal abscess.

The p-value and estimated odds ratio associated with each sonographic finding as a predictor for diagnosis of epididymo-orchitis data were calculated.

Data were analyzed by using STATA version 12.0.

Result

From 171 patients in this study, epididymo-orchitis was 28.1% (48 patients). The percentages of each diagnosis in this study were shown in Table 1. Ages of patients ranged from 3 months to 82 years. Twenty-five patients (52%) of all epididymo-orchitis cases were over 40 years of age. The most common presenting symptom is scrotal pain (89.6%), followed by scrotal swelling and palpable mass. The clinical data of epididymo-orchitis patients were presented in Table 2.

Common sonographic findings in epididymo-orchitis were enlarged epididymis/testis and increased internal flow in the effected epididymis/testis. Detailed numbers of patients with presence or absence of each characteristic sonographic finding of epididymo-orchitis were displayed in Table 3.

The overall sensitivity, specificity, accuracy, NPV, and PPV of gray-scale sonography and color Doppler sonography for diagnosis of epididymo-orchitis were 97.9%, 99.2%, 98.8 %, 99.2%, and 97.9% respectively. Enlarged epididymis/testis was the most sensitive finding for epididymo-orchitis, while increased internal flow and abscess were the most specific findings, reaching 100% specificity. The sensitivity, specificity, accuracy, NPV, and PPV of each characteristic sonographic finding for diagnosis of epididymo-orchitis were shown in Table 4.

Increased internal flow is the best predictor for diagnosis of epididymo-orchitis (odds ratio of 1366.7, p-value < 0.001 (CI = 76.4 - 24451.9)). The p-value and estimated odds ratio associated with each sonographic finding as a predictor for diagnosis of epididymo-orchitis were provided in Table 5.

Table 1 Number and percentage of diagnoses of patients in this study

Diagnosis	Number of case, N=171 (%)
Epididymo-orchitis	48 (28.1%)
Cystic lesions (epididymal cyst, spermatocele)	29 (17%)
Varicocele	27 (15.8%)
Hydrocele	27 (15.8%)
Inguinal hernia	13 (7.6%)
Undescended testis	13 (7.6%)
Testicular microlithiasis	5 (2.9%)
Testicular torsion	3 (1.8%)
Tumors	3 (1.8%)
Post-surgical change	2 (1.2%)
Scrotal hematoma	1 (0.6%)

Table 2 Clinical data of patients with clinical diagnosis of epididymo-orchitis

Clinical data	Number of case, N= 48 (%)
1. Age(years)	
< 10	5 (10.4%)
10 - 20	5 (10.4%)
21 - 30	6 (12.5%)
31 - 40	7 (14.6%)
41 - 50	10 (20.8%)
51 - 60	5 (10.4%)
> 60	10 (20.8%)
2. Duration of symptoms (days)	
1 - 3	11 (22.9%)
4 - 7	17 (35.4%)
8 - 14	8 (16.7%)
15 - 30	4 (8.3%)
> 30	8 (16.7%)
3. Presentation symptoms	
1. Swelling of scrotum	35 (72.9%)
2. Scrotal mass	21 (43.75%)
3. Scrotal pain	43 (89.6%)
4. Pus discharge	1 (2.1%)

Table 3 Number of patients in each sonographic characteristic

Sonographic findings	Epididymo-orchitis	Other diagnosis
Enlarged epididymis/testis		
Present	44	4
Absent	4	119
Abnormal echogenicity epididymis/testis		
Present	32	2
Absent	16	121
Hydrocele		
Present	28	31
Absent	20	92
Testicular involvement		
Present	26	5
Absent	22	118
Increased internal flow		
Present	41	0
Absent	7	123
Thickened scrotal skin		
Present	38	3
Absent	10	120
Intrascrotal calcification		
Present	4	5
Absent	44	118
Abscess		
Present	7	0
Absent	41	123

Table 4 Sensitivities, specificities, accuracies, negative predictive value (NPV) and positive predictive value (PPV) of the sonographic findings for diagnosis of epididymo-orchitis

Sonographic findings	Sensitivity (%)	Specificity (%)	Accuracy (%)	NPV (%)	PPV (%)
1. Enlarged epididymis/testis	91.7%	96.7%	95.3%	96.7%	91.7%
2. Abnormal echogenicity epididymis/testis	66.7%	98.4%	89.5%	88.3%	94.1%
3. Hydrocele	58.3%	74.8%	70.2%	82.1%	47.5%
4. Testicular involvement	54.2%	95.9%	84.2%	84.3%	83.9%
5. Increased internal flow	85.4%	100%	95.9%	94.6%	100%
6. Thickened scrotal skin	79.2%	97.6%	92.4%	92.3%	92.7%
7. Intrascrotal calcification	8.3%	95.9%	71.3%	72.8%	44.4%
8. Abscess	14.6%	100%	76%	75%	100%

Table 5 The p-value and odds ratio associated with each sonographic finding as a predictor for diagnosis of epididymo-orchitis

Sonographic findings	p-value	Odds ratio	95 % CI
1. Enlarged epididymis/testis	< 0.0001	327.25	78.4 - 1365.3
2. Abnormal echogenicity epididymis/testis	< 0.0001	121.0	26.4 - 553.7
3. Hydrocele	0.0001	4.15	2.1 - 8.4
4. Testicular involvement	< 0.0001	27.9	9.7 - 80.5
5. Increased internal flow	< 0.0001	1366.7	76.4 - 24451.9
6. Thickened scrotal skin	< 0.0001	152	39.8 - 581
7. Intrascrotal calcification	0.2711	2.2	0.6 - 8.4
8. Abscess	0.0098	44.6	2.5 - 798.6

Discussion and Conclusion

Gray-scale sonography in combination with color-Doppler study is the most widely used diagnostic tool for evaluating the scrotal abnormality[7]. Acute epididymitis and epididymo-orchitis are common causes of acute scrotum in adolescent boys and adults[4 - 8].The diagnosis of epididymitis is usually based on clinical evaluation and laboratory results. However, when necessary, sonography can provide valuable information about tissue morphology and enabling exclusion of abscess or tumor[9]. In our study, epididymo-orchitis was the most common diagnosis in the study population, 48 from 171 patients (28.1%). Ages of patients with epididymo-orchitis in our study widely ranged from 3 months to 82 years. More than 50% of patients were over 40 years of age. Only 20.8% of patients were under 20 years of age. We had already known that epididymitis and epididymo-orchitis usually associated with lower urinary tract infection, prostatitis and/or seminal vesiculitis, or sexually transmitted infections. These were more

common in adults. Epididymitis and epididymo-orchitis were uncommon in infants and boys, unless they had UTI and/or underlying genitourinary congenital anomaly[2, 5, 10].

The results in our study indicated impressively high sensitivity, specificity, accuracy, NPV, and PPV of gray-scale and color Doppler sonography for the diagnosis of epididymo-orchitis. In the analysis of each specific sonographic finding, enlarged epididymis/testis, increased internal flow, and thickened scrotal skin are the top three findings with very high sensitivity, specificity, accuracy, NPV, and PPV, ranging from 79.2 - 100%. The specificity and PPV of increased internal flow for diagnosis of epididymo-orchitis were 100%. Presence of intrascrotal abscess also had 100% specificity and PPV but its sensitivity was very low (14.6%).

Several studies of Horstman WG, et al.[9], Burks DD, et al.[11], Rizvi SA, et al.[12], and Wilbert DM, et al.[13] have found results similar to those in our study, that was gray-scale and color Doppler sonography had high sensitivity and specificity in diagnosis of epididymo-orchitis. To our knowledge, none of these previous studies were designed to provide a detailed analysis of each specific finding, as well as assessment of the predictive utility of each sonographic characteristic. In our study, increased internal flow had the highest association with epididymo-orchitis (odds ratio of 1366.7 and p-value < 0.001 (CI = 76.4 - 24451.9)). Furthermore, enlarged epididymis/testis, thickened scrotal skin, and abnormal echogenicity epididymis/testis also had very high odds ratio (ranging from 121 - 327.25) and p-value < 0.001. They were good predictors for epididymo-orchitis. Intrascrotal calcification was the only sonographic finding that did not have statistically significant association with epididymo-orchitis (odds ratio of 2.2 and p-value 0.2711 (CI = 0.6 - 8.4)).

One-third of patients with clinical diagnosis of epididymo-orchitis (16 of 48, 33%) had normal gray-scale echogenicity of the epididymis/testis with various degree of increased vascularity in color Doppler sonography (Figure 1). In addition, other findings, such as the presence of hydrocele and scrotal skin thickening, helped lead to correct diagnoses. Although most patients show an abnormal gray-scale sonography, it has been shown that the appearance of epididymis/testis can be normal even in the presence of acute epididymitis[8]. Color flow Doppler of acute epididymitis can easily demonstrate the characteristic increased blood flow within the epididymis in comparison to the asymptomatic side. With the modern sonography machines, blood flow can be seen in the normal epididymis on color Doppler sonography, therefore, it is important to compare the vascular flow between symptomatic and asymptomatic sides[8].

In our study, one case presented sonographic diagnosis of incomplete testicular torsion. Patient underwent surgery and the pathologic diagnosis turned out to be epididymo-orchitis with abscess formation (Figure 7). This situation may be a result of marked parenchymal edema from an infection that can compromise testicular blood flow. In this setting, Doppler US findings of epididymo-orchitis may be indistinguishable from those of torsion[14]. It is also difficult to differentiate focal heterogeneity echoic lesion in the effected testis from neoplastic process. Though most testicular tumors may show focal or diffuse hypervascularity on color Doppler sonography, the presence of pain symptom and sonographic epididymal hyperemia allow distinction of orchitis from a testicular neoplasm10. The diffusely infiltrative malignancy of testis, such as leukemia and lymphoma, may have a gray-scale and color Doppler appearance similar to diffuse orchitis. In such cases, the clinical history is the extremely important key for the diagnosis[5].

In our study, the causative organisms of epididymo-orchitis were not classified. According to studies of Chung JJ, et al.[15] and Kim SH, et al.[16], heterogeneously hypoechoic pattern of epididymal enlargement favors a diagnosis of tuberculosis. Because bacterial and tuberculous epididymo-orchitis have different treatment regimens, further study that compares tuberculosis and non-tuberculosis epididymo-orchitissonographic findings is needed.

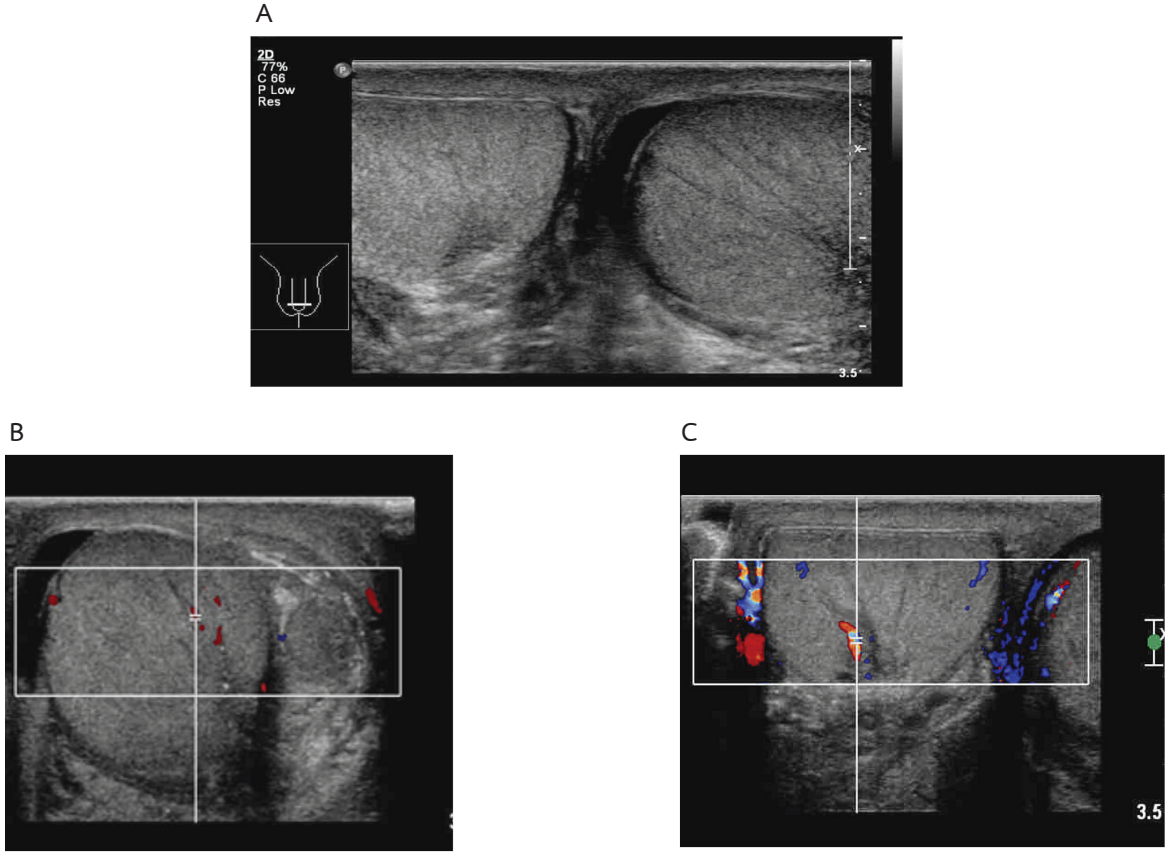

Figure 7 (A) Gray-scale sonography shows enlarged left testis with small amount of left hydrocele. The color Doppler sonography shows relatively decreased flow of the left testis (B) as compared to the right testis (C).

Limitations of the study

This study was a retrospective study. Hence significant limitations included incomplete medical records and selection bias. Variations in the performance of ultrasounds might also affect the assessment. The ultrasound examinations in this study were performed by several radiologists in our department, thus there might be some operator-dependent variation among the imaging data. Lastly, there were a small number of other scrotal abnormalities which are the important mimics of epididymo-orchitis, such as testicular torsion and scrotal tumors, included in this study.

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บทคัดย่อ

การใช้คลื่นเสียงความถี่สูง (gray-scale sonography) และคลื่นเสียงความถี่สูงชนิดสี (color Doppler sonography) ในการวินิจฉัยโรค ท่อเก็บอสุจิและลูกอัณฑะอักเสบ (Epididymo-orchitis)

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บทนำ: การตรวจด้วยคลื่นเสียงความถี่สูงให้ความแม่นยำและความไวสูงในการตรวจหาความผิดปกติในถุงอัณฑะ โรคหรือความผิดปกติในถุงอัณฑะบางภาวะสามารถทำให้เกิดอาการที่คล้ายกันได้ การวินิจฉัยแยกโรคทางอายุรกรรมและศัลยกรรมออกจากกันได้และทำให้ผู้ป่วยมีแนวทางในการรักษาที่ถูกต้องแม่นยำ วัตถุประสงค์เพื่อหาประสิทธิภาพของคลื่นเสียงความถี่สูงและคลื่นเสียงความถี่สูงชนิดสีในการวินิจฉัยโรคท่อเก็บอสุจิและลูกอัณฑะอักเสบ

วิธีการศึกษา: เป็นการศึกษาแบบย้อนหลัง จากข้อมูลผู้ป่วยที่ได้รับการตรวจถุงอัณฑะด้วยคลื่นเสียงความถี่สูงที่แผนกรังสีวิทยาโรงพยาบาลธรรมศาสตร์เฉลิมพระเกียรติ จำนวน ๑๗๑ ราย ระหว่างวันที่ ๑ มกราคม พ.ศ. ๒๕๕๒ ถึง ๓๑ มกราคม พ.ศ. ๒๕๕๗

ผลการศึกษา: ค่าความไว, ความจำเพาะ, ความแม่นยำ, negative predictive value และ positive predictive value โดยรวมของคลื่นเสียงความถี่สูงในการวินิจฉัยโรคท่อเก็บอสุจิและลูกอัณฑะอักเสบ คือ ร้อยละ ๙๗.๙, ร้อยละ ๙๙.๒, ร้อยละ ๙๘.๘, ร้อยละ ๙๙.๒ และร้อยละ ๙๗.๙ ตามลำดับ พบว่าการขยายขนาดของท่อเก็บอสุจิและลูกอัณฑะ การเพิ่มขึ้นของเลือดที่มาเลี้ยง และการหนาตัวของผิวหนังรอบถุงอัณฑะมี predictive value สูงที่สุดสามอันดับแรก

วิจารณ์ และสรุปผลการศึกษา: การตรวจพบการขยายขนาดของท่อเก็บอสุจิและลูกอัณฑะ การเพิ่มขึ้นของเลือดที่มาเลี้ยง และการหนาตัวของผิวหนังรอบถุงอัณฑะ จะเพิ่มความแม่นยำในการวินิจฉัยโรคท่อเก็บอสุจิและลูกอัณฑะอักเสบมากขึ้น

คำสำคัญ: ท่อเก็บอสุจิและลูกอัณฑะอักเสบ, การตรวจถุงอัณฑะด้วยคลื่นเสียงความถี่สูง, คลื่นเสียงความถี่สูง, คลื่นเสียงความถี่สูงชนิดสี