BMUS

THE BRITISH MEDICAL ULTRASOUND SOCIETY



The acute scrotum – the two most difficult US problems

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The Acute Scrotum

1. Ischaemia
    1. Spermatic cord torsion
    2. Torsion of a testicular or epididymal appendage
    3. Testicular Infarction (Other vascular causes)
2. Trauma
3. Infection
    1. Acute epididymitis, epididymo-orchitis, orchitis
    2. Abscess
    3. Fournier's gangrene
4. Inflammation
    1. Henoch-Schonlein purpura
5. Incarcerated/strangulated inguinoscrotal hernia
6. Other
    1. Testicular tumour (rupture, haemorrhage, infarction)
    2. Varicocoele
    3. Hydrocoele/Spermatocoele rupture, infection

Scrotal Trauma

Suspected torsion of the spermatic cord

Bottom Line: Does the Patient Need Surgery Now?

Scrotal Trauma

- Rare (<1% of trauma related injuries)
- Testes protected by:
  - Mobility in scrotum
  - Cremasteric reflex
  - Strength of tunica albuginea

Normal Anatomy

- Tunica albuginea
  - Very high tensile strength (50kg)
- Tunica vasculosa
  - Lies immediately below albuginea
  - When disrupted results in ischaemia and disruption of the blood-testis barrier (possible effect on fertility)

Mechanism of Injury

- Blunt injury (85%)
  - Crush against pubic bone (Rt>Lt)
  - Sporting activity >50%
  - RTA 9-17%
- Penetrating injury (15%)
  - Sharp objects and missiles
  - Bites (human and animal)

Blunt Scrotal Trauma

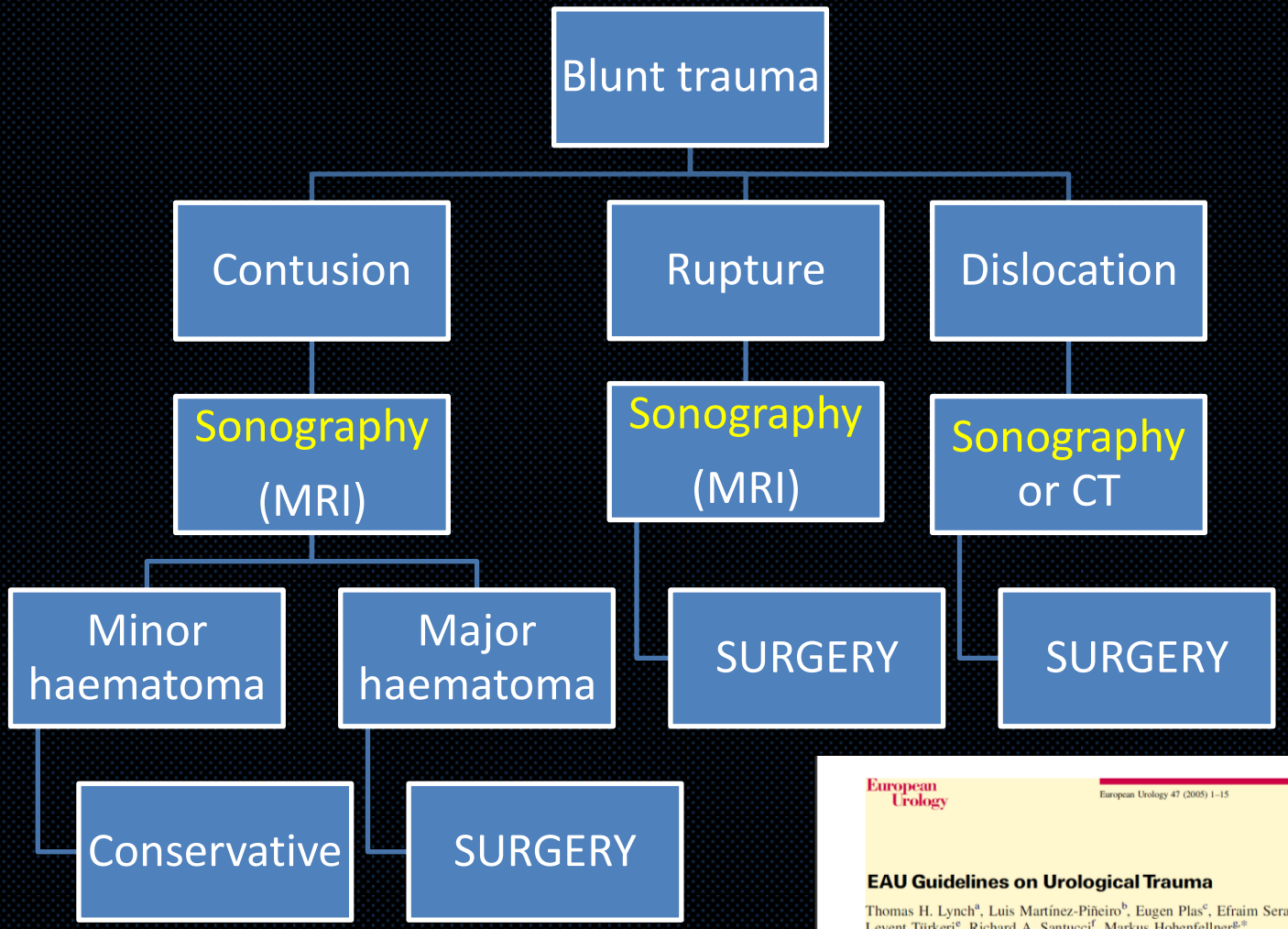
- Spectrum of injuries
  - Testicular rupture
  - Testicular fracture
  - Testicular dislocation
  - Spermatic cord torsion
  - Haematoma
    - Intratesticular
    - Extratesticular
  - Haematocoele

Clinical Examination

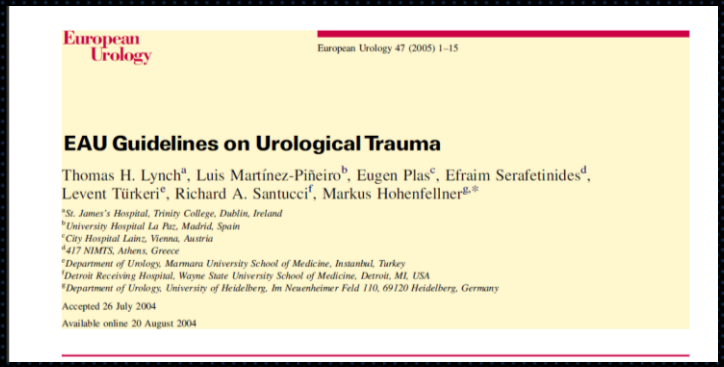
- Clinical examination can be very difficult in the setting of trauma
- Swelling and tenderness suggests a significant injury but rupture may be present without pain[1]
- Clinical findings are unreliable in predicting severity of injury[2]
- Application of trauma severity scales (AAST) not prospectively validated[3]

1. Chandra RV Urology 2007;70:230 2. Bhatt S Radiographics 2008;28:1617 3. Terlecki R emedicine.medscape.com

EUA Guidelines



European Urology 2005;17:1-15



European Urology

European Urology 47 (2005) 1–15

EAU Guidelines on Urological Trauma

Thomas H. Lynch[a], Luis Martínez-Piñeiro[b], Eugen Plas[c], Efraim Serafetinides[d], Levent Türkeri[e], Richard A. Santucci[f], Markus Hohenfellner[g,*]

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[g]Department of Urology, University of Heidelberg, Im Neuenheimer Feld 110, 69120 Heidelberg, Germany

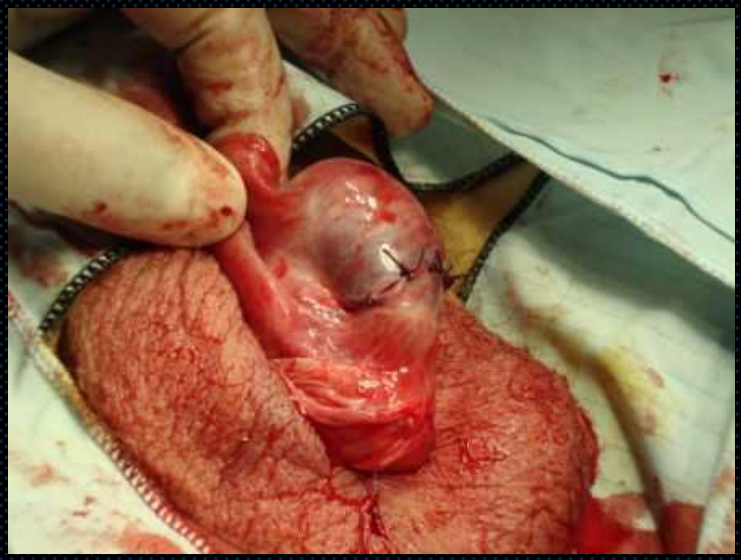
Accepted 26 July 2004

Available online 20 August 2004

Testicular Rupture

- Found in up to 50% of cases of blunt trauma
- Early surgical intervention (<72 hrs.) results in 80-90% testicular preservation, delayed surgery requires orchidectomy in 45-55%
- Excision of necrotic tissue and closure of the tunica albuginea
- Testis preservation surgery if > 50% of parenchyma preserved





Testicular Rupture: US Features

Direct Features

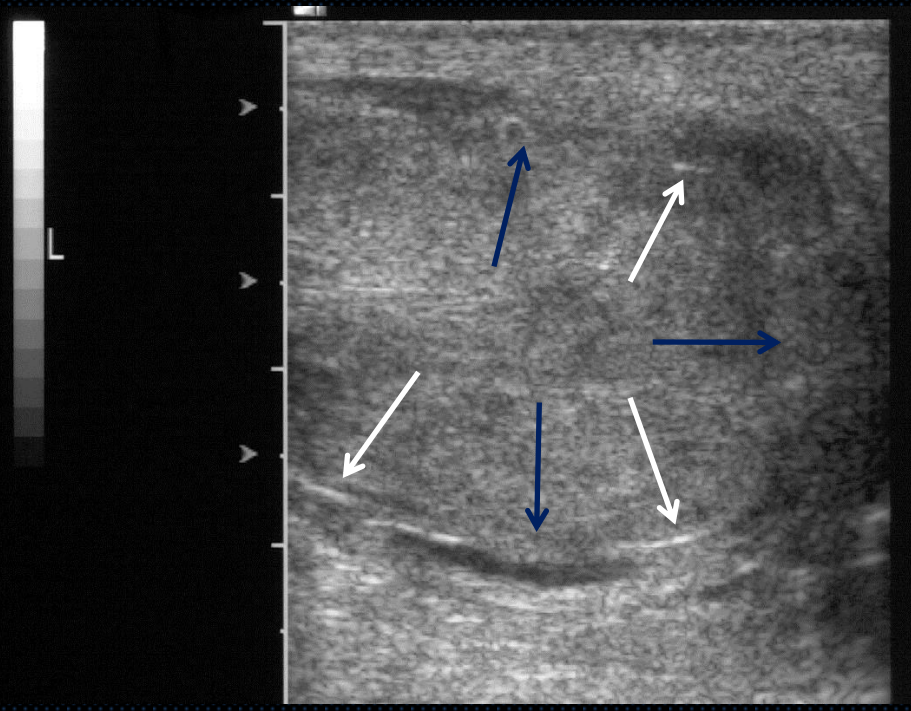
1. Disruption of the Tunica Albuginea
2. Contour abnormality of the testis

Associated features

1. Intra-testicular haematoma (inhomogeneous parenchyma)
2. Absent blood flow

Disruption of the Tunica Albuginea

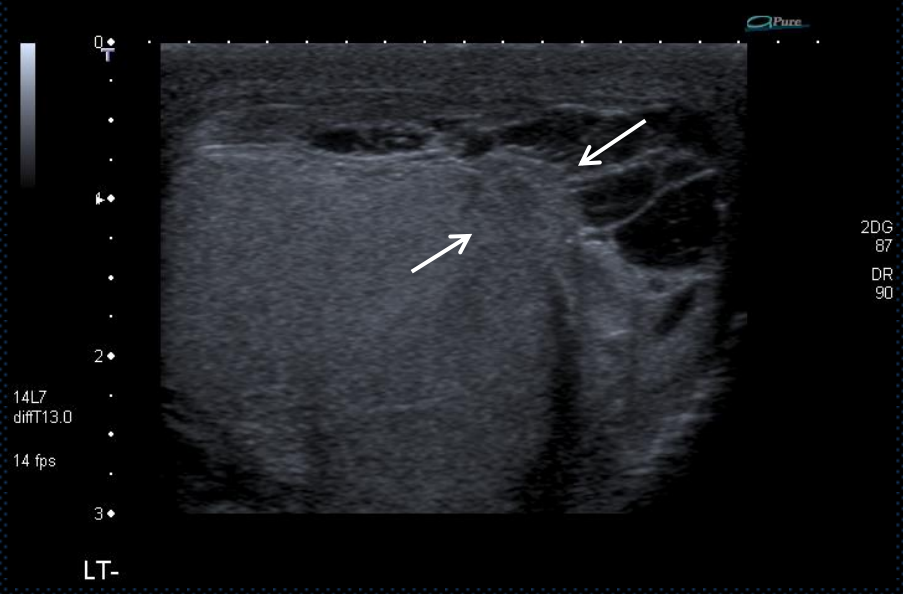
- Intact tunica on US allows confident exclusion of rupture[1]
- Discontinuity of tunica alone is only 50% sensitive and 76% specific for rupture[2]
- US frequently inconclusive when there is no scrotal fluid or a large echogenic haematoma

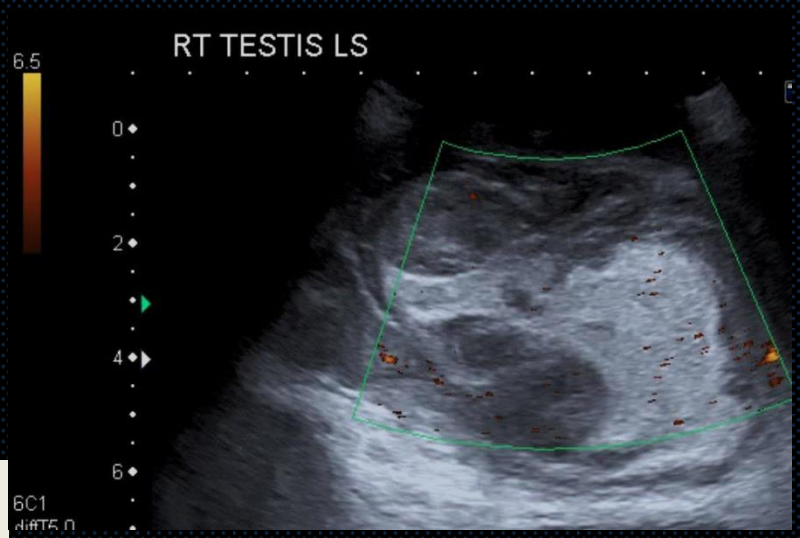


1. Bhatt S. AIUM 2007 2. Guichard G. Urology 2008;71:52

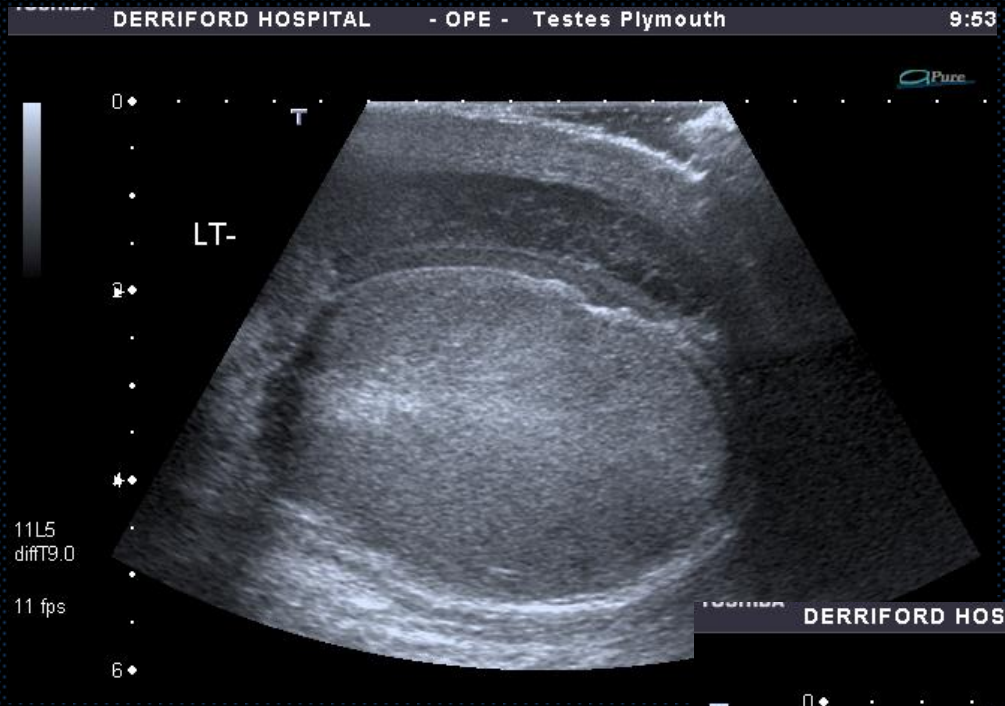
Contour Abnormality

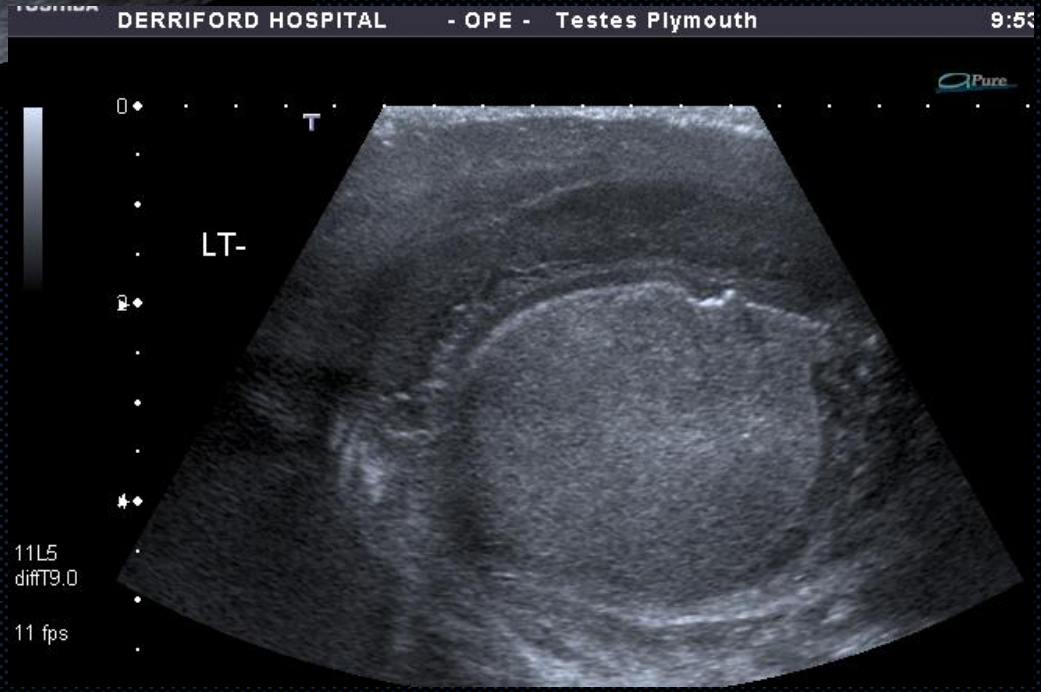
- Extrusion of testicular parenchyma through tunical defect
- Contour abnormality 90% accurate for testicular rupture – most valuable US predictor[1]
- Contour abnormality and intratesticular haematoma have 100% sensitivity and 93.5% specificity for rupture[2]
- US is valuable for triage[3]





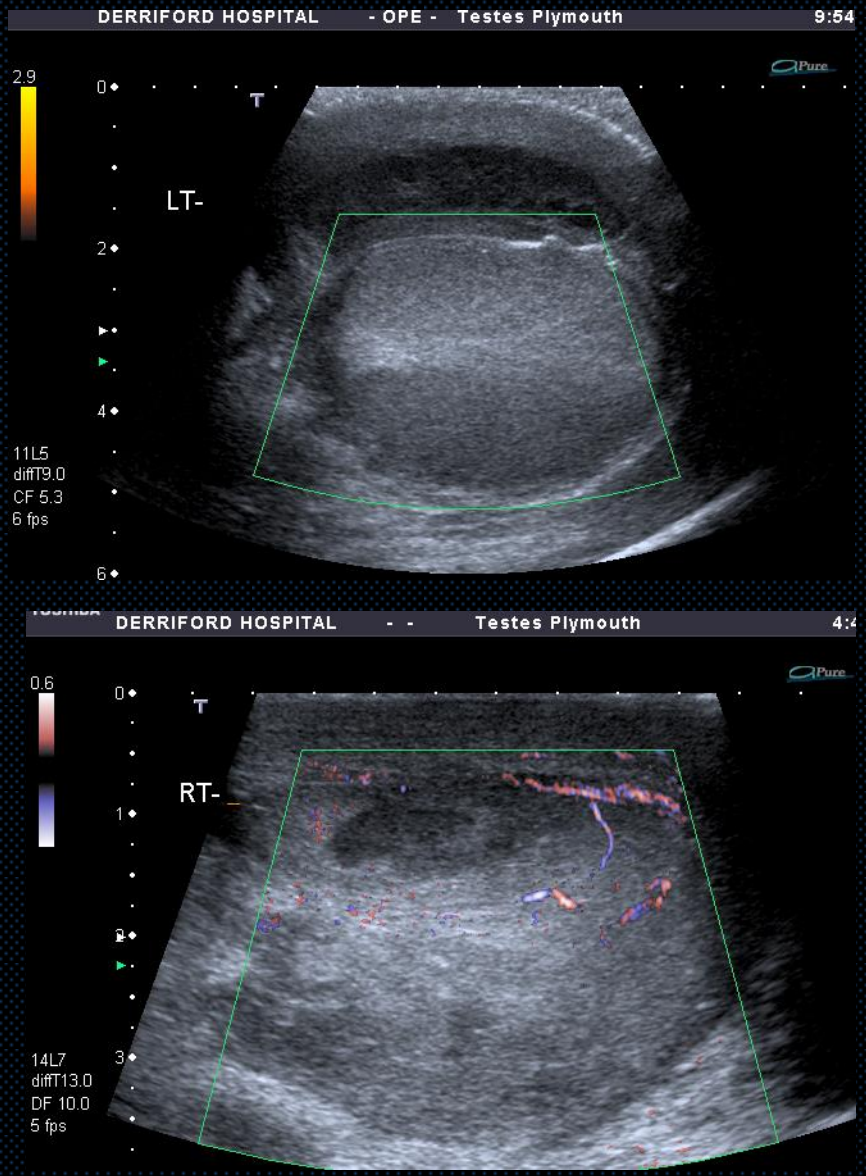
1 . Kim SH. J Ultrasound Med 2007;28:549 2. Buckley J J Urol 2006;175:175 3. Yagil Y J Ultrasound Med 2010;29:11


DERRIFORD HOSPITAL - OPE - Testes Plymouth 9:53
LT-
11L5
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11 fps


DERRIFORD HOSPITAL - OPE - Testes Plymouth 9:53
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Absent Vascularity

- Complete
  - Consider injury to spermatic cord or torsion
  - Needs surgical exploration
- Incomplete
  - Disruption of the tunica vasculosa
  - Helps determine viability of testis and extent of surgical debridement required
- Loss of vascularity correlates with severity of injury



CEUS In Scrotal Trauma

EFSUMB Guidelines and Recommendations for CEUS in Non-Hepatic Indications: Update 2017

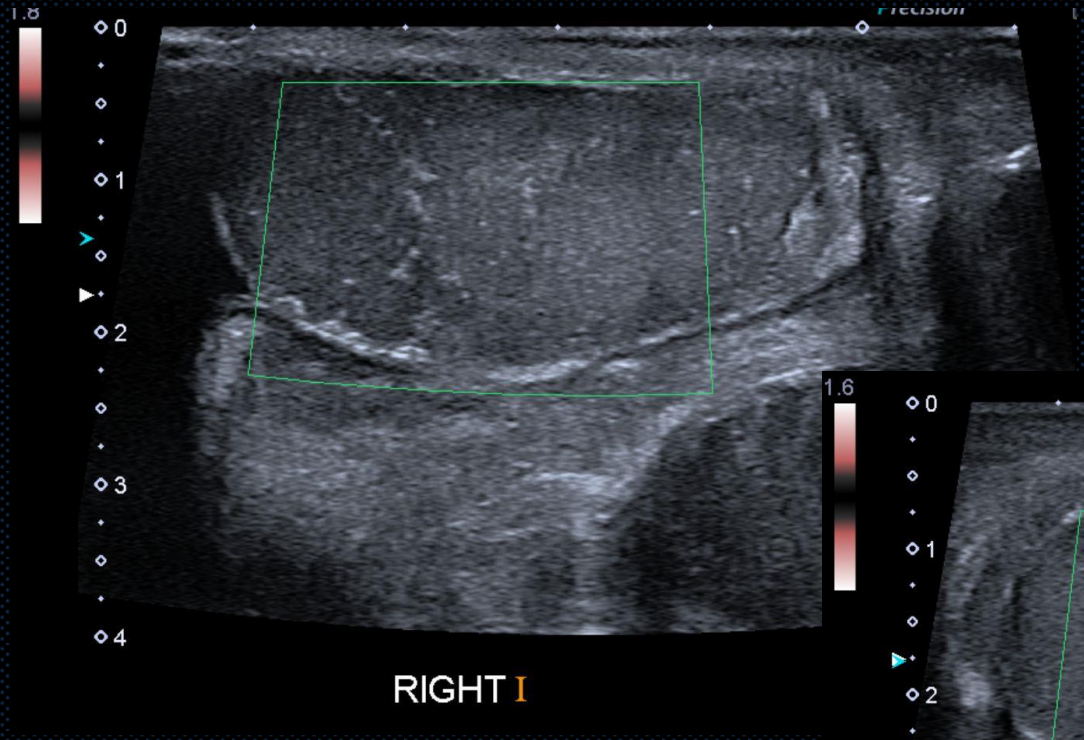
- CEUS can discriminate non-viable regions in testicular trauma (Recommendation 15)
- CEUS allows better delineation of testicular fracture lines and haematoma

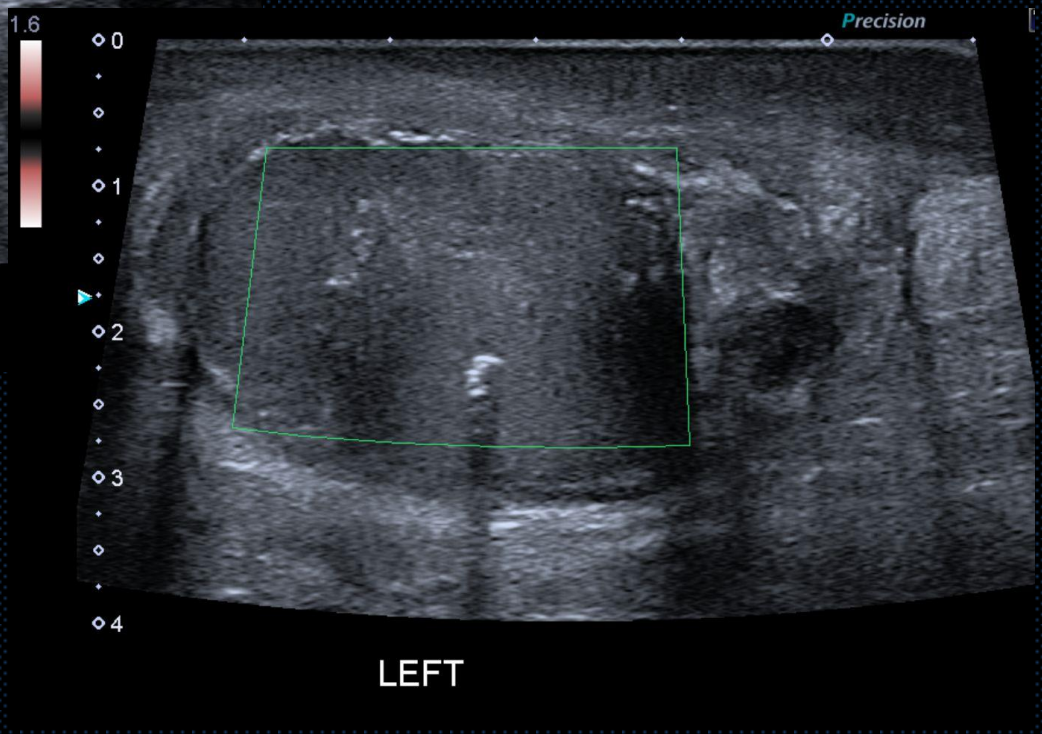
Lobianco R. Journal of Ultrasound 2011;14:188

40 patients with blunt scrotal trauma. 24 positive.

- Concordance between basal US and CEUS (24 cases):
  - High – 38%, Moderate – 33%, Low – 12.5%, Absent – 16%
- Relevance of additional information from CEUS (40 cases):
  - High 10%, Moderate 17.5%, Low – 32.5%, None – 35%

“Astride” Injury

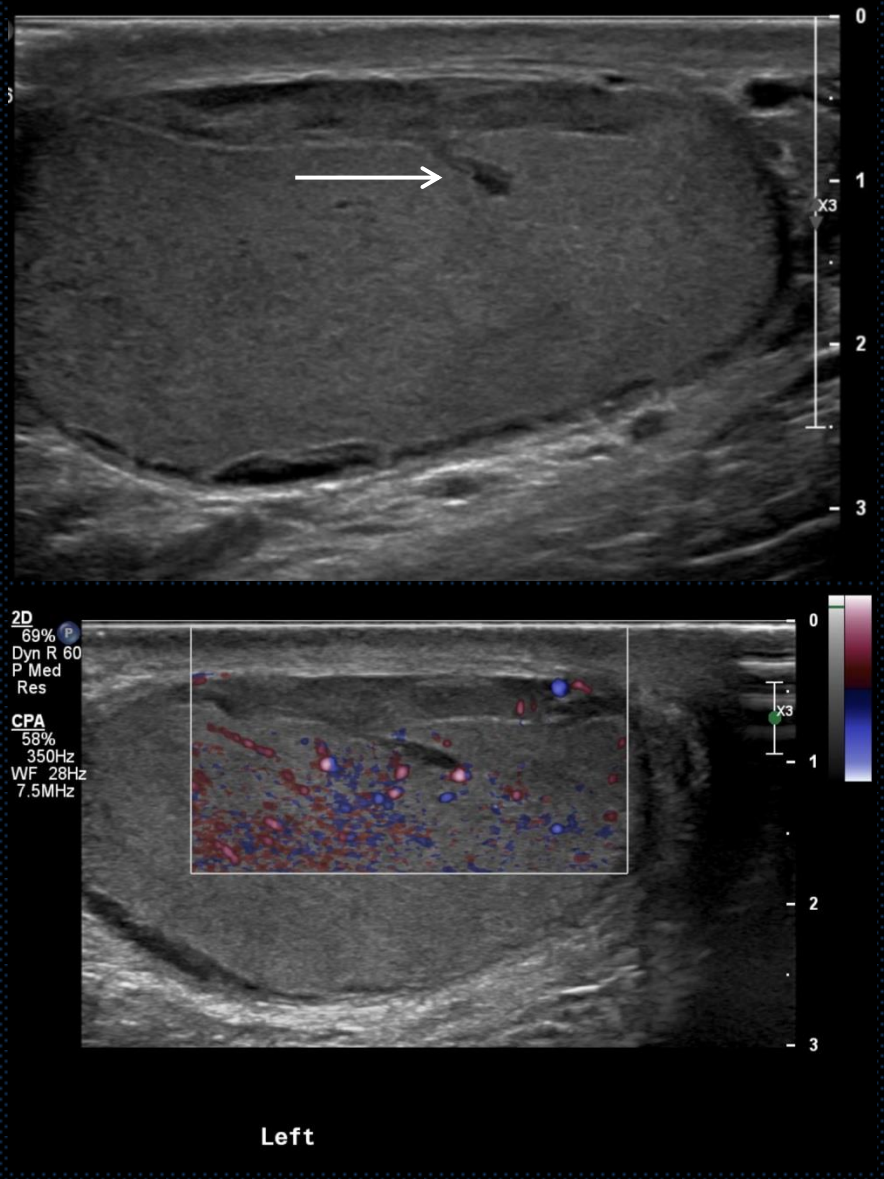





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INJ 2 LT
AP0.38%
AP0.32%
A 00:51

Testicular Fracture

- Break of the normal testicular parenchyma
- Rare injury (17%) of cases of trauma
- Frequently treated conservatively if tunica intact and flow is satisfactory, debridement for severe cases
- Hypoechoic fracture line seen on US



Testicular Dislocation

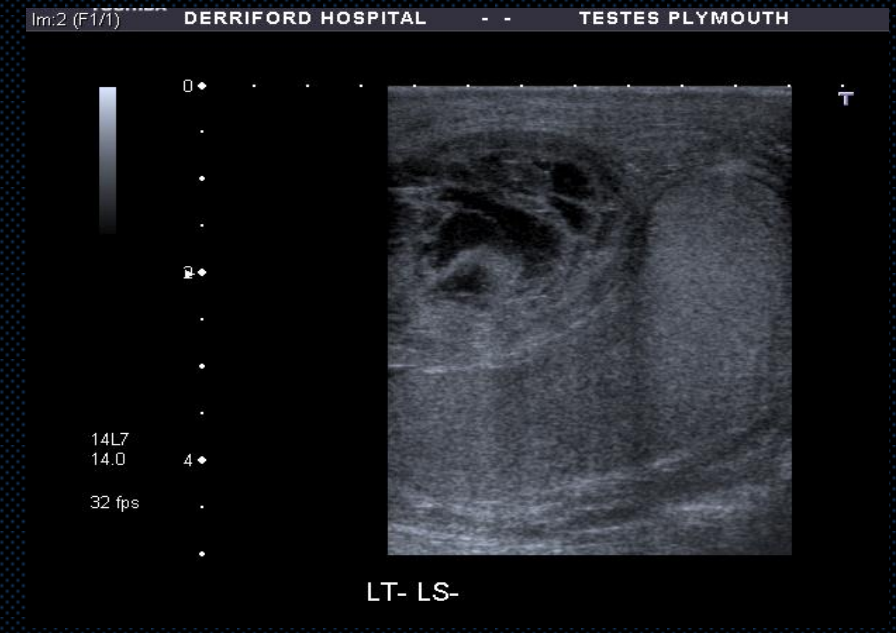
- Rare injury
- Impact against fuel tank in motorcycle accidents
- Needs urgent surgical repositioning
- Sites:
  - Type 1: Inguinal canal (50%) or abdomen
  - Type 2: Subcutaneous – inguinal, pubic, crural, penile

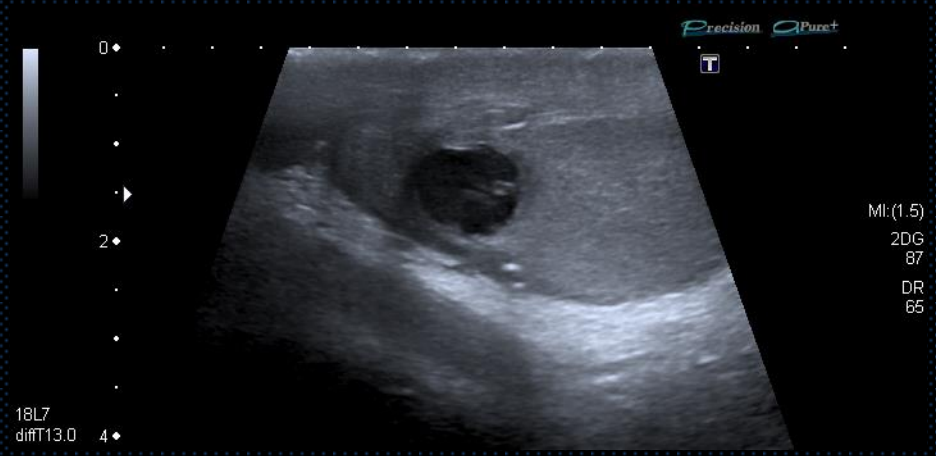
Perera E J Clin Imaging Sci 2011;1:17

Schwartz SL Urology 1994;31:743

Haematoma

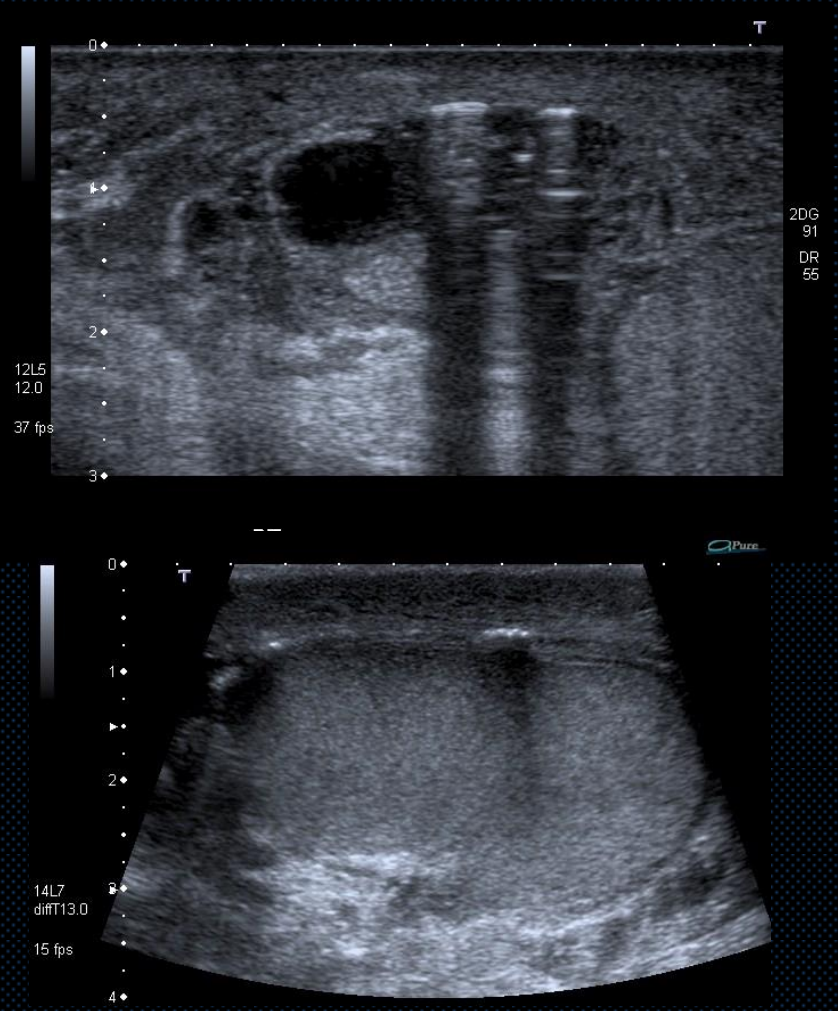
- Extra-testicular haematoma usually treated conservatively if testicular perfusion satisfactory
- Surgical management if large (> x3 size of testis) – reduces pain and hospital stay
- Intra-testicular haematomas managed conservatively if tunica intact and good perfusion of testis
- US follow-up of conservatively treated intra-testicular haematoma is required (infection/necrosis in 40%, underlying tumour)





Penetrating Injury

- Gunshot injury most common
- More frequently bilateral
- Conflicting evidence on the role of ultrasound:
  - sensitivity is limited for diagnosing rupture after gunshot wounds (60%) and should not prevent scrotal exploration[1]
  - Sensitivity of US 100% for testicular injury[2]
- US findings as for blunt trauma but also gas in soft tissues and foreign bodies
- Surgical exploration usually performed



1. Powers R J Urol 2018;199::1546 2. Churukanti GR. Urology 2016;95:208

Take home messages

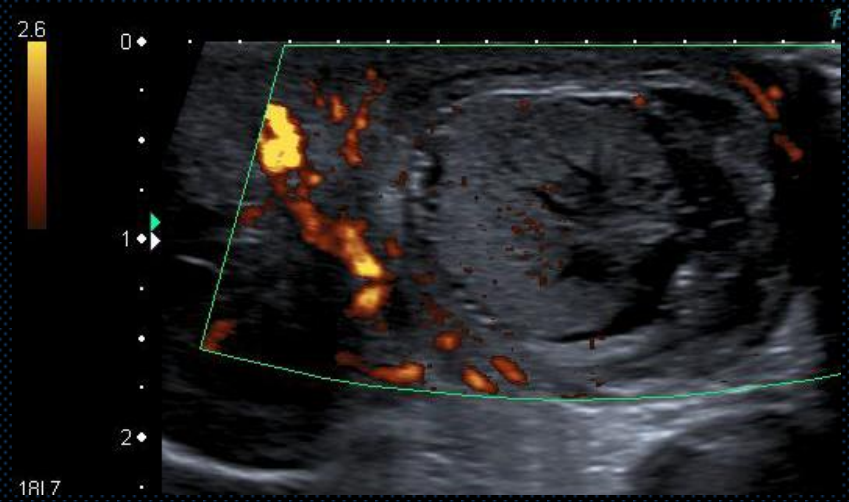
1. Clinical evaluation is difficult and unreliable in testicular trauma
2. Early surgery improves outcomes for severe injury
3. US is valuable in triage
   - Intact tunica excludes significant injury but often difficult to confirm
   - Testicular contour abnormality is the most valuable US sign of rupture.
   - CEUS valuable for increasing conspicuity of lacerations/haematoma and determining testicular viability
4. Equivocal ultrasound should lead to surgical exploration due to the consequences of delayed diagnosis of testicular rupture

Torsion of the Spermatic Cord

Spermatic cord torsion

Extravaginal torsion

- Neonates
- Entire testis, epididymis and tunica vaginalis twist
- Rare associated with an inguinal hernia



Intravaginal torsion

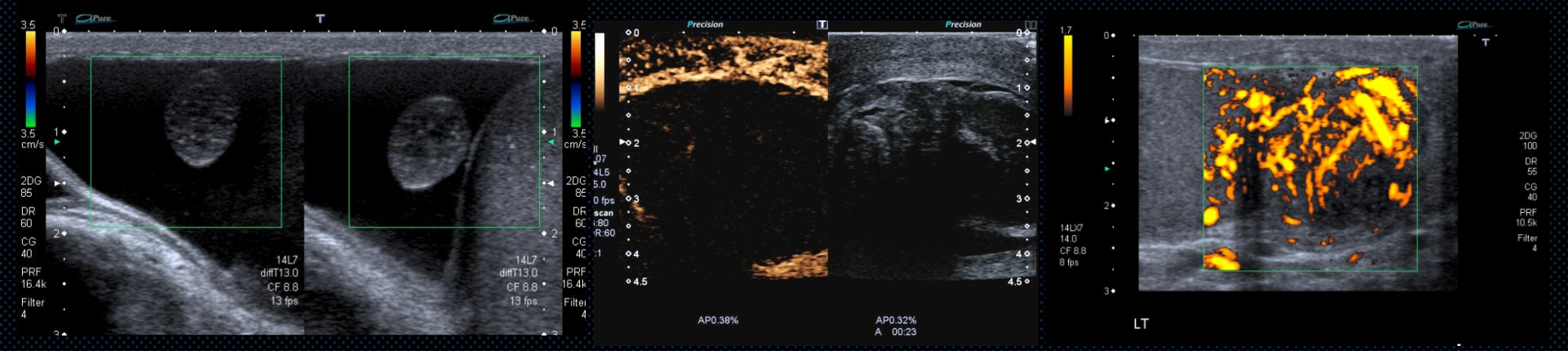
- Rotation of testis within the tunica vaginalis
- Peak age 13-16 years
- Rare below age 7 (7%)



Age Distribution of the causes of an acute-scrotum seen at surgical exploration

Age Group (years)	Testicular torsion (%)	Torted appendix testis (%)	Epididymo-orchitis (%)
0 – 11	6.6	62	6
12 – 16	52	32	3
17 - 40	48	5	27

Watkin NA. Br J Urol 1996;78:623–627.



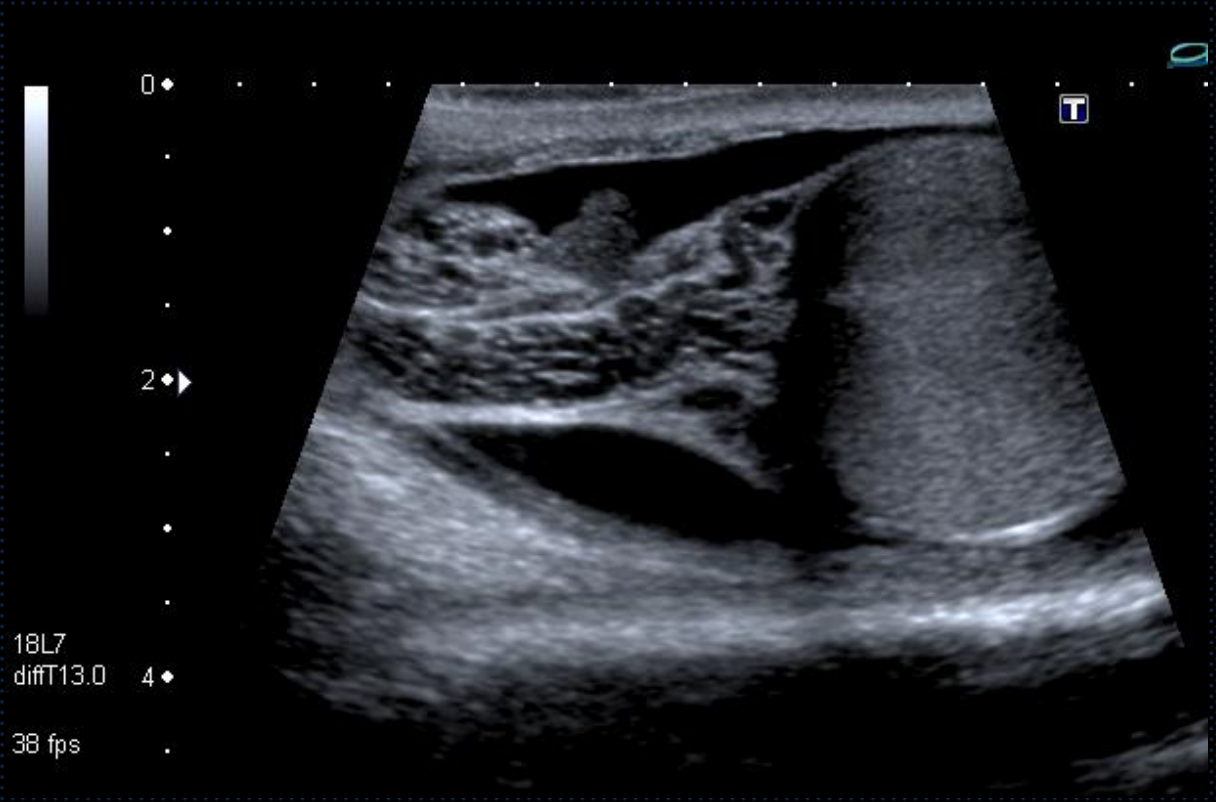
Bell-Clapper testis

- Prime diagnostic risk
- Abnormal high attachment of the parietal tunica vaginalis
- 12% boys
- 78% bilateral
- Testis hangs freely in scrotal sac with no posterior attachment
- Frequently horizontal lie





Bandarkar, A.N. & Blask, A.R. Pediatr Radiol (2018) 48: 735. https://doi.org/10.1007/s00247-018-4093-0


0
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Why Spermatic Cord Torsion Matters

For the patient

- Complications of untreated or delayed treatment include:
  - Infarction
  - Atrophy
  - Cosmetic deformity
  - **Subfertility in 36-39%.**

For us

- We want to help not hinder!
- Medicolegal issues:
  1. USA (1979-1997) negligence claims[1]:
     - Clinical misdiagnosis of epididymitis (61%)
  2. Poorly managed TT is the third most common cause of malpractice cases in adolescent males presenting to emergency departments (USA)[2]
  3. In 64% of cases leading to litigation there was a false negative US[3] (USA)

1. Matteson JR Urology 2001;57 2. Selbst SM. Paediatr Emerg Care 2005;21:165 3. Gaither T . J Urol 2016;195:S e

Three Dangerous Torsion Myths[1]

1. The history is pathognomonic
   - Rapid onset of pain, nausea and vomiting also seen in TAT and EO
2. The aetiology of scrotal pain can be diagnosed by physical examination alone
   - Absent cremasteric reflex and high riding testicle (Prehn's test), scrotal erythema, swelling and oedema, and transverse lie are all unreliable and seen in TT, EO and TAT
3. After six hours of pain the testicle is unsalvageable

1. Mellick LB. Emergency Medicine Reports

Viability of the testis

- Duration of symptoms
  - Time is the enemy.
  - Salvage rates 90% at < 8 hours, 80% < 12hours, 40% <24 hours, 10% >24hours
- Degree of twisting
  - Between 360-540 degrees there is significant occlusion of arterial flow leading to testicular injury

Probability of non-salvage

- Duration:

  =4 + (3 x duration in hours)
- Degree of twist:

  = 7 + (0.05 x degree of twist)

- e.g. torsion duration 6 h and 360^{o} twist = 22 – 25% chance of non-salvage

Yu K-J Chang Gung Med J 2012;35:38-45

Howe AS. Trans AndrolUrol 2017;6:1159-1166

Is there any role for US? - Guidelines

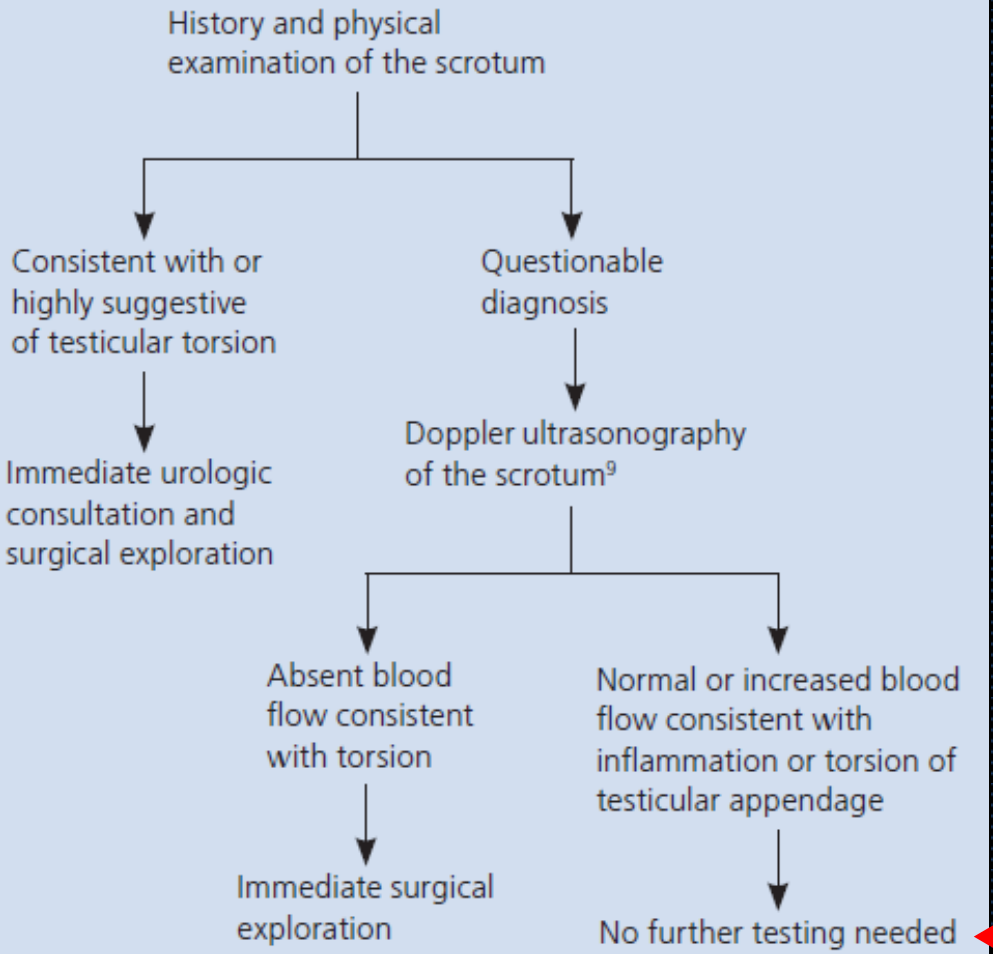
1. Immediate surgery should be performed if testicular torsion is suspected, and should not be delayed by imaging studies (Evidence level C)[1]
2. NICE Guidelines: All cases of acute testicular pain are due to torsion until proved otherwise. If torsion is suspected after a prompt clinical assessment, a scrotal exploration should be carried out without delay[2]
3. EAU Guidelines: Doppler US may reduce the number of patients undergoing unnecessary surgical exploration but may show misleading appearances in the early phases, in partial or intermittent torsion. Testicular torsion requires prompt surgical treatment[3]
4. AUA: With a high degree of suspicion, one may reasonably recommend surgical exploration[4]

BOTTOM LINE:

1. **SURGICAL EXPLORATION SHOULD NOT BE DELAYED BY ULTRASOUND IN INTERMEDIATE/HIGH RISK CASES**
2. **ULTRASOUND MAY GIVE MISLEADING APPEARANCES**

1. Sharp VJ. Am Fam Physician 2013;88:835-840 2. www.evidence.nhs.uk/Search?q=testicular+torsion 3. EAU Guidelines on Paediatric Urology 2015 4.https://www.auanet.org/search?Keywords=acute+scrotum

Evaluation of the Acute Scrotum



← DANGER - BEWARE!

Sharp VJ. Am Fam Physician 2013;88:835-840

How accurate is US

- Varying Results in the Literature:
  - Sensitivity 69.2 – 100%, Specificity 87 – 100%

Author	Year	Number	% TT	Sensitivity	Specificity	PPV	NPV	Accuracy
Waldert	2010	298	20.9	96.8	97.9	92.1	99.1	
Günes	2015	97	74					98.6
Kalfa	2007	919	23		99			88.7

Waldert M. Urology 2010;75(5);1170

Günes M. Cent European J Urol. 2015; 68: 252-256

Kalfa N. J Urol. 2007;177:297-301

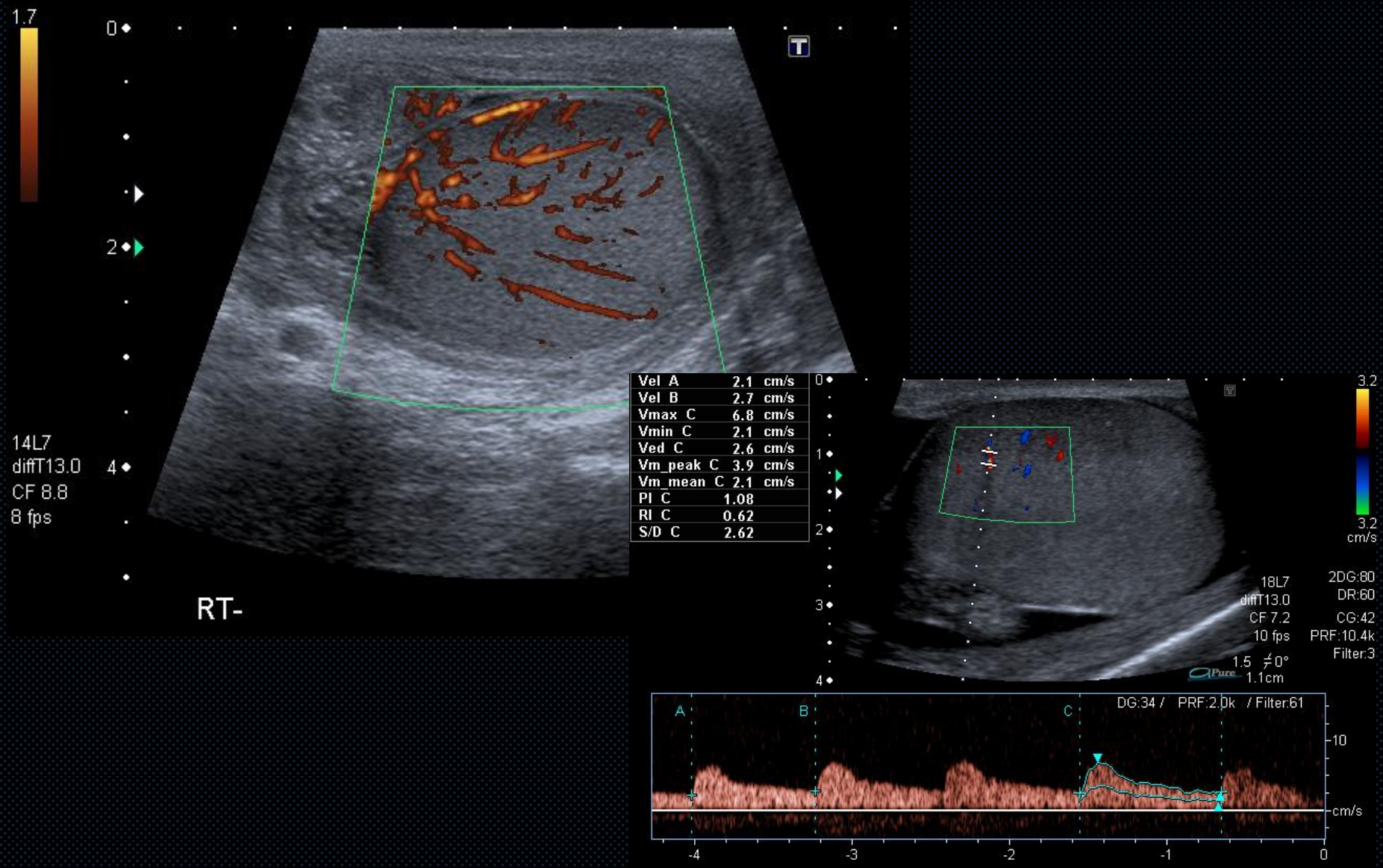
Suggested Examination Technique

High frequency linear transducer, warm gel.

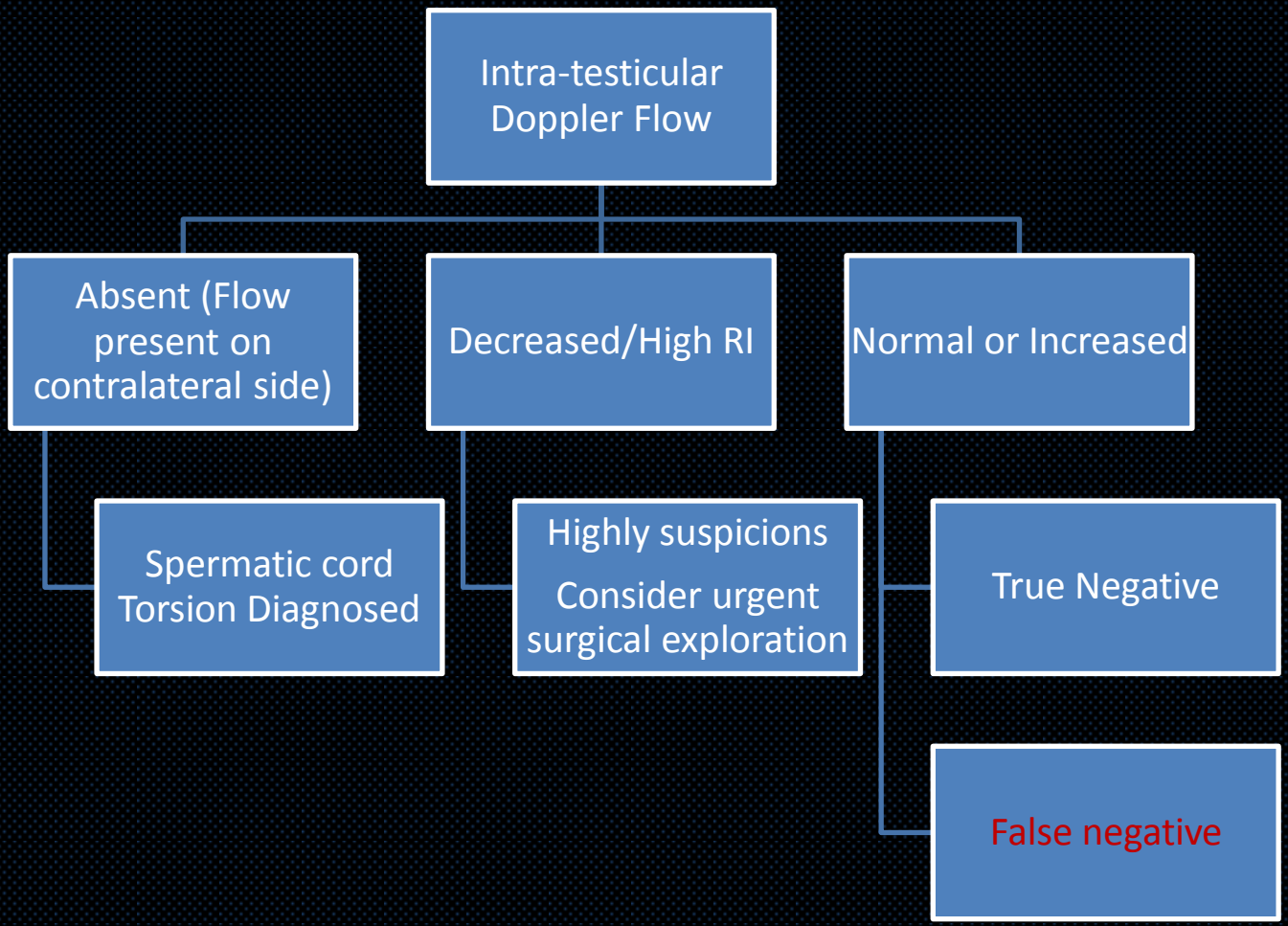
1. Grey scale transverse view (testicular lie)
2. Transverse colour Doppler/power Doppler images (optimise gain and scale), short cine clip
3. Grey scale transverse and longitudinal images both testes – calculate testicular volume (LxWxHx0.71)
4. Colour and spectral Doppler examination of both testes, calculate RI values
5. Examine the epididymis and record images including colour Doppler
6. Examine the spermatic cord in LS and TS from internal ring to scrotum. Greyscale, colour Doppler and cine clip images
7. Record any other pathology

Bandarkar AN. Paediatric Radiology 2018;48:735–744 https://doi.org/10.1007/s00247-018-4093-0

Normal Doppler US

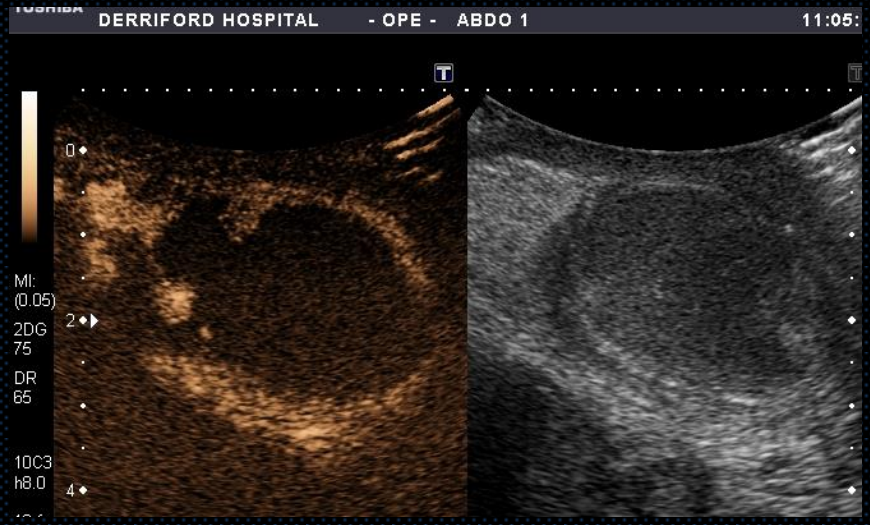


Interpreting the examination



Sometimes it's easy!





- No intra-testicular flow
- Flow present in the contralateral testis
- Epididymis usually enlarged but hypovascular
- In late-phase torsion (> 24 hrs) a halo sign may be present
- CEUS has no established role in TT but may help determine the viability of the testis[1]

1. Sidhu. Ultraschall in Med 2018;39:2-44

Sometimes it's difficult!

Torsion with preserved intra-testicular flow

- Intra-testicular flow may be present in 24-30% of patients with spermatic cord torsion
- May be reduced, normal or increased – subjective and difficult to evaluate.
- Usually < 360^{o} twist
- Experience of the ultrasound practitioner is the most important factor predicting the correct US diagnosis
- Differentiation from epididymitis is critical

Kalfa N. J Urology 2004;172:1692-169 Kalfa N. J Urol 2007;177:297-301

Recognising Torsion When Flow is still present – examine the cord

Most reliable:

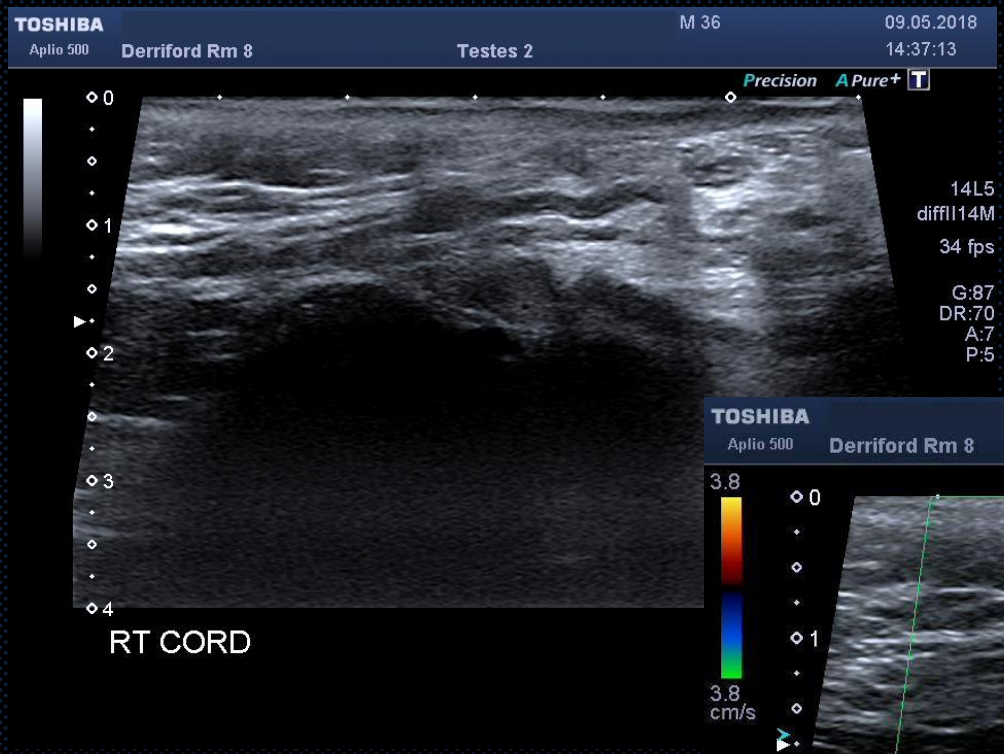
1. Whirlpool sign
2. Epididymal-cord complex
3. Horizontal or abnormal lie (side by side view)

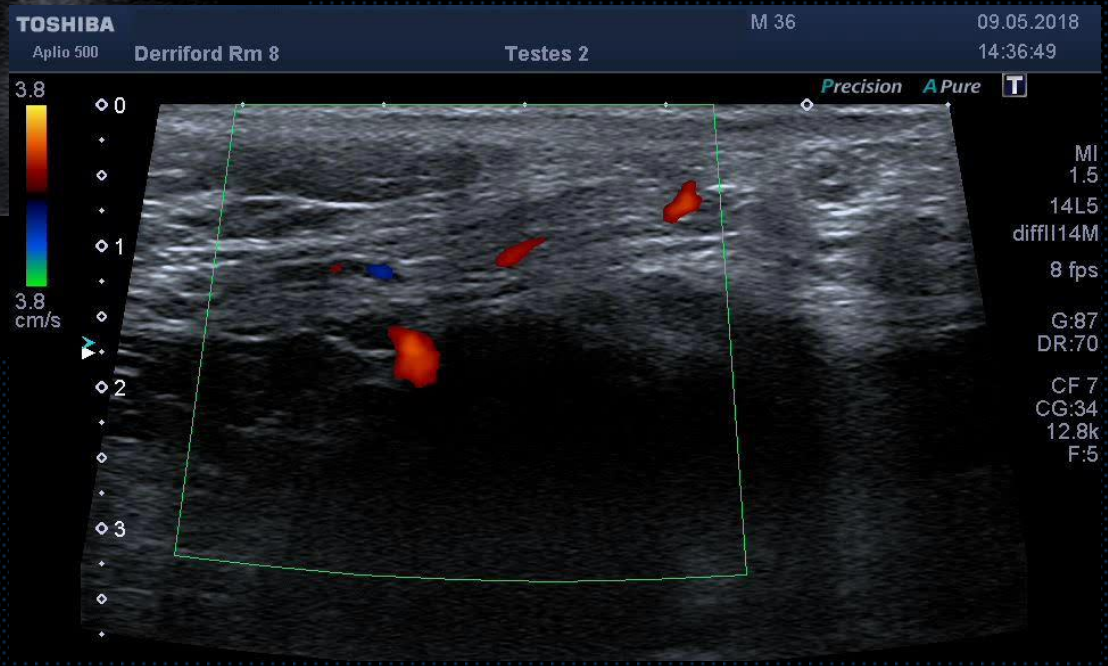
Of concern but seen in other conditions:

1. Global testicular enlargement (venous congestion) – don't mistake for orchitis
2. Heterogeneous testis echotexture – often non-viable
3. Epididymal enlargement without hyperaemia – don't mistake for epididymitis
4. Increased vascular resistance on spectral Doppler (RI >0.75)

Bandarkar AN. Paediatric Radiology 2018;48:735–744 https://doi.org/10.1007/s00247-018-4093-0

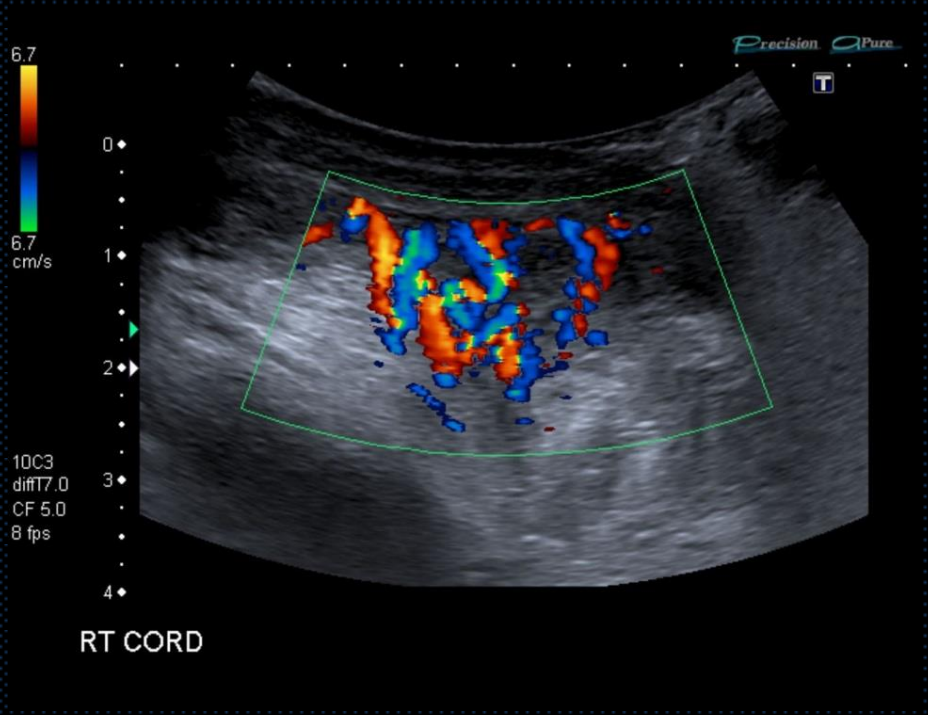
Normal spermatic cord





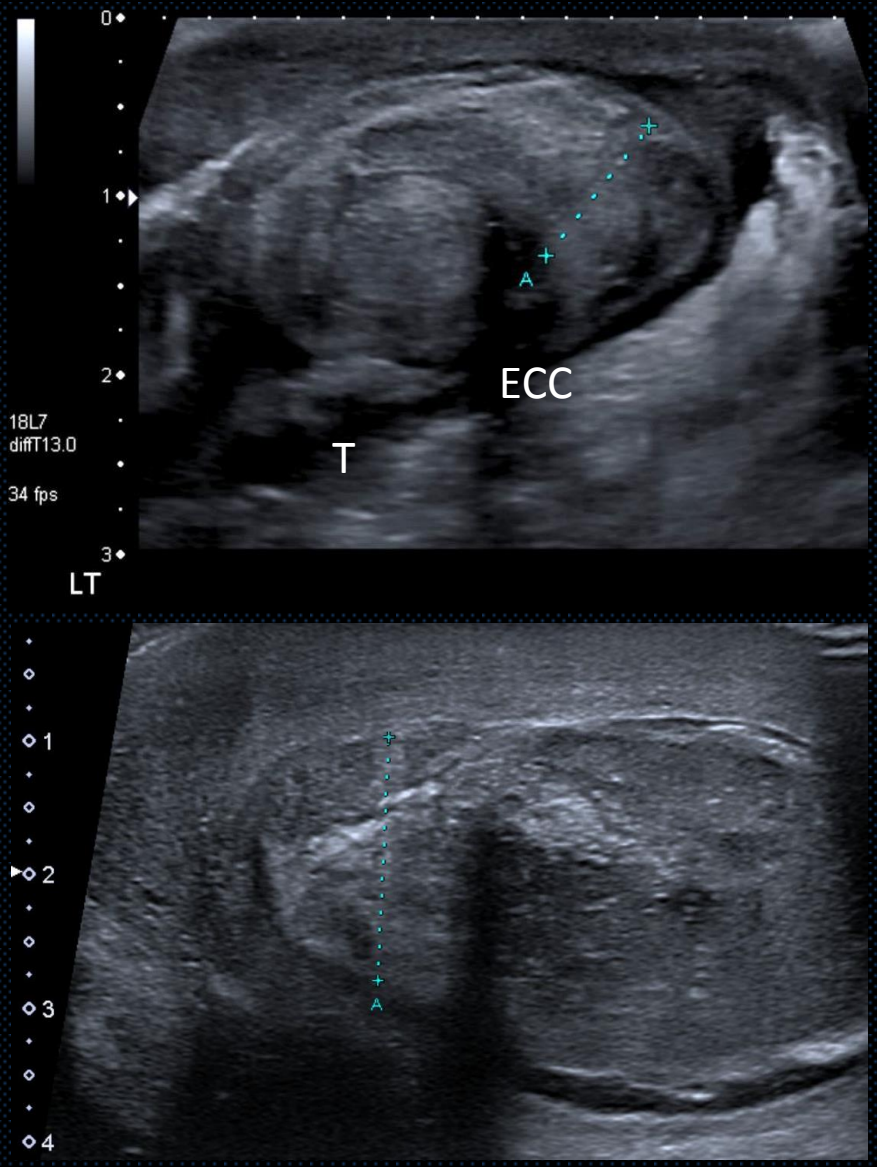
Whirlpool Sign

- Spiral twist of the cord below the external ring
- Direct sign of torsion
- Not always seen



Epididymal cord complex

- Pseudomass representing redundant spermatic cord often involving epididymal head
- Above testis (usually) often surrounded by fluid
- May contain congested vessels
- Usually low vascularity
- Easy to mistake for focal epididymitis

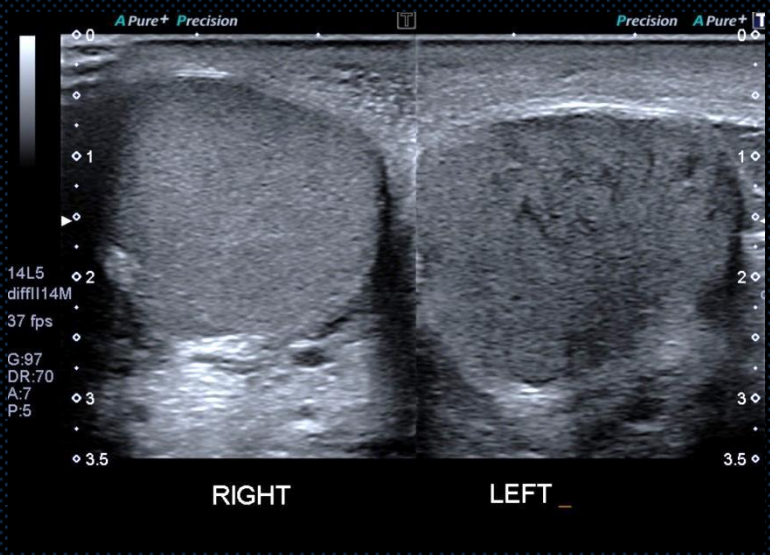



TOSHIBA
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M 36
09.05.2018
Testes 2
14:33:33
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A Pure+
MI
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14L5
diffII14M
28 fps
G:87
DR:70
A:7
P:5
0
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5.5
LT CORD ING


TOSHIBA
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3.8
3.8
cm/s
0
5
5.5
LT CORD ING

Additional features

1. Horizontal testicular orientation or abnormal orientation (position of mediastinum testis)
2. Diffusely enlarged testis
3. Altered testicular echogenicity (oedema/infarction), often a bad prognostic feature
4. Abnormal high resistance intra-testicular spectral Doppler spectrum (normal <0.75)





Take home messages

- TT is a difficult clinical diagnosis
- Time is critical - Ultrasound must not delay surgical intervention in intermediate and high risk cases
- US may reduce unnecessary surgery if rapidly available, operator experience is important
- Use a standardised US examination technique
- An avascular testis implies torsion but intra-testicular flow is still present in 24-30% of cases and is sometimes normal or increased
- Examine the spermatic cord and be aware of the additional sonographic features of TT - if present have a high index of suspicion even if testicular flow present
- Be aware that the US features of TT will often mimic epididymitis
- Close collaboration between paediatrician, urologist and radiologist is essential - ensure that referrers are aware of the strengths and limitations of ultrasound