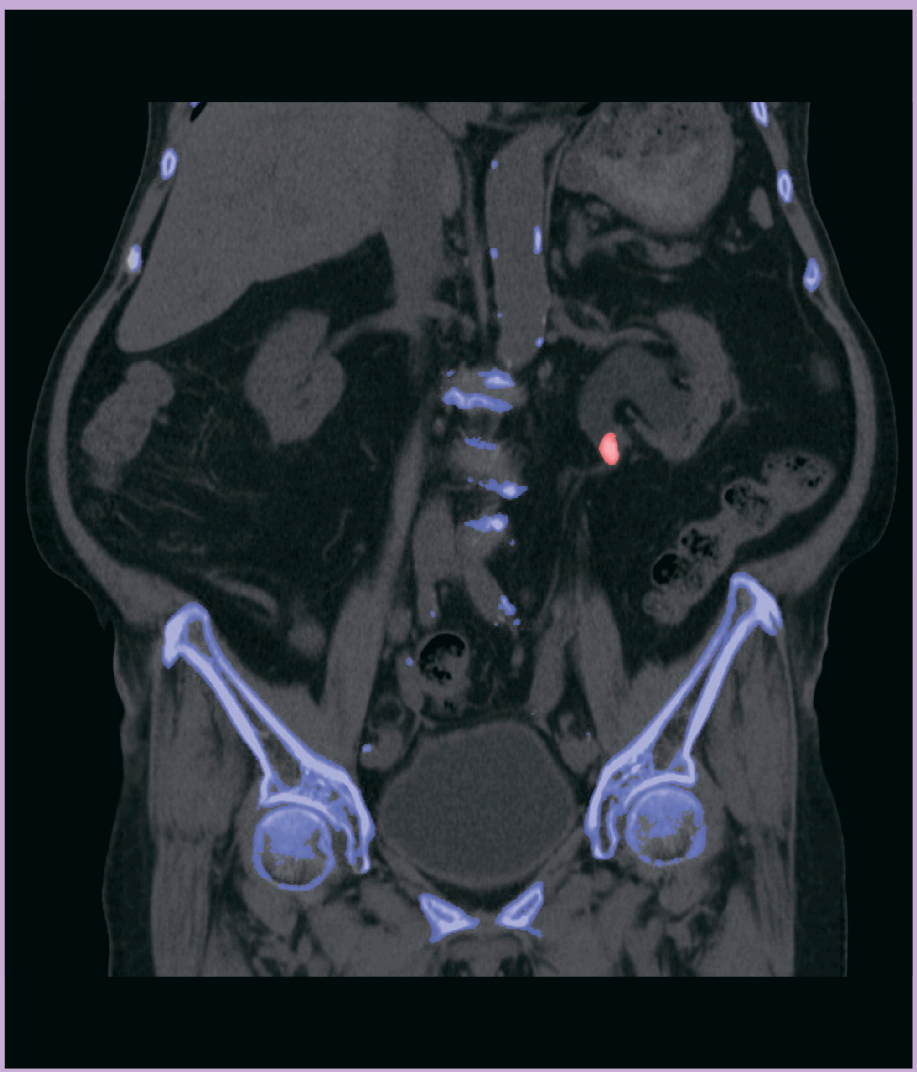
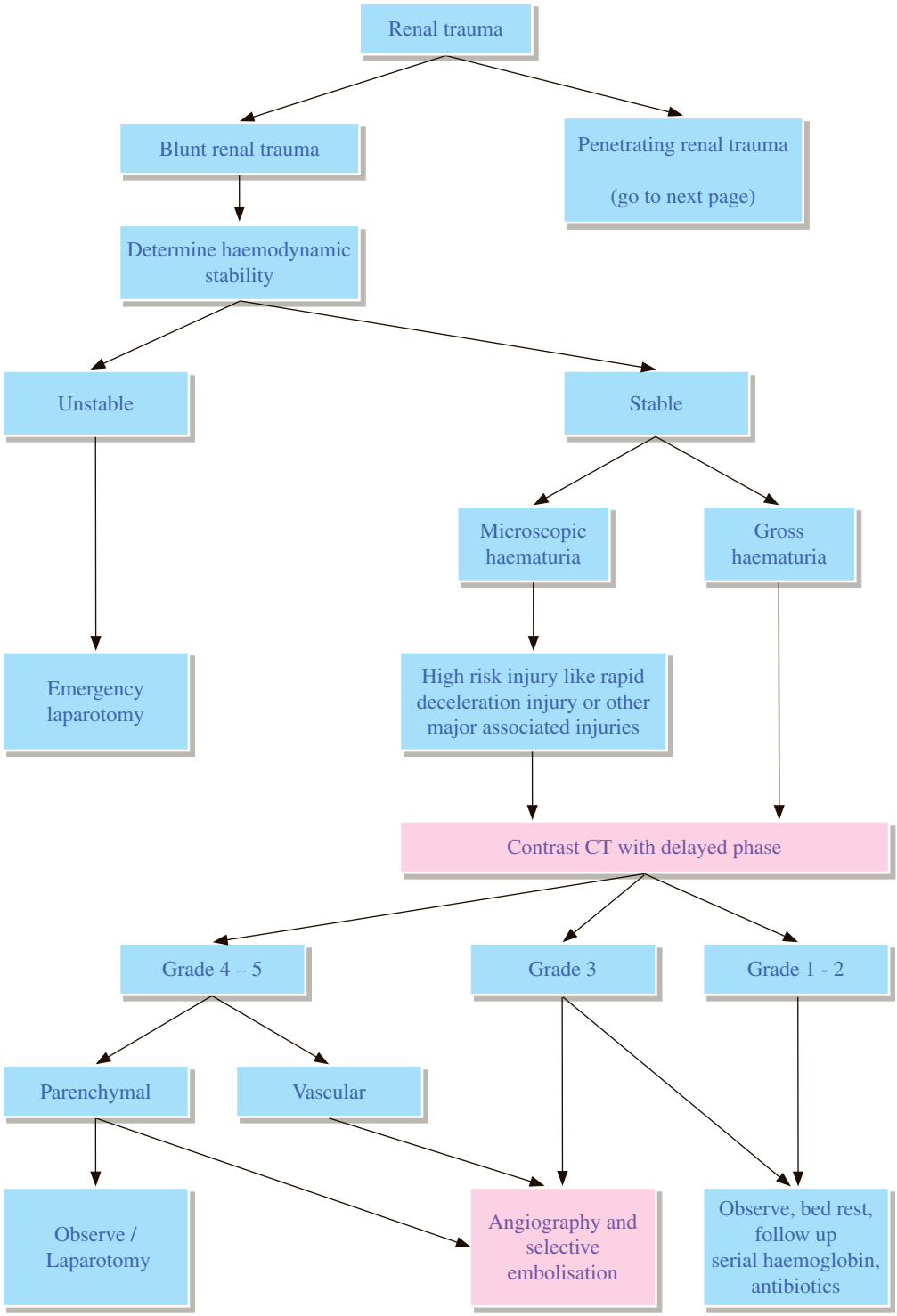
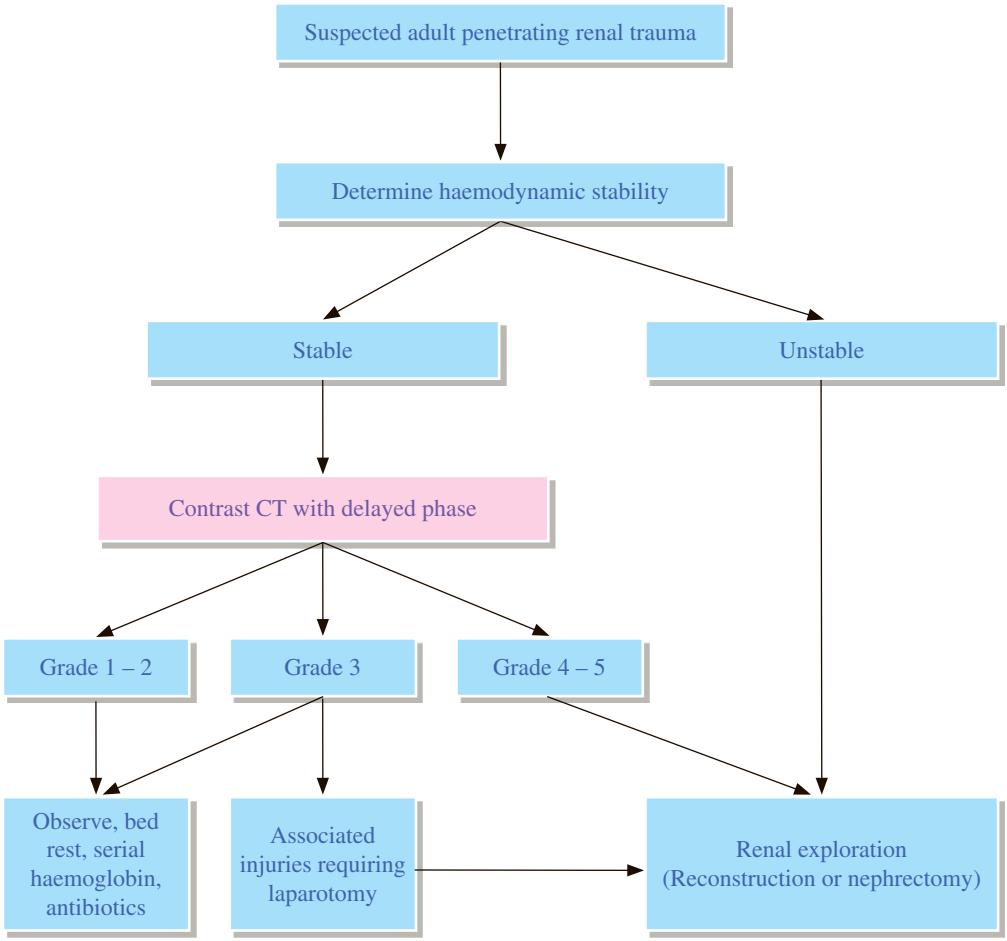
Uroradiology



Hong Kong College of Radiologists


Renal trauma
Blunt renal trauma
Penetrating renal trauma
(go to next page)
Determine haemodynamic stability
Unstable
Stable
Microscopic haematuria
Gross haematuria
Emergency laparotomy
High risk injury like rapid deceleration injury or other major associated injuries
Contrast CT with delayed phase
Grade 4 – 5
Grade 3
Grade 1 - 2
Parenchymal
Vascular
Observe / Laparotomy
Angiography and selective embolisation
Observe, bed rest, follow up serial haemoglobin, antibiotics



Renal injuries are classified into grades 1 to 5 based on the severity of the injury using the American Association for the Surgery of Trauma (AAST) organ injury severity scale:

- Grade 1: Contusion or nonexpanding subcapsular haematoma without parenchymal laceration.
- Grade 2: Non-expanding perirenal haematoma laceration <1 cm deep without extravasation.
- Grade 3: Laceration >1 cm without urinary extravasation.
- Grade 4: Laceration extending through renal cortex into collecting system, or segmental renal artery or vein injury with contained hemorrhage, or partial vessel laceration, or vessel thrombosis.
- Grade 5: Laceration with shattered kidney, or renal pedicle injury, or avulsion of renal hilum.

REMARKS

1 General

1.1 Surgical operation should be given first priority if the patient is haemodynamically unstable.

2 Intravenous urogram (IVU)

2.1 The use of IVU is recommended when it is the only modality available. IVU can be used to establish the presence or absence of one or both kidneys, clearly define the parenchyma, and outline the collecting system. The most significant findings are non-function and extravasation.

3 US

3.1 US should not be used as a primary imaging modality because it gives no information about the renal function and may show an apparently normal kidney when the renal artery is occluded.

3.2 While the role of Focused Assessment with Sonography for Trauma (FAST) in the haemodynamically unstable trauma patient is well recognized, its utility in the haemodynamically stable patient is more controversial, as CT is usually required for precise delineation of underlying injuries.

3.3 US is useful for the routine follow-up of parenchymal lesions or haematomas in the intensive care unit and for serially evaluating stable injuries for the resolution of urinomas and retroperitoneal haematomas.

4 CT

4.1 CT is currently the gold standard to assess renal trauma.

4.2 Contusions, lacerations (and their extent), extra-renal haematomas and urinary extravasation can all be identified on CT.

4.3 Intravenous contrast administration is necessary.

5 Angiography

5.1 Arteriography has a high degree of specificity in detecting the bleeder, it is usually performed as part of a therapeutic embolization and directed towards a suspected abnormality detected on contrast-enhanced CT. The additional contrast load administered during embolotherapy does not seem to have long-term impact on renal function. Embolotherapy has been shown to be safe and effective in the management of renovascular injuries and may be associated with shorter hospital stay compared to surgical intervention.

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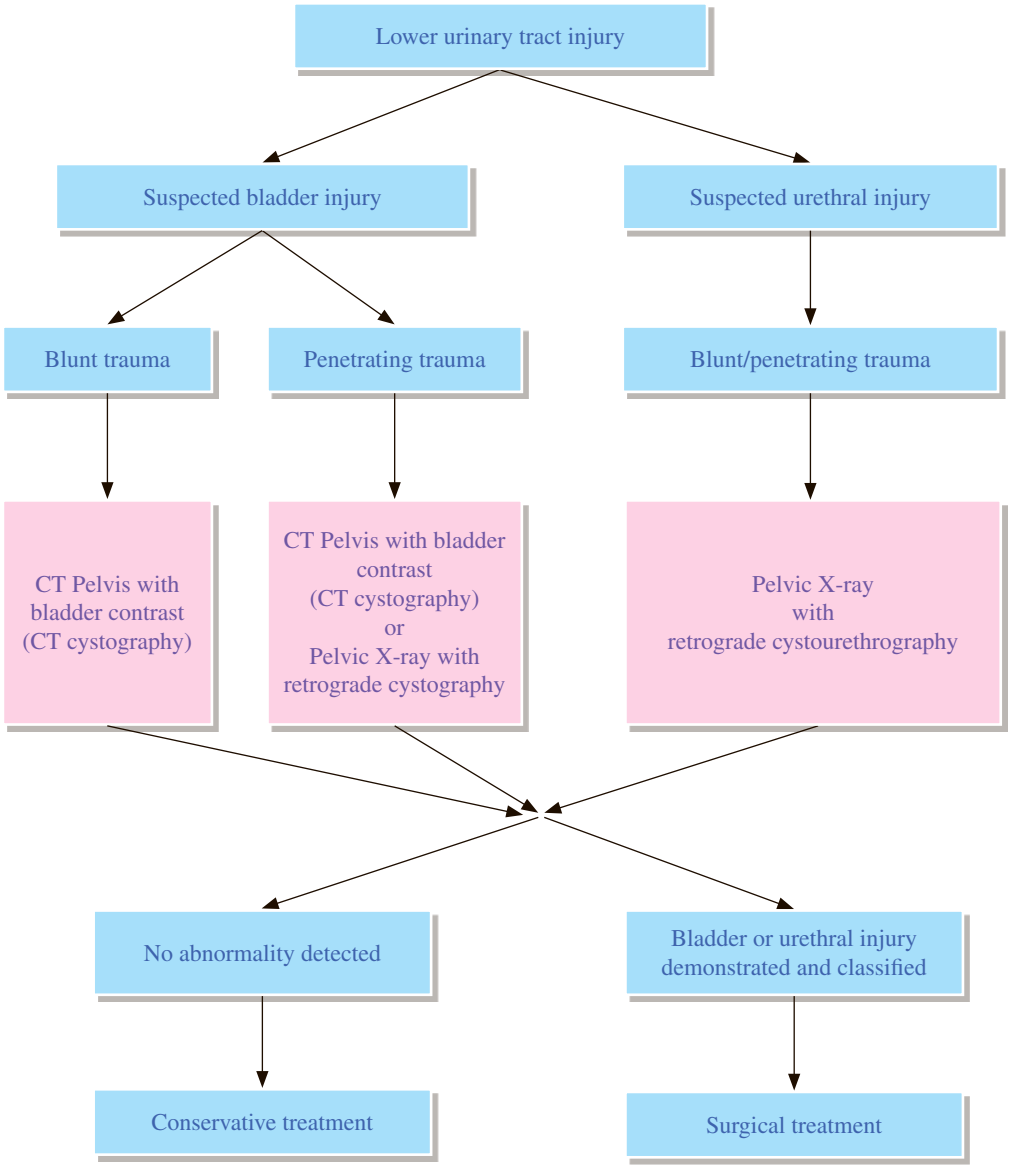
UR 2 Lower urinary tract injury



REMARKS

1 Plain radiograph

1.1 Approximately 10% of patients with pelvic fracture have an associated bladder injury.

1.2 About 70% of bladder injuries have an associated pelvic fracture. The severity of the pelvic injury roughly correlates with the likelihood of bladder and urethral injury.

1.3 About 10% of male patients with pelvic fracture have posterior urethral injury.

1.4 Can look for any foreign body e.g. bullet.

2 Cystogram and urethrogram

2.1 Catheterization into urinary bladder should only be performed after an associated urethral injury has already been excluded by a retrograde urethrogram. Cystogram should be performed with a suprapubic catheter in a patient with urethral injury.

2.2 A normal cystogram cannot exclude bladder contusion (type 1 injury), which is a diagnosis by exclusion.

3 CT Pelvis with bladder contrast (CT cystography)

3.1 CT cystography is a variation of the traditional fluoroscopic cystogram. Instead of anterograde opacification of the urinary collecting system (as with CT urography), contrast is instilled retrograde into the patient's bladder, and then the pelvis is imaged with CT.

3.2 Fluoroscopic and CT cystography are considered equivalent for suspected bladder rupture.

3.3 CT pelvis with CT cystography is considered to be the investigation of choice for patients with blunt trauma as about 80% of patients with bladder injuries due to blunt trauma have associated pelvic fractures which can be detected by CT pelvis.

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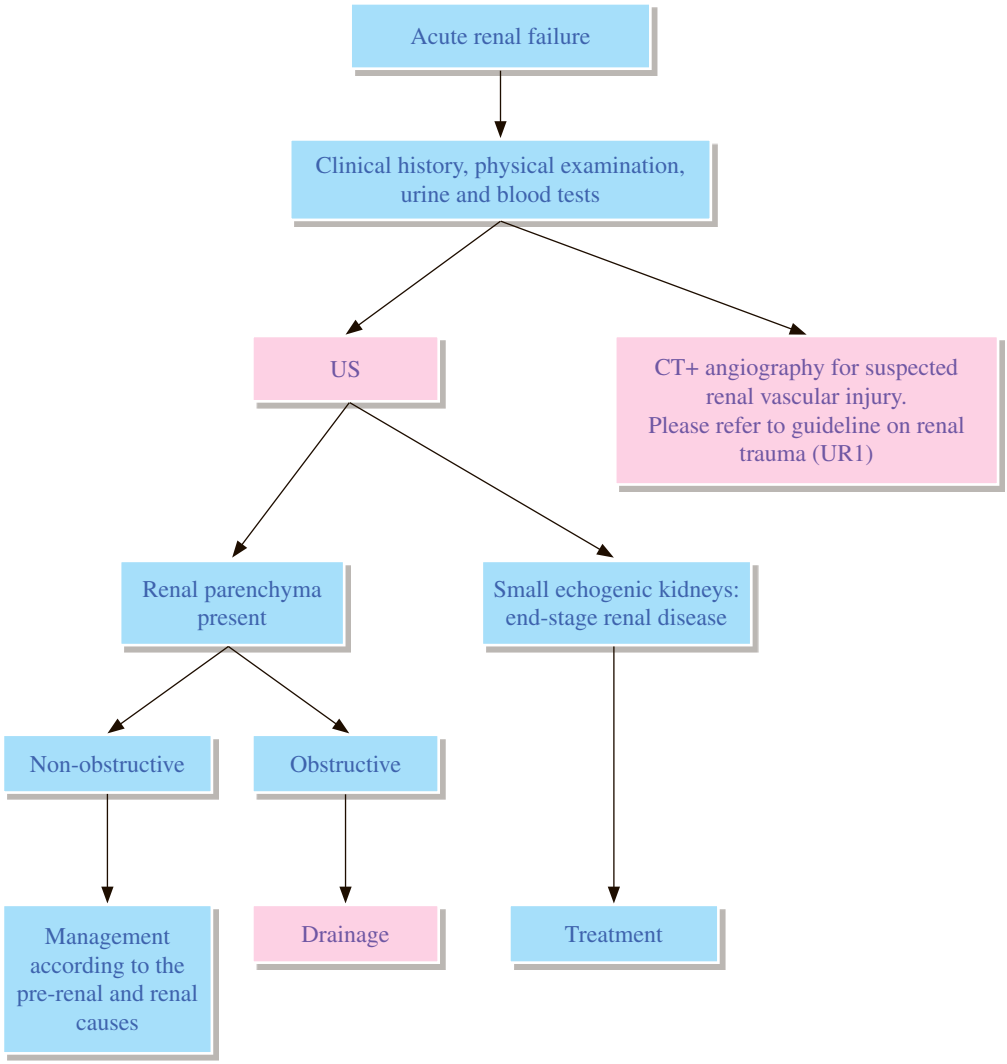
Acute renal failure
Clinical history, physical examination, urine and blood tests
US
CT+ angiography for suspected renal vascular injury. Please refer to guideline on renal trauma (UR1)
Renal parenchyma present
Small echogenic kidneys: end-stage renal disease
Non-obstructive
Obstructive
Management according to the pre-renal and renal causes
Drainage
Treatment

REMARKS

1 Intravenous urogram (IVU)

1.1 IVU has no role in acute renal failure.

2 US

2.1 US should be the initial imaging study. It helps to differentiate potentially reversible acute renal failure from chronic end-stage renal disease. In cases of chronic renal failure, US can define the renal sizes and their echogenicity, presence of pelvicalyceal dilatation and cystic disease.

2.2 Color Doppler US can be used to assess the renal arterial supply and venous drainage.

3 Nuclear medicine

3.1 Renal scan provides assessment of global and differential renal function which may reflect the potential reversibility of the renal failure. It is generally not useful in clinical decision making.

4 CT

4.1 CT is of value for ruling out stone disease, surveying the retroperitoneum for masses in patients with suspected post-renal cause of dysfunction.

5 MRI

5.1 In hypertensive patients or in those with extensive peripheral atherosclerotic vascular disease, magnetic resonance angiogram (MRA) with/without contrast is useful for detecting renal artery stenosis when duplex Doppler US is negative or non-diagnostic.

6 Pathological diagnosis

6.1 Percutaneous US-guided renal biopsy yields tissue for pathological examination in patients with intrinsic renal dysfunction, such as glomerular, vascular or tubulointerstitial diseases.

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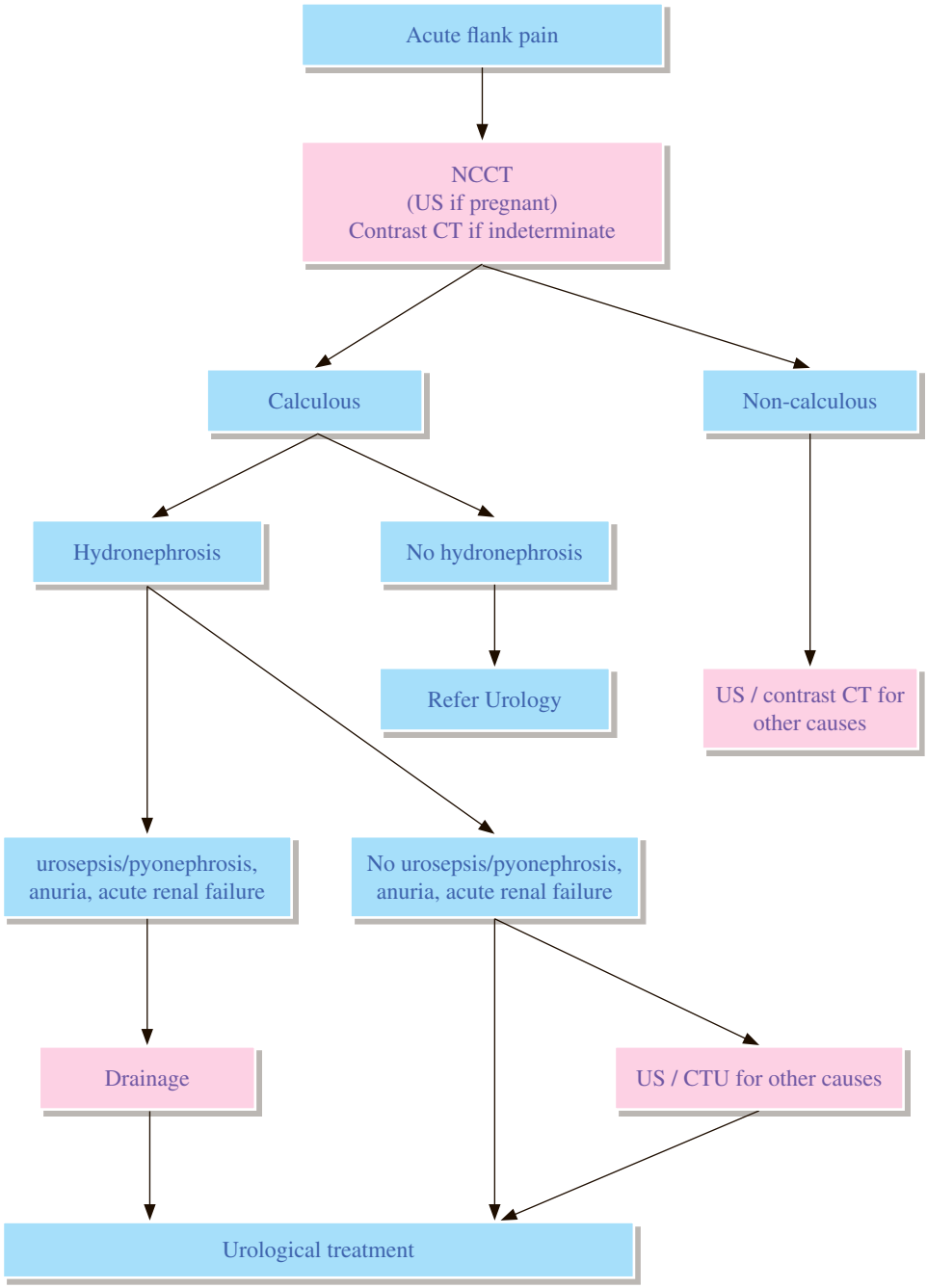
UR 4 Acute flank pain



REMARKS

1 General

1.1 Renal calculi tend to be recurrent, and flank pain is a non-specific symptom that may be associated with other entities; therefore, evaluation with imaging is recommended at the initial presentation.

2 Plain radiograph

2.1 Kidney, ureter and bladder radiograph (KUB) may be sufficient to diagnose ureterolithiasis in patients with known stone disease and previous KUBs. The sensitivity of the KUB for ureterolithiasis in other patients is poor.

2.2 While the KUB may be a valuable part of the intravenous urogram (IVU) or US evaluation of flank pain, it has a very limited role when used alone, and it should not be used to triage which patients should receive non-contrast computed tomography (NCCT).

3 IVU

3.1 The IVU is the previous standard study for ureterolithiasis and is still the best investigation if NCCT is not available. It provides information regarding site and degree of obstruction, size of stone, and effect of obstruction on renal excretion.

4 US

4.1 US is particularly useful in patient with high risk of contrast media reaction or pregnancy.

4.2 The size of stones cannot be measured accurately and ureteric stones may not be shown on US.

4.3 When US is combined with KUB, it can increase the capability to detect small stones and more accurately measure stone size.

5 CT

5.1 NCCT as the initial study in evaluating flank pain, numerous investigations have confirmed it to be the study with the highest sensitivity (95%-96%) and specificity (98%) for ureterolithiasis. Stone size can be measured accurately in cross-section, aiding in predicting outcome. Stone location, accurately depicted by NCCT, has also been associated with spontaneous stone passage rates, with the more proximal stones having a higher need for intervention.

5.2 NCCT is also reliable for diagnosing flank pain due to causes other than ureterolithiasis such as appendicitis and diverticulitis.

5.3 When CT is available, it is the best first study in the non-pregnant adult presenting with flank pain likely to be due to stone disease, and it has been shown to be more cost-effective than IVU.

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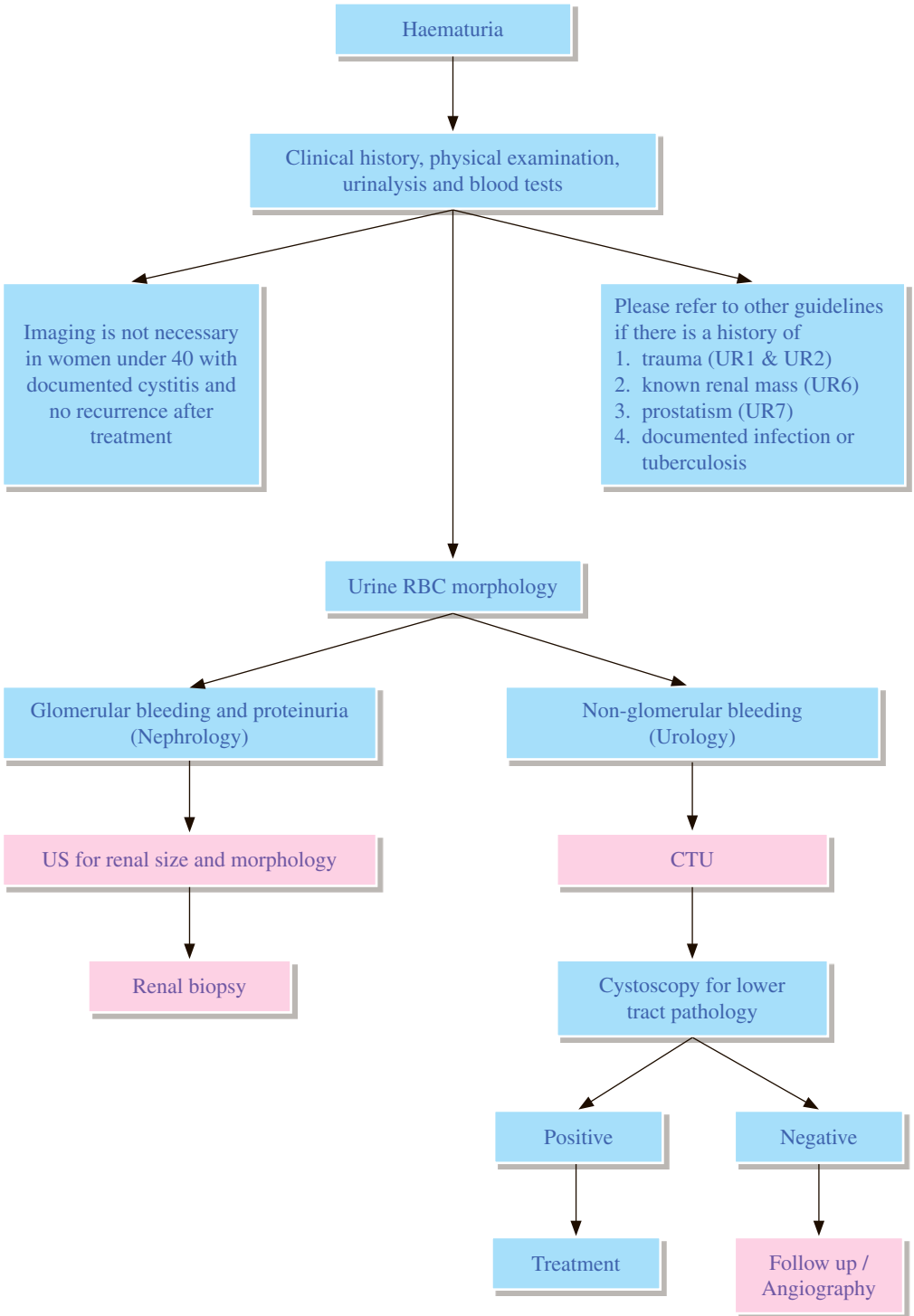
Haematuria
Clinical history, physical examination, urinalysis and blood tests
Imaging is not necessary in women under 40 with documented cystitis and no recurrence after treatment
Please refer to other guidelines if there is a history of
1. trauma (UR1 & UR2)
2. known renal mass (UR6)
3. prostatism (UR7)
4. documented infection or tuberculosis
Urine RBC morphology
Glomerular bleeding and proteinuria (Nephrology)
Non-glomerular bleeding (Urology)
US for renal size and morphology
CTU
Renal biopsy
Cystoscopy for lower tract pathology
Positive
Negative
Treatment
Follow up / Angiography

REMARKS

1 General

1.1 Haematuria can originate from any site in the urinary tract and be due to a wide range of causes, which can be roughly divided into renal, urothelial, or prostatic causes. Thorough evaluation of gross haematuria is recommended, and this is usually done with a combination of clinical examination, cystoscopic evaluation, and urinary tract imaging.

1.2 Patients on anticoagulants who present with gross or microscopic haematuria have a sufficiently high prevalence of important disease including tumours such that workup cannot be forgone.

1.3 In comparison to gross haematuria, the situation is somewhat different in patients with microscopic haematuria. The recommended definition of microscopic haematuria is three or more red blood cells per high-power field on microscopic evaluation of urinary sediment from two of three properly collected urinalysis specimens.

1.4 Young women with a clinical picture of simple cystitis, and other patients whose haematuria completely and permanently resolves after successful therapy, are unlikely to benefit from any imaging.

2 Intravenous urogram (IVU)

2.1 IVU has low sensitivity for detecting renal masses <2–3 cm in size, and even if a mass is visualized, further cross sectional studies such as US, CT, or MRI are then necessary to characterize the mass.

3 Retrograde pyelography

3.1 Retrograde pyelography does not rely on renal excretion of intravascular contrast. In patients with impaired renal function, or contraindications to computed tomography urogram (CTU) or magnetic resonance urogram (MRU), or suboptimal CTU or MRU, a retrograde pyelography may be a reasonable adjunct to cystoscopy in patients with suspected upper tract lesions.

4 US

4.1 US still has a role in the initial workup of haematuria to search for bleeding urinary tract lesions. It is especially useful in radiation-sensitive populations, such as children and pregnant or child-bearing age women, to detect renal calculi and renal masses.

4.2 In patients in whom glomerular disease is the cause of haematuria, US can examine the renal parenchyma and follow disease progression. US can evaluate renal length, echogenicity, cortical thickness, and parenchymal thickness.

5 CT

5.1 Numerous studies have established that CTU is superior to IVU for detecting upper tract urothelial lesions in patients with haematuria. In a meta-analysis, CTU was proved to be a very sensitive and specific method for the detection of urothelial malignancy with pooled sensitivity of 96% and pooled specificity of 99%, and was superior in direct comparison to IVU in terms of sensitivity and specificity.

6 Cystoscopy

6.1 Cystoscopy is still considered to be the optimal technique to detect the plaque-like lesions of early bladder cancers, although newer studies suggest that a properly performed CTU in an adequately distended bladder is quite sensitive in detecting bladder cancer. Patients with no bladder abnormality on CTU can proceed to office cystoscopy, while those with a suspected bladder neoplasm can undergo cystoscopy in the operating room with intent to biopsy.

7 Angiography

7.1 Rarely, vascular disorders such as aneurysms, arteriovenous malformations or obstruction of a calyx from overlying artery (Fraley's syndrome) may result in haematuria. In these suspected situations, catheter angiography may be useful for diagnosis and for therapeutic interventions.

8 MRI

8.1 MRI is an excellent technique to evaluate the renal parenchyma for masses and other abnormalities; it is inferior to CTU and IVU in detection of small stones and urothelial lesions.

9 Pathological diagnosis

9.1 Renal biopsy should be performed for cases suspected to have glomerulonephritis.

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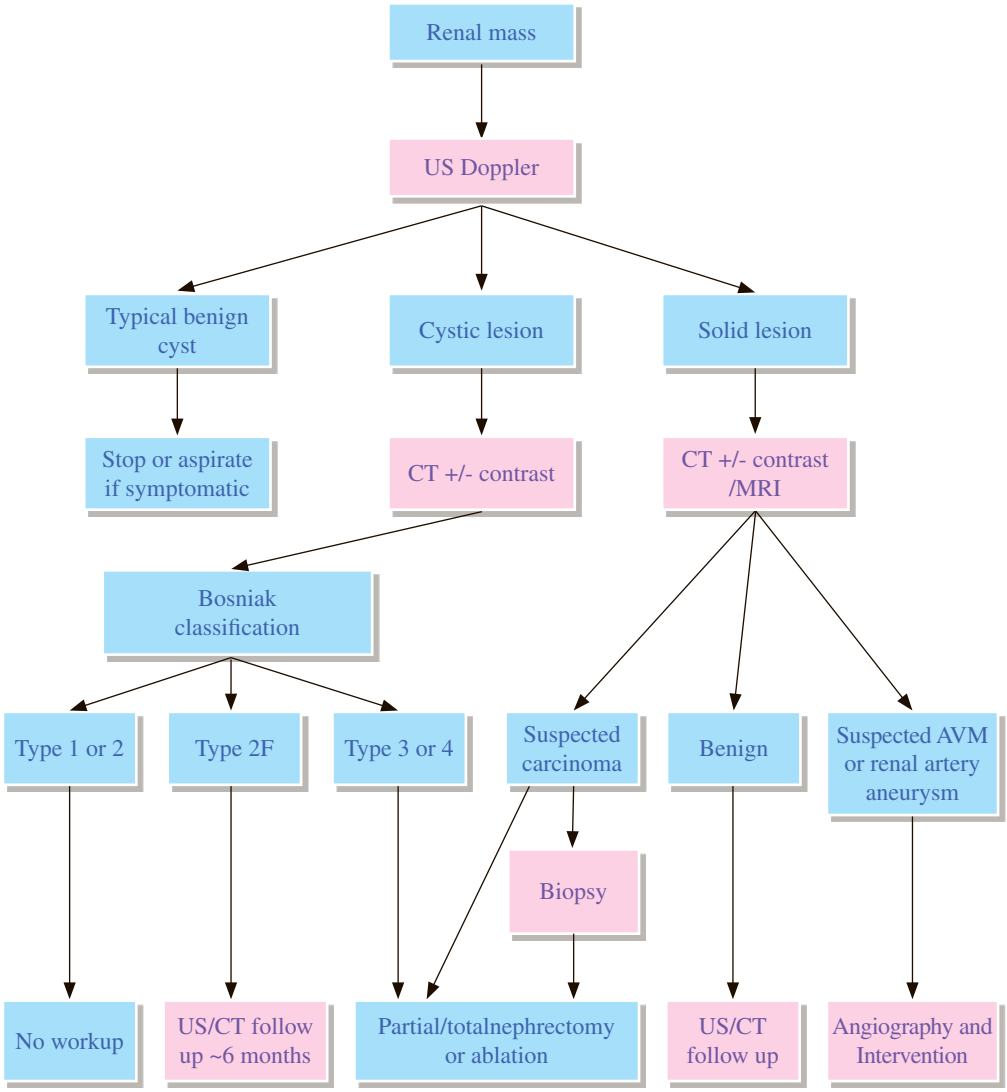

Bosniak Classification 2005 version

Bosniak 1
- simple cyst: imperceptible wall, rounded

Bosniak 2
- minimally complex: a few thin <1 mm septa or thin calcifications (thickness notmeasurable); non-enhancing high-attenuation (due to proteinaceous or haemorrhagic fluid) renal lesions of less than or up to 3 cm are also included in this category; these lesions are generally well marginated

Bosniak 2F
- minimally complex: increased number of septa, minimally thickened wall or septa with nodular or thick calcifications but no measurable contrast enhancement, hyperdense (>20 Hounsfield unit) cyst >3 cm diameter, mostly intrarenal (less than 25% of wall visible)

Bosniak 3
- indeterminate: thick, nodular multiple septa or wall, with measurable enhancement, hyperdense on CT (see 2F)

Bosniak 4
- clearly malignant: solid mass with a large cystic or a necrotic component

REMARKS

1 Plain radiograph

1.1 Kidney, ureter and bladder radiograph (KUB) has a very low sensitivity and specificity in detecting renal mass.

2 Intravenous urogram (IVU)

2.1 IVU with nephrotomography has only 67% sensitivity in detecting renal masses ≤3 cm in diameter, and without tomography the sensitivity is even less. It is rarely used in current management of the indeterminate renal mass.

3 US

3.1 When all the criteria of a simple benign cyst (anechoic, good through transmission, thin, sharply marginated, smooth walls) are found on US, no further imaging study is needed.

3.2 A hyperechoic mass is highly suggestive of angiomyolipoma. CT or angiogram may be required in doubtful cases.

4 CT

4.1 CT is used to clarify all hypoechoic masses or complex cysts not fulfilling all the criteria of a simple cyst e.g. cyst with septa, thick or calcified walls, infection or haemorrhage.

4.2 CT is more accurate than US in detecting small renal lesions less than 1.5cm. Small lesion <1.5cm suspected to be renal cell carcinoma can be followed up by CT at 6-month, 1 year and then yearly interval.

4.3 Demonstration of a small amount of fat in a lesion on CT can accurately suggest an angiomyolipoma.

5 MRI

5.1 MRI is indicated when CT cannot be performed due to the risk of contrast media reaction or renal insufficiency.

5.2 MRI is as accurate as CT. However, MRI is more sensitive in detecting thrombus in renal veins and inferior vena cava.

6 Angiography

6.1 Although two-thirds of renal tumours have enough vascularity to allow identification of tumour neovascularity, one-third will be of such a hypovascular or "avascular" state that angiography will not help identify the lesion as benign or malignant.

6.2 Angiogram is useful to exclude arteriovenous malformation (AVM) and renal artery aneurysm.

7 Pathological diagnosis

7.1 Tissue diagnosis is rarely necessary in establishing diagnosis of renal mass and a negative result does not exclude malignancy. However, it is useful to confirm infected cyst, lymphoma and metastasis.

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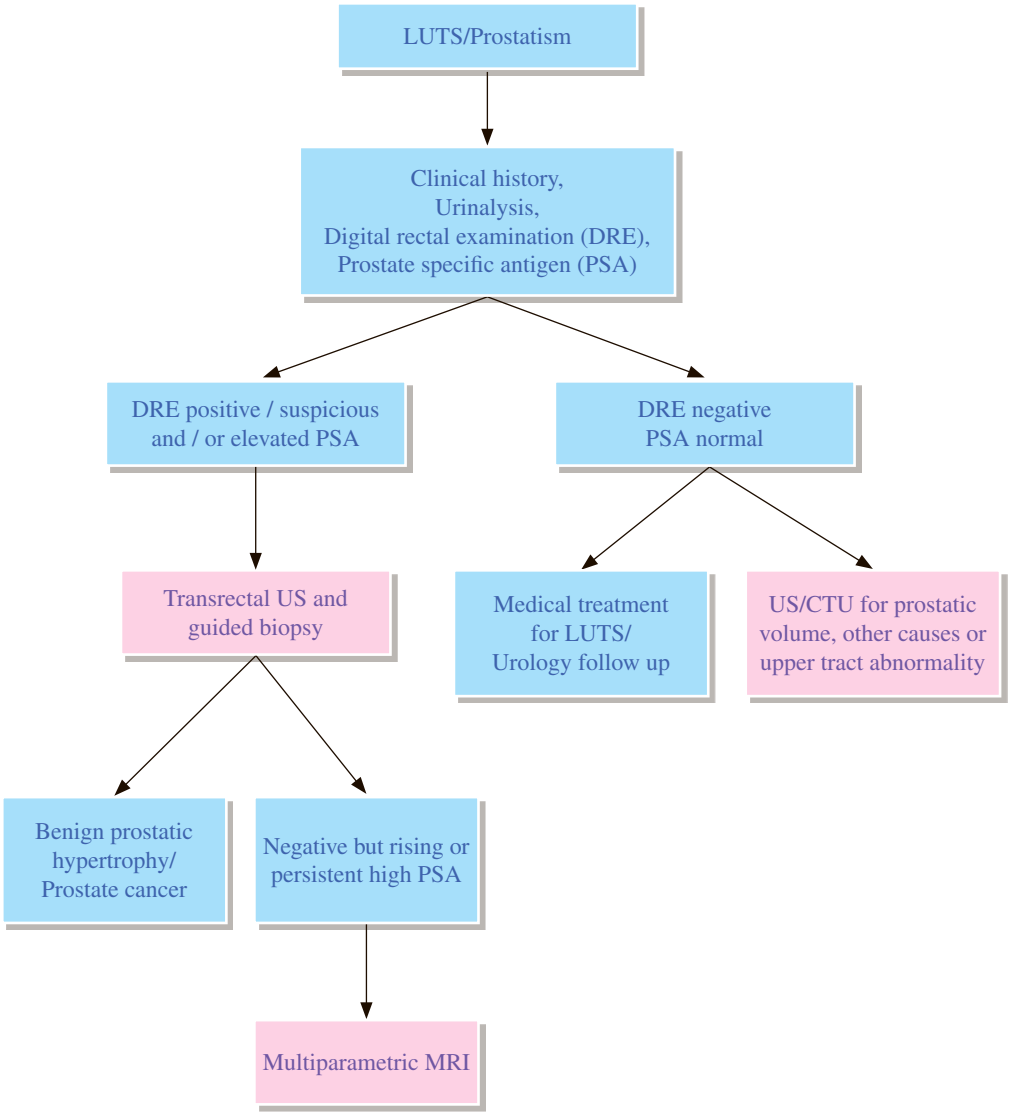
LUTS/Prostatism
Clinical history,
Urinalysis,
Digital rectal examination (DRE),
Prostate specific antigen (PSA)
DRE positive / suspicious
and / or elevated PSA
DRE negative
PSA normal
Transrectal US and
guided biopsy
Medical treatment
for LUTS/
Urology follow up
US/CTU for prostatic
volume, other causes or
upper tract abnormality
Benign prostatic
hypertrophy/
Prostate cancer
Negative but rising or
persistent high PSA
Multiparametric MRI

REMARKS

1 Pelvic US / Transrectal US

1.1 Both transabdominal US and transrectal US (TRUS) are equally accurate for measuring prostate volume. Identifying the size of the prostate is important since it helps determine the type of therapy indicated.

1.2 The US pattern is still too nonspecific to differentiate benign from malignant prostate lesions. TRUS-guided biopsy greatly improves accuracy.

1.3 Generally TRUS is more accurate than CT in detecting capsular transgression but the accuracy does not appear high enough to support decision regarding the operability of individual lesion.

1.4 TRUS allows volume correlation with PSA level.

2 Nuclear medicine

2.1 Bone scan is important in staging of prostate cancer and sensitive for bone metastasis detection.

3 CT

3.1 CT is used in staging pelvic extent of prostate cancer.

3.2 CT has not proven to be of much value in evaluating the benign, enlarged prostate.

4 MRI

4.1 The primary indication for MRI of the prostate is in the evaluation of prostate cancer after an ultrasound guided prostate biopsy has confirmed cancer in order to determine if there is extracapsular extension.

4.2 MRI is also useful in evaluating prostate size, although other less costly procedures, such as US, are preferred.

4.3 Increasingly MRI is also being used to detect prostate cancer particularly when the PSA is persistently elevated, but routine TRUS biopsy is negative; and to localize and stage a newly diagnosed prostate cancer for optimal treatment.

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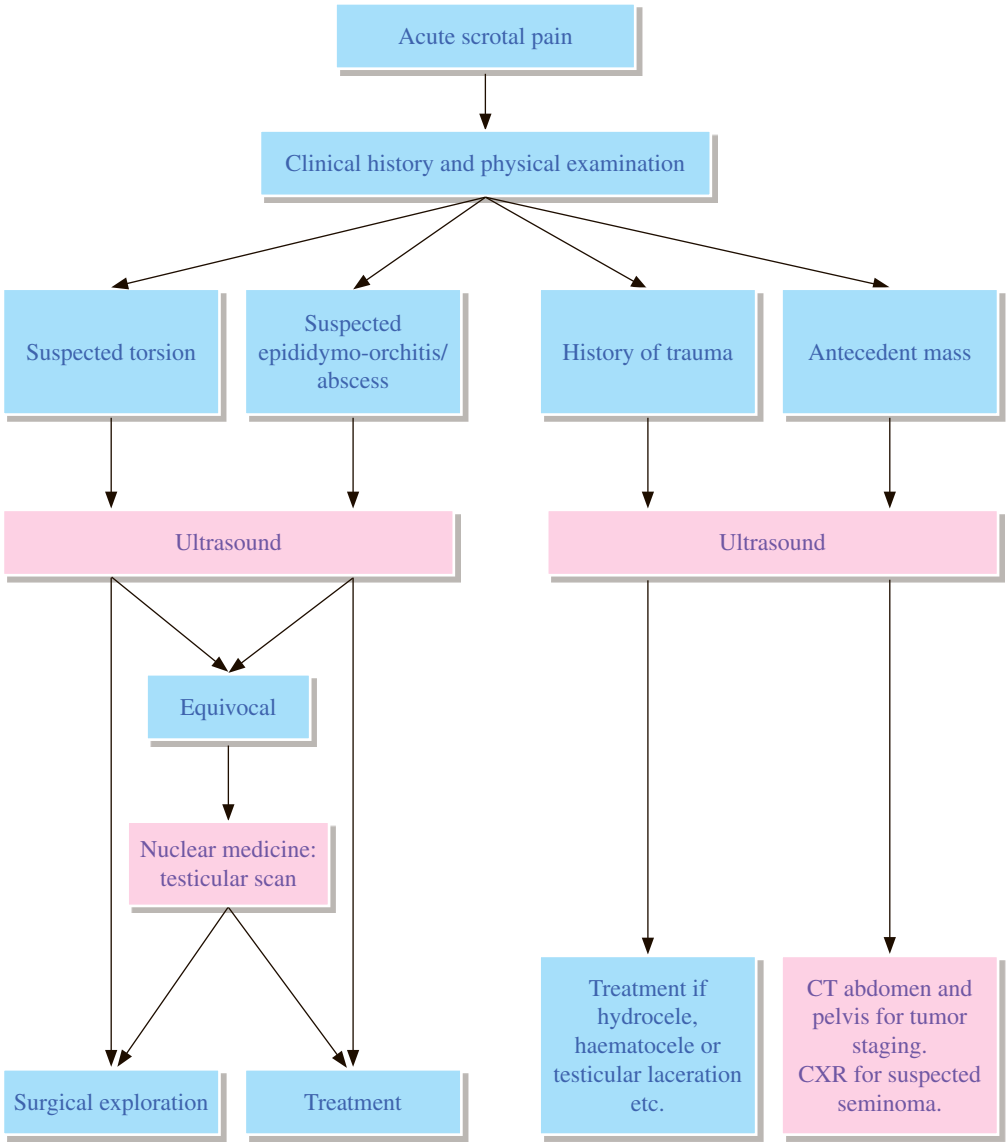
Acute scrotal pain
Clinical history and physical examination
Suspected torsion
Suspected epididymo-orchitis/ abscess
History of trauma
Antecedent mass
Ultrasound
Ultrasound
Equivocal
Nuclear medicine: testicular scan
Surgical exploration
Treatment
Treatment if hydrocele, haematocele or testicular laceration etc.
CT abdomen and pelvis for tumor staging. CXR for suspected seminoma.

REMARKS

1 General

1.1 For surgery to be successful, the diagnosis of acute torsion must be established within 4-8 hours from the onset of pain.

1.2 Patients in whom there is strong clinical suspicion for testicular torsion can be promptly referred for scrotal exploration.

2 US

2.1 The studies should include both the scrotum and inguinal areas.

2.2 US can localize a scrotal swelling to see whether it is arising from the testis or from the epididymis and to distinguish a varicocele from a hydrocele.

2.3 Color Doppler US can reliably assess blood flow within the testis. Blood flow is markedly reduced or absent in torsion of testis but is increased in epididymo-orchitis. In adults, with careful study and appropriate equipment, the specificity is close to 100%. Overall sensitivity is about 90%. False negatives may be found in incomplete torsion (less than 180 degrees) and in spontaneous de-torsion. Color Doppler US should be used in cases of suspected torsion or epididymo-orchitis.

2.4 Imaging in clinically equivocal cases may lead to an early diagnosis of testicular torsion and thus decrease the number of unnecessary surgeries.

3 Nuclear medicine

3.1 Testicular scan has 90% sensitivity and 98% specificity in assessing testicular torsion.

3.2 Testicular scan is uncommonly requested nowadays given the high accuracy of US. It may be used when diagnosis is less likely and if torsion of the testis still cannot be excluded from history and physical examination. This should be done without inordinate delays for emergency intervention.

3.3 Problems in examination performance may arise in infants and very small children whose genitalia are small and therefore difficult to image. Its poor anatomical detailing, and the time required for radionuclide scrotal imaging examinations are also limiting factors.

4 MRI

4.1 Techniques are not typically used for the acute scrotum due to the limited availability of equipment and the long examination time involved. However, the use of MRI in scrotal diseases is increasing. A retrospective study reports that MRI has 93% sensitivity and 100% specificity for diagnosing testicular torsion.

4.2 The most sensitive finding in torsion is decreased or lack of perfusion on dynamic contrast-enhanced MRI.

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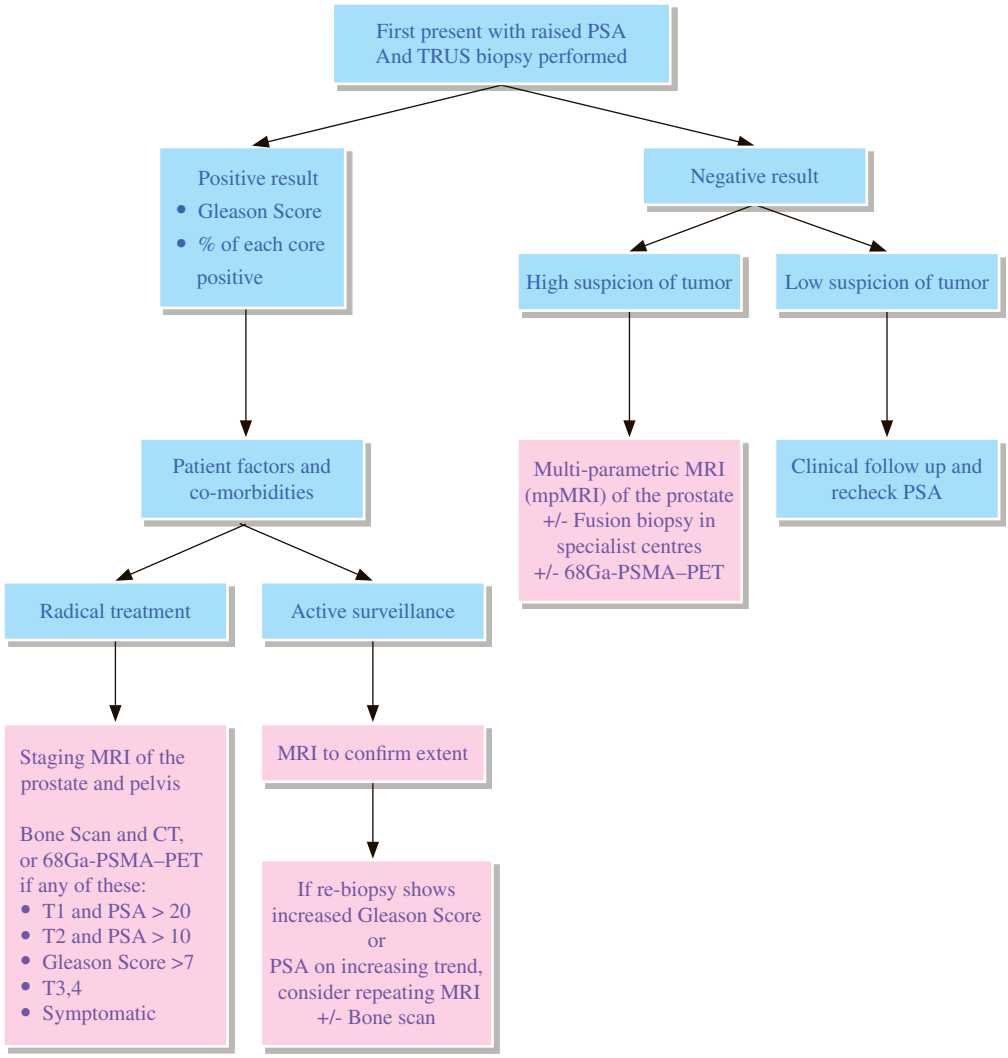
First present with raised PSA
And TRUS biopsy performed
Positive result
Gleason Score
% of each core positive
Negative result
High suspicion of tumor
Low suspicion of tumor
Patient factors and co-morbidities
Multi-parametric MRI (mpMRI) of the prostate +/- Fusion biopsy in specialist centres +/- 68Ga-PSMA–PET
Clinical follow up and recheck PSA
Radical treatment
Active surveillance
Staging MRI of the prostate and pelvis
Bone Scan and CT, or 68Ga-PSMA–PET if any of these:
T1 and PSA > 20
T2 and PSA > 10
Gleason Score >7
T3,4
Symptomatic
MRI to confirm extent
If re-biopsy shows increased Gleason Score or
PSA on increasing trend, consider repeating MRI +/- Bone scan

REMARKS

1 US and MRI are the most well established techniques for local imaging of prostate.

2 CT and Bone scans are traditionally used for high-risk patient or metastatic disease.

3 Choosing the correct imaging modality should be individualized based on consideration of the clinical parameters that are predictive of the likelihood of extra-prostatic extension, seminal vesicle invasion and metastatic disease. Clinical parameters to take into account include the pretreatment prostatic specific antigen (PSA) level and the rate of rise or doubling time, the Gleason score and sometimes the number of positive biopsies, including percentage of the core involved.

4 Imaging in low-risk patients is likely to have a low yield in detection of tumor. There may be a role for MRI in the context of active surveillance for low-risk patients.

5 For intermediate-risk and high-risk individuals, imaging has a role in staging and in selecting or tailoring therapy. MRI appears to be the most accurate imaging test available for local staging of the prostate, providing both loco-regional and nodal evaluation. Consensus is building around multi-parametric MRI (mpMRI) as the most accurate and useful approach. T2 weighted imaging with diffusion weighted imaging, dynamic contrast enhanced imaging and magnetic resonance spectroscopy imaging appear to be useful adjuncts depending on radiologist preference and experience.

6 Bone scan and CT is helpful for staging of localized disease with high-risk:
- 6.1 clinical T3/T4, or
- 6.2 T1 and PSA >20, or
- 6.3 T2 and PSA >10, or
- 6.4 Gleason score ≥8, or
- 6.5 any stage with symptoms suggestive of bone metastases

7 Bone scan is also useful for evaluation after radical treatment:
- 7.1 After prostatectomy: if PSA fails to drop to undetectable level, or detectable PSA that increased on 2 subsequent times.
- 7.2 After radiotherapy: if increasing PSA or positive digital rectal examination (to determine if patient needs additional local therapy or systemic treatment)

8 Bone scan is particularly important in metastatic prostate cancer for disease monitoring,

9 When there is strong clinical suspicion for the presence of prostate cancer in an individual due to rising or persistently high PSA despite (generally multiple) negative biopsy sessions, MRI may be useful in identifying suspicious regions in the prostate that can be targeted for diagnosis.

10 Gallium-68 prostate specific membrane antigen PET (68Ga-PSMA–PET) imaging is currently under rapid development and has been shown to be useful in localized, advanced, as well as recurrent disease. 68Ga-PSMA-PET holds great future promise with emerging indications including:

10.1 localized disease: for primary staging in high risk group

10.2 advanced disease: for disease monitoring, as well as staging before and during PSMA-directed radiotherapy for metastatic castration-resistant prostate cancer

10.3 recurrent disease: for localization of tumor

10.4 for targeted biopsy after previous negative biopsy in patient with high suspicion of prostate cancer

11 C11-Choline PET imaging is a reasonable alternative for imaging local recurrence, nodal and distant metastasis in prostate cancer. However, its uptake overlaps between benign and malignant prostatic pathology and does not correlate with tumour grading, PSA, Gleason score.

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