

# Diagnostic Imaging Pathways - Abdominal Blunt Trauma

## Population Covered By The Guidance

This pathway provides guidance for imaging adult patients with blunt abdominal trauma. The initial steps depend on the haemodynamic stability of the patient.

**Date reviewed: August 2013**

**Date of next review: 2017/2018**

**Published: August 2013**

## Quick User Guide

Move the mouse cursor over the **PINK** text boxes inside the flow chart to bring up a pop up box with salient points.

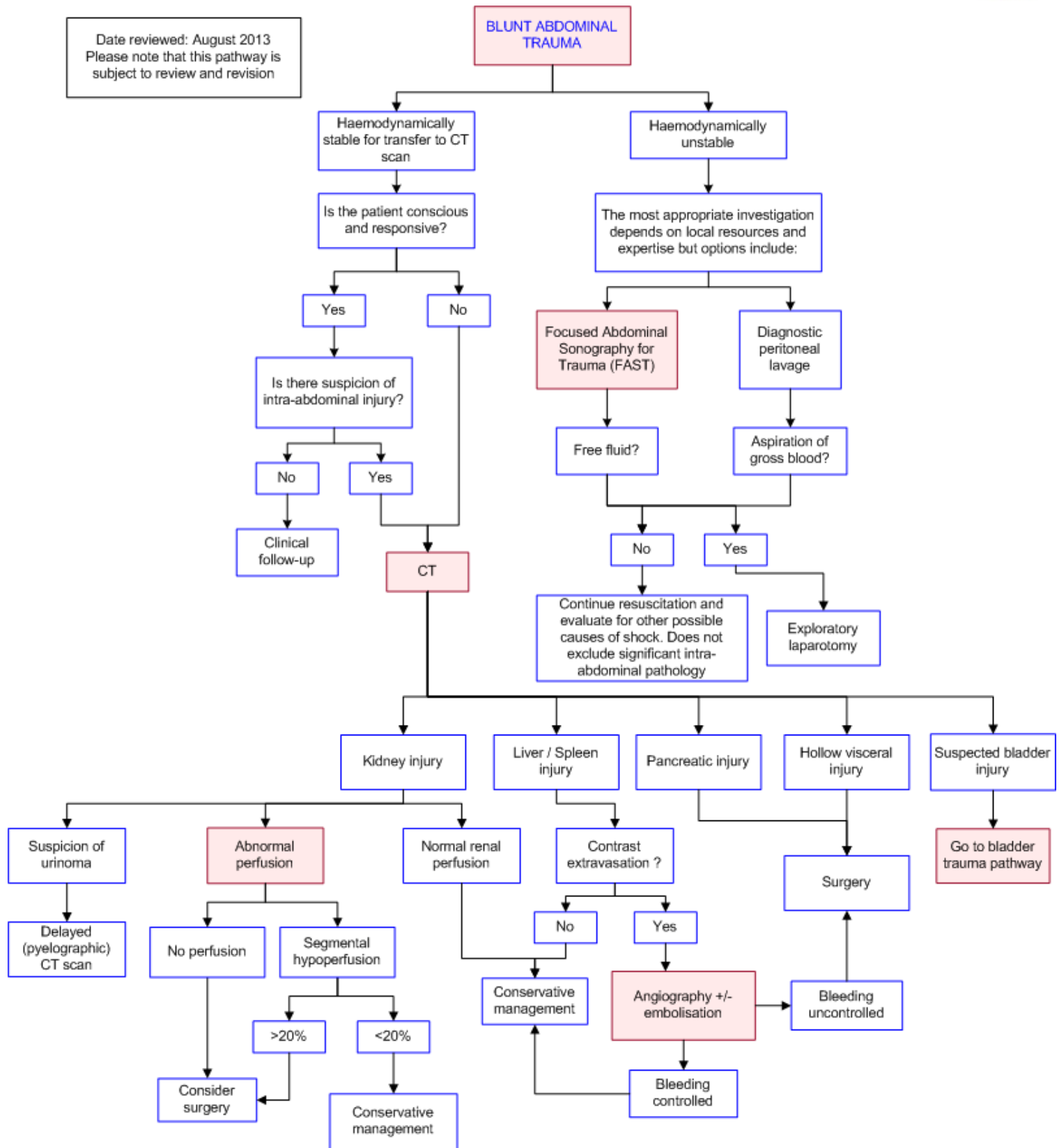
Clicking on the **PINK** text box will bring up the full text.

The relative radiation level (RRL) of each imaging investigation is displayed in the pop up box.

SYMBOL	RRL	EFFECTIVE DOSE RANGE
	None	0
	Minimal	< 1 millisieverts
	Low	1-5 mSv
	Medium	5-10 mSv
	High	>10 mSv

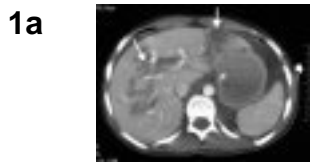
## Pathway Diagram

Date reviewed: August 2013  
 Please note that this pathway is subject to review and revision



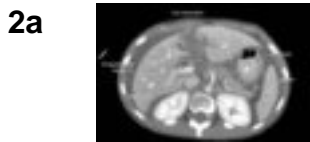
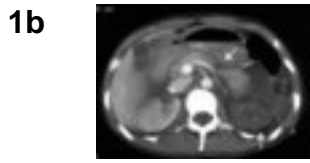
## Image Gallery

Note: These images open in a new page



### Blunt Abdominal Trauma

Image 1a and 1b (Computed Tomography): Traumatic lacerations to the right and left liver lobes (arrows, Image 1a) and pancreas (Image 1b, arrow) with left renal pedicle injury (lack of enhancement of the left kidney, arrow, Image 1b)



### Blunt Abdominal Trauma

Image 2a (Computed Tomography): Traumatic laceration to the liver. Note extensive free intra-peritoneal blood.

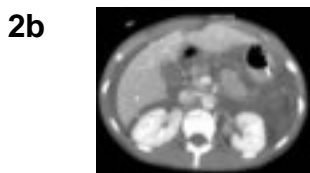
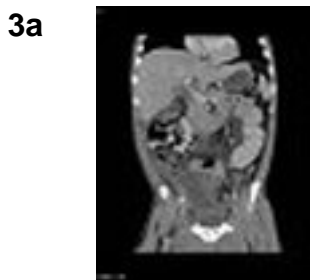
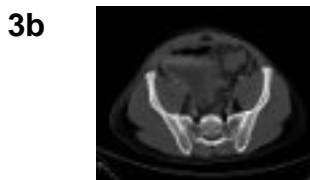


Image 2b (Computed Tomography): Traumatic laceration to the pancreas. Note extensive free intra-peritoneal blood.



### Blunt Abdominal Trauma

Image 3a and 3b (Computed Tomography): Coronal and axial views showing small bowel perforation with adjacent collection (arrow).



## Teaching Points

- In a patient who is haemodynamically unstable 'FAST' (Focused Abdominal Sonography for Trauma) ultrasound is useful to assess for intraperitoneal bleeding
- In stable patients, CT is the investigation of choice

## Angiography and Embolisation

- Depending on local facilities, angiography may be used as an adjunct to non-operative management of splenic and liver injuries in haemodynamically stable patients with high success rates
- Findings on CT which are predictive of the need for splenic angiography and embolisation (or surgical intervention) include the presence of devascularisation or laceration involving more than 50% of the splenic parenchyma, contrast extravasation of more than 1cm in diameter and haemoperitoneum. [38,39](#) The sensitivity and specificity of these findings are 100% and 88% respectively [40](#)



- The current indication for hepatic artery angiography and embolisation is active bleeding (contrast extravasation) in the liver parenchyma on CT in a haemodynamically stable patient [47](#)
- Aggressive use of angiography for splenic injuries is associated with high rates of non-operative management (>80%) and failure rates of less than 5%. [41-45](#) However, some studies have found no difference in failure rates compared to conservative management without angiography [46](#)
- Based on limited data, reported success rates for hepatic artery embolisation range from 85% to 100% [47](#)
- There is also emerging evidence to support the safe and successful use of angiography and embolisation in haemodynamically unstable patients responsive to initial resuscitation [48,49](#)
- Controversy currently surrounds whether main splenic artery or super-selective embolisation or both represent optimal management [44](#)
- There is limited evidence evaluating the usefulness of routine follow-up CT scans to prevent late complications of non-operative management of splenic injuries, particularly delayed rupture of pseudoaneurysms [44](#)
- Disadvantages
  - Some series report up to a 30% major complication rate for splenic artery embolisation including failure to control bleeding, missed injuries, delayed pseudoaneurysm rupture, splenic infarction, atrophy and abscess formation [42-44,50](#)
  - Complications for liver embolisation include massive liver ischaemia and gallbladder infarction
  - Cannot be used for juxtahepatic venous injury [51](#)
  - Labor intensive requiring continuous monitoring

## Computed Tomography (CT)

- Imaging modality of choice in the initial evaluation of haemodynamically stable blunt trauma injury [1-5](#)
- Most accurate (>95% sensitivity and specificity) and cost effective modality for localisation and grading of specific organ injuries which helps decide if a patient needs a period of close observation or urgent therapeutic intervention [6-8](#)
- Initial CT of the abdomen should be performed with intravenous contrast to facilitate the diagnosis of hollow viscus injuries [1](#)
- Universal agreement does not exist on the use of oral contrast, but it has been shown to assist the diagnosis of bowel injury
- Direct signs of free intraperitoneal or retroperitoneal perforation as well as signs of a vascular mesenteric lesion usually mandate exploratory laparotomy, whereas other, more indirect signs may raise the suspicion of a bowel injury and usually warrant further investigation or close observation [9](#)
- High negative predictive value of spiral CT and repeat standardised abdominal examination can help decide which patients can be safely discharged home [5-10](#)
- Advantages [11](#)
  - Gives complete visualisation of the intra-abdominal solid organs
  - Sensitive for the detection of intra-abdominal or retroperitoneal haematoma and pneumoperitoneum, which may result from a bowel injury
- Limitations [11](#)
  - Not appropriate for haemodynamically unstable patients
  - Less sensitive in detection of bowel injury [12](#)
- Helical CT or MDCT is the imaging technique of choice in patients with blunt renal trauma [9](#)
- Multidetector CT (MDCT) has a higher speed of data acquisition and is able to obtain thinner imaging sections compared to single slice helical CT, resulting in increased contrast opacification in the vasculature and parenchyma [27](#)

- Using MDCT, active haemorrhage in patients with blunt abdominal trauma may be visualised as a jet of extravasated contrast media which is an indication for immediate intervention [28](#)
- Advantages of MDCT compared to single slice helical CT [27-30](#)
  - Larger volume scanned per breath hold
  - Increased spatial resolution with improved identification and evaluation of vasculature and parenchymal organs
  - Reduced scanning times due to faster scanning speeds
  - Significantly lower doses of IV contrast medium required for similar enhancement

## CT Cystogram

- Conventional CT of the abdomen/pelvis has a poor sensitivity of 50-60% for detecting blunt bladder injuries. [32,33](#) Its role in this setting is to identify other abdominal injuries.
- The accuracy of CT for detecting and categorising bladder injuries can be greatly improved with a CT cystogram.
- Indications for this study include gross haematuria, pelvic fractures or high clinical suspicion of bladder injury. [34](#)
- Recent studies support the use of retrograde filling of the bladder with dilute iodinated contrast. Using this technique, the reported sensitivity for detecting bladder rupture ranges from 95% to 100% and the specificity is 100%. [34-37](#) These figures are comparable to conventional retrograde cystography. [34](#)
- For categorising the type of bladder injury, the accuracy of a CT cystogram for identifying extraperitoneal injury is similar to conventional cystography. However, the sensitivity is slightly lower for intraperitoneal injury (94% versus 100%). [34](#)
- Multidetector CT with multiplanar reformation may help better localise the site of bladder rupture. [37](#)
- In order to minimise exposure to radiation, time and costs, CT cystograms can be performed as part of the screening abdominopelvic CT without the need for postvoid images. [34, 55, 56](#)
- Disadvantages:
  - Conventional cystography may still be required for equivocal results
  - Differentiating intra and extraperitoneal injury may be difficult and requires expertise in this field

## CT Angiography

- CT Angiography is an effective technique for assessment of the vascular system and the detection of active haemorrhage in patients with blunt abdominal trauma. [29,31](#)
- Multidetector CT Angiography is more efficient than single slice helical CT Angiography with faster scanning times, increased spatial resolution and less IV contrast required. [27](#)
- Advantages compared to intra-arterial digital subtraction angiography: [27](#)
  - More readily available than conventional angiography
  - Less invasive

## Conventional Cystography

- Previously considered the reference standard for non-operative diagnosis of traumatic blunt bladder injuries. However, recent studies have demonstrated similar accuracy for CT cystograms.

### [34](#)

- Should be considered if CT cystograms are equivocal for the diagnosis or categorisation of bladder rupture.
- For classifying the type of injury, conventional cystography and CT cystograms have comparable accuracy for diagnosing extraperitoneal injury. Conventional cystography has a slightly higher sensitivity for intraperitoneal injury (100% verses 94%). [34](#)
- Disadvantages:
  - May be difficult in trauma patients requiring spinal precautions
  - Does not provide detailed information on surrounding structures
  - May be limited by overlying fracture fragment or fixation devices
  - Involves additional exposure to ionising radiation in addition to screening abdominopelvic CT
  - Requires postvoid films to avoid missing small extravasations obscured by contrast-filled bladder

## Focused Abdominal Sonography in Trauma (FAST)

- Particularly useful for the evaluation of haemodynamically unstable patients with blunt abdominal trauma [13-15](#)
- Enables the identification of patients with significant haemoperitoneum who require immediate exploratory laparotomy [13-15](#)
- A number of studies support the routine use of abdominal US in the evaluation of patients with blunt abdominal trauma, but the sensitivity of FAST for the detection of intra-abdominal injuries has varied considerably from 42% to over 90% [6,14-19,21-23](#)
- Advantages [11](#)
  - Rapid, non-invasive
  - No patient preparation
  - No exposure to ionising radiation
  - Does not interfere with resuscitation
  - Allows serial imaging to reassess the patient should there be interval change in the patient's haemodynamics or condition
- Limitations [4,11,16](#)
  - False-negative results [20,21](#)
  - Much more operator dependent than other imaging modalities
  - Very poor for evaluation of the retroperitoneum (kidneys, duodenum and pancreas)
  - Inability to detect bowel injury or active bleeding
  - Lack of sensitivity for directly demonstrating organ injury [23](#)

## Abnormal Renal Perfusion

- No renal perfusion on CT suggests renal pedicle avulsion which is considered an absolute indication for prompt surgical exploration [52-54](#)
- Large segmental hypoperfusion of more than 20%, particularly when combined with parenchymal laceration and contrast extravasation, may be an indication for surgical exploration [52](#)

## References



References are graded from Level I to V according to the Oxford Centre for Evidence-Based Medicine, Levels of Evidence. [Download the document](#)

1. EAST Practice Management Guidelines Work Group. **Practice management guidelines for the nonoperative management of blunt injury to the liver and spleen.** EAST practice management guidelines for trauma. 2000.
2. Hughes TM. **The diagnosis of gastrointestinal tract injuries resulting from blunt trauma.** Aust N Z J Surg. 1999;69:770-7. (Review article)
3. Becker CD, Mentha G. **Blunt abdominal trauma in adults: role of CT in the diagnosis and management of visceral injuries. Part I: Liver and Spleen.** Eur Radiol. 1998;8:553-62.
4. Shuman WP. **CT of blunt abdominal trauma in adults.** Radiology. 1997;205(2):297-306.
5. Brasel KJ, Borgstrom DC, Kolewe KA, et al. **Abdominal computed tomography scan as a screening tool in blunt abdominal trauma.** Surgery. 1996;120:780-4. (Level II/III evidence)
6. Liu M, Lee CH, P'eng FK. **Prospective comparison of diagnostic peritoneal lavage, computed tomographic scanning, and ultrasonography for the diagnosis of blunt abdominal trauma.** J Trauma. 1993;35(2):267-70. (Level II evidence) [View the reference](#)
7. Navarrete-Navarro P, Vazquez G, Bosch JM, et al. **Computer tomography vs clinical and multidisciplinary procedures for evaluation of severe abdomen and chest trauma - a cost analysis approach.** Intensive Care Med. 1996;22:208-12. (Level I/II evidence) [View the reference](#)
8. Federle MP, Courcoulas AP, Powell M, et al. **Blunt splenic injury in adults: clinical and CT criteria for management with emphasis on active extravasation.** Radiology. 1998;206:137-42. (Level II evidence) [View the reference](#)
9. Becker CD, Mentha G, Schmidlin F, et al. **Blunt abdominal trauma in adults: role of CT in the diagnosis and management of visceral injuries. Part II: Gastrointestinal tract and retroperitoneal organs.** Eur Radiol. 1998;8:772-80.
10. Livingston DH, Lavery RF, Passannante MR, et al. **Admission or observation is not necessary after a negative abdominal computed tomography scan in patients with suspected blunt abdominal trauma: results of a prospective, multi-institutional trial.** J Trauma. 1998;44:273-82. (Level II evidence) [View the reference](#)
11. Amoroso TA. **Evaluation of the patient with blunt abdominal trauma: an evidence based approach.** Emerg Med Clin North Am. 1999;17(1):63-75.
12. Butela ST, Federle MP, Chang PJ, et al. **Performance of CT in detection of bowel injury.** AJR Am J Roentgenol. 2001;176:129-35. (Level III evidence)
13. Poletti P-A, Wintermark M, Schnyder P, et al. **Traumatic injuries: role of imaging in the management of the polytrauma victim (conservative expectation).** Eur Radiol. 2002;12:969-78.
14. Bode PJ, Edwards MJR, Kruit MC, et al. **Sonography in a clinical algorithm for early evaluation of 1671 patients with blunt abdominal trauma.** AJR Am J Roentgenol. 1999;172:905-11. (Level II evidence) [View the reference](#)
15. McGahan JP, Richards JR. **Blunt abdominal trauma: the role of emergent sonography and a review of the literature.** AJR Am J Roentgenol. 1999;172:897-903.
16. Brown MA, Casola G, Sirlin C, et al. **Blunt abdominal trauma: screening US in 2,693 patients.** Radiology. 2001;218:352-8. (Level II/III evidence)
17. Rose JS, Levitt MA, Porter J, et al. **Does the presence of ultrasound really affect computed tomographic scan use? A prospective randomized trial of ultrasound in trauma.** J Trauma. 2001;51:545-50. (Level II evidence) [View the reference](#)
18. Brown CK, Dunn KA, Wilson K. **Diagnostic evaluation of patients with blunt abdominal trauma: a decision analysis.** Acad Emerg Med. 2000;7(4):385-96. (Level II/III evidence)
19. Branney SW, Moore EE, Cantrill SV, et al. **Ultrasound based key clinical pathway reduces the use of hospital resources for the evaluation of blunt abdominal trauma.** J Trauma. 1996;120:780. (Level III evidence)

20. Chiu WC, Cushing BM, Rodriguez A, et al. **Abdominal injuries without haemoperitoneum: a potential limitation of focused abdominal sonography for trauma (FAST).** J Trauma. 1997;42:617. (Level III evidence)
21. Miller MT, Pasquale MD, Bromberg WJ, Wasser TE, Cox J. **Not so fast.** J Trauma. 2003;54:52-60 (Level II evidence) [View the reference](#)
22. Richards JR, Schleper NH, Woo BD, et al. **Sonographic assessment of blunt abdominal trauma: a 4-year prospective study.** J Clin Ultrasound. 2002;30:59-67 (Level II/III evidence)
23. Poletti PA, Kinkel K, Vermeulen B, et al. **Blunt abdominal trauma: should US be used to detect both free fluid and organ injuries?** Radiology. 2003;227:95-103 (Level II evidence) [View the reference](#)
24. Hagiwara A, Sakaki S, Goto H, et al. **The role of interventional radiology in the management of blunt renal injury: a practical protocol.** J Trauma. 2001;51:526-31. (Level II /III evidence)
25. Hagiwara A, Yukioka T, Satou M, et al. **Nonsurgical management of patients with blunt hepatic injury: efficacy of transcatheter arterial embolization.** AJR Am J Roentgenol. 1997;169:1151-6. (Level II/III evidence)
26. Hagiwara A, Yukioka T, Ohta S, et al. **Nonsurgical management of patients with blunt splenic injury: efficacy of transcatheter arterial embolization.** AJR Am J Roentgenol. 1996;167:159-66. (Level II/III evidence)
27. Rubin GD, Shiau MC, Leung AN, Kee ST, Logan LJ, Sofilos MC. **Aorta and iliac arteries, single vs multiple detector row helical CT angiography.** Radiology. 2000;215:670-676. (Level II evidence) [View the reference](#)
28. Wilmann JK, Roos JE, Platz A, et al. **Multidetector CT: detection of active haemorrhage in patients with blunt abdominal trauma.** AJR Am J Roentgenol. 2002;179(2):437-44 (Level III evidence)
29. Shanmuganathan K. **Multidetector row CT imaging of blunt abdominal trauma.** Semin Ultrasound CT MR. 2004;25(2):180-204. (Review article)
30. Weishaupt D, Grozaj AM, Wilmann JK, Roos JE, Hilfiker PR, Marincek B. **Traumatic injuries: imaging of abdominal and pelvic injuries.** Eur Radiol. 2002;12:1295-311 (Review article)
31. Nunez D, Bencerra JL, Fuentes D, Pagson S. **Traumatic occlusion of the renal artery: helical CT diagnosis.** AJR Am J Roentgenol. 1996;167:777-80. (Level III/IV evidence)
32. Mee SL, McAninch JW, Federle MP. **Computerized tomography in bladder rupture: diagnostic limitations.** J Urol. 1987;137(2):207-9. (Level III evidence)
33. Haas CA, Brown SL, Spirnak JP. **Limitations of routine spiral computerized tomography in the evaluation of bladder trauma.** J Urol. 1999;162(1):51-2. (Level II evidence)
34. Quagliano PV, Delair SM, Malhotra AK. **Diagnosis of blunt bladder injury: a prospective comparative study of computed tomography cystography and conventional retrograde cystography.** J Trauma. 2006;61(2):410-21. (Level III evidence)
35. Deck AJ, Shaves S, Talner L, Porter JR. **Computerized tomography cystography for the diagnosis of traumatic bladder rupture.** J Urol. 2000;164(1):43-6. (Level III evidence)
36. Peng MY, Parisky YR, Cornwell EE, 3rd, Radin R, Bragin S. **CT cystography versus conventional cystography in evaluation of bladder injury.** AJR Am J Roentgenol. 1999;173(5):1269-72. (Level III evidence)
37. Chan DP, Abujudeh HH, Cushing GL, Jr., Novelline RA. **CT cystography with multiplanar reformation for suspected bladder rupture: experience in 234 cases.** AJR Am J Roentgenol. 2006;187(5):1296-302. (Level III evidence)
38. Gavant ML, Schurr M, Flick PA, Croce MA, Fabian TC, Gold RE. **Predicting clinical outcome of nonsurgical management of blunt splenic injury: using CT to reveal abnormalities of splenic vasculature.** AJR Am J Roentgenol. 1997;168(1):207-12. (Level III evidence)
39. Shanmuganathan K, Mirvis SE, Boyd-Kranis R, Takada T, Scalea TM. **Nonsurgical management of blunt splenic injury: use of CT criteria to select patients for splenic arteriography and potential endovascular therapy.** Radiology. 2000;217(1):75-82. (Level II evidence)





40. Thompson BE, Munera F, Cohn SM et al. **Novel computed tomography scan scoring system predicts the need for intervention after splenic injury.** J Trauma. 2006;60(5):1083-6. (Level II evidence)
41. Wahl WL, Ahrns KS, Chen S, Hemmila MR, Rowe SA, Arbabi S. **Blunt splenic injury: operation versus angiographic embolization.** Surgery. 2004;136(4):891-9. (Level III evidence)
42. Haan J, Scott J, Boyd-Kranis RL, Ho S, Kramer M, Scalea TM. **Admission angiography for blunt splenic injury: advantages and pitfalls.** J Trauma. 2001;51(6):1161-5. (Level IV evidence)
43. Haan JM, Biffi W, Knudson MM et al. **Splenic embolization revisited: a multicenter review.** J Trauma. 2004;56(3):542-7. (Level IV evidence)
44. Moore FA, Davis JW, Moore EE, Jr., Cocanour CS, West MA, McIntyre RC, Jr. **Western Trauma Association (WTA) critical decisions in trauma: management of adult blunt splenic trauma.** J Trauma. 2008;65(5):1007-11. (Review article)
45. Ekeh AP, Izu B, Ryan M, McCarthy MC. **The impact of splenic artery embolization on the management of splenic trauma: an 8-year review.** Am J Surg. 2009;197(3):337-41. (Level IV evidence)
46. Harbrecht BG, Ko SH, Watson GA, Forsythe RM, Rosengart MR, Peitzman AB. **Angiography for blunt splenic trauma does not improve the success rate of nonoperative management.** J Trauma. 2007;63(1):44-9. (Level IV evidence)
47. Monnin V, Sengel C, Thony F et al. **Place of arterial embolization in severe blunt hepatic trauma: a multidisciplinary approach.** Cardiovasc Intervent Radiol. 2008;31(5):875-82. (Level IV evidence)
48. Lin WC, Chen YF, Lin CH et al. **Emergent transcatheter arterial embolization in hemodynamically unstable patients with blunt splenic injury.** Acad Radiol. 2008;15(2):201-8. (Level IV evidence)
49. Hagiwara A, Fukushima H, Murata A, Matsuda H, Shimazaki S. **Blunt splenic injury: usefulness of transcatheter arterial embolization in patients with a transient response to fluid resuscitation.** Radiology. 2005;235(1):57-64. (Level IV evidence)
50. Wu SC, Chen RJ, Yang AD, Tung CC, Lee KH. **Complications associated with embolization in the treatment of blunt splenic injury.** World J Surg. 2008;32(3):476-82. (Level IV evidence)
51. Hagiwara A, Murata A, Matsuda T, Matsuda H, Shimazaki S. **The efficacy and limitations of transarterial embolization for severe hepatic injury.** J Trauma. 2002;52(6):1091-6. (Level IV evidence)
52. Heyns CF. **Renal trauma: indications for imaging and surgical exploration.** BJU Int. 2004;93(8):1165-70. (Review article)
53. Corriere JN, Jr., McAndrew JD, Benson GS. **Intraoperative decision-making in renal trauma surgery.** J Trauma. 1991;31(10):1390-2. (Level IV evidence)
54. Meng MV, Brandes SB, McAninch JW. **Renal trauma: indications and techniques for surgical exploration.** World J Urol. 1999;17(2):71-7. (Review article)
55. Lynch D, Martinez-Pineiro L, Plas E, Serafetinidis E, Turkeri L, Santucci R, et al. **Guidelines on urological trauma.** European Association of Urology. 2008. (Level II evidence) [View the reference](#)
56. Holevar M, J Christopher DiGiacomo, Ebert J, Luchette F, Nagy K, Nayduch D, et al. **Practice management guidelines for the evaluation of genitourinary trauma.** Eastern Association For The Surgery of Trauma. 2003. (Level II evidence) [View the reference](#)

## Information for Consumers

Information from this website	Information from the Royal Australian and New Zealand College of Radiologists' website
-------------------------------	--

<p><a href="#">Consent to Procedure or Treatment</a></p> <p><a href="#">Radiation Risks of X-rays and Scans</a></p> <p><a href="#">Angiography (Angiogram)</a></p> <p><a href="#">Computed Tomography (CT)</a></p> <p><a href="#">Computed Tomography (CT) Angiography</a></p> <p><a href="#">Ultrasound</a></p>	<p><a href="#">Angiography</a></p> <p><a href="#">Computed Tomography (CT)</a></p> <p><a href="#">Contrast Medium (Gadolinium versus Iodine)</a></p> <p><a href="#">Gadolinium Contrast Medium</a></p> <p><a href="#">Iodine-Containing Contrast Medium</a></p> <p><a href="#">Radiation Risk of Medical Imaging During Pregnancy</a></p> <p><a href="#">Radiation Risk of Medical Imaging for Adults and Children</a></p> <p><a href="#">Ultrasound</a></p>
--	--

## Copyright

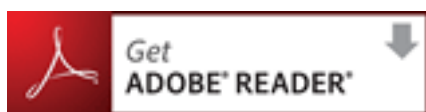
© Copyright 2015, Department of Health Western Australia. All Rights Reserved. This web site and its content has been prepared by The Department of Health, Western Australia. The information contained on this web site is protected by copyright.

## Legal Notice

Please remember that this leaflet is intended as general information only. It is not definitive and The Department of Health, Western Australia can not accept any legal liability arising from its use. The information is kept as up to date and accurate as possible, but please be warned that it is always subject to change

## File Formats

Some documents for download on this website are in a Portable Document Format (PDF). To read these files you might need to download Adobe Acrobat Reader.



## [Legal Matters](#)