Splenic blunt trauma - from diagnostic MDCT to embolisation: The role of the radiologists

Poster No.: C-1859
Congress: ECR 2010
Type: Educational Exhibit
Topic: Interventional Radiology
Authors: J. Cazejust, B. Bessoud, Y. Menu; Paris/FR
Keywords: Splenic blunt trauma, MDCT, Interventional radiology
DOI: 10.1594/ecr2010/C-1859

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR’s endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Learning objectives

1- To know the diagnostic strategy in case of abdominal injuries in a patient with polytrauma and to discuss the relevance of MDCT for the diagnosis

2- To illustrate the different stages of splenic injuries from laceration and haematoma to infarction and avulsion, according to the AAST and to be able to find presence and origin of active bleeding

3- To describe MDCT features of delayed complications, such as vascular complication (delayed rupture, pseudoaneurysm and arteriovenous fistula), splenic pseudocysts (subcapsular or intraparenchymal) or abscesses

4- To review the role of interventional procedures in case of non operative management of blunt splenic trauma

Background

Blunt trauma is the most frequent cause of death in young people, notably because of motor vehicle crashes

Radiologic imaging plays a critical role both in diagnosing these injuries and in determining the initial management

MDCT is the most useful technique in order to carry out this goal.

A splenic injury severity classification was developed by the Organ Injury Scaling Committee of the American Association for the Surgery of Trauma (AAST)

Non operative management has become the standard of care in hemodynamically stable patients with blunt splenic trauma

Blunt trauma is the most frequent cause of death in young people, notably because of motor vehicle crashes

Radiologic imaging plays a critical role both in diagnosing these injuries and in determining the initial management
MDCT is the most useful technique in order to carry out this goal.

A splenic injury severity classification was developed by the Organ Injury Scaling Committee of the American Association for the Surgery of Trauma (AAST)

Non operative management has become the standard of care in hemodynamically stable patients with blunt splenic trauma

Diagnostic strategy:

1- Hemodynamically instable:

Fast US examination
Neck, lung and pelvic radiographies
If negative: body MDCT scan

2- Hemodynamically stable:

Body MDCT scan

MDCT protocol:

Many CT protocols but the use of contrast-enhanced MDCT seems to be the best tool

Unenhanced helical study (spontaneous hyperdense haemorrhage) versus only after IV injection examinations * (possibly add excessive and harmful radiation exposure)?

An arterial then a portal venous phase versus a biphasic IV injection?

Oral contrast* or not (masked digestive extravasations)?


MDCT is currently the diagnostic modality of choice for the evaluation of blunt splenic trauma in hemodynamically stable patients

- MPR reconstruction
- Decrease the time required for scanning
- Motion artifacts can be minimized
Parenchymal splenic injuries can be accurately detected on contrast material-enhanced CT scans

**Imaging findings OR Procedure details**

**Our MDCT protocol (fig.1):**

No unenhanced helical study (ALARA)

Biphasic injection:
- First IV injection of 50 mL
- Second IV injection 60 sec after the first one of 80 mL
- Helical study 30 seconds after the second IV injection

No oral contrast (masked digestive extravasations)

1- **Lacerations:**

Splenic lacerations appear as irregular linear or branching low-attenuation areas, sometimes stellar (fig.2)

Lacerations can be classified as superficial (3 cm in depth) or deep (>3 cm) The term of rupture is used in case of laceration from one side to the other of spleen

Absence of spleen vascularisation in case of associated vascular injury

In case of multiple and spread laceration, these lesions are called shattered spleen (fig.3)

2- **Hematomas:**

Subcapsular or intra parenchymal hematomas are spontaneous hyperdensity on unenhanced helical phase (fig.4)

After contrast media IV injection, splenic or sub capsular hematoma appear as low attenuated lesions within the spleen or the subcapsular region
3- Infarction :

Infarction is a lack of enhancement from a splenic part due to an intra splenic segmental vascular lesion

The spleen appears as a patchwork of regions of differing attenuation at portal venous phase: some part of the spleen are well enhance, whereas others are not (fig.5)

Sometimes the splenic capsule demonstrates a thin enhancing portion, if capsular vessels are undamaged (the « splenic rim sign »)
At a more serious stage, laceration of hilar vessels could produce major devascularization, materialized with a non enhanced spleen most often associated with haematoma in the splenic area

Completely shattered spleen is the more serious event of splenic blunt trauma

4- Vascular lesions :

It represent the group of all lesions at high haemorragic risk : intra or extra splenic contrast extravasation, pseudoaneurysm or intra splenic blush contrast (fig.6 and 7)

Theses lesions are at high delayed haemorragic and haemodynamic instability risks, and are factors orienting through endovascular treatment

AAST Classifiaction :

The Organ Injury Scaling was developed by the Organ Injury Scaling Committee of the American Association for the Surgery of Trauma (AAST) Originally convened in 1987, these scoring systems are modified and updated as deemed appropriate (fig.12)

The last version for spleen and liver has been published in 1995

MDCT features of delayed complications

More and more complex splenic injuries, with higher grade (even grade IV and V) have been non operatively managed

The reported prevalence of complications during nonsurgical management of blunt splenic trauma is up to 8%

**Post traumatic complications :**

Occur more frequently in high grade injury => to propose a MDCT follow-up in case of non operatively managed grade III or greater splenic injury

Occur most of the time within the 2 weeks of the injury, but, can, in rare instances, occur months after trauma

Gaarder. J Trauma. 2006


Lin. Acad Radiol. 2008


1- **Delayed haemorrhage :**

2 groups :

- true delayed haemorrhage (less than 1%)

- delayed recognition in rupture is reported as high as 40%

Higher risk of mortality, compared to the primary splenic injury

Delayed haemorrhage can occur in case of splenic rupture from an increasing subcapsular or intra parenchymal hematoma but even in case of pseudoaneurysm or arteriovenous fistula

The increasing size of splenic hematoma in follow-up imaging is the best sign suggesting an impending rupture risk and then delayed haemorrhage

2- **Pseudo aneurysms :**

- well-circumscribed areas of contrast enhancement with an attenuation value similar to that of an adjacent contrast-enhanced artery (fig.9)

The emergence of pseudoaneurysm is related to intimal trauma leading to intimal fragmentation and weakening of the arterial wall

A rare life treating condition
Could occur in splenic artery or intraparenchymal vessels

Occur more frequently in high grade splenic trauma and progress over time until rupture, leading to secondary delayed splenic haemorrhage

3- Arterio venous fistula

Post traumatic splenic arteriovenous fistulae are rare and usually associated with a pseudo aneurysm

It remains asymptomatic for a long time but splenomegaly, portal venous hypertension or cardiac failure could occur in chronic arteriovenous fistulae On MDCT, arteriovenous fistulae are a splenic high attenuation well-circumscribed area at arterial venous phase and become isoattenuated related to splenic parenchyma on delayed phase

4- Splenic pseudo cysts :

Uncommon but exceptionally resolved spontaneously

Usually occur later in case of nonoperatively managed sub capsular or intra parenchymal splenic hematoma

Partial or complete splenectomy should be considered in case of large (> 5 cm) symptomatic splenic pseudocysts, because the rupture risk is 25% and because percutaneous drainage and laparoscopic fenestration have an unacceptably high rate of failure (recurrence, abscesses)

5- Infection :

Abscesses can occur several months after splenic trauma in case of nonoperative management and after splenic embolisation

The modality of choice to treat such complication is percutaneous drainage

THE ROLE OF INTERVENTIONNAL RADIOLOGY :

Acute phase : arterial embolization

Delayed phase : IArterial pseudo aneurysms embolization IIIntra or peri splenic abscesses percutaneous drainages

Non operative management versus surgical management
Hemodynamically instability: surgery or interventional radiology is quickly mandatory in order to decrease mortality.

Hemodynamically stable patient: the nonoperative by means of strict bed rest and observation management has become the standard of care in splenic injuries, notably in high grades.

The major endpoint of nonoperative management is to save the spleen and preserve its functions, mainly the immune function that allows protection against overwhelming sepsis.

**Splenic arterial embolisation**

Splenic artery embolisation could be performed either in acute blunt trauma or in case of failure of non operative management and delayed splenic haemorrhage, and has been proposed as an adjunct to nonoperative management in the following conditions:

(1) Traumatic splenic injuries associated with vascular injury (i.e., contrast material extravasation, arteriovenous fistula, or pseudoaneurysm)

(2) AAST grade III to V splenic injuries and/or splenic injuries associated with CT evidence of active contrast extravasation or blush.

In case of acute blunt trauma, the aim of treatment is to control active haemorrhage. The indication of splenic embolisation is now based on MDCT grading: grade III or higher or active bleeding, because of the risk of failure of nonoperative management alone.

**Various techniques (fig. 12; 13 and 14):**

Regarding the targeted site of occlusion: main splenic artery or intrasplenic branches.

Regarding the occluding agents: gelatin sponge pledgets or coils.

But no major long-term impact on the splenic anatomy and immune function in case of proximal splenic artery embolisation.


Failure of nonoperative management caused by delayed splenic haemorrhage occurs in 2% to 20% of patients.

Active bleeding is most of time an enlargement of initially asymptomatic intraparenchymal false aneurysms or subcapsular hematomas, which may then rupture into the peritoneum.
Splenic artery embolisation is a well tolerated and efficient technique and improves outcomes patients with pseudo aneurysms managed nonoperatively as been reported in many studies

Most of delayed haemorrhages in case of nonoperative management of splenic injuries occur within the next two weeks in inpatients

The reported rate of failure of splenic artery embolisation for acute splenic trauma range between 3% and 27% of patients

Whereas in case of late delayed haemorrhage, no failure of splenic artery embolisation have been reported

**Drainage** :

Finally, after splenic injury, abscesses or fluid pouch can occur and delayed MDCT follow-up is helpful for the diagnosis

Percutaneous drainage US or MDCT-guided is the best tool to treat such complications (fig.15)

**Images for this section:**
MDCT protocol

- While the spleen is heterogeneous during the arterial phase, analysing it in this phase alone is not recommended.

Normal spleen in both arterial and portal venous phases in 3 patients with blunt abdominal trauma.

**Fig. 1:** Normal spleen with arterial and portal venous phase MDCT.
Fig. 2: Splenic lacerations
Fig. 3: Shattered spleen

Hematomas

Peri splenic haematoma  Intra splenic haematoma  Voluminous sub capsular splenic haematoma
**Fig. 4:** Splenic haematomas

**Fig. 5:** Splenic infarction
Fig. 6: Splenic false aneurysm
Fig. 7: Contrast media extravasation from spleen
<table>
<thead>
<tr>
<th>Grade</th>
<th>Injury description</th>
</tr>
</thead>
</table>
| I     | Haematoma Subcapsular, <10% surface area  
Laceration Capsular tear, <1cm parenchymal depth |
| II    | Haematoma Subcapsular, 10-50% surface area  
Intraparenchymal, <5cm diameter  
Laceration 1-3cm parenchymal depth, not involving vessels |
| III   | Haematoma Subcapsular, >50% surface area or expanding.  
Ruptured subcapsular or parenchymal haematoma  
Intraparenchymal haematoma >5cm or expanding  
Laceration >3cm parenchymal depth or involving trabecular vessels |
| IV    | Laceration of segmental or hilar vessels producing major devascularization (>25% of spleen) |
| V     | Laceration: Completely shattered spleen  
Vascular Hilar vascular injury which devascularized spleen |

**Fig. 8:** Splenic injury severity classification, developed by the Organ Injury Scaling Committee of the American Association for the Surgery of Trauma (AAST)
Pseudo aneurysms

- These vascular injuries may be surrounded by low-attenuation parenchyma or hematoma
- On delayed imaging the attenuation becomes similar to or slightly higher than that of adjacent organ parenchyma
- The large majority of pseudoaneurysms are noted on delayed imaging studies, which plead in favour to follow-up studies particularly in case of high grade splenic trauma

Fig. 9: Splenic false aneurysm
Splenic collection 4 days after arterial splenic embolisation with coils

Fig. 10: Peri splenic abcess after arterial splenic embolization
Fig. 11: Peri splenic abcess
Proximal embolisation / Decreasing intra splenic pressure

- Before embolisation: Microcatheter 2.7 F (arrow) et intra splenic pressure catheter (arrow head).
  PA 111/79/95 (PASyst/PADiast/PAMean)
- After embolisation: Coils (arrows). Decreasing intra splenic pressure. PA 53/47/50

**Fig. 12:** Proximal splenic artery embolisation
Fig. 13: Splenic arterial embolisation
Grade IV with contrast media extravasation (arrows)
1. Splenic angiography. Cobra 5F. Extra splenic extravasation
2. Juxta hilar catheterism and coils embolisation
3. After embolisation: splenic artery is occluded.
Arrows show caudal pancreatic arteries

Fig. 14: Splenic embolisation
Drainage

- Finally, after splenic injury, abscesses or fluid pouch can occur and delayed MDCT follow-up is helpful for the diagnosis.
- Percutaneous drainage US or MDCT-guided is the best tool to treat such complications.

Fig. 15: Percutaneous drainage from splenic abscess
Conclusion

MDCT is useful to determine splenic injury in blunt abdominal trauma and allows a severity classification, according to the AAST

In case of non operative management, interventional procedures, such as arterial embolisation or percutaneous drainages are helpful in order to take care of the patients

Personal Information

References


Krohmer SJ, Hoffer EK, Burchard KW. Transcatheter Embolization for Delayed Hemorrhage Caused by Blunt Splenic Trauma. CVIR. 2009