The pelvic trauma: what orthopedics want to know and radiologists must learn to describe

Poster No.: C-2378
Congress: ECR 2015
Type: Educational Exhibit
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Keywords: Trauma, Education and training, Education, Computer Applications-3D, CT, Conventional radiography, Emergency, Bones
DOI: 10.1594/ecr2015/C-2378

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Learning objectives

The pelvic trauma is a particular condition where bone fractures may be associated with vascular or other organ lesions. The presence of such lesions make difficult to correctly evaluate and diagnose bone lesion. there is the need to provide a clear and concise report quickly, given the frequent hemodynamic instability of these patients which complicates therapeutic interventions.

The learning objectives are:

- To distinguish the different meanings of fractures of pelvic ring and fractures of the acetabulum to optimize the complex treatment in patients with multiple lesions.

- To recognize, correctly classify and describe fractures of pelvic ring in Polytrauma Patients, according to orthopedic purpose.
Background

In the last few years the field of the emergency and trauma medicine saw the establishment of the so-called "trauma Team", i.e. the formation of a group of doctors, coming from different specialties, converging to achieve a better trauma patient's management. The complexity of damage needs multiple specialist approach from resuscitation to thoracic, abdominal and orthopaedic surgery, directed to the correction of physiopathological consequences of haemorrhage, shock, parenchymal trauma and bone fractures.

The word "Team" expresses very well the nature of this group, where each member plays a different role aimed at a common goal: rapidly decide which lesions have to be treated first to stabilize the clinical conditions of the patient. Therefore, to get the best result, each component will have to play its role by working openly with others, just like in a sport team. The role of the radiologist in Trauma Team is crucial today: to provide, through the report, a diagnosis of numbers and type of lesions, classified on the basis of international schemes, based on the interpretation of radiological images to help the clinician or surgeon to define the best treatment and set a consistent therapeutic program.

The radiologist, however, is the less "clinical" among the team and not really lives the burden of managing the patient, nor its urgency. Often the report, although it is correct from the point of view of diagnosis, not clearly gives information that may have an immediate impact in the patient's management.

Provide a report focused on useful and specific parameters means avoiding the needs of other colleagues of reviewing the study and perform this analysis after the receipt of the report, slowing the therapeutic iter and removing importance to the work of the radiologist. In other words, the radiologist should not merely describe the anatomical findings, but he has to turn them into clinicopathological entities and underline the parameters that can change the therapeutical process.

This standardized model in which the radiologist knows and actively search this parameters, also specifying their absence, constitutes a valid information chain that gives to the surgeon a specialized radiological consultancy, helping him to program the surgery.
Findings and procedure details

FRACTURE CLASSIFICATION

Young e Burgess classification

The Young and Burgess classification system is the classification that stood up in the recent years. This classification takes into account the mechanism that causes the injury, illustrating the pattern of more frequent presentation and relating them to possible vascular damage. The classification of Young and Burgess distinguishes four groups:

Anteroposterior compression injuries (APC) (the force vector of the traumatic acts has an anteroposterior direction).

- The type 1 are characterized by a diastasis of the pubic symphysis less than 2.5 cm and by an absence of posterior instability, both radiological and clinical (integrity of the sacroiliac joint).
- The type 2 are characterized by a diastasis of the pubic symphysis more than 2.5 cm and by the posterior instability arising from the injury of the sacroiliac joint. It's been demonstrated (by Tile et al. [45]) that the the opening of the pubic symphysis (up to a maximum of 2.5 cm) is possible without damages to the sacroiliac joint.
- The type 3 are characterized by the complete lesion of the posterior structures.

Lateral compression injuries (LC) (the force vector of the traumatic acts has a latero-lateral direction). Injuries from side compression occurs when the force act laterally and medially to the pelvis. The occurrence of a fracture is more frequent in the case of a lateral compression than an anteroposterior compression.

- The type I results from a force applied laterally on the rear portion of the pelvis and have a wide spectrum of presentation.
- The type II derives instead from a force applied more anteriorly, determining an internal rotation of the hemipelvis with a possible external rotation of the rear part with the sacroiliac joint that serves as a fulcrum. The resulting back injury can be a sacral fracture, a fracture of the sacroiliac joint or its ligaments or a fracture of the ilium.
- The type III instead derive from a force of greater magnitude; the internal rotation of the ipsilateral hemipelvis causes the lesion of the contralateral hemipelvis with the destruction of the sacroiliac ligaments, sacrospinous and sacrotuberous.
Vertical shear injuries (VS) (the force vector acting from the bottom upwards). The lesions by vertical shear derived from a force vector with a caudo-cranial direction on one or both hemi-pelvis, laterally to the midline.

Generally it is a high-energy trauma, such as precipitation from a considerable height. The sacrum is pushed down from the iliac wing resulting in a complete lesion of the sacrospinous, sacrotuberous and sacroiliac ligaments. There may be a bone fracture instead of the ligament lesions.

Complex cases (in which at least two force vectors acts on the pelvis). The complex lesions derives from the combination of the patterns just presented, more frequently between a LC type lesion with a type APC or VS.

The AO classification (Academy of Orthopedics Trauma Association classification system)

The AO classification system is the most widely used today and it takes into account not only the injury mechanism but also the type of instability that results.

We distinguish three degrees of instability

- Stable: The mechanical structure of the pelvic ring remains intact (Type A, 50-70% incidence);
- Partially unstable: partial rear lesion or rotational instability after anteroposterior or lateral compression (type B, 20-30% incidence);
- Unstable: front and rear injuries combined, vertical instability (type C, 10-20% incidence).

IMAGING METHODS

The study of pelvic trauma is based on various methods: ultrasound, x-ray imaging and CT.

Ultrasound, in particular with the FAST technique (Focused Assessment with Sonography in Trauma), allows a rapid diagnosis of peritoneal fluids, which is supposed to be blood and/or urine.

The emergency room physicians and the intensivists are the main perpetrators of this technique, which responds only to a question: peritoneal fluids or no.
Radiographs of the pelvis starts with an anteroposterior radiograph, completed with "inlet" and "outlet" projections. Sometimes it is completed with the study of lumbosacral column.

This method has an excellent sensitivity in depicting fractures and it is extremely rapid, useful if the patient is unstable (the examination can be carried out directly in the "emergency room").

It is mandatory a proper execution of these projections: the patient must be lying supine on the couch or on a radiographic cassette.

The anteroposterior projection is useful to evaluate:

Anterior injuries (lesions of the branches and pubic symphysis diastasis, sacred iliac joint injuries, iliac fractures, facet avulsions, lesions of the lumbar transverse processes);

Symmetry of the pelvis

Coxo-femoral joint dysmetria

The inlet projection (performed by tilting the X-ray tube 45 degrees in the cranio-caudal) is useful to evaluate:

The pelvico egress

The dislocations of the sacroiliac joints

The internal rotations of the ileum

Sacrum lesions caused by impaction (shortening of one side of the sacrum)

The presence of fracture-avulsion of the ischial spines.

The outlet projection (performed by tilting the X-ray tube 45 degrees in the caudal-cranial) is useful to evaluate

Eventual rotations of the superior hemipelvis

The dislocation of the pelvis in the vertical direction.

CT scan of the pelvis is definitely the most accurate method allowing an accurate assessment of each individual fragment of the fracture and is excellent in the pre-
operative planning; it allows the assessment of pelvic organs and soft tissues and it helps the radiologist to diagnose the source of any bleeding.

It is however the slowest modality and it’s not indicated in markedly unstable patients.

It is mandatory to perform the CT with proper collimation (thickness of at least 1.25 and interval of 1 mm, with the possibility of back-reconstructions to lower thickness) and image reconstruction algorithms for both soft tissue to bone.

It is also necessary the administration of contrast medium in order to exclude soft tissue injuries and bleeding.
Images for this section:

Fig. 2: Young and Burgess classification

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Fig. 3: The AO Classification Modified from "Fractures and dislocations of the pelvic ring" - Polhemann - Surgical Techniques in Orthopaedics and Traumatology 55-410-A-10

AO classification of pelvic ring injuries. Three different grades of stability/instability are differentiated.
A. Type A: rotationally and vertically stable lesions.
B. Type B: rotationally unstable and vertically stable lesions.
C. Type C: rotationally and vertically unstable lesions.

3 Radiographic projections for evaluation of pelvic ring injuries:
A. Pelvic AP projection and resulting radiograph.
B. Caudal projection (inlet view) and resulting radiograph.
C. Cephalad projection (outlet view) and resulting radiograph.
Fig. 4: Inlet and outlet projections
Conclusion

In the wider comprehensive analysis of emergency CT in pelvic and abdominal trauma, the description of pelvic ring fractures represents only a partial aspect, but it is necessary to describe correctly the effect of trauma on bones to correctly plan time and type of the treatment.

These are the information that must be present on the report for general and orthopedic purposes, in order to facilitate the therapeutic planning:

1. The description of pelvic hematomas or active bleeding (both on the arterial and venous side) are essential for patient management (external closing of pelvic ring, surgical packing, embolization). Even the coexistence of bladder, urethral and ureteral lesions become fundamental information in major trauma, particularly in those with anteroposterior force vector, and when an external closing of pelvic ring is planned.
2. Description of the presence or absence of one or more lesions of the transverse processes of the vertebrae L4 and L5 (marker of instability)
3. A precise measurement of the pubic symphysis or sacroiliac joint diastasis, with the description of the geometry of the lesion and the distance between the body midline and the hemipelvis
4. Measurement of the diameter reduction in case of pelvic ring closure
5. The description of any bone fragments located in the pelvis and their relationships with the adjacent structures.
References

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