

ESR Essentials: trauma team and the role of Interventional Radiology-practice recommendations by the Cardiovascular and Interventional Radiological Society of Europe.

Cardiovascular and Interventional Radiological Society of Europe (CIRSE) · 2026

Interventional Radiology in Trauma Care: A Comprehensive Study Guide

This study guide synthesizes the practice recommendations and clinical evidence regarding the integration of Interventional Radiology (IR) into trauma care, based on the Cardiovascular and Interventional Radiological Society of Europe (CIRSE) essentials.

I. Core Practice Recommendations

The integration of Interventional Radiology into trauma care is structured around three primary recommendations, graded by Level of Evidence (LoE) and Strength of Recommendation (SoR).

Recommendation	LoE	SoR	Key Components
1. 24/7 IR Integration	III	B	IR must be part of the trauma team activation at Level I centers. Angiosuites should be located near trauma bays.
2. Whole-Body Contrast CT	II	A	Use in stable or "stabilizable" patients to guide IR. Detection of active extravasation or pseudoaneurysm necessitates prompt embolization.
3. Standardized Protocols	IV	B	Maintain 24/7 access to essential materials (coils, plugs, stent-grafts, REBOA). Define organ-specific strategies for Non-Operative Management (NOM).

II. Trauma Center Classification and IR Responsibilities

The role of IR is determined by the capabilities and infrastructure of the trauma facility:

- **Level I Centers:** Provide comprehensive, 24/7 multidisciplinary care. Continuous access to IR, surgery, and ICU is a core requirement.
 - **Level II Centers:** Capable of stabilizing many cases but may lack 24/7 on-site IR or ICU support. They require structured call systems.
 - **Level III Centers:** Primarily responsible for initial stabilization and must have efficient coordination for rapid transfer to higher-level facilities.
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III. Diagnostic and Management Strategies

The Multidisciplinary Team (MDT)

Effective trauma management requires collaboration between emergency physicians, intensive care specialists, diagnostic radiologists, interventional radiologists, anesthesiologists, and trauma/orthopedic surgeons.

Key Assessment Tools

- **Shock Index:** Defined as the ratio of heart rate to systolic blood pressure. A Shock Index > 1 is an early indicator for IR involvement.
- **Imaging Gold Standard:** Total-body Multislice Computed Tomography (MSCT) is the gold standard for polytrauma due to speed and precision. Plain radiography and Ultrasound (FAST/eFAST) are useful for initial evaluation.
- **Hybrid Emergency Rooms:** Japanese models that integrate CT, IR, and surgical capabilities in one room to eliminate the need for patient relocation.

Non-Operative Management (NOM)

NOM is favored for hemodynamically stable patients with blunt trauma. IR is central to NOM by controlling active bleeding without requiring open surgery. Failure of NOM is defined as secondary clinical deterioration (e.g., persistent bleeding or expanding hematoma) after an initial conservative attempt.

IV. Organ-Specific Injury Management

The American Association for the Surgery of Trauma (AAST) uses the Organ Injury Scale (OIS) to grade severity from Grade I (minor) to Grade V/VI (severe).

Pelvic Fractures

- **Venous/Cancellous Bleeding:** Often managed with orthopedic stabilization and compressive pelvic binders.
- **Arterial Bleeding:** Requires urgent IR intervention. Angioembolization has a success rate exceeding 85%.
- **Primary Approaches:** Internal iliac artery branches (superior gluteal or obturator) are common targets.

Solid Organ Injuries (Liver, Spleen, Kidney)

- **Liver:** Transarterial embolization (TAE) achieves hemostasis in over 90% of stable patients with high-grade (Grades IV-V) injuries.
- **Spleen:** Two endovascular strategies exist:
 - *Proximal:* Coil occlusion of the main splenic artery to lower pressure while preserving collateral flow.
 - *Distal:* Selective occlusion of the specific bleeding branch.
- **Kidney:** Selective embolization is preferred to preserve renal function. For renal artery dissection or occlusion, revascularization via stent should ideally occur within 4-6 hours.

Vascular Emergencies

- **Thoracic Aortic Injury:** Most common at the aortic isthmus (90%). Grades III (pseudoaneurysm) and IV (complete rupture) require urgent Thoracic Endovascular Aortic Repair (TEVAR).
- **Musculoskeletal/Extremity Trauma:** IR is a targeted adjunctive therapy used when bleeding is deep or surgically inaccessible.
- **Sandwich Technique:** A method of embolizing both proximal and distal segments of an injured vessel to prevent retrograde bleeding from collateral circulation.

V. Short-Answer Practice Questions

1. **What is the "Shock Index," and what value suggests IR should be considered?**
 - *Answer:* The Shock Index is the ratio of heart rate to systolic blood pressure. A value greater than 1 suggests the need for IR involvement.
2. **Why is MRI generally not used in acute trauma settings?**
 - *Answer:* MRI has long scan times, low availability, and low diagnostic value for detecting acute bleeding compared to MSCT.
3. **What are the four grades of traumatic aortic injury?**
 - *Answer:* Grade I (Intimal tear), Grade II (Intramural hematoma), Grade III (Pseudoaneurysm), and Grade IV (Complete rupture).

4. **In which scenario is "proximal" splenic artery embolization preferred over "distal" embolization?**
 - *Answer:* Proximal embolization is used to lower overall arterial pressure and promote spontaneous hemostasis while preserving collateral flow; distal is used when a specific active extravasation site is identified.
 5. **What is the ideal time window for endovascular revascularization of a traumatic renal artery injury?**
 - *Answer:* Approximately 4–6 hours after the injury.
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VI. Essay Prompts for Deeper Exploration

1. **Analyze the role of Interventional Radiology in the shift toward Non-Operative Management (NOM).** Discuss how IR allows for organ preservation and reduces the need for traditional surgery in high-grade solid organ injuries.
 2. **Evaluate the organizational differences between Level I, II, and III trauma centers regarding IR access.** Explain why 24/7 IR availability is considered a "core requirement" for Level I status and the potential risks associated with the transfer protocols required in Level III centers.
 3. **Discuss the "Hybrid Emergency Room" concept.** How does integrating CT, IR, and surgical capabilities into a single resuscitation space impact patient outcomes and workflow efficiency in the context of life-threatening hemorrhage?
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VII. Glossary of Terms

- **AAST:** American Association for the Surgery of Trauma.
- **Angioembolization:** A procedure where an interventional radiologist uses coils, plugs, or liquid agents to block a blood vessel and stop bleeding.
- **FAST / eFAST:** Focused Assessment with Sonography for Trauma (extended); a rapid ultrasound exam used to identify free fluid or air.
- **Hemodynamically Stable:** A state where a patient's blood pressure and heart rate are within normal limits or have been stabilized with fluids/resuscitation.
- **ICS (Intraoperative Cell Salvage):** The process of recovering blood lost during surgery and re-infusing it into the patient.
- **MSCT:** Multislice Computed Tomography; the gold standard for rapid trauma diagnosis.
- **Pseudoaneurysm:** A "false" aneurysm where blood leaks through an injured arterial wall but is contained by surrounding tissues.
- **REBOA:** Resuscitative Endovascular Balloon Occlusion of the Aorta; a technique used to temporarily stop heavy bleeding by inflating a balloon in the aorta.

- **TAE:** Transcatheter Arterial Embolization.
- **TEVAR:** Thoracic Endovascular Aortic Repair; the use of a stent-graft to repair the thoracic aorta.