

Precision in the Golden Hour

Integrating Interventional Radiology
into Trauma Resuscitation Pathways

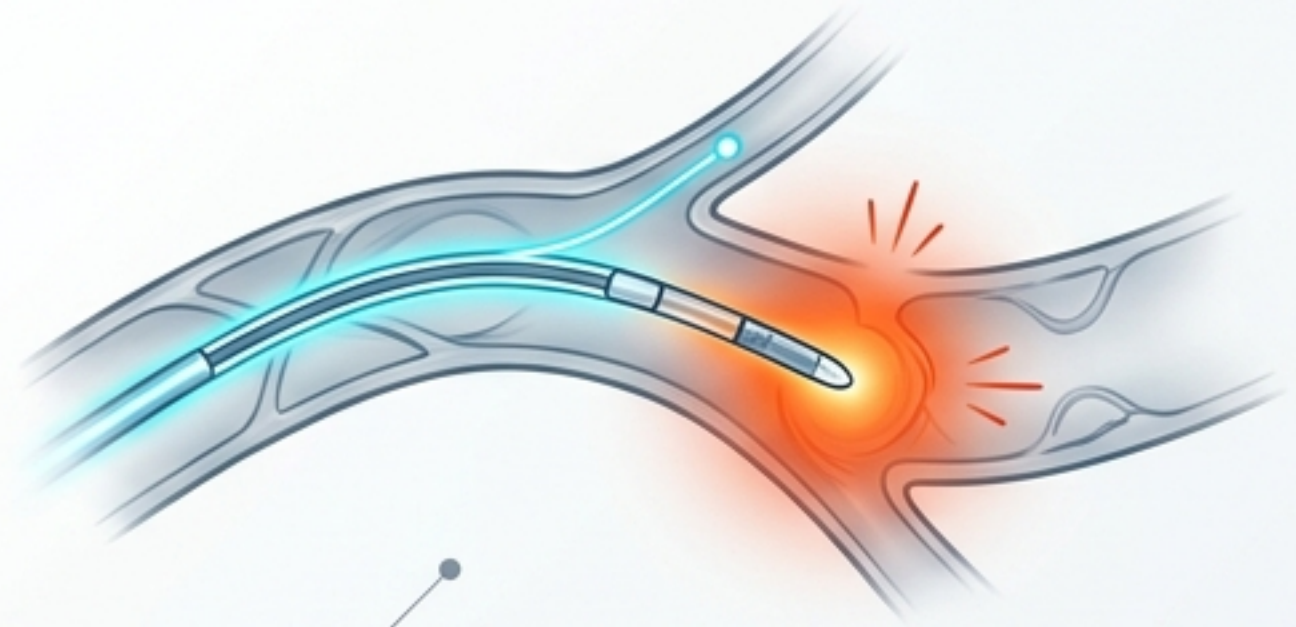
Based on CIRSE/ESR Practice
Recommendations

The shift toward minimally invasive hemorrhage control



THE CHALLENGE

Uncontrolled non-compressible bleeding remains the most preventable cause of early trauma mortality. Traditional open surgery in hemodynamically stable patients can lead to unnecessary morbidity.



THE SOLUTION

Interventional Radiology (IR) enables rapid, targeted hemorrhage control. By combining advanced imaging with endovascular techniques, IR preserves organ function and reduces the need for open surgery.

Three mandates for modern trauma care



24/7 Team Integration

Embed Interventional Radiologists directly into trauma teams with continuous availability at Level I centers.

Level of Evidence: III



Immediate CT Diagnostics

Perform whole-body contrast-enhanced CT in stable/stabilizable patients to instantly guide IR intervention.

Level of Evidence: II

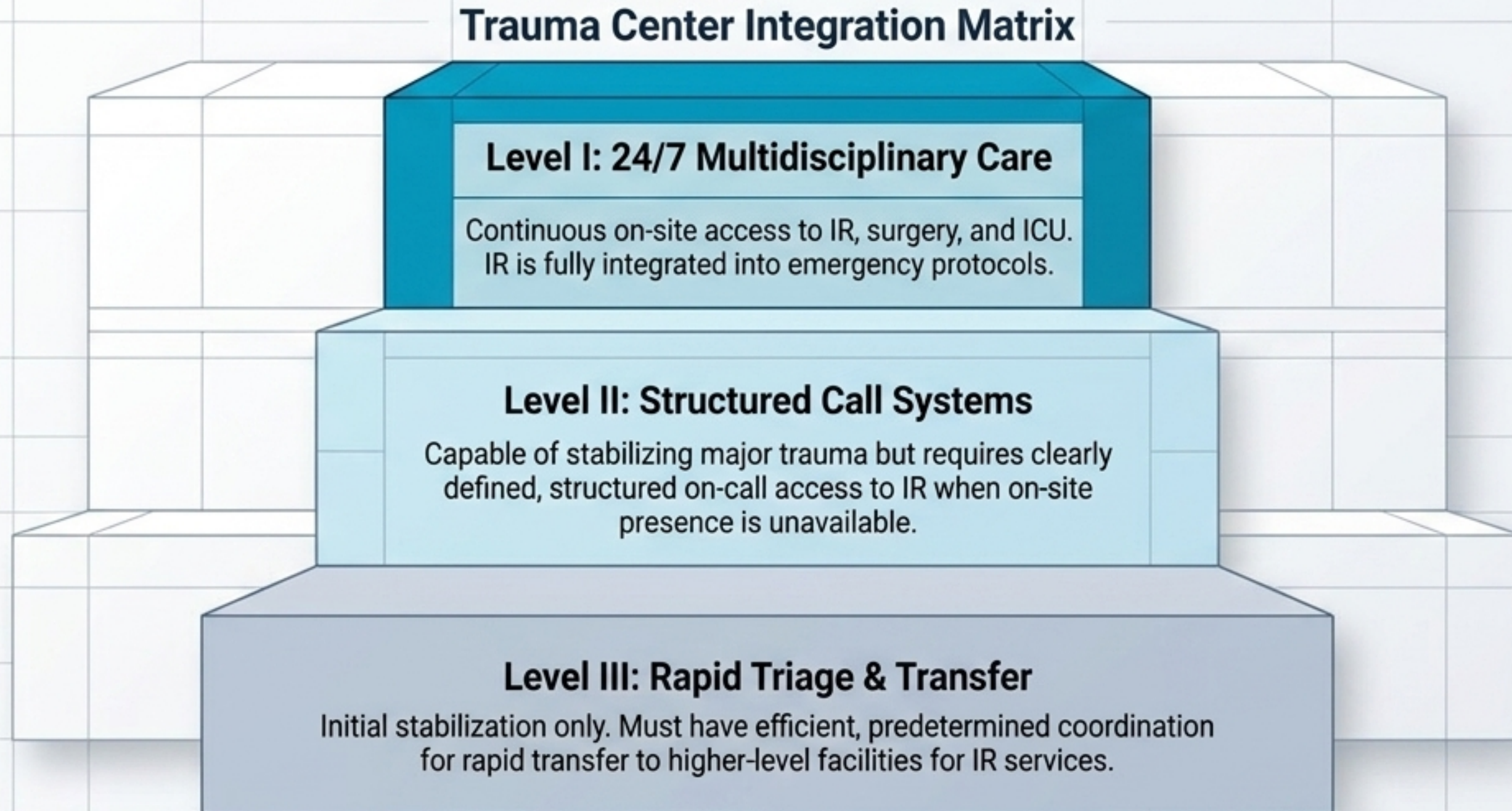


Standardized Protocols

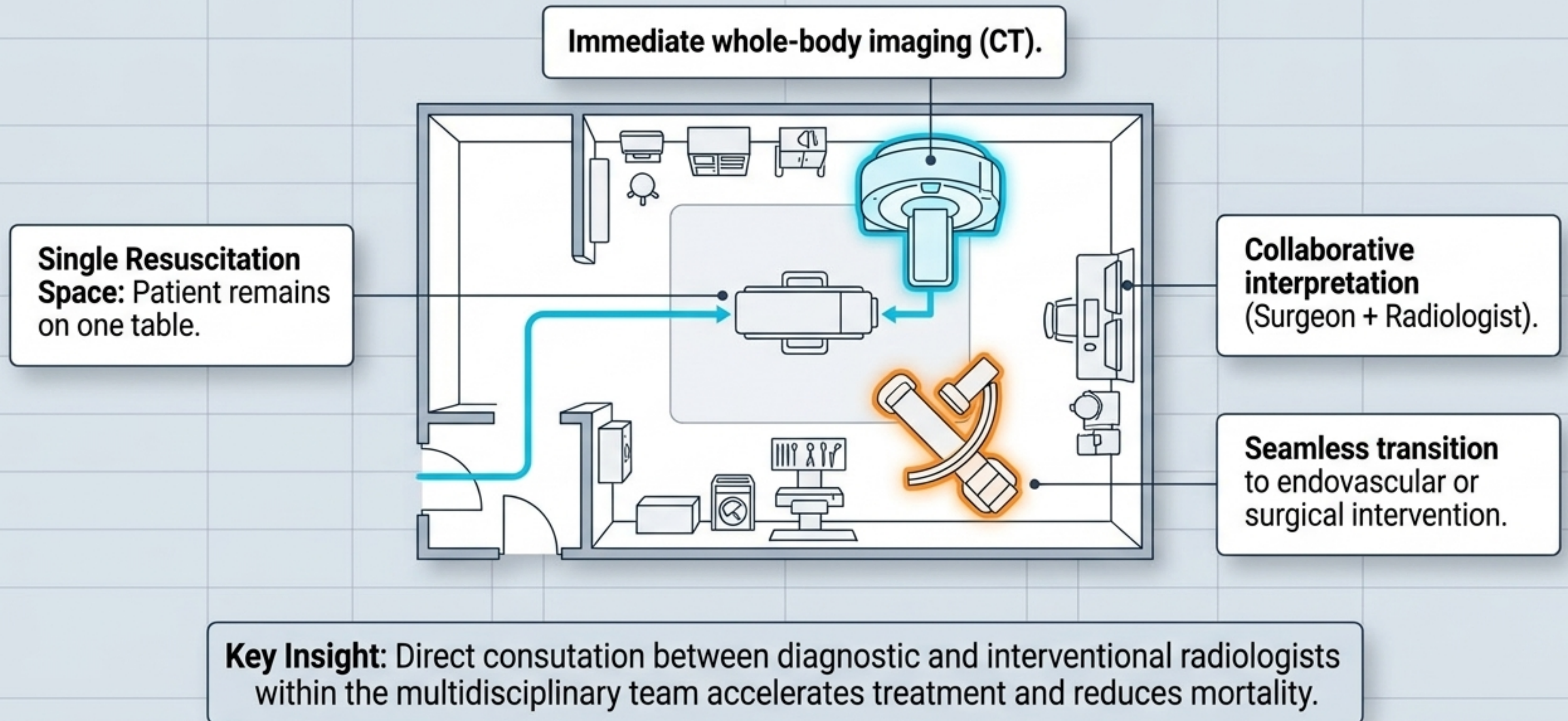
Maintain immediate, standardized access to embolic materials and organ-specific algorithms.

Level of Evidence: IV

Matching IR capabilities to trauma center levels

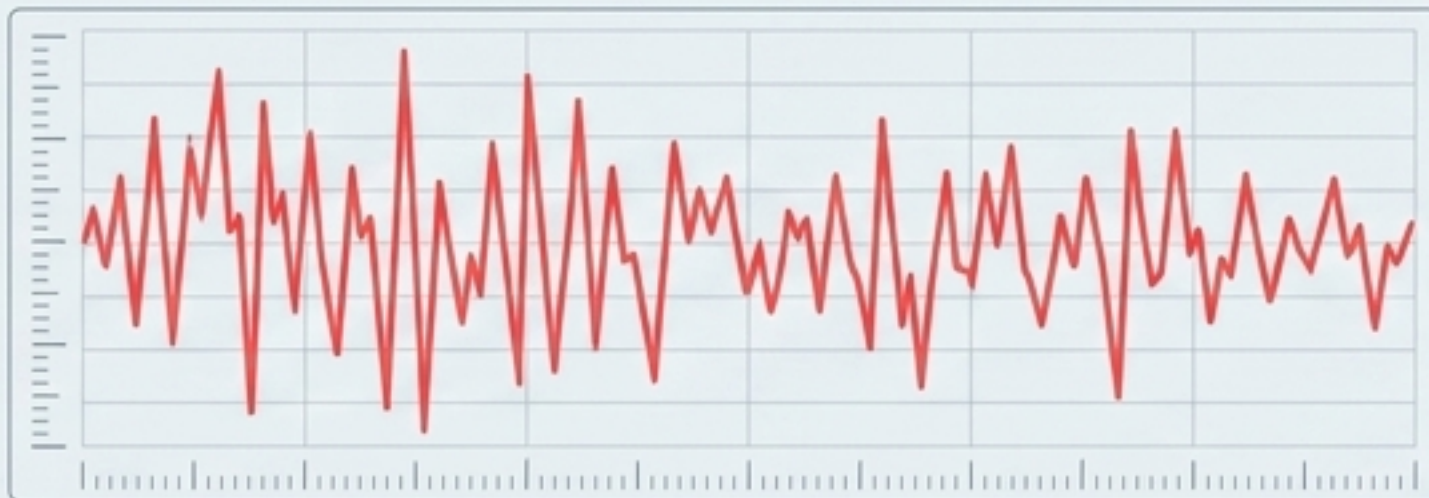


Eliminating transfer delays with the Hybrid ER



The primary fork in the trauma pathway

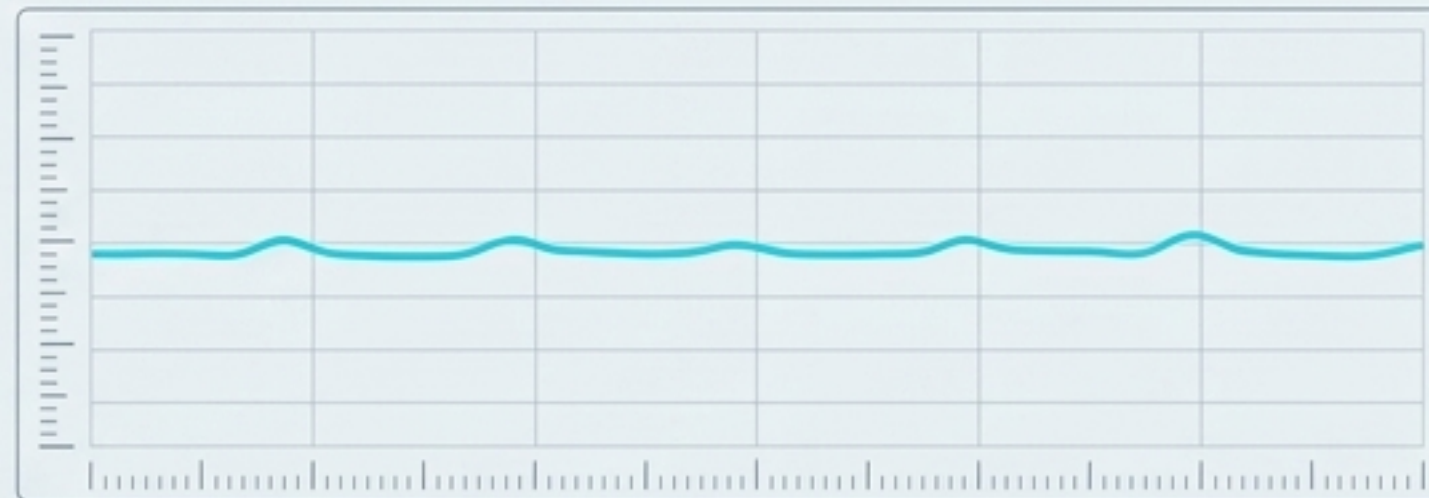
Hemodynamic Decision Matrix



Unstable / Transient Responder

High-priority clinical intervention. Immediate Damage Control Resuscitation.

- Use of REBOA (Resuscitative Endovascular Balloon Occlusion of the Aorta) or direct Operating Room / IR transfer.

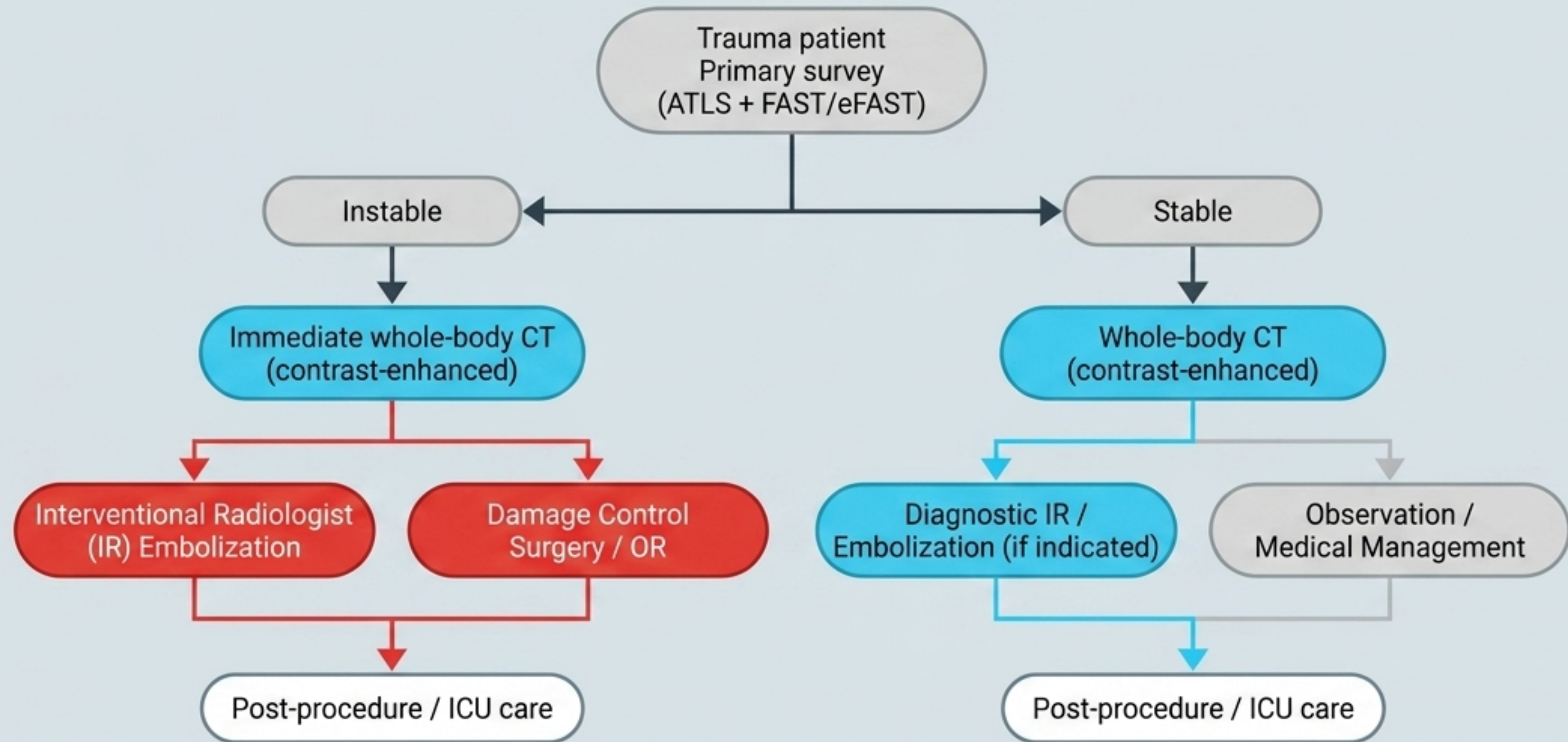


Stable / Stabilizable

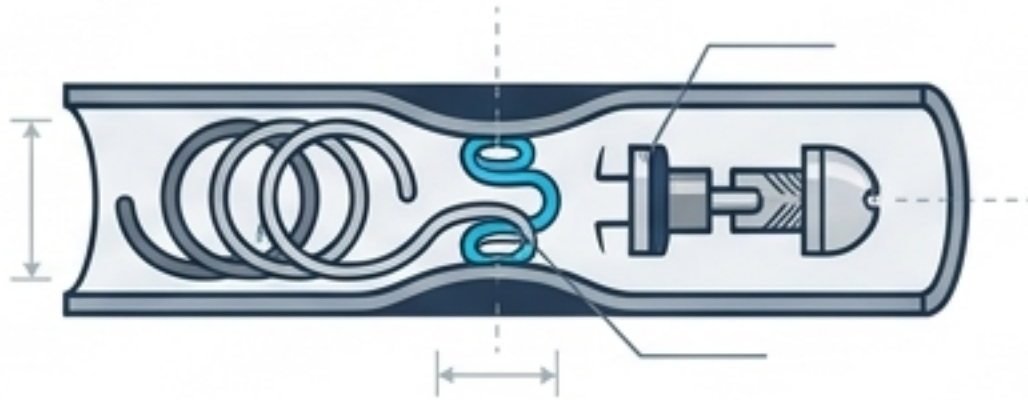
The Diagnostic Window. Immediate Whole-Body Contrast-Enhanced CT (plain, arterial, portal venous phases).

- If active extravasation or pseudoaneurysm is detected -> Prompt IR Embolization.

The standardized algorithm for IR integration

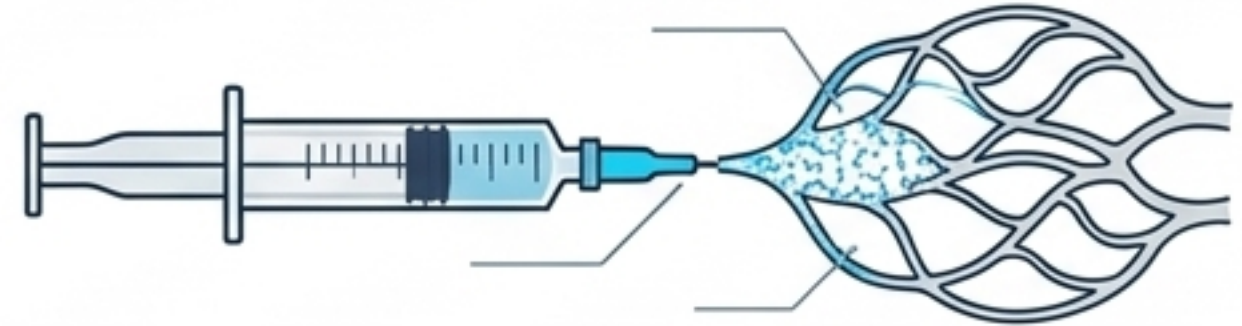


The trauma-ready IR inventory



Coils & Plugs

For precise, permanent mechanical occlusion of targeted bleeding vessels.



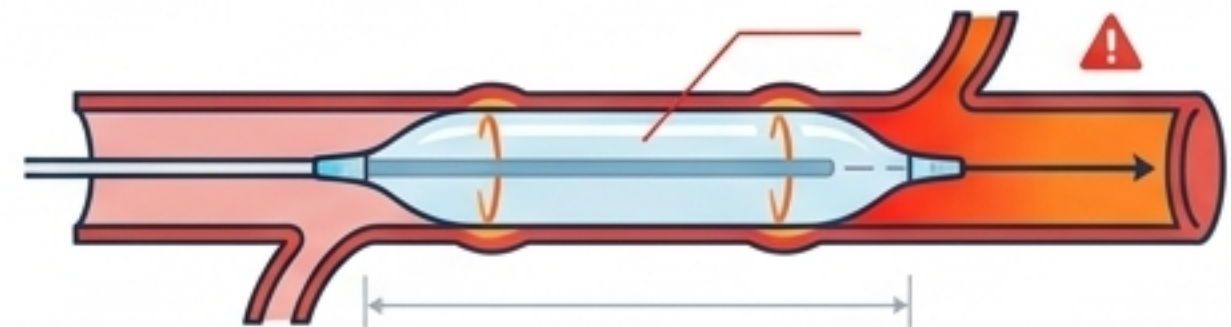
Liquid Embolics & Gelfoam

For complex vascular beds and rapid, flow-directed hemostasis.



Stent-Grafts

For repairing larger vascular injuries, transections, and pseudoaneurysms while preserving distal blood flow.

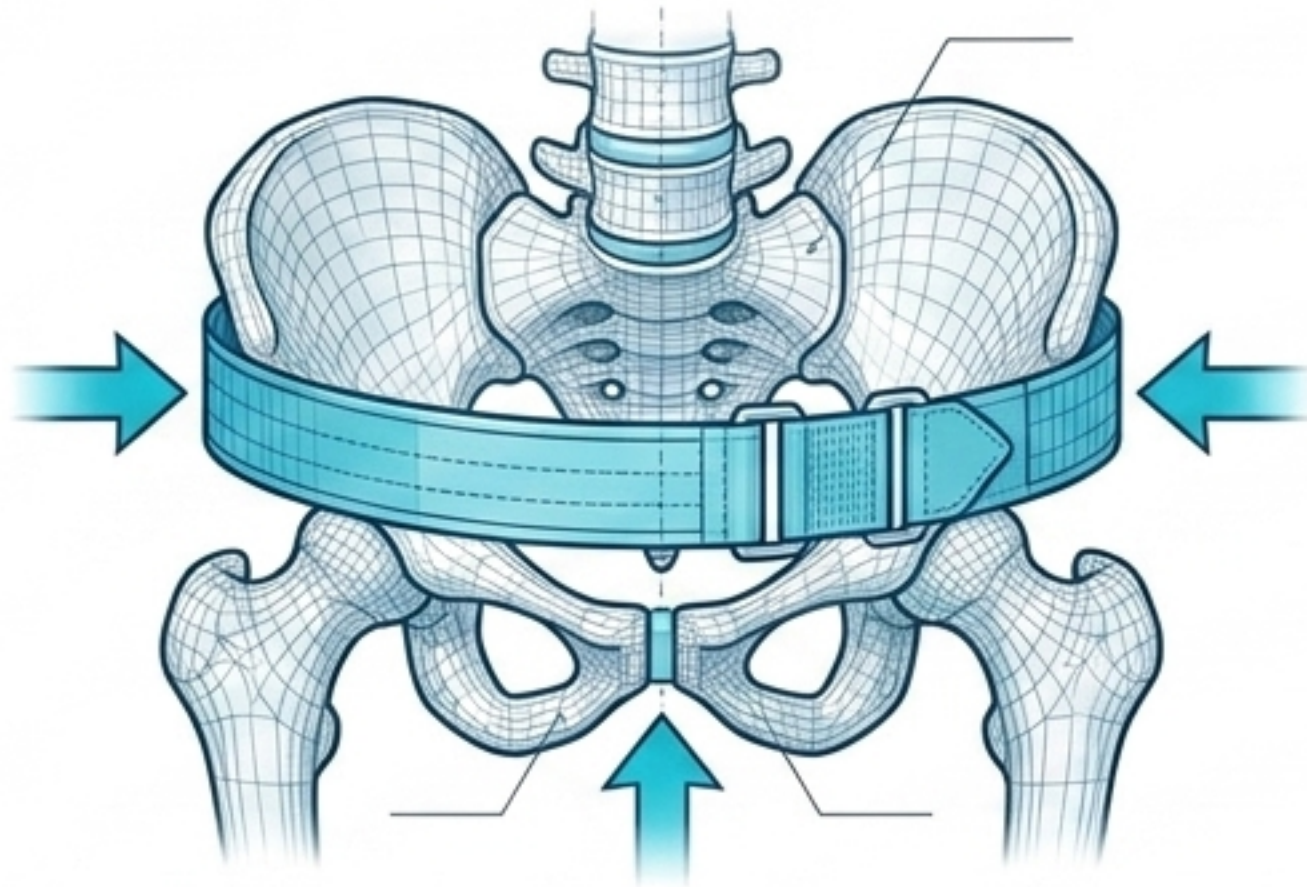


REBOA

Resuscitative balloons for temporary, last-resort aortic occlusion in hemodynamically unstable patients to prevent exsanguination.

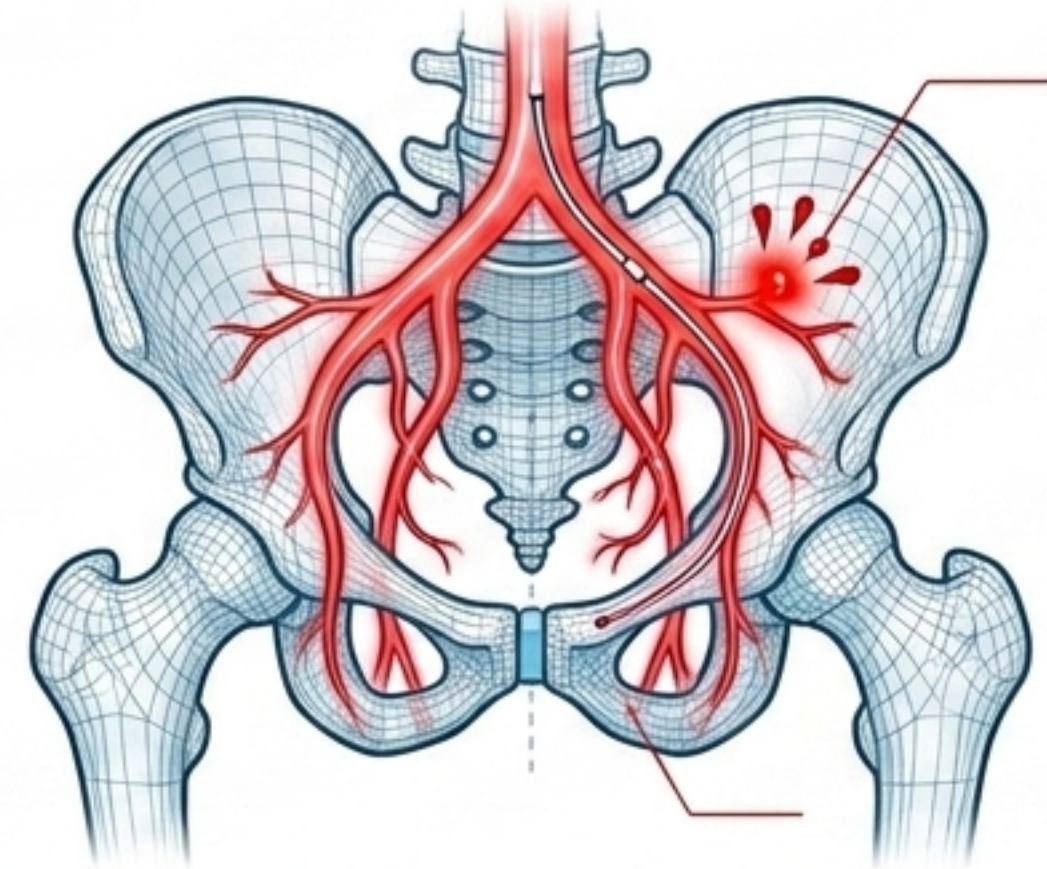
Pelvic hemorrhage: mechanical vs. endovascular control

Orthopedic Stabilization



Compressive pelvic binders effectively reduce pelvic volume, tamponading low-pressure venous or cancellous bone hemorrhage (particularly in anterior-posterior compression injuries).

Angioembolization



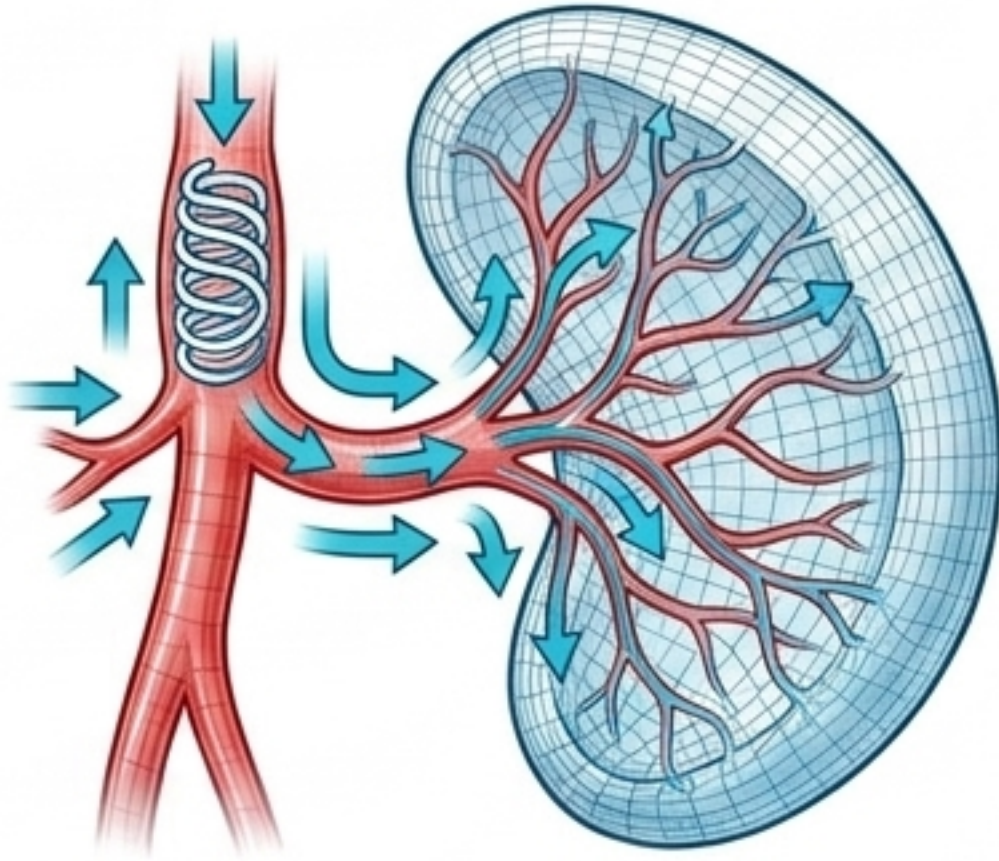
Patients who remain unstable or show arterial extravasation require urgent IR. Embolization of internal iliac branches (e.g., superior gluteal, obturator) achieves >85% success in controlling high-pressure arterial bleeding.

Interventional thresholds for solid organ trauma

	Solid Organ Management Matrix		
	Liver	Spleen	Kidney
Grades I - II (Minor/Moderate)	Non-Operative Management (NOM). Conservative management with clinical and laboratory monitoring.		
Grades III - V (High-Grade or Active Bleeding)	Transarterial embolization (TAE). Surgery reserved for non-salvageable parenchymal destruction.	TAE as first-line therapy to prevent rebleeding.	Selective embolization to stop bleeding while maximizing preservation of renal function.

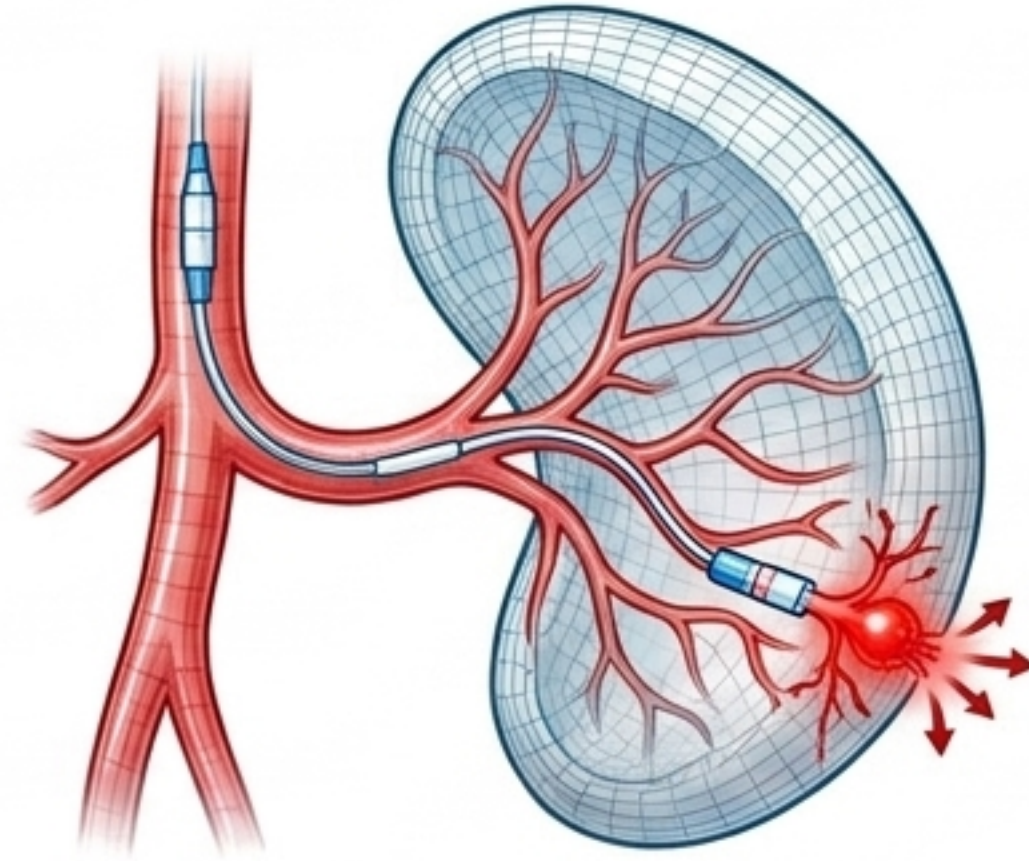
Targeted hemostasis: Splenic embolization strategies

Proximal Embolization



Lowers arterial pressure within the entire organ to promote spontaneous hemostasis while preserving vital collateral blood flow (reduces rebleeding).

Distal/Selective Embolization



Directly occludes the specific bleeding branch when localized active extravasation is identified, sacrificing a small segment to save the whole.

Time-critical vascular repair

Renal Revascularization

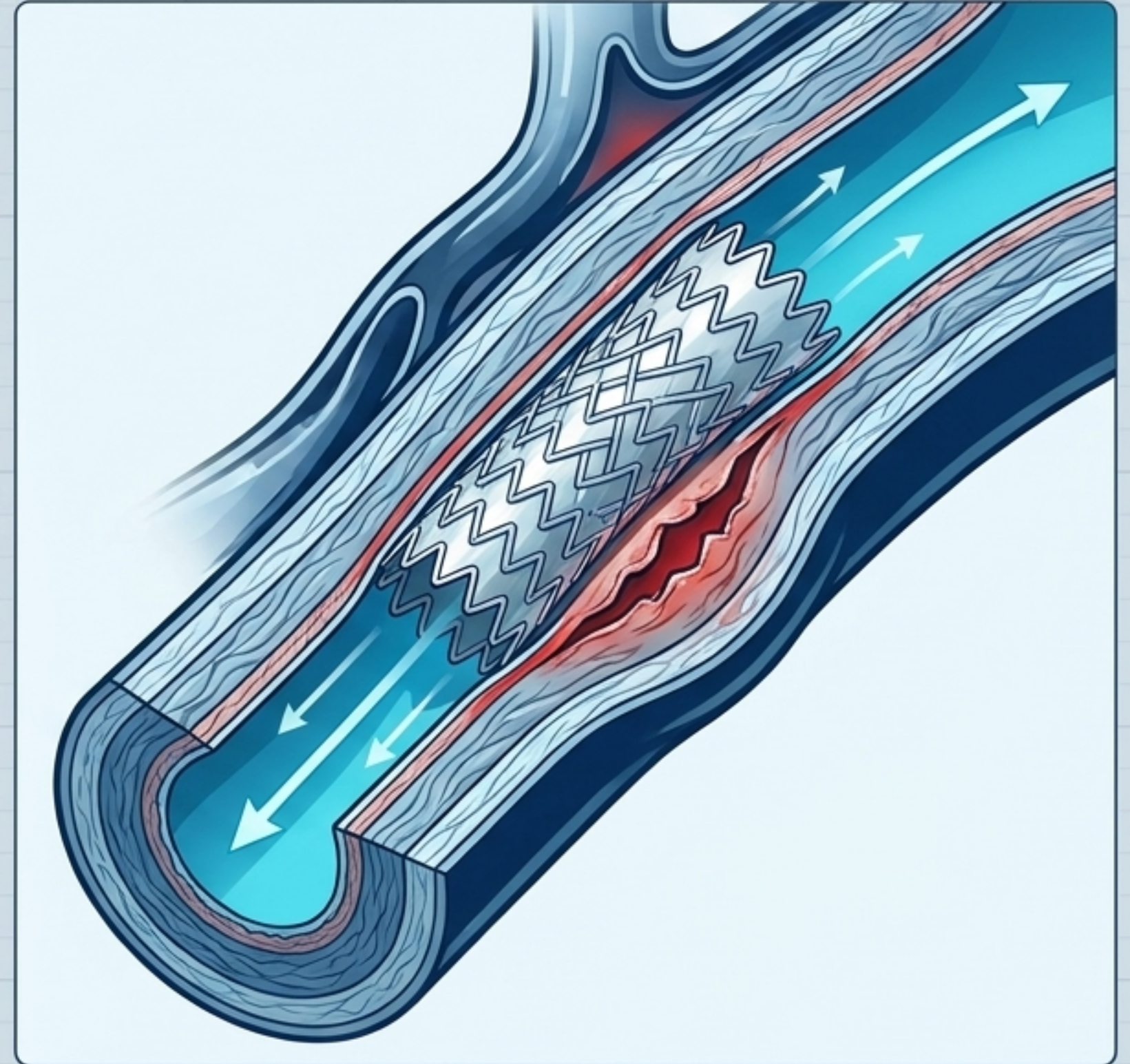


Traumatic renal artery dissection or occlusion requires endovascular stent placement or thrombectomy. The critical window for success is **4–6 hours** post-injury.

Thoracic Aortic Injury

High-energy trauma commonly injures the thoracic aortic isthmus.

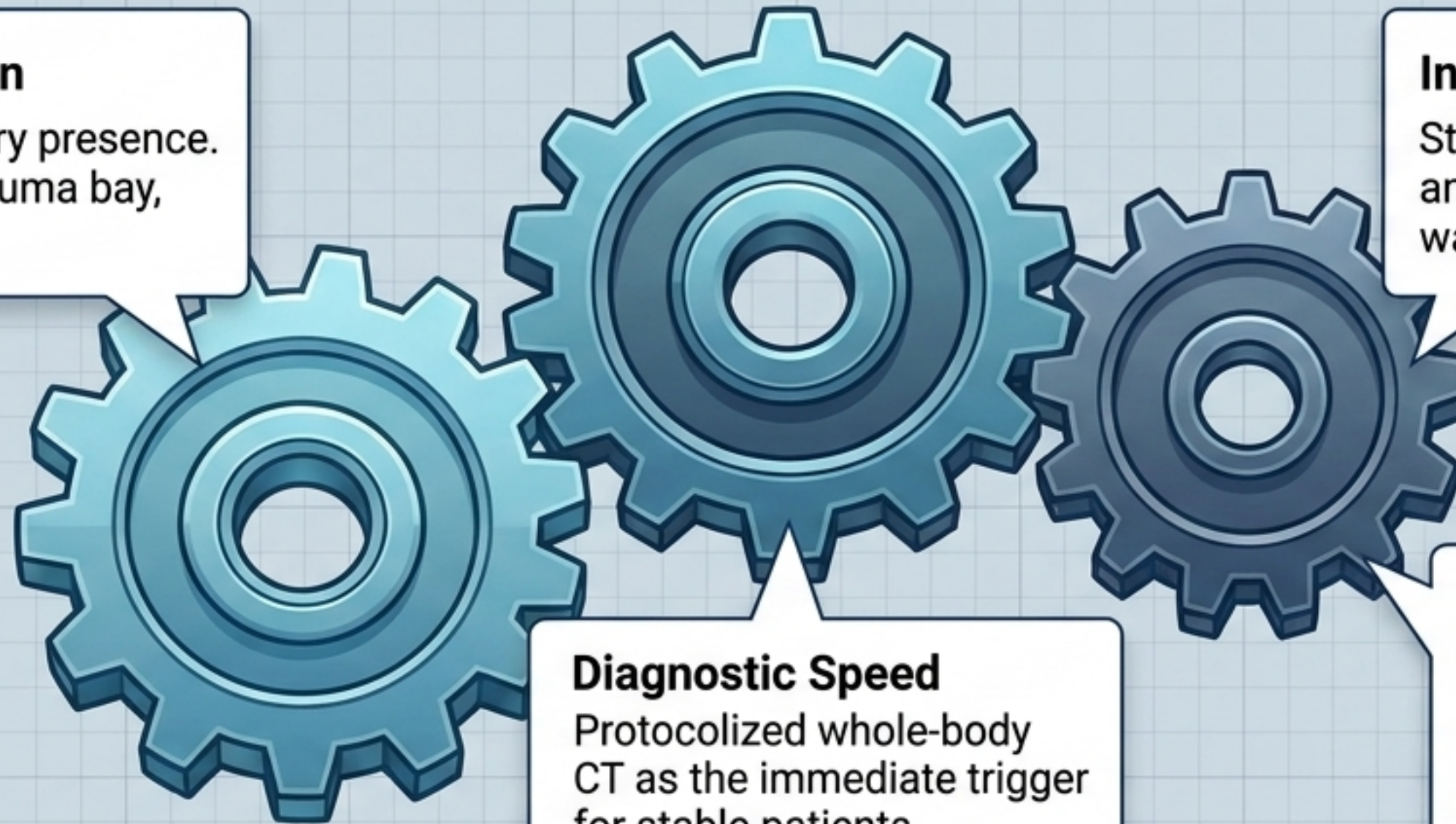
Thoracic Endovascular Aortic Repair (TEVAR) is **urgently** indicated for contained ruptures or rapid pseudoaneurysms, markedly reducing mortality compared to open surgical repair.



IR is a system, not just a procedure

System Integration

24/7 Multidisciplinary presence.
IR must be in the trauma bay,
not just on-call.



Interventional Readiness

Standardized hardware kits
and organ-specific algorithms
waiting in the angiosuite.

Diagnostic Speed

Protocolized whole-body
CT as the immediate trigger
for stable patients.

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Takeaway: Interventional Radiology cannot function as a silo. Its life-saving potential is entirely dependent on upfront integration into the institutional trauma algorithm.