

The Golden Hour of Trauma Care: past, present and future

Gill Cryer MD



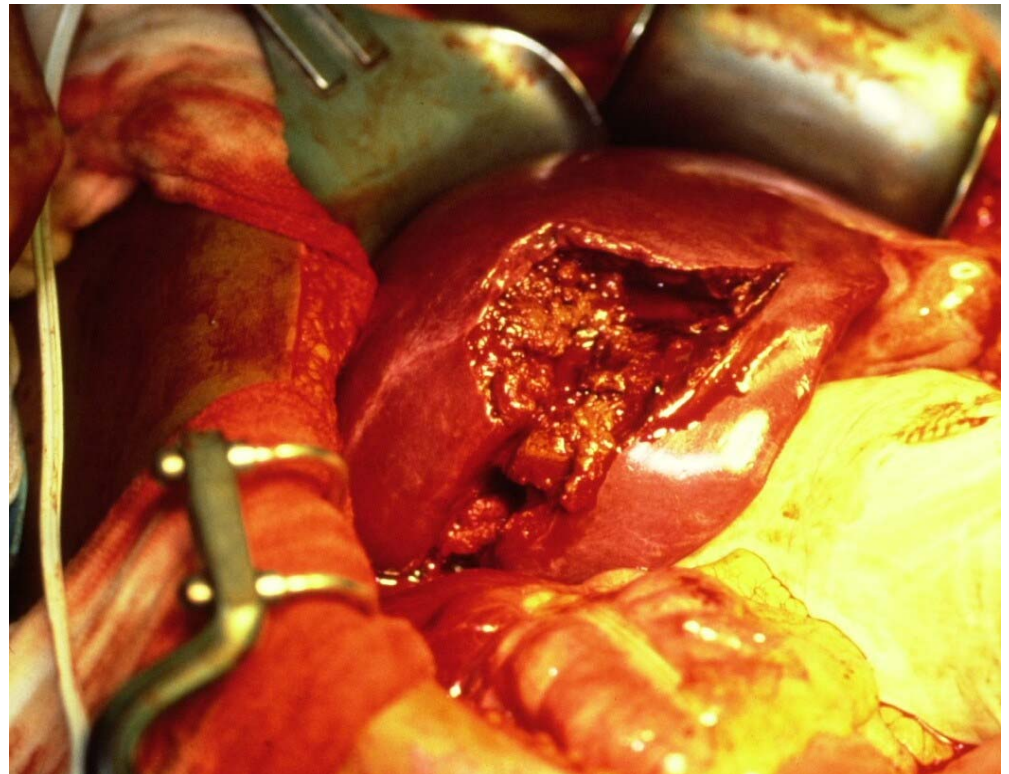
Man kicked by horse

- Complains of severe abdominal pain
- Horse shoe mark RUQ
- Taken to nearest hospital
- Evaluated by:
 - Triage nurse?
 - Family doctor?
 - EM physician?



Man kicked by horse

- Suspect internal bleeding
- General surgeon called
- Surgeon arrives 2 hours later
- Takes patient to operation

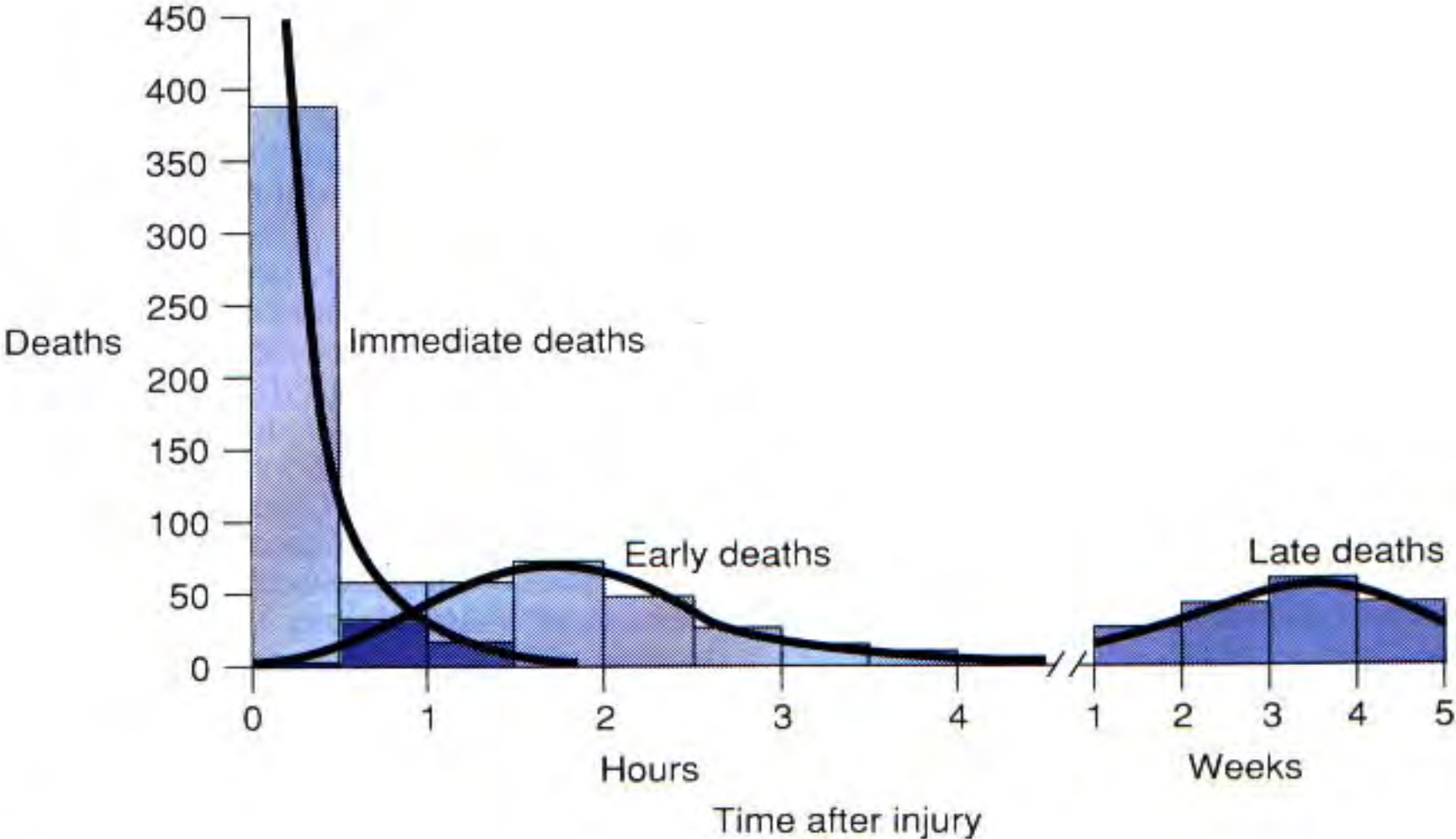


Man kicked by horse

- Lots of bleeding
 - ran out of blood
- Surgeon not used to operating on liver
- No help
- Patient died!



Trimodal distribution of death from Trauma



Immediately life threatening injuries

- Brain injury (50% of mortality)
- Bleeding/shock (35% of mortality)
- May have both
- Both are time sensitive, minutes count!

The Golden Hour

- The goal is to find immediately life threatening injuries and fix them.
- Trauma center high performance team always ready and waiting for the patient when they arrive



Trauma Center Commitment

- ALL departments
 - Trauma Surgeon
 - Other physicians
 - Emergency medicine
 - Critical care
 - Neurosurgery
 - Orthopedics
 - Cardiothoracic
 - Plastics and ENT
 - Anesthesia
 - Radiology
 - Nurses
 - Every other staff member



Trauma Center

- Open 24/7
- All resources available
 - Operating rooms
 - CT scan
 - Physician specialists
- They know you are coming
- The team is waiting for you ready to go!



Standards for Care of the Injured Patient

Optimal hospital resources for care of the seriously injured

The responsibility for providing optimal hospital resources for the care of the seriously injured falls on a number of entities: hospitals, subspecialties, physicians, and others. They must evaluate each specialty's current resources and a long-term plan for the future, with emphasis on the most important areas: emergency resuscitation and resuscitation staff, resuscitation and critical care, and subspecialty services. It is essential that all these areas be available at all times, and that the hospital have the staff, equipment, and facilities for maintaining a high level of care. It is also essential that the hospital have an organized, coordinated, multi-specialty program for emergency resuscitation and critical care. This program should be coordinated with the subspecialties and emergency services, and should be coordinated with the subspecialties and emergency services. It is essential that the hospital have the staff, equipment, and facilities for maintaining a high level of care. It is also essential that the hospital have an organized, coordinated, multi-specialty program for emergency resuscitation and critical care. This program should be coordinated with the subspecialties and emergency services, and should be coordinated with the subspecialties and emergency services.

in brief

Optimal Hospital Resources for the Seriously Injured is a report of a subcommittee of the Committee on Trauma of the American College of Surgeons. The report was prepared and issued in June 1976. It is the first of a series of reports on the design of specific facilities to meet the needs of the seriously injured patient. The design of specific facilities to meet the needs of the seriously injured patient is a complex task, and one that requires the cooperation of all concerned parties. This report is intended to provide a framework for the design of such facilities, and to provide a basis for the development of standards for the care of the seriously injured patient.

Hospital and Prehospital Care of the Injured Patient and Appendices A through J

AMERICAN COLLEGE OF SURGEONS

RESOURCES FOR OPTIMAL CARE OF THE INJURED PATIENT



COMMITTEE ON TRAUMA
AMERICAN COLLEGE OF SURGEONS

RESOURCES FOR OPTIMAL CARE OF THE INJURED PATIENT: 1993




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RESOURCES FOR OPTIMAL CARE OF THE INJURED PATIENT: 1999



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RESOURCES FOR OPTIMAL CARE OF THE INJURED PATIENT 2006



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RESOURCES

FOR OPTIMAL CARE
OF THE INJURED PATIENT

2014



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*Inspiring Quality:
Highest Standards, Better Outcomes*

100+ years

ACS COT prioritization strategy

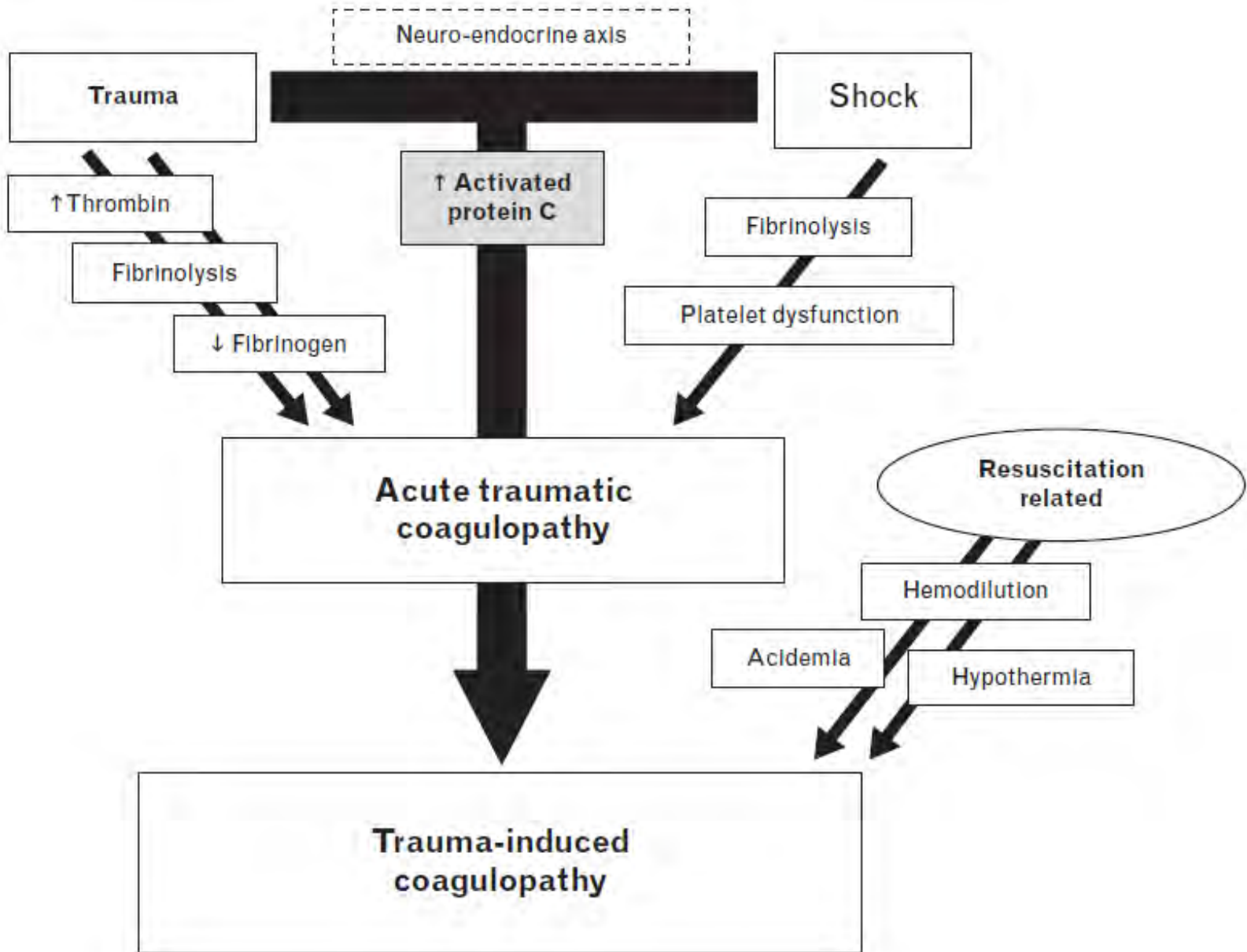
ATLS course

- Airway
- Breathing
- Circulation
 - Free bleeding
 - Contained bleeding
- Disability
 - Space occupying lesion
 - prevent secondary injury

Initial strategy

- Rapid resuscitation
 - Blood not crystalloid
 - Restore perfusion
 - Buy time to use diagnostic tools
- Find the problem
 - Site of hemorrhage
 - Brain injury
- Fix the problem

Trauma induced coagulopathy



Blood clot



Fibrin

Red cells

Platelets

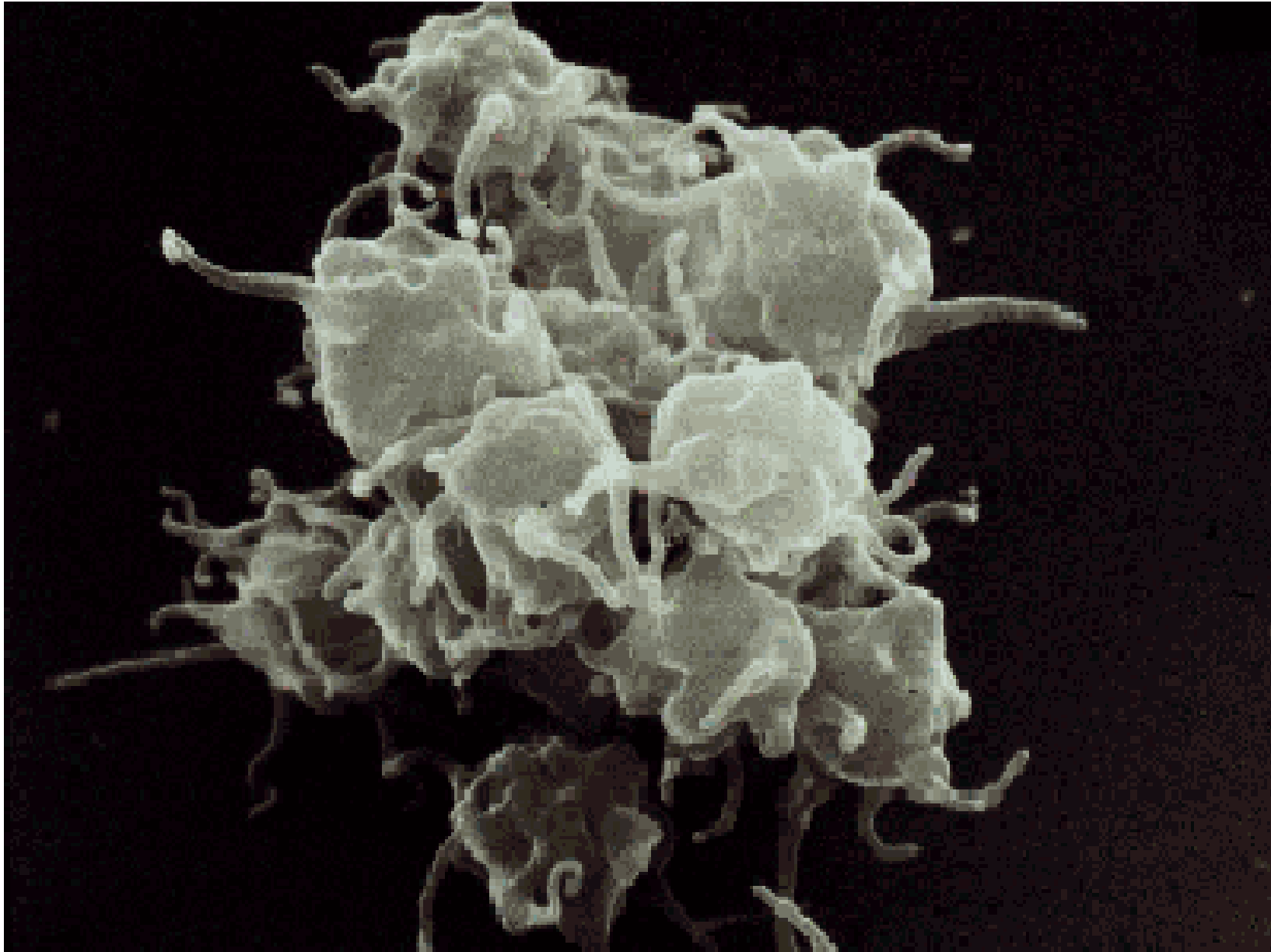
Plasma



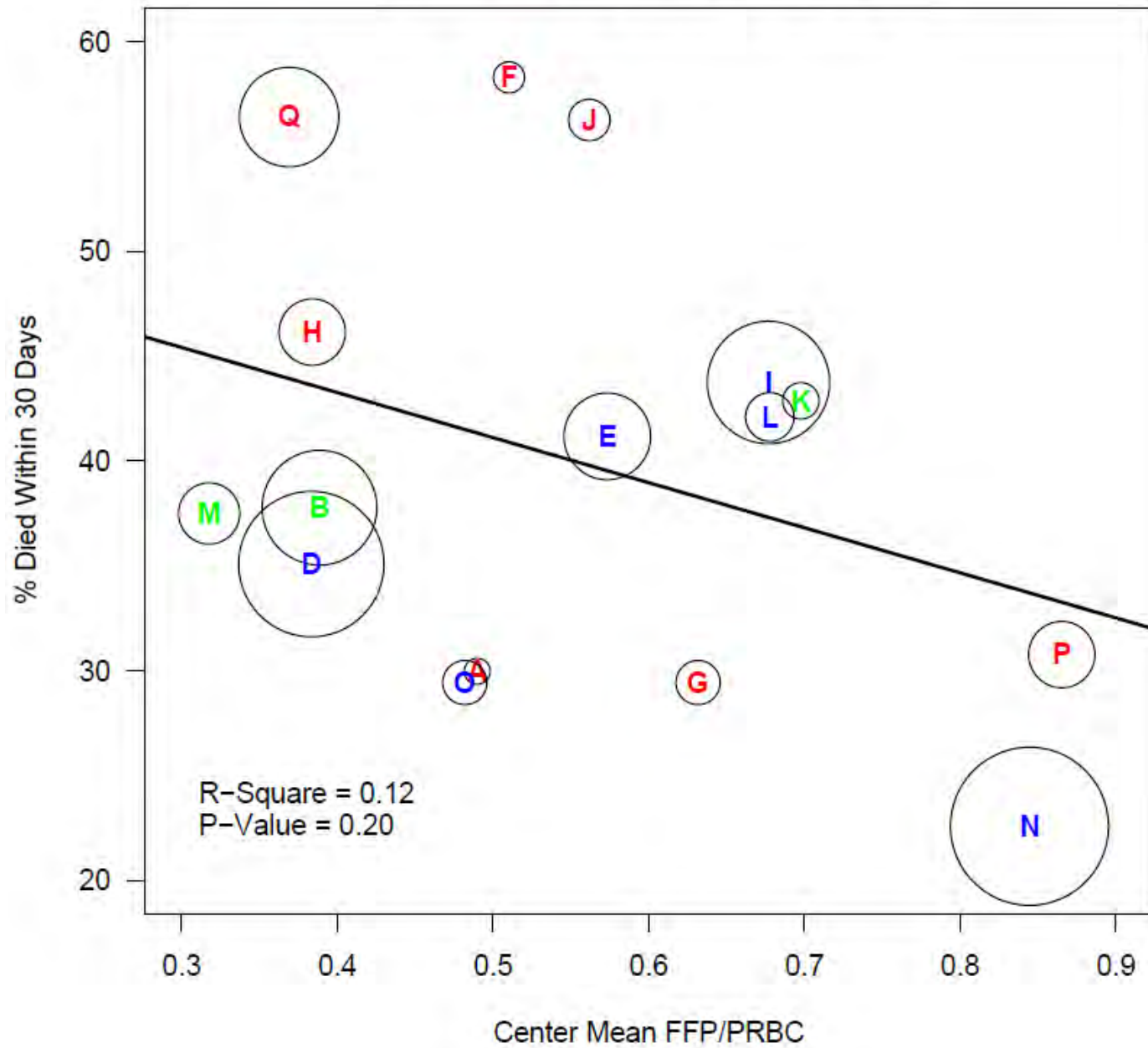
Packed red blood cells



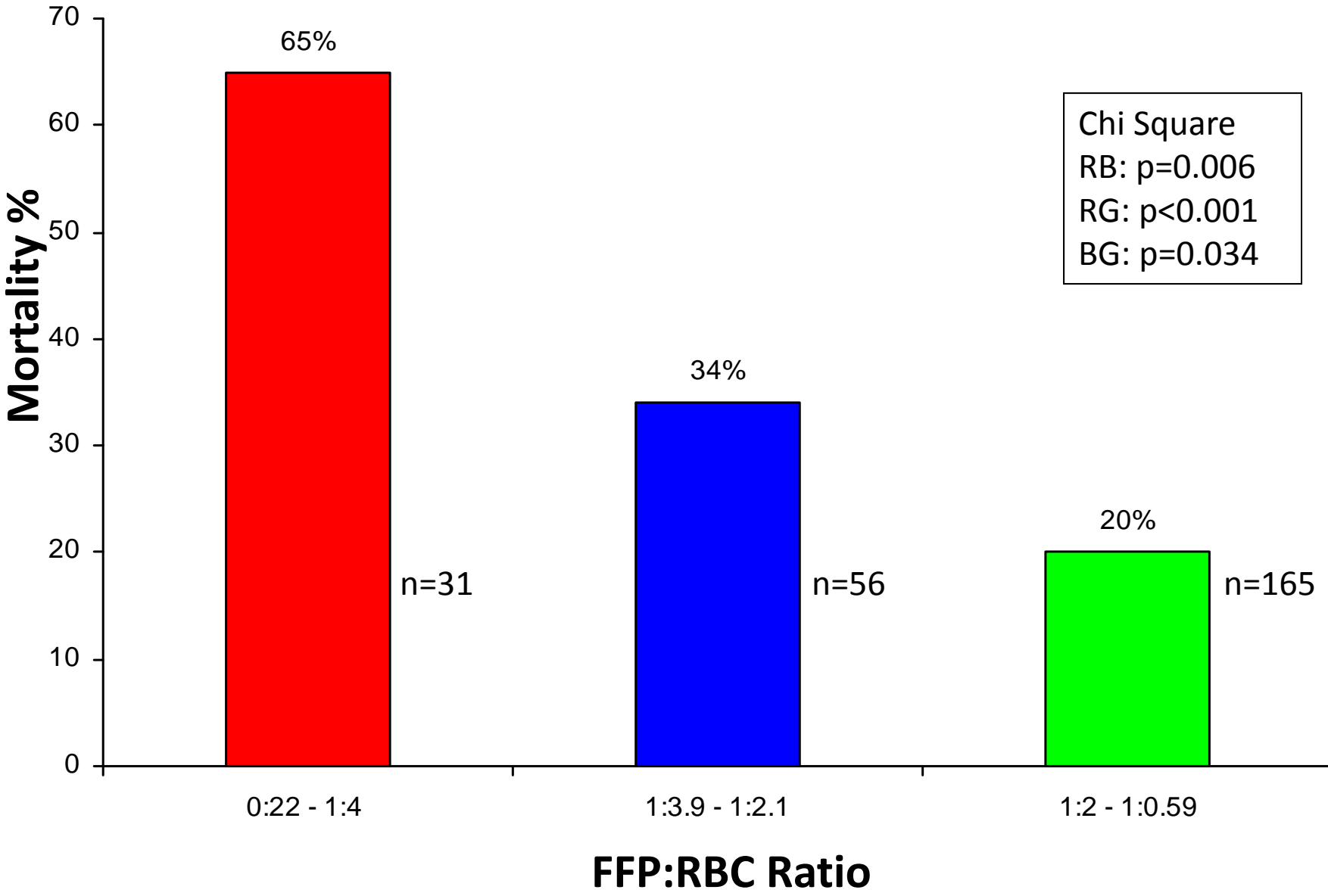
Platelets



Mortality by FFP/PRBC Population BA within 30 days of ED



Effect of FFP:RBC Ratio on Overall Mortality





ACS TQIP MASSIVE TRANSFUSION IN TRAUMA GUIDELINES



100years

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Highest Standards, Better Outcomes



COMMITTEE
ON TRAUMA

- Transfuse universal RBC and plasma in a ratio between 1:1 and 1:2 (plasma to RBC).
- Transfuse one single donor apheresis or random donor platelet pool for each six units of RBC.
- Blood products should be automatically sent by the transfusion service in established ratios.
- Subsequent coolers should be delivered at 15-minute intervals until the MTP has been terminated.
- The goal is to keep at least one MTP cooler ahead for the duration of the MTP activation.

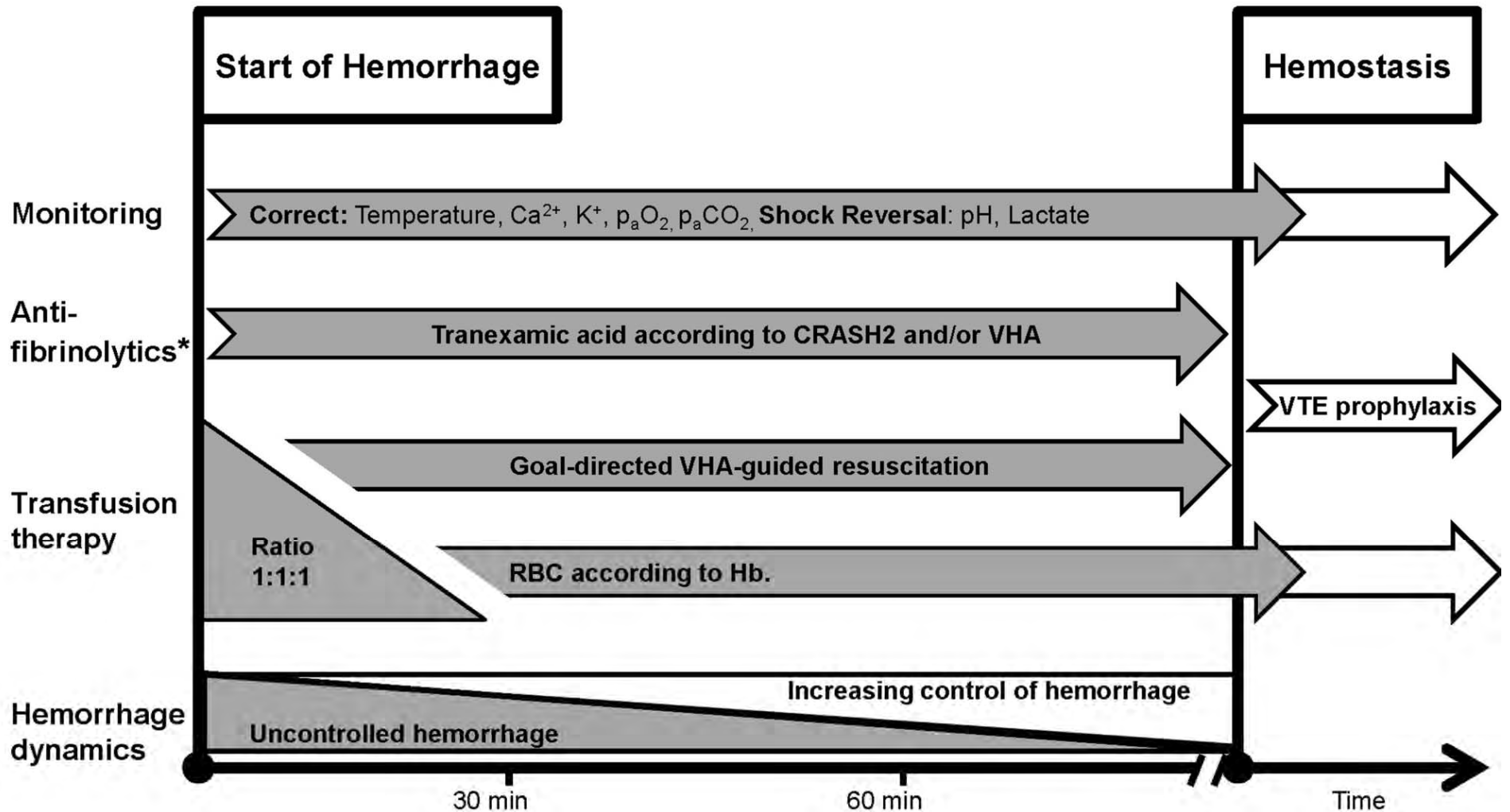
Damage control resuscitation

- Whole blood or 1:1:1 ratio PRBC, FFP and platelets
- Minimize crystalloid
- Arrest bleeding and contamination
- Restore perfusion
- Restore normal physiology
- Delayed or staged definitive repair

Damage control surgery

- Rapid initial control of hemorrhage and contamination and temporary closure
- ICU for physiologic resuscitation
- Reoperation for planned definitive repair once normal physiology has been restored.
- Avoid the lethal triad of hypothermia, acidosis and coagulopathy (bloody vicious cycle)

Golden hour of hemorrhagic shock



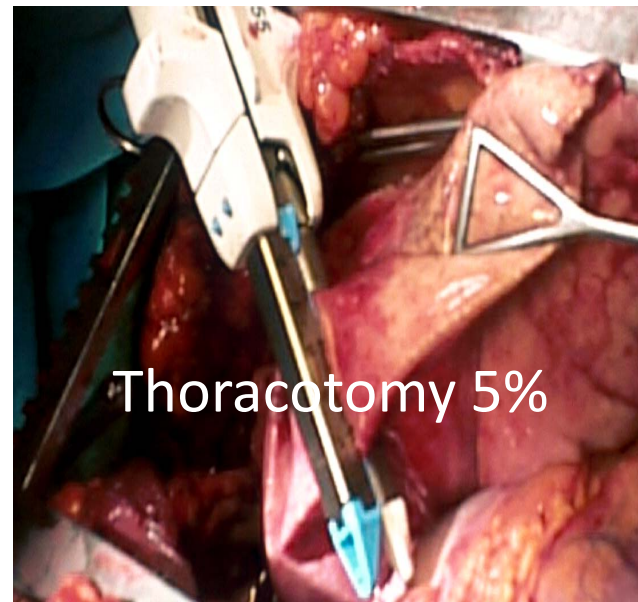
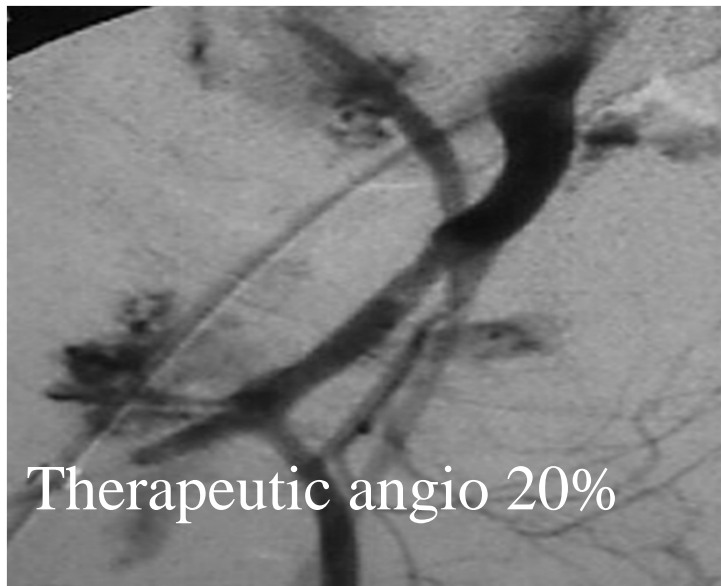
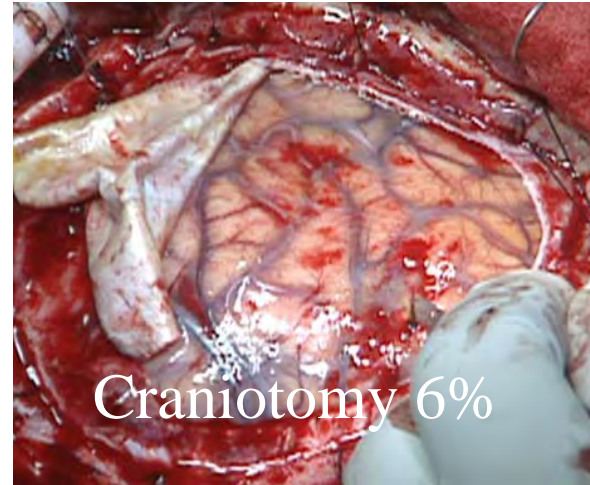
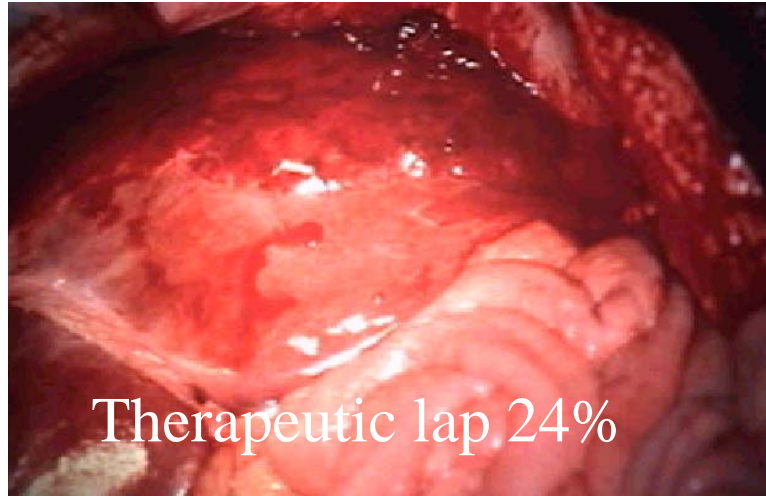
Diagnostic tools: bed side ultrasound



Definitive diagnostic test: CAT SCAN



What operations/procedures are needed?



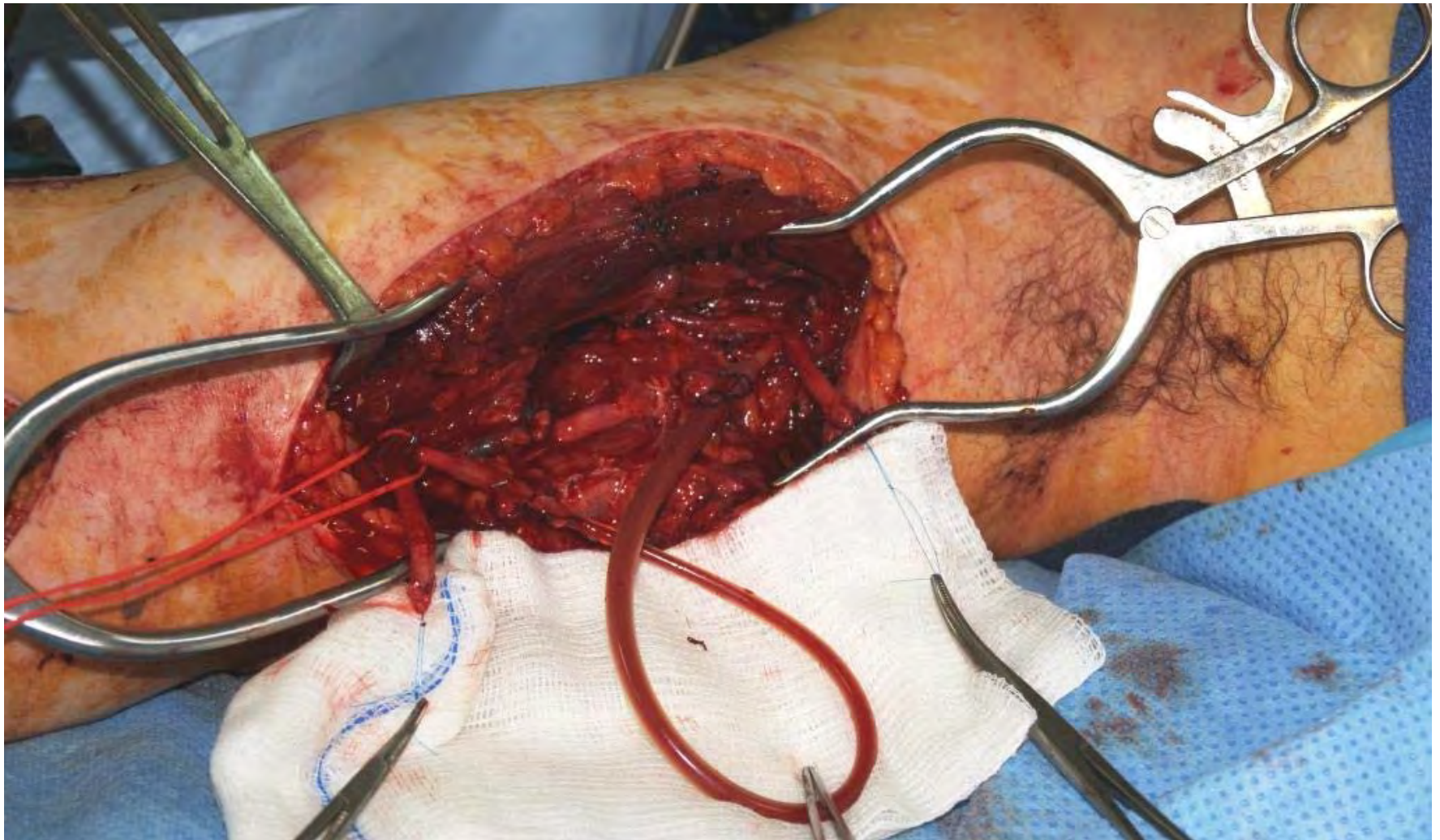
Operating room (60%)



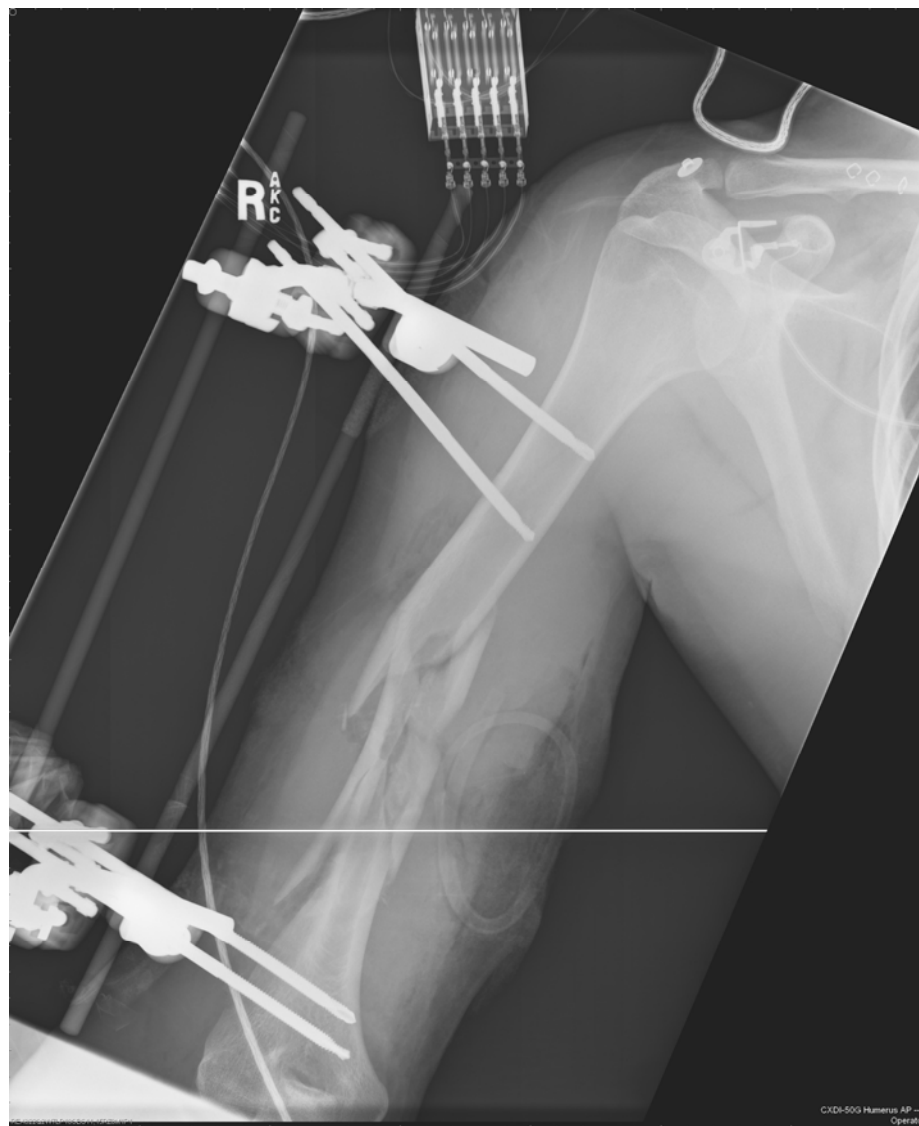
Extremity damage control

- GSW upper arm, no pulse at wrist
- Expedited exploration
 - Humerus fx, transected brachial artery and nerve
 - Hemostasis, Javid shunt, external fixator, forearm fasciotomy
 - Pulse restored
 - Stabilize for later definitive care

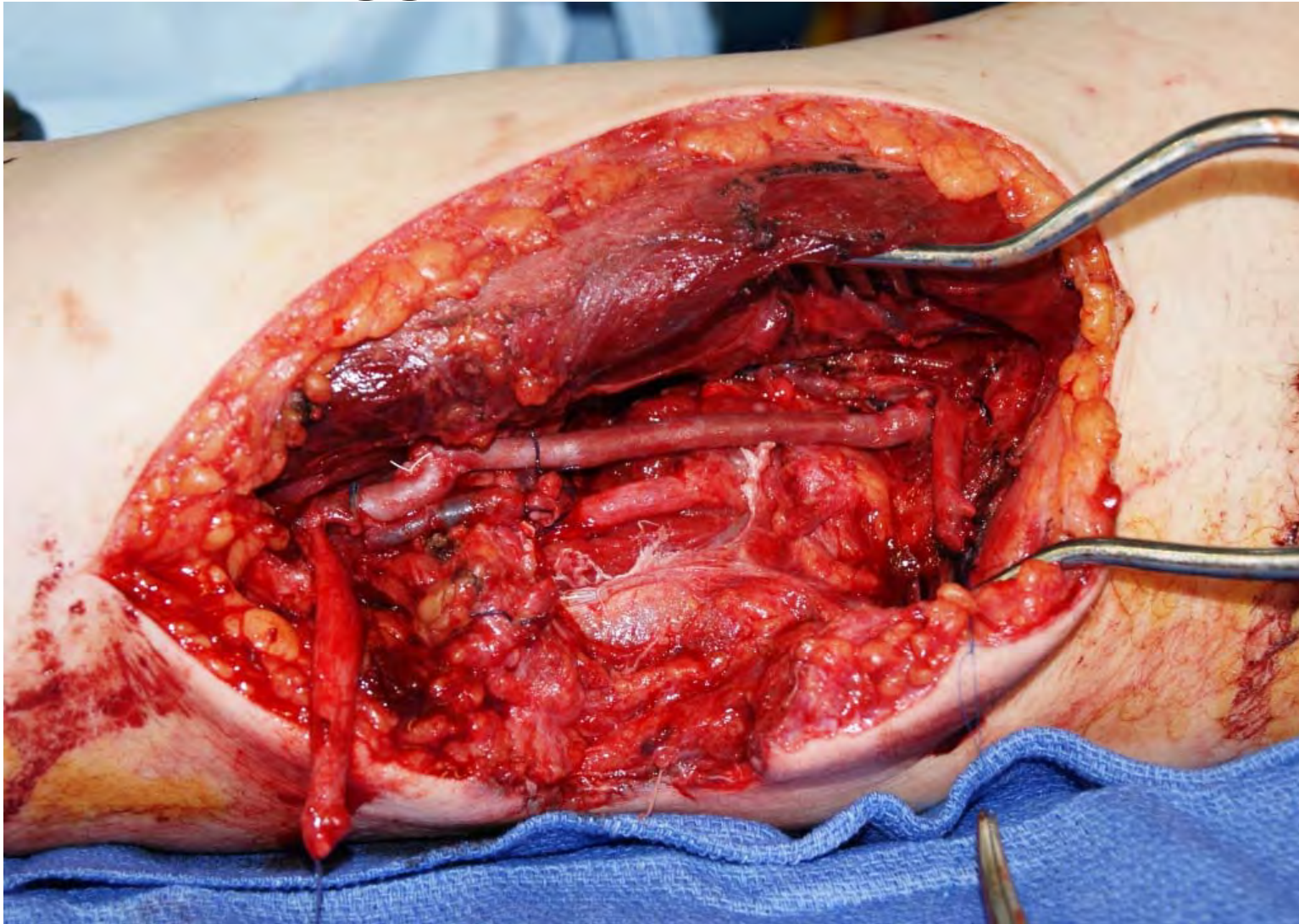
Damage control: 1st operation hemostasis, shunt, fasciotomy and external fixator



Damage control: first stage completed



2nd operation: definitive repair artery, tagged median nerve



Adjusted fixator and VAC

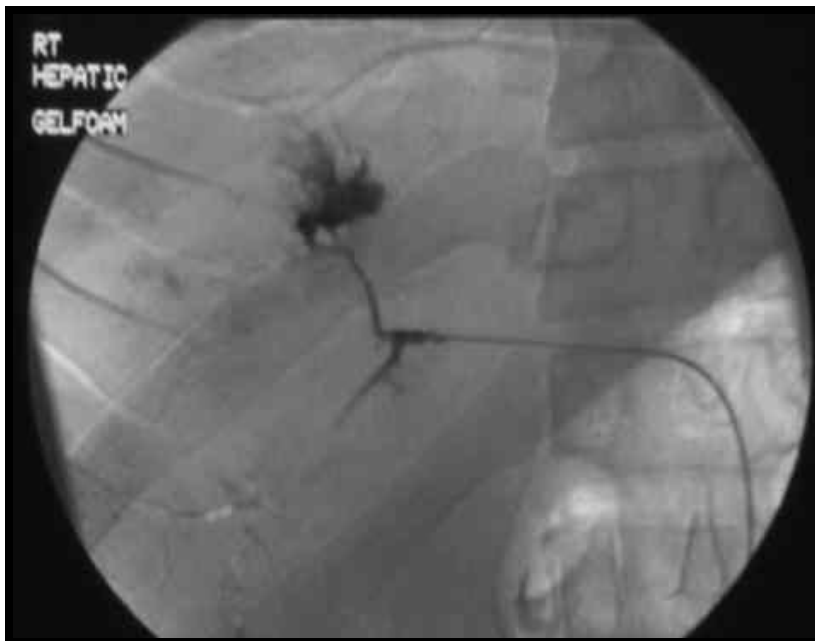


Interventional Radiology (20%)

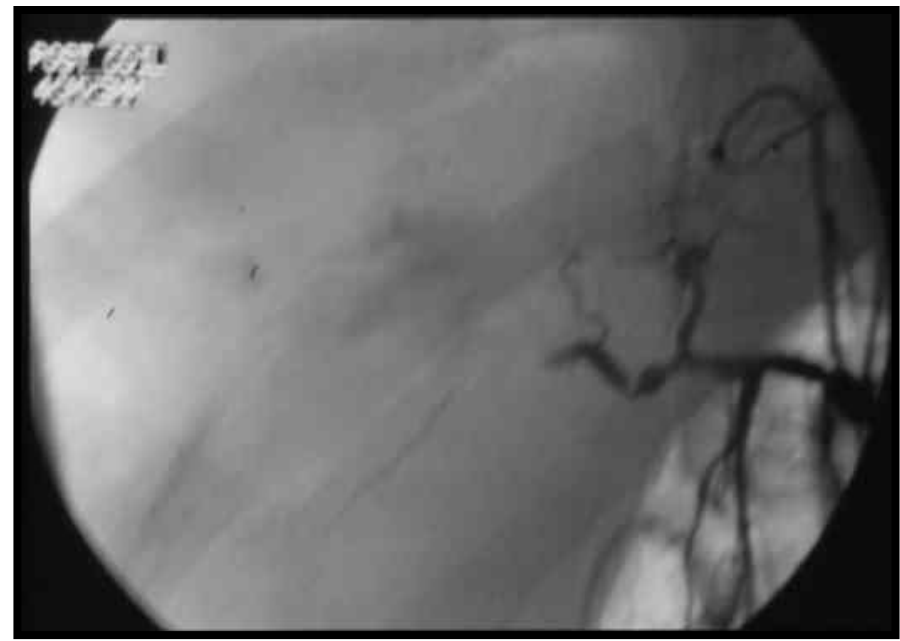


Selective Angiography and Transcatheter Embolization

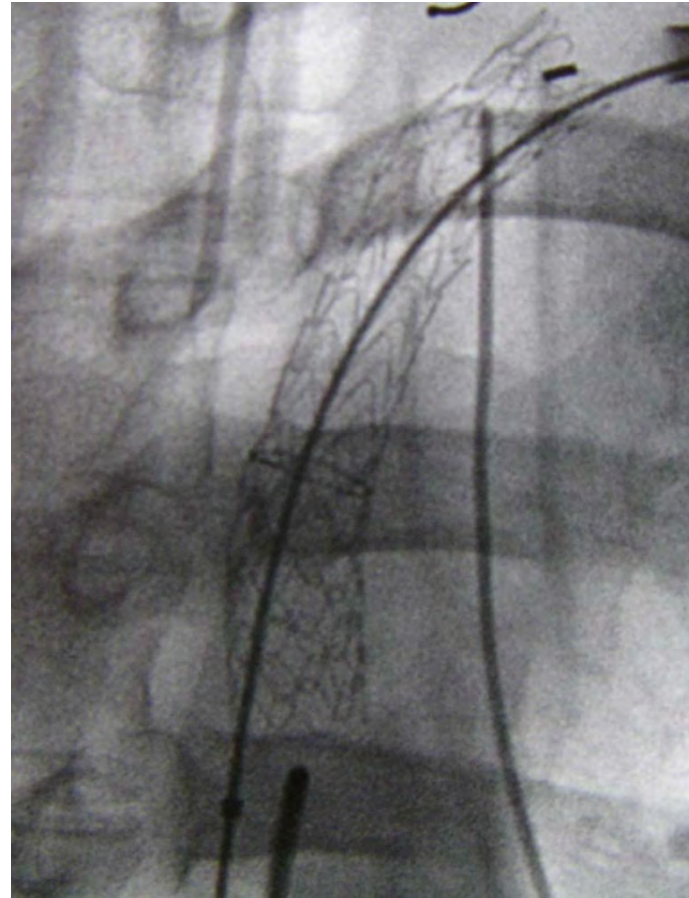
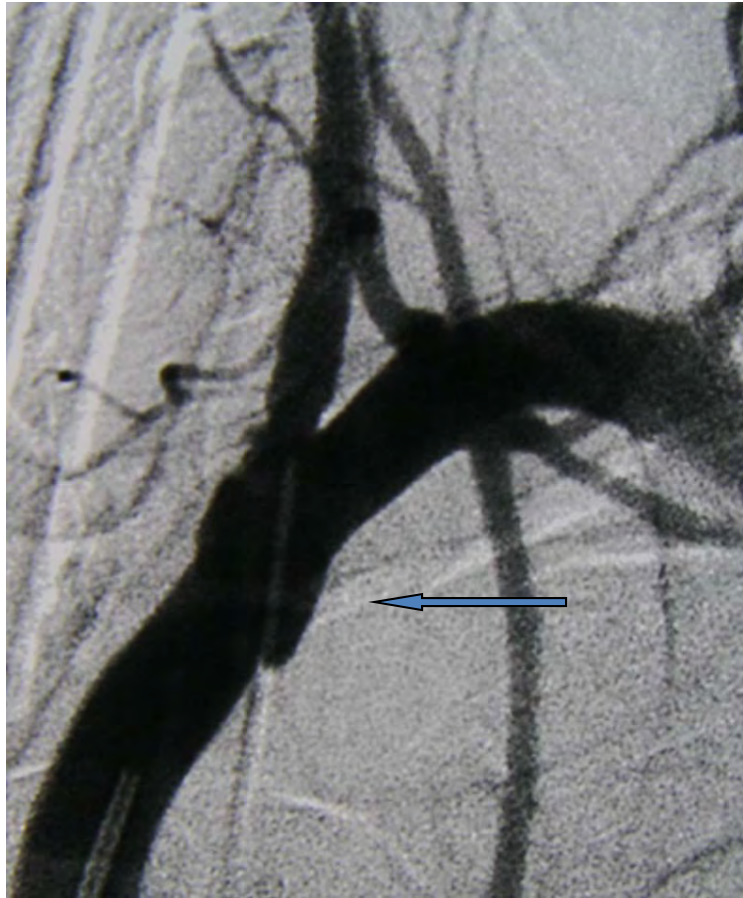
Pre-embolization



Post-embolization

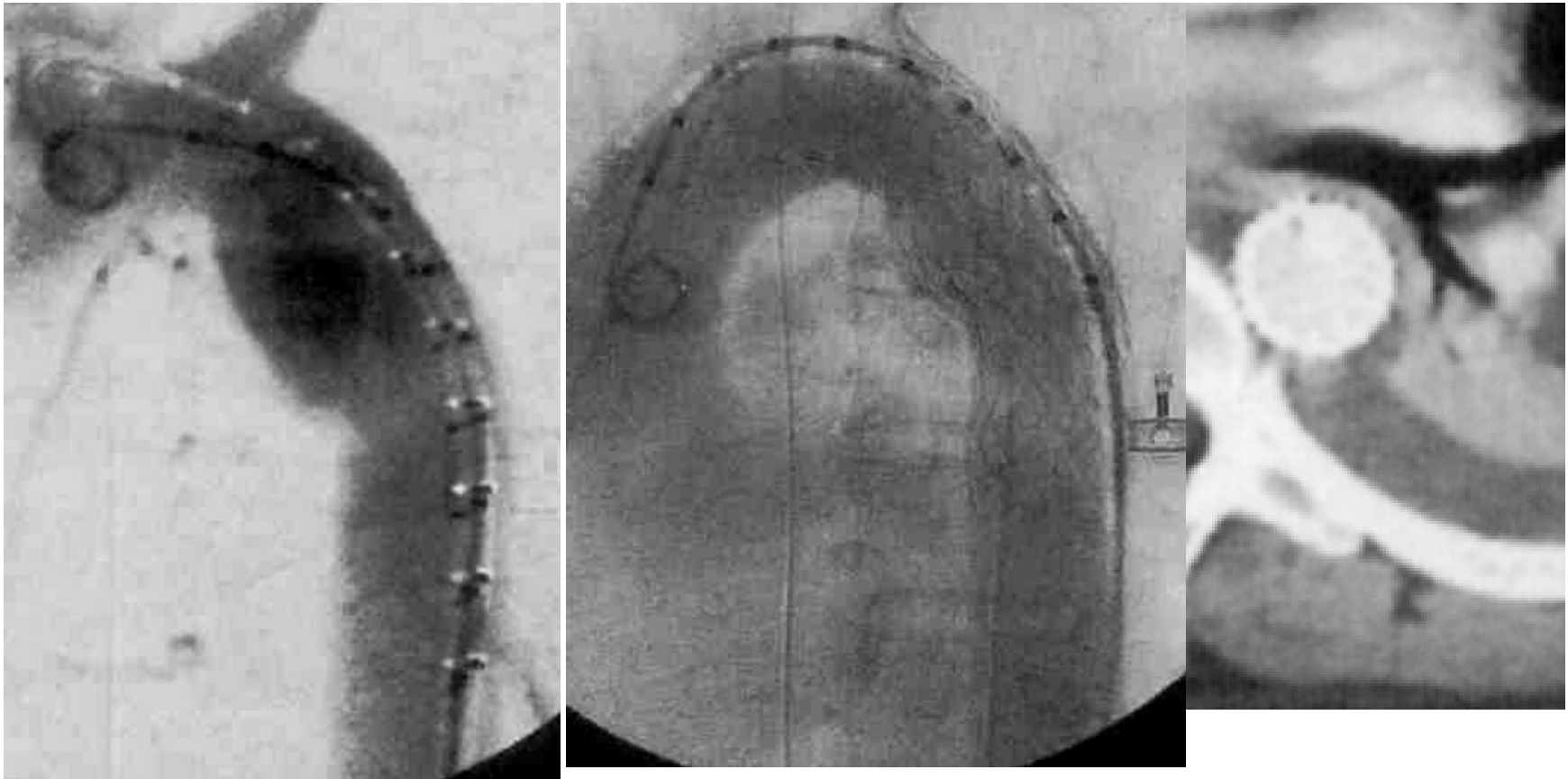


Endovascular stent of subclavian artery injury



Stenting the transected aorta

Zager et al. J Trauma, 2003



Surgical ICU (25%)



Impact of delayed transfer of critically ill patients from the emergency department to the intensive care unit*

Donald B. Chalfin, MD, MS, FCCM; Stephen Trzeciak, MD, MPH; Antonios Likourezos, MA, MPH; Brigitte M. Baumann, MD, MSCE; R. Phillip Dellinger, MD, FCCM; for the DELAY-ED study group



ED



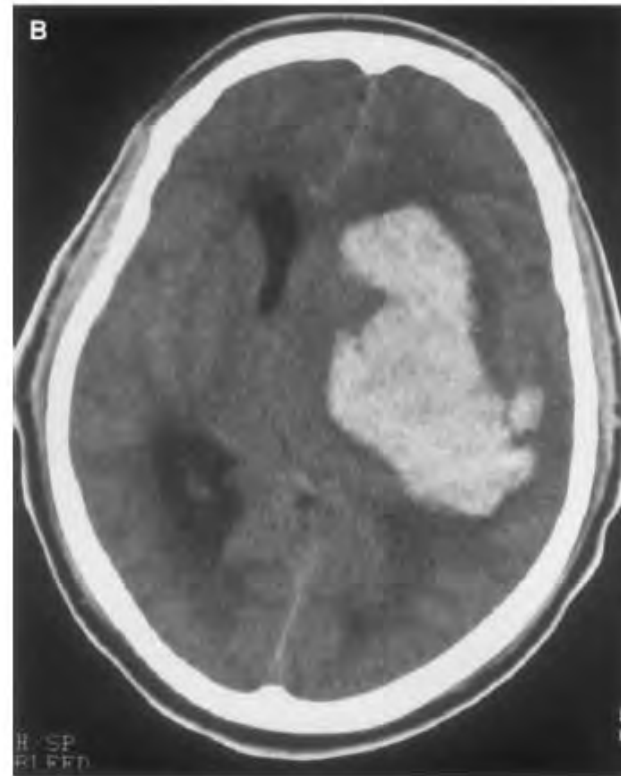
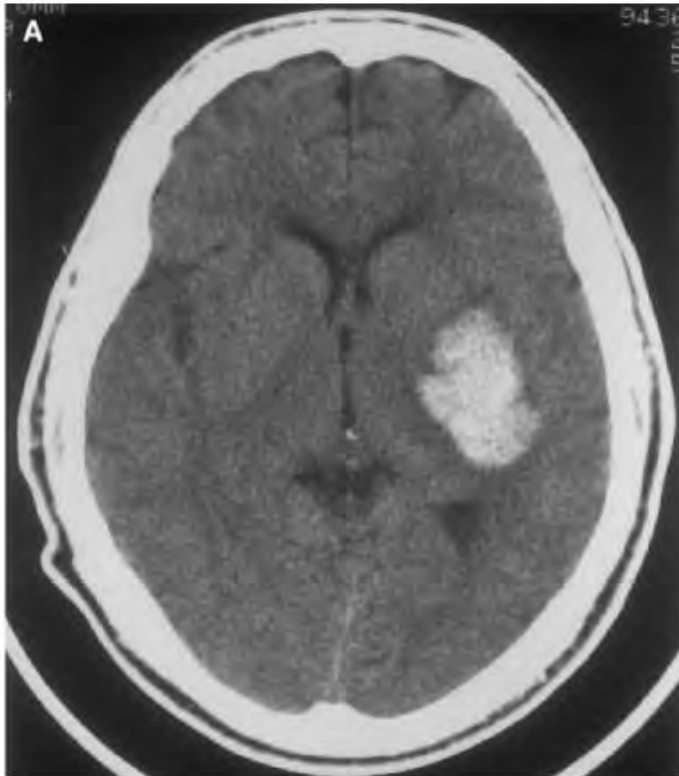
ICU

National estimates of severe sepsis in United States emergency departments

Henry E. Wang, MD, MS; Nathan I. Shapiro, MD, MPH; Derek C. Angus, MD, MPH; Donald M. Yealy, MD

- **67 minute delay to ICU**
- **3 x ↑ mortality**

Pathophysiology: Early Hematoma expansion



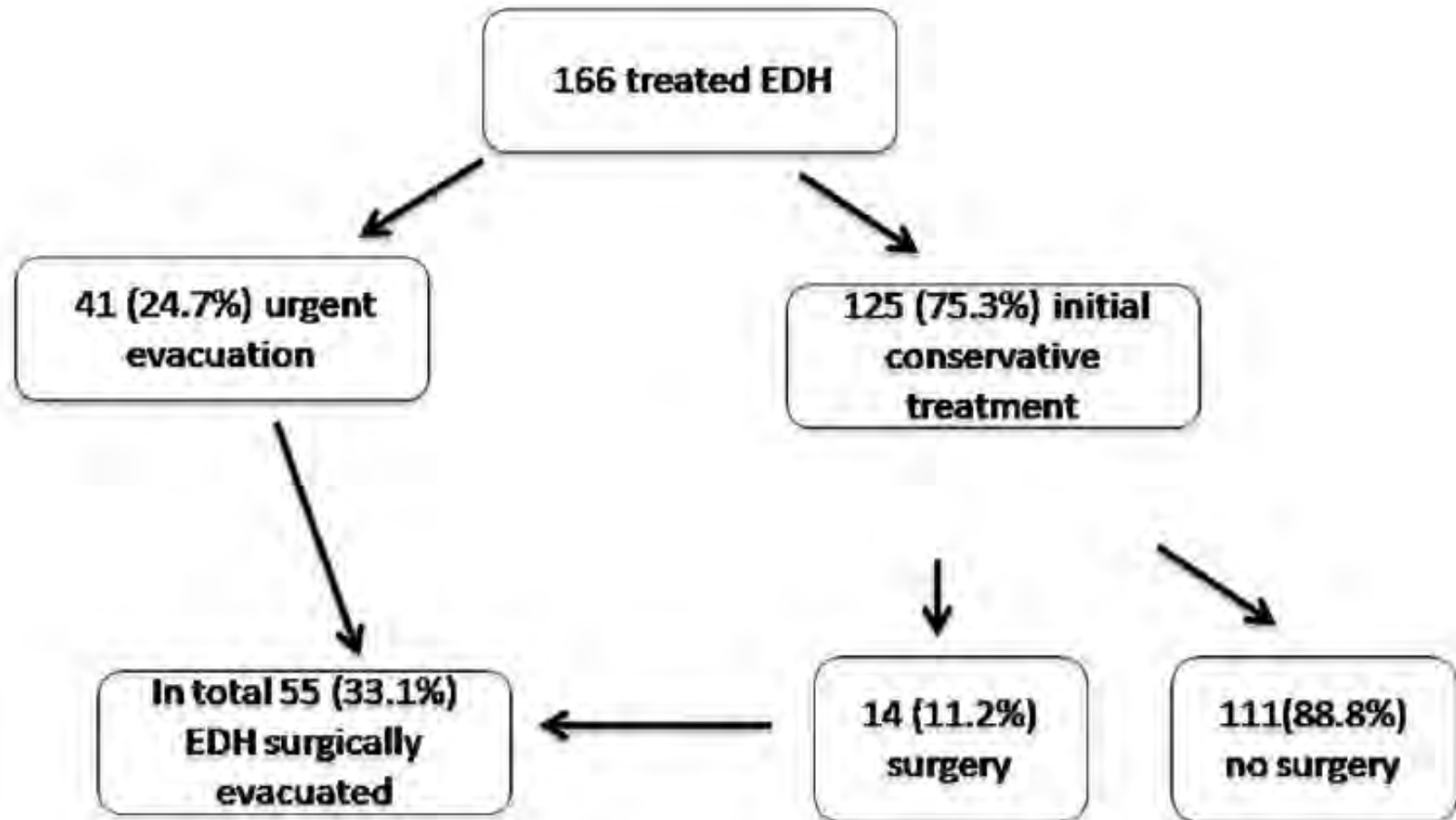
Epidural Hematoma



Epidural Hematoma Treated Conservatively: When to Expect the Worst

Can J Neurol Sci. 2016; 43: 74-81

Mohammed Basamh, Antony Robert, Julie Lamoureux, Rajeet Singh Saluja,





ACS TQIP

BEST PRACTICES IN
THE MANAGEMENT
OF TRAUMATIC
BRAIN INJURY

- TBI patients presenting to the ED in coma should be taken to surgery immediately upon arrival if a large hematoma is identified as the cause of the coma

- A large traumatic hematoma should be evacuated before neurological deterioration develops, irrespective of the GCS

- Close monitoring is required during general anesthesia to avoid high ICP, hypotension, hypoxia, and hypo- or hypercarbia

- ICP monitoring is indicated in comatose patients (GCS ≤ 8) and if there is evidence of structural brain damage on initial CT imaging

- ICP monitoring should be considered in patients with a GCS > 8 who have structural brain damage with high risk for progression (large/multiple contusions, coagulopathy)

- ICP monitoring should be considered in patients who require urgent surgery for extracranial injuries, who need mechanical ventilation because of extracranial injuries, or who evidence progression of pathology on CT imaging or clinical deterioration

- If patients with TBI require orthopedic operations, these should ideally be delayed 24 to 48 hours for initial stabilization of intracranial hypertension

Case presentation

- 25 yo woman is severely injured in a motor vehicle crash





AMBULANCE
ENTRANCE



Case presentation

- In ED BP 90/40, pulse 130, pale
- Right femur deformity
- Pelvic tenderness

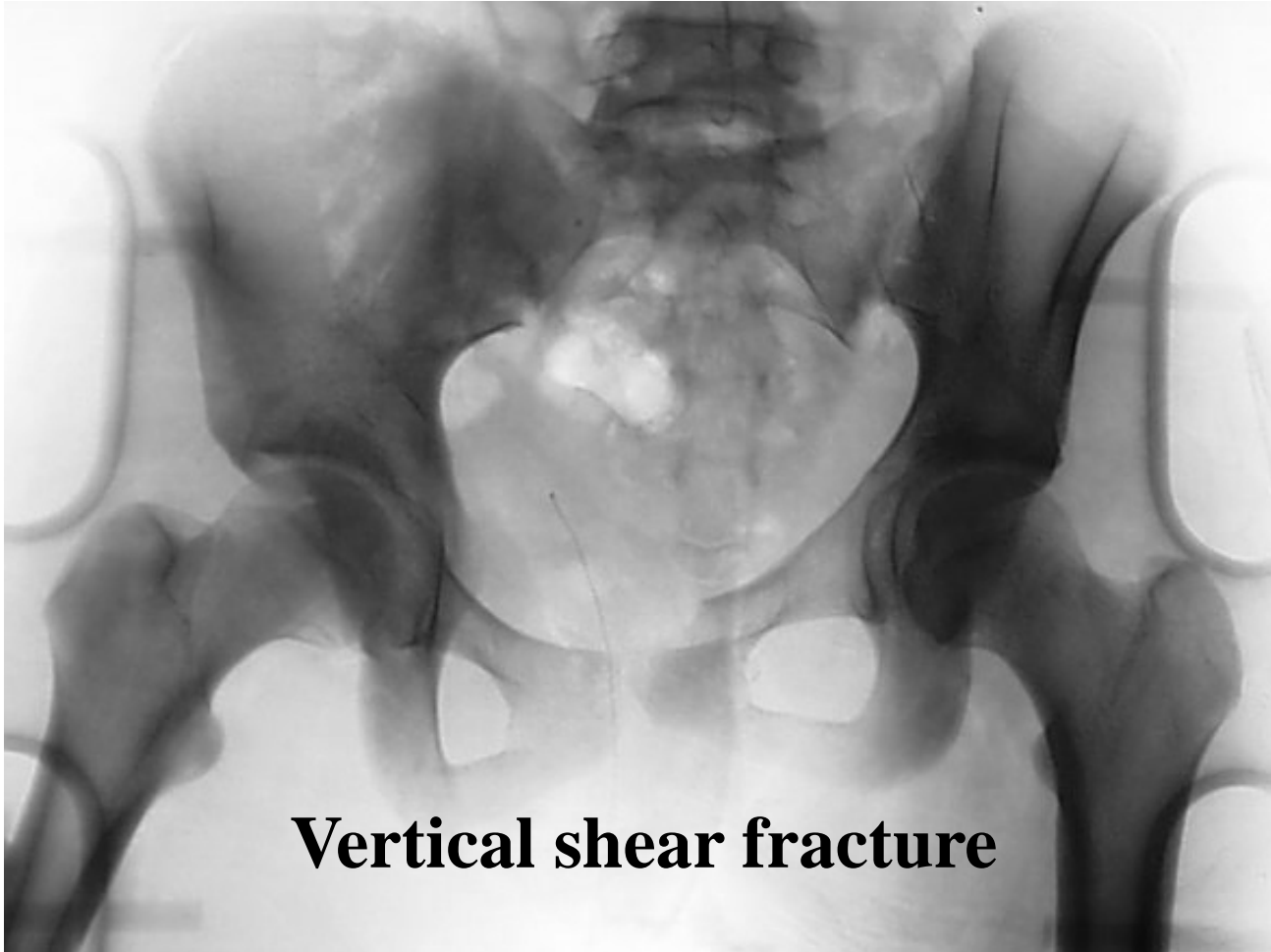


Case presentation

- Blood pressure improves with resuscitation with PRBC, Plasma and Platelets



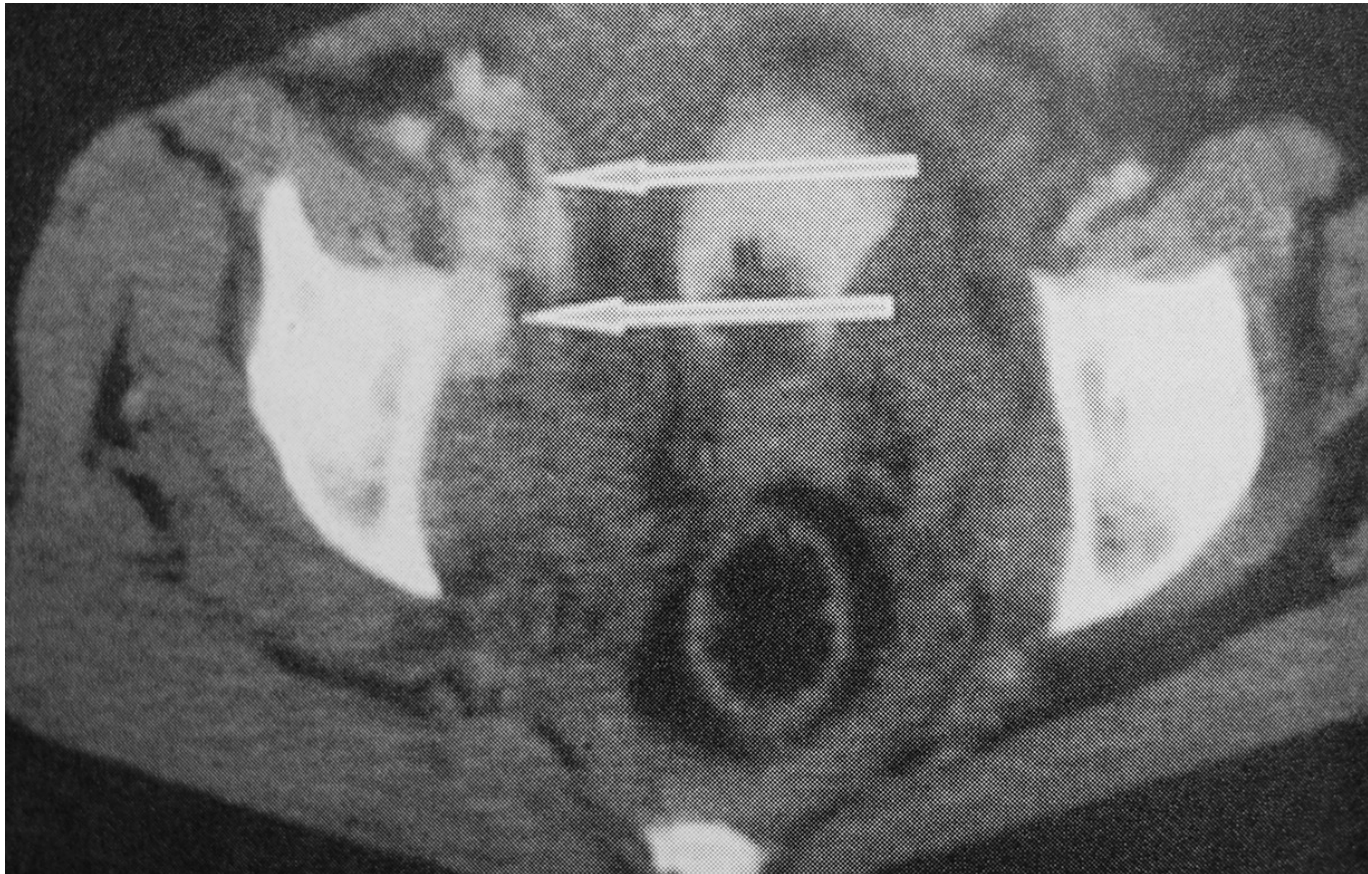
Pelvic fracture on X-ray



Vertical shear fracture

Angio is called immediately on seeing this X-ray

Ct-scan shows pelvic arterial bleeding



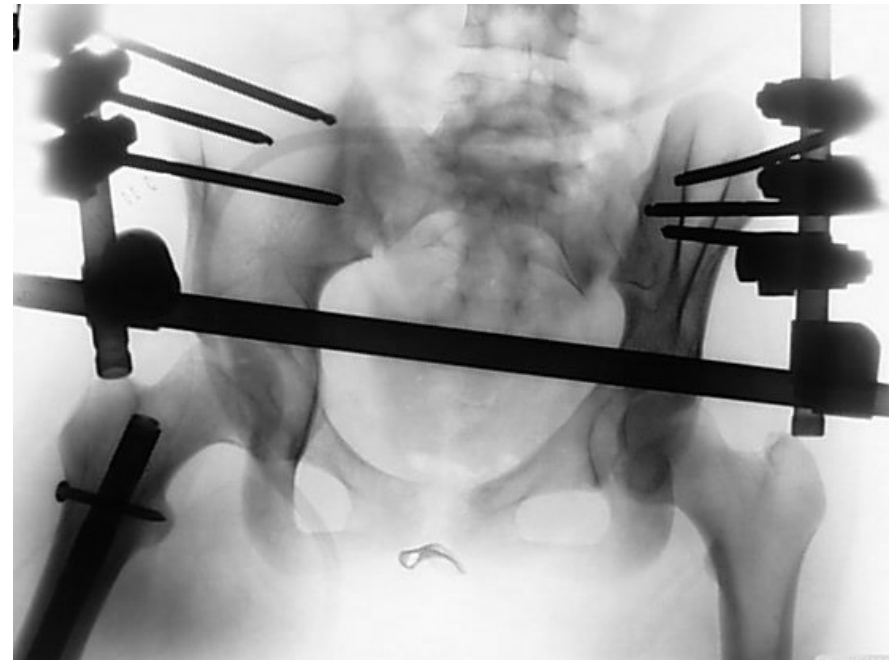
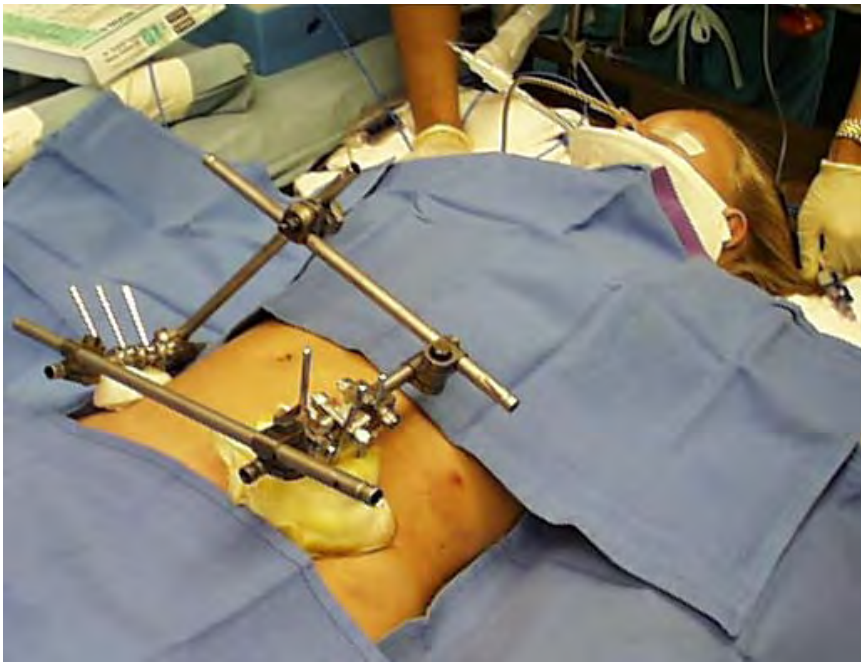
Angiographer there to see scan and team is setting up

In angio within 30 minutes

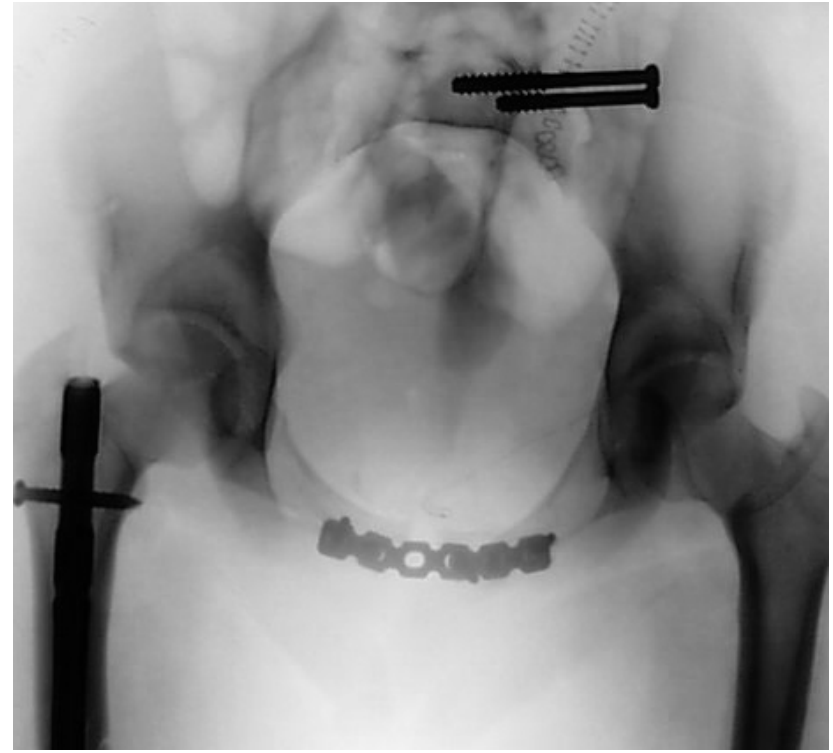


Blood pressure stabilized immediately after embolization
CT-scan negative for any other injuries

Patient stable for damage control operation on femur fracture and pelvic fracture



3 days later definitive open reduction and internal fixation



Back to work 6 weeks later and normal function at 6 months

Angiography Disadvantages

- 32 unstable patients with negative FAST went from ED to Angio
- 47% had therapeutic angio
- 41% required therapeutic laparotomy
- Some patients were in the wrong place
- Time consuming



What if the problem is in the belly, chest, or head?

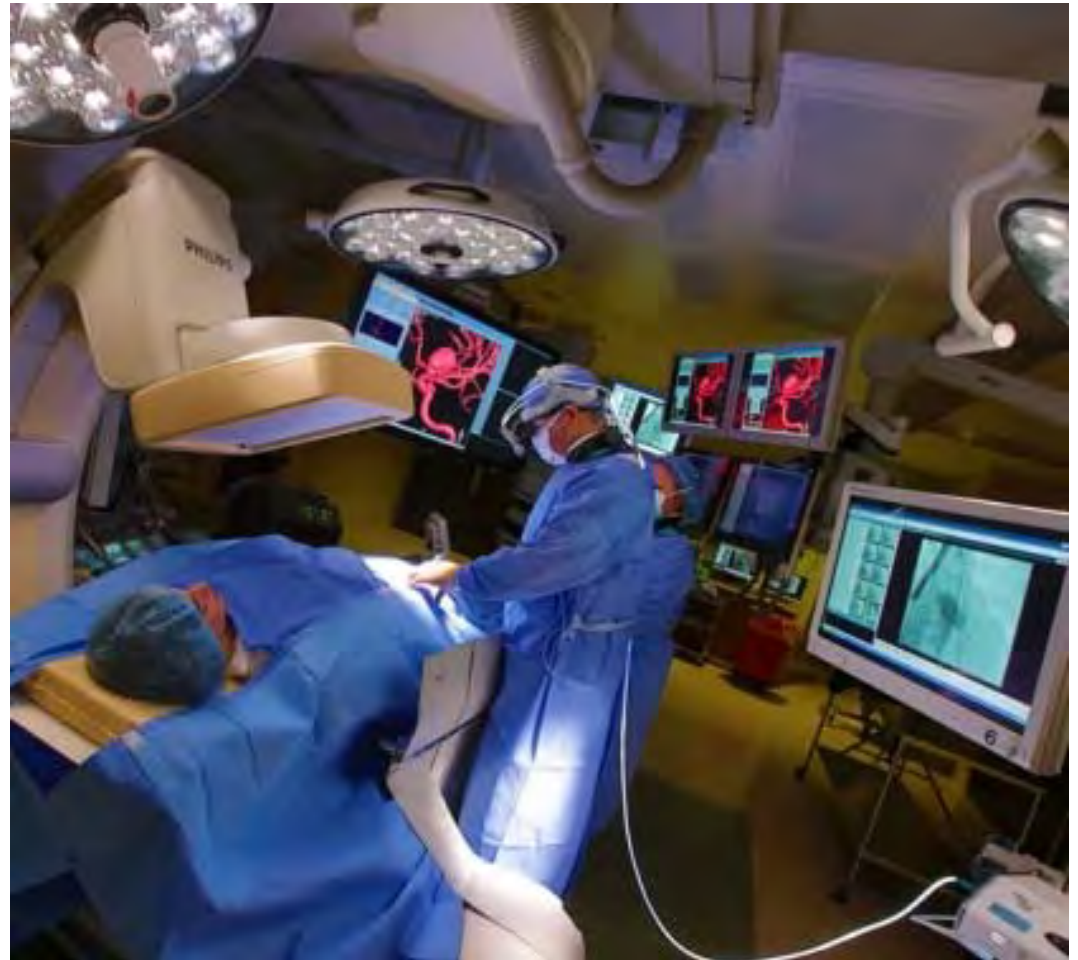


So put it all together



Hybrid operating room

- C-arms
- CT- scan on rails
- MRI portable
- Robotics
- 3D-imaging
- Fusion imaging
- Overlay imaging



Needs a lot of room (70 sq meters)



Control Room, lead shielding



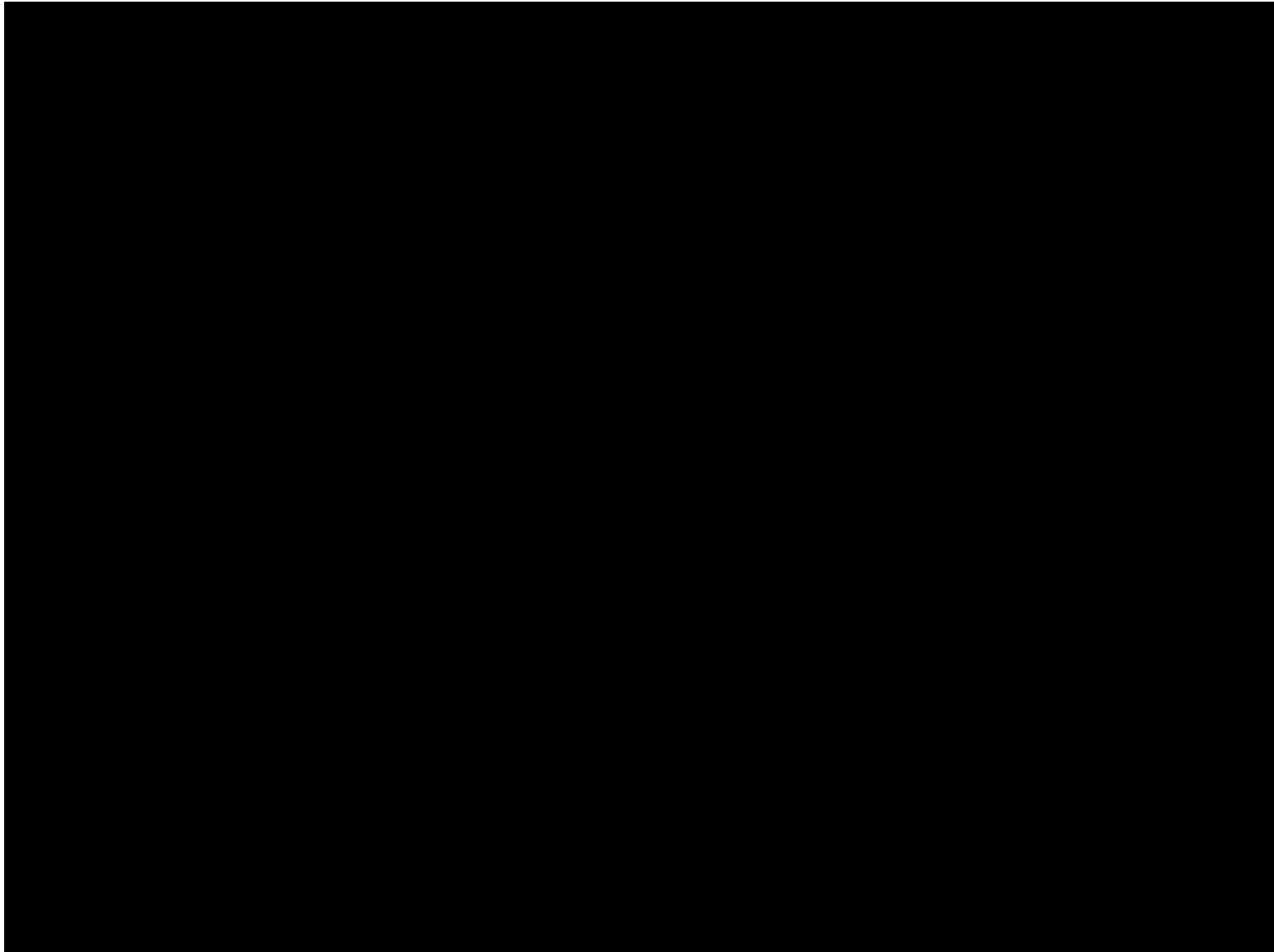
Lots of people (8-20): 24/7



Logistical problems for trauma

- Very expensive, who pays?
- Who uses it?
- Will it be available?
- Staffing 24 hours per day
- Speed of information transfer?
- Lots that can go wrong
- Coordination of multiple teams

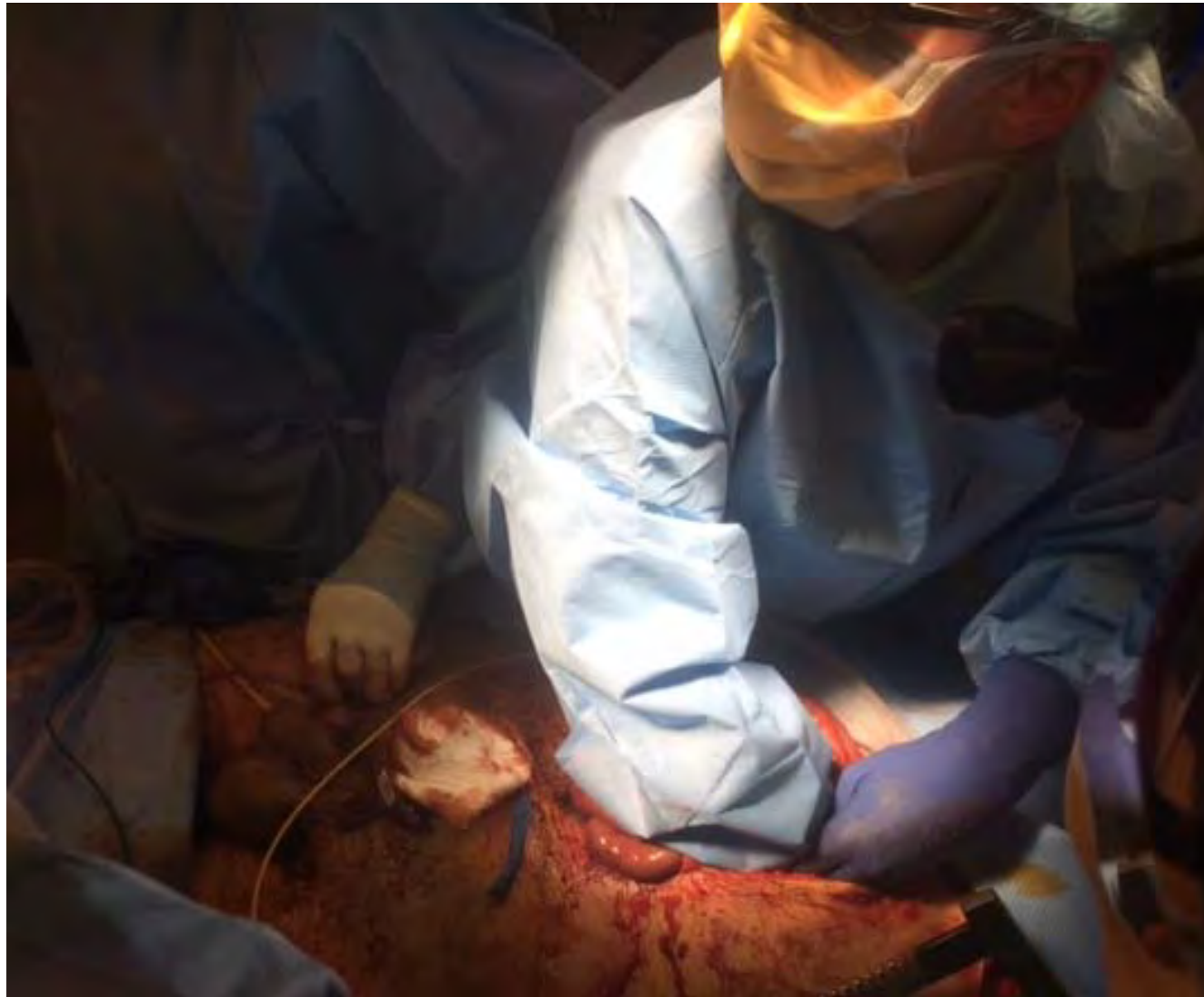
ED thoracotomy to the OR



Ongoing blood product resuscitation



Trauma team in the abdomen



Angio and Ortho setting up



Angio in the OR



Ex fix going on



Trauma, ortho and angio



Multifunctional trauma OR: the future?



Summary of the “golden hour”

- Severely injured patient to trauma center
- Damage control resuscitation
- Injuries identified
- Damage control surgery
- Stabilization in the ICU
- In the future do it all in the same place

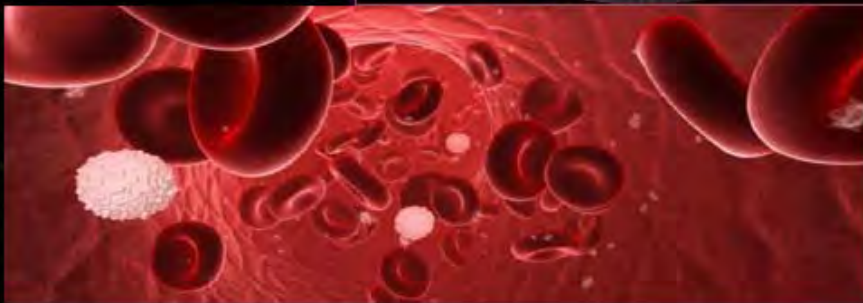
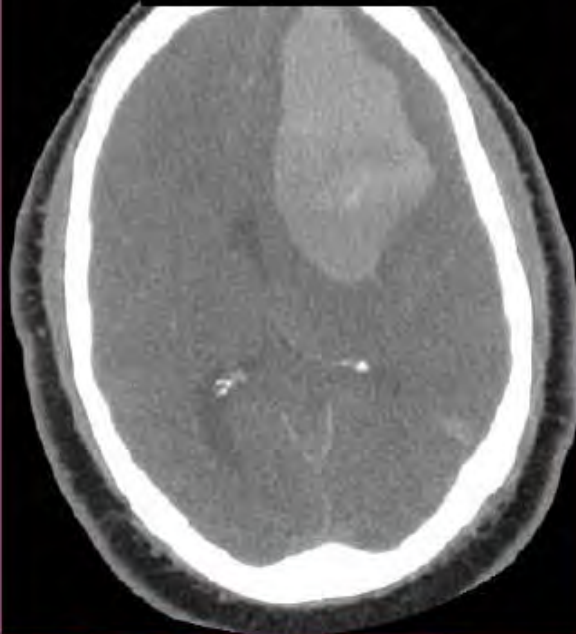
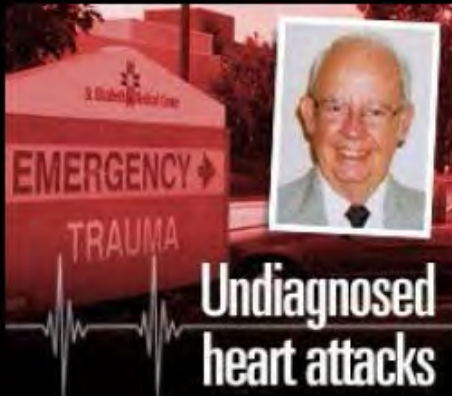
Time Sensitive Diagnoses & Mortality



MISSED MI <10%

STROKE 7%

TRAUMA 5%



SEPSIS

18-47%

Don't let the golden hour sneak up on you!



Thank you

Next to the operating room



