Postoperative Care in Trauma

Prevention and Management of Secondary Complications

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About the Speaker



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Intensivist — Postoperative trauma care, ARDS, mechanical ventilation and brain–lung interaction

Research and clinical focus: ICU organ support, de-escalation and recovery after major trauma

CONTEXT

Why postoperative trauma care matters

4%

of all ARDS cases attributed to trauma

36%

developed ARDS in a selected cohort with lung contusion

78%

required intubation in the same cohort (n = 147)

15.1–29.7%

mortality in trauma-related ARDS, 2007–2019

The ICU phase determines whether survival becomes meaningful recovery.

Lassola et al., Intensive Care Med, 2026

CONTEXT

A postoperative trauma patient arrives in ICU

42-year-old man after a road traffic collision

Emergency laparotomy for splenic bleeding.
Surgical hemostasis achieved.

Associated injuries

Bilateral lung contusions, multiple rib fractures
and a small cerebral contusion.

On ICU arrival

Intubated: SpO_2 92% on FiO_2 0.60, PEEP 8 cmH_2O
$PaCO_2$ 43 mmHg; MAP 72 mmHg
Lactate 3.2 mmol/L, down from 5.6



What are your priorities in the first 30 minutes?

Fictional teaching case. AI-generated illustration.

The first 30 minutes: what needs attention?

01 Oxygenation and ventilation

What explains the oxygen requirement? What should be checked before changing ventilator settings?

02 Bleeding and perfusion

Does a falling lactate exclude ongoing bleeding?
Which operative details and bedside trends are still missing?

03 Brain–lung interaction

How will the cerebral injury influence ventilation and sedation?
What neurological information is needed before making changes?

PATHWAY

Clinical timeline after major trauma

1 **Resuscitate**

2 **Hemostasis**

3 **Stabilize in ICU**

4 **Protect organs**

5 **Recover**

6 **Rehabilitate**

Decisions in the first hours shape complications that appear days later.

Evidence map

Source	Year	Design	Scope
ERATIC, Part 2	2025	Consensus guideline	Postoperative ICU pathway
Lassola et al.	2026	Narrative review	Trauma-related ARDS
EAST / CWIS	2023	Practice guideline	Older adults with rib fractures
Werle et al.	2026	Meta-analysis, 6 RCTs	NIV in blunt chest trauma
Pieri et al.	2025	Case series, n = 3	Exploratory hemoadsorption

Full references and source links in speaker notes

ERATIC 2025 framework

37 domains across ERATIC

- IATSIC and ERAS Society consensus
- GRADE appraisal with modified Delphi
- Part 2: postoperative and ICU care
- Links organ support with rehabilitation
- Trauma-specific randomized evidence is limited

Clinical value

A common pathway for daily priorities, de-escalation and rehabilitation.

Hardcastle et al., World J Surg, 2025

First 24 hours checklist

Hemorrhage	Reassess hemostasis, operative findings and drain output
Perfusion	Integrate lactate trends with examination and urine output
Fluids	Avoid cumulative overload after hemostasis
Temperature	Active rewarming and fever evaluation
Transfusion	Balanced components or selected whole blood pathway
De-escalation	Set daily goals for oxygen, support, sedation and devices

Hemostasis, fluids and transfusion

Before hemostasis

Permissive hypotension may apply when TBI is absent.

After hemostasis

Every bolus must be weighed against lung water and perfusion response.

Major hemorrhage

Balanced components: plasma, platelets and red cells (1:1:1).
Whole blood is a separate protocol.

Avoid synthetic colloids. Correct hypothermia, calcium and acidosis.

Multi-hit model of trauma related ARDS

1

Mechanical injury

Contusion, rib fractures, pneumothorax

2

Systemic inflammation

DAMPs, cytokines and neutrophil activation

3

Iatrogenic and secondary hits

Fluid overload, transfusion, infection, fat embolism

Preventable secondary insults offer opportunities for intervention.

Lassola et al., 2026

Imaging and early risk prediction

Modality	Strength	Limitation
Chest radiograph	Portable and available	May miss early edema or limited contusion
Lung ultrasound	Repeatable bedside assessment	Operator and training dependent
CT chest	Best estimate of contusion extent	Transport and radiation burden

Contusion >20–24% of lung volume is associated with higher ARDS risk.

Thresholds support monitoring. They do not replace clinical trajectory.

Ventilation strategy

Decision	Clinical approach
Tidal volume	ARDS: 4–8 mL/kg predicted body weight
PEEP	Use ARDS guidance; reassess recruitability and circulation
Pressure and effort	Measure plateau pressure; interpret ΔP and dyssynchrony
Carbon dioxide	Account for ICP, pH and cerebral perfusion

Plateau pressure <30 cmH_2O; interpret driving pressure with mechanics and effort.

Qadir et al., 2024; Lassola et al., 2026

Ventilation: findings that change the plan

Finding	Action / reassessment
Plateau pressure ≥30 cmH_2O	Review VT, mechanics and effort; reduce VT as tolerated
Hypoxemia despite initial optimization	Recheck reversible causes; assess PEEP response
Persistent severe ARDS	Assess proning feasibility; consider selected rescue support
Dyssynchrony or excessive effort	Optimize analgesia and synchrony; selective NMBA
TBI or worsening cerebral physiology	Recheck $PaCO_2$, ICP and CPP before further changes

Reassess oxygenation, mechanics and circulation after each intervention.

Qadir et al., 2024; ACS, 2024

When chest trauma and TBI coexist

Brain priorities

- Avoid hypoxemia and hypotension
- $PaCO_2$ 35–45 mmHg without raised ICP
- Raised ICP: use a tiered neurocritical care protocol
- Reassess ICP and CPP after changes

Lung priorities

- PBW-based protective ventilation
- Plateau pressure <30 cmH_2O
- Titrate PEEP to lung and circulatory response
- Proning: assess ICP and injury constraints

$PaCO_2$ 32–35 mmHg is a selected ICP treatment, not a routine target.

Weaning, extubation and VAP prevention

- Assess sedation and breathing readiness daily when safe
- Extubation also requires airway protection and secretion control
- Optimize pain relief, cough and chest physiotherapy
- Plan post-extubation support for selected high-risk patients
- Continue oral care, positioning and early mobility

Hardcastle et al., 2025

Analgesia first sedation

1

Treat pain

2

Use multimodal analgesia

3

Add the least sedation needed

4

Reassess every day

Regional analgesia can improve breathing and cough while reducing systemic opioid exposure.

Deeper sedation may be needed for specific neurologic or respiratory indications.

Hardcastle et al., 2025; ACS, 2024

Sedative and analgesic comparison

Agent	Main role	Key concern	TBI consideration
Dexmedetomidine	Light sedation	Bradycardia; hypotension	Facilitates examination
Propofol	Rapid titration	Hypotension; infusion syndrome	Useful for selected ICP control
Ketamine	Analgesia adjunct	Hemodynamic and behavioral effects	ICP concern alone is not an absolute exclusion
Opioids	Pain control	Respiratory depression; ileus	May obscure examination

Choose the agent and depth according to physiology and the clinical indication.

Hardcastle et al., 2025; ACS, 2024

Delirium, sleep and mobility

Sedation	Validated target and daily reassessment
Delirium	Routine screening and medication review
Sleep	Protect nighttime sleep and orientation
Mobility	Progressive activity when physiology permits
Family	Communication and participation in recovery

Hardcastle et al., 2025

Secondary brain injury

Hypoxemia

Optimize airway and oxygen delivery

Hypotension

Preserve cerebral perfusion and search for bleeding

CO_2 extremes

Avoid routine profound hypocapnia

Hyperthermia

Treat fever and its cause

Dysglycemia

Avoid marked hypo- or hyperglycemia

Seizures

Detect and treat clinically significant seizures

Neuromonitoring: the question behind each signal

Signal	Clinical question
Examination	Is neurologic function changing?
ICP and CPP	Is pressure or perfusion inadequate?
Brain oxygen	Is regional oxygen delivery inadequate?
EEG	Are seizures contributing?
Imaging	Has the structural injury evolved?
Biomarkers and AI	What is validated for this specific use?

Chest trauma risk and escalation

Lower risk	Intermediate risk	High risk
Stable oxygenation and effective cough Continue analgesia and reassessment	Rising oxygen need or weak cough Optimize pain relief; consider monitored NIV	Fatigue, worsening gas exchange or airway risk Escalate promptly; assess intubation

NIV requires airway protection, close observation and a clear escalation plan.

Mukherjee et al., 2023; Werle et al., 2026

Regional analgesia for rib fractures

Pattern / context	Possible technique	Selection issue
Anterior / lateral ribs	Serratus anterior plane	Coverage and local expertise
Posterior rib pain	Erector spinae plane	Coverage and response vary
Extensive / bilateral injury	Epidural or paravertebral	Coagulation and hemodynamic status

Select by anatomy, coagulation, hemodynamics and local expertise.

Mukherjee et al., 2023; Lassola et al., 2026

NIV versus invasive ventilation in chest trauma

Outcome	Effect versus invasive ventilation	Certainty
Mortality	OR 0.15 (95% CI 0.06–0.37)	Moderate
Complications	OR 0.10 (95% CI 0.05–0.20)	Moderate
Infections	OR 0.11 (95% CI 0.05–0.24)	Moderate
ICU stay	−2.29 days (95% CI −3.78 to −0.80)	Low

Review: 6 RCTs, 300 patients; mortality analysis: 5 RCTs

Small, often older trials limit generalizability.
These results do not justify delaying necessary intubation.

Werle et al., 2026. doi:10.1016/j.bjpt.2025.101540

Timing of fracture fixation

Long bone and pelvic fixation

- Early fixation may reduce pulmonary complications
- Interpret observational associations cautiously
- Balance definitive fixation against physiologic instability

Surgical stabilization of rib fractures

- Selected flail chest patients may benefit
- Assess displacement, respiratory failure and pain
- Associated injuries influence timing and suitability

Operate early when physiology is ready and the indication is clear.

Suspected infection: treatment and source control

1 **Recognize infection and assess shock**

2 **Cultures and empiric antibiotics**

3 **Urgent source assessment and control**

4 **Reassess and narrow treatment**

- Shock or high likelihood of sepsis: immediate antibiotics, ideally within 1 hour
- Obtain cultures first only if this does not meaningfully delay treatment
- Source control and resuscitation proceed alongside antimicrobial therapy
- Reassess infection probability, cultures and antibiotic need daily

Evans et al., 2021; Hardcastle et al., 2025

Preventable ICU complications

VTE

Mechanical and pharmacologic prophylaxis when bleeding risk permits

Lines

Aseptic insertion and prompt removal

Urinary catheter

Daily indication review

Skin

Pressure redistribution and examination

Stress ulcer

Prophylaxis only when indicated

Lung

Oral care, positioning and secretion clearance

AKI and rhabdomyolysis

1 **Muscle injury**

2 **Myoglobin release**

3 **Tubular and oxidative injury**

4 **AKI and electrolyte disturbance**

- Treat the cause and correct hypovolemia without fluid overload
- Track potassium, calcium, phosphate, acid base status and kidney function
- CK describes muscle burden but does not independently trigger dialysis
- Start renal replacement therapy for accepted clinical indications

Hardcastle et al., 2025

Hemoadsorption: exploratory evidence

Domain	Finding
Design	Retrospective uncontrolled series: 3 patients
Intervention	Two CytoSorb cartridges in parallel
Reported signal	Laboratory markers decreased during treatment
Clinical outcome	All received CRRT; one patient died
Interpretation	No causal estimate of renal or survival benefit

Experimental therapy; no established clinical benefit

Pieri et al., 2025. doi:10.1177/03913988251339080

Nutrition, mobility and rehabilitation

Domain	Early ICU action	Outcome focus
Nutrition	Enteral feeding when perfusion permits	Protein delivery and tolerance
Mobility	Daily readiness and progressive activity	ICU acquired weakness
Cognition	Orientation, sleep and delirium prevention	Functional recovery
Family	Goals and participation	Continuity after ICU
Transition	Medication and rehabilitation plan	Post ICU follow-up

Hardcastle et al., 2025

Practical priorities and remaining uncertainty

Priority	Evidence and limitation
Structured recovery	ERATIC combines evidence with expert consensus
Protective ventilation	Use ARDS guidance; account for associated injuries
Selective NIV	Promising effects in small chest-trauma trials
Neuromonitoring	Use indications and clinical context
Hemoadsorption	Exploratory evidence; not established routine care

Evidence strength differs across interventions and patient groups.

Individualized monitoring is not proof that every monitoring strategy improves outcomes.

Evidence synthesis; source links in speaker notes

Take-home messages

- Recheck hemostasis and search for reversible deterioration
- Protect lungs while preserving cerebral perfusion
- Treat pain and set an individualized sedation target
- Use NIV selectively with an explicit failure plan
- Treat probable sepsis promptly and secure source control
- Plan nutrition, mobility and rehabilitation from the ICU

Key references

Hardcastle TC, et al. (2025). ERATIC: Paper 2, postoperative and intensive care recommendations. World J Surg, 49, 2029–2054. doi:10.1002/wjs.70004

Lassola S, et al. (2026). ARDS management in trauma patients. Intensive Care Med, 52, 1943–1957. doi:10.1007/s00134-026-08581-5

Mukherjee K, et al. (2023). Non-surgical management and analgesia strategies for older adults with multiple rib fractures. J Trauma Acute Care Surg, 94, 398–407. doi:10.1097/TA.0000000000003830

Werle RW, et al. (2026). Noninvasive ventilation in adults with blunt chest trauma: A meta-analysis of randomized clinical trials. Braz J Phys Ther, 30, 101540. doi:10.1016/j.bjpt.2025.101540

Pieri M, et al. (2025). Dual concomitant CytoSorb hemoadsorption therapy in severe rhabdomyolysis. Int J Artif Organs, 48, 429–433. doi:10.1177/03913988251339080

Qadir N, et al. (2024). An update on management of adult patients with ARDS: An official ATS clinical practice guideline. Am J Respir Crit Care Med, 209, 24–36. doi:10.1164/rccm.202311-2011ST