Abdominal Trauma Management
-Except REBOA-

Wonju College of Medicine
Department of Surgery
Division of Traumatology
Seongyup Kim, M.D.

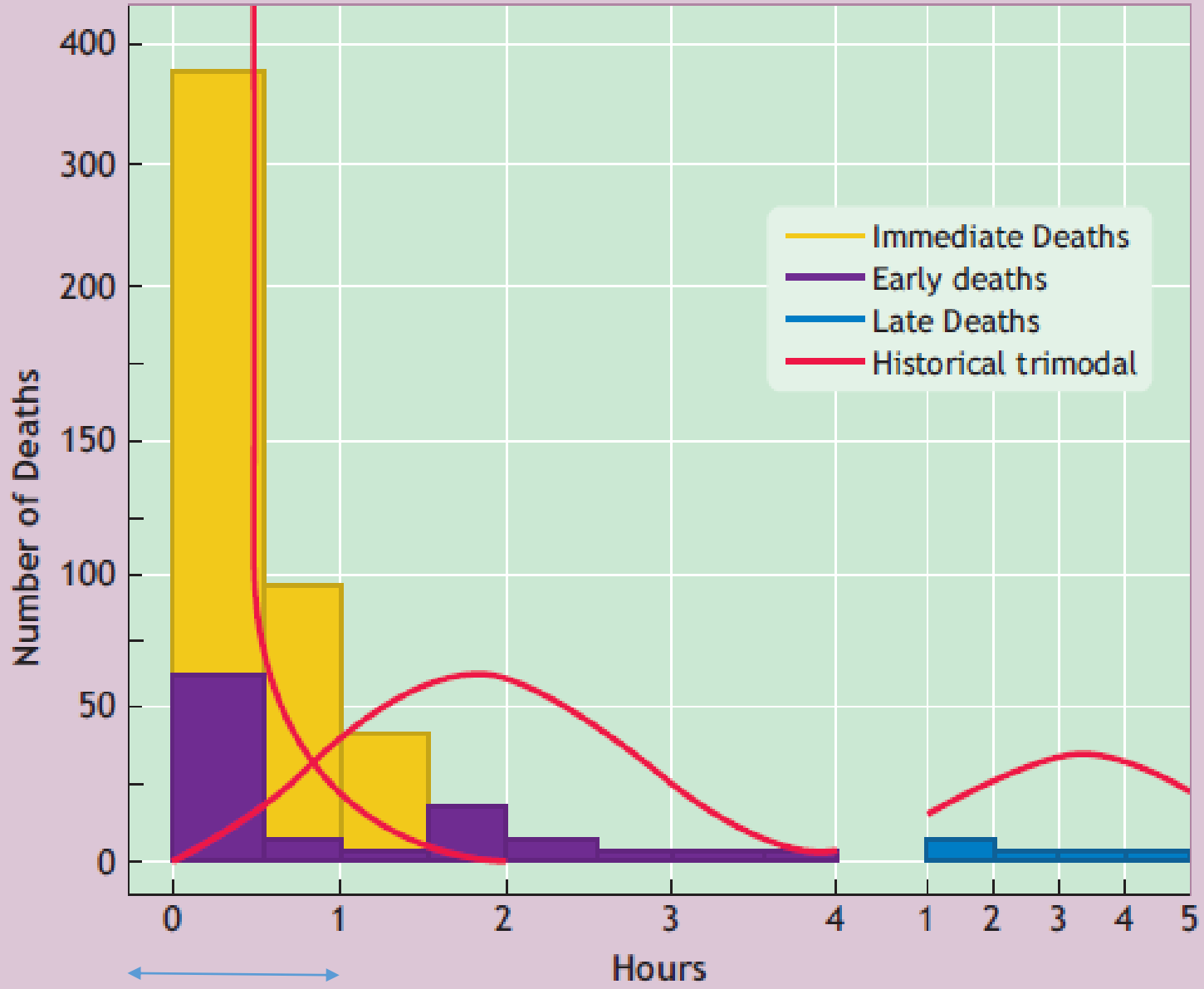
- **No conflict of interest**

Contents

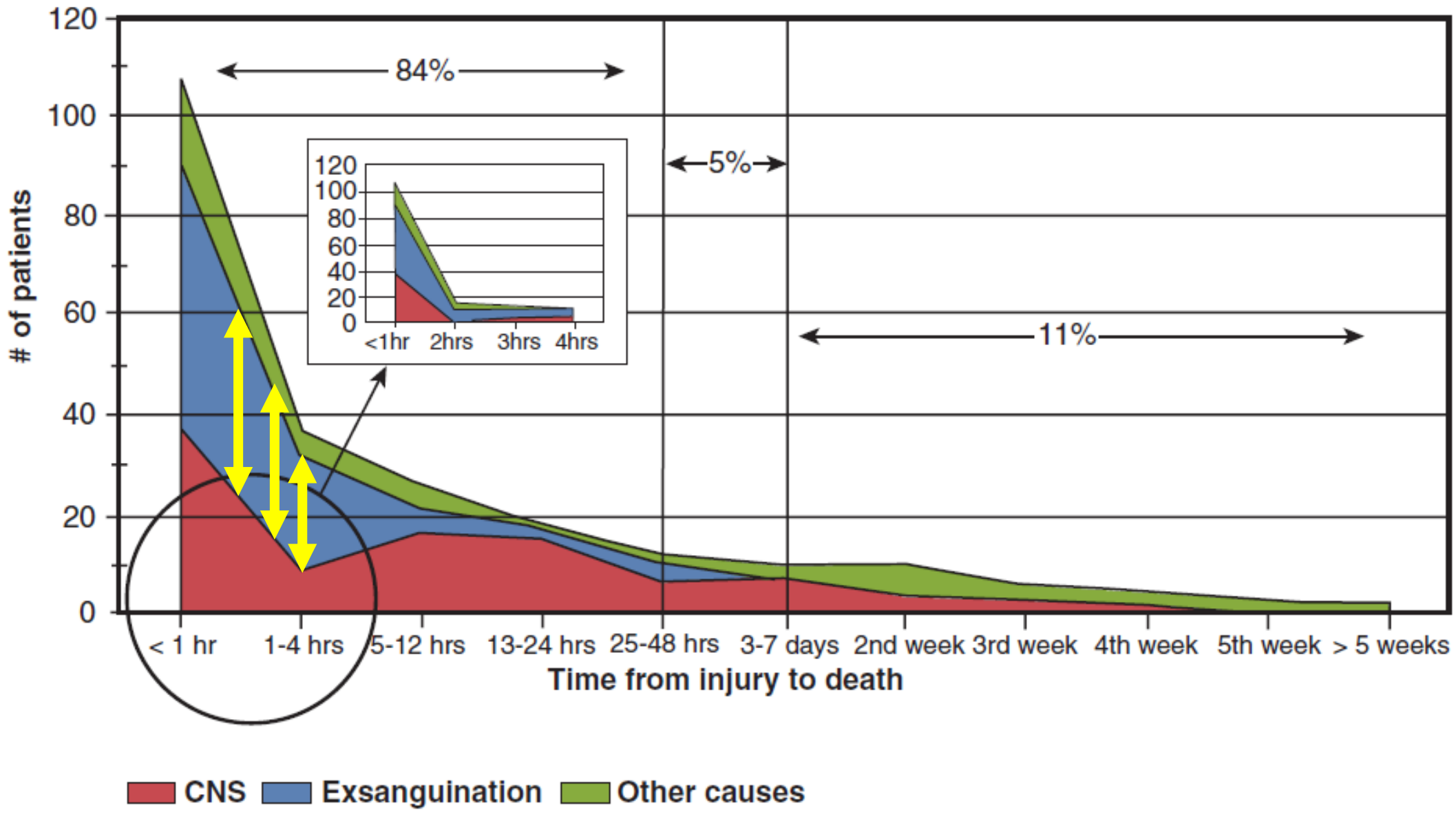
Contents

- **Abdominal Trauma Management: General consideration**
  - **Initial assessment**
  - Transfusion
  - Abdominal compartment syndrome
- Hollow viscus injury
- Solid organ injury
- Bladder injury
- Diaphragm injury
- Pelvic fracture
- Damage control surgery

Timing Distribution of Trauma Deaths Compared With the Historical Trimodal Distribution



ATLS® 10th ed.



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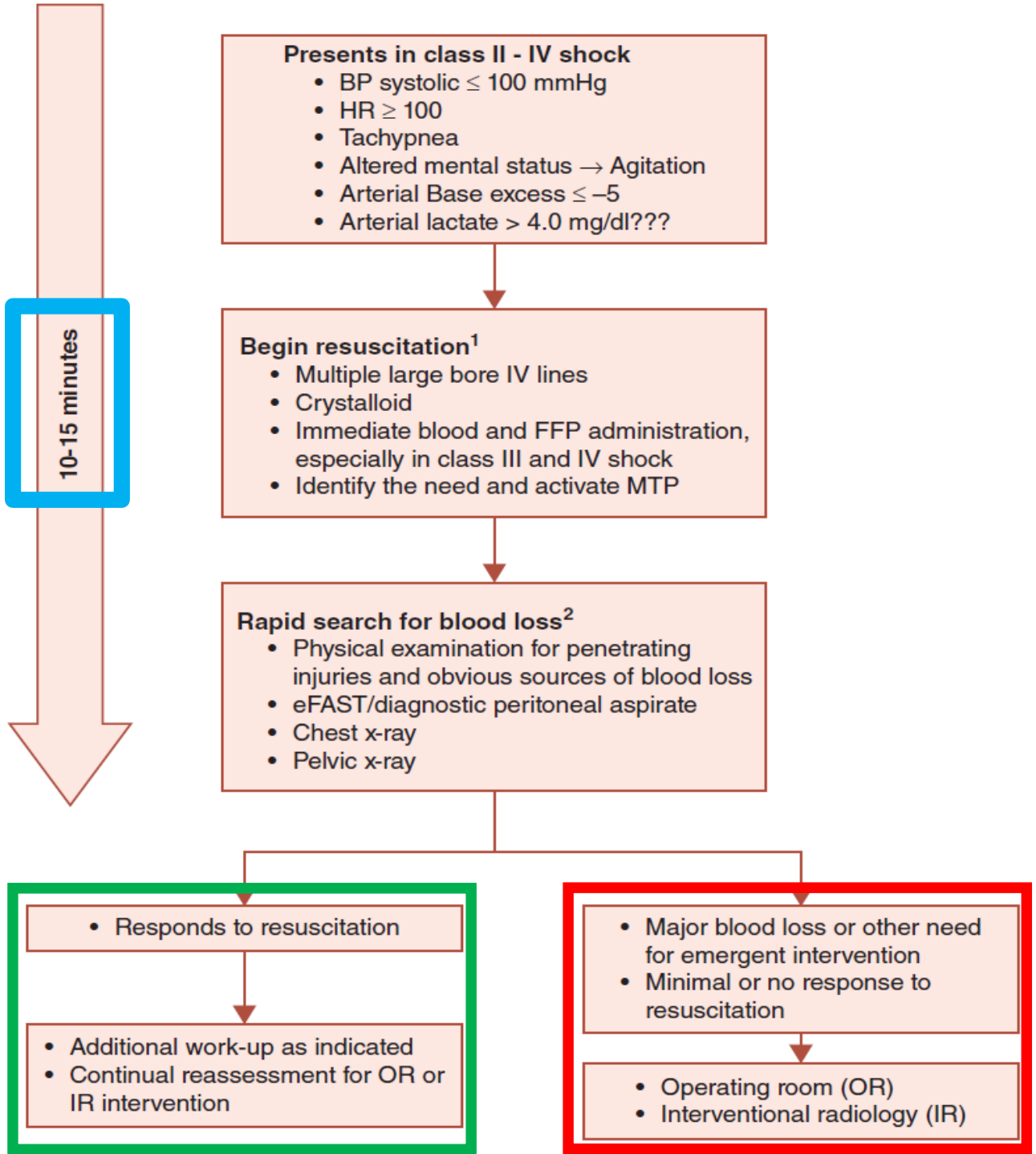
Trauma 9th ed.


10-15 minutes
Presents in class II - IV shock
• BP systolic ≤ 100 mmHg
• HR ≥ 100
• Tachypnea
• Altered mental status → Agitation
• Arterial Base excess ≤ –5
• Arterial lactate > 4.0 mg/dl???
Begin resuscitation[1]
• Multiple large bore IV lines
• Crystalloid
• Immediate blood and FFP administration, especially in class III and IV shock
• Identify the need and activate MTP
Rapid search for blood loss[2]
• Physical examination for penetrating injuries and obvious sources of blood loss
• eFAST/diagnostic peritoneal aspirate
• Chest x-ray
• Pelvic x-ray
• Responds to resuscitation
• Additional work-up as indicated
• Continual reassessment for OR or IR intervention
• Major blood loss or other need for emergent intervention
• Minimal or no response to resuscitation
• Operating room (OR)
• Interventional radiology (IR)

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Assessment element	1° Technique for assessment	Possible adjuncts	Treatment or intervention
EMS report	M.IS.T		
Airway	Talking visual inspection	Sit patient upright	Intubation surgical airway
Breathing	Auscultation palpation	CXR ultrasound	Chest tube thoracotomy
Circulation	Pulse exam search for hemorrhage	Fast pelvic Xray DPA	Direct pressure tourniquet surgery angiography
Disability	GCS/neuro exam		Intubation if GCS ≤ 8
Exposure	Measure core temperature		Warm blanket, IV fluid and room

Trauma 9th ed.

Focused Assessment with Sonography for Trauma(FAST)

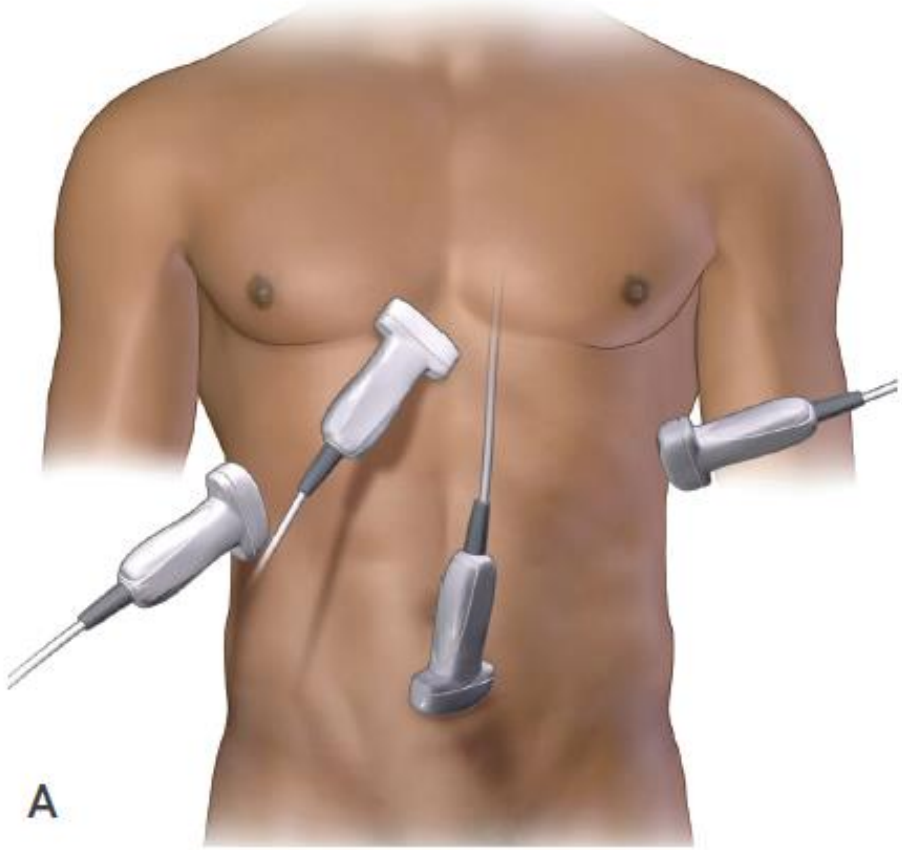

FIGURE 5-5 A. Probe locations. B. FAST image of the right upper quadrant showing the liver, kidney, and free fluid.

ATLS® 10th ed.

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- Diaphragm injury
- Pelvic fracture
- Damage control surgery

ORIGINAL ARTICLE

Mortality after emergent trauma laparotomy: A multicenter, retrospective study

John A. Harvin, MD, Tom Maxim, Kenji Inaba, MD, Myriam A. Martinez-Aguilar, MD, David R. King, MD, Asad J. Choudhry, MD, Martin D. Zielinski, MD, Sam Akinyeye, MD, S. Rob Todd, MD, Russell L. Griffin, PhD, Jeffrey D. Kerby, MD, PhD, Joanelle A. Bailey, MD, David H. Livingston, MD, Kyle Cunningham, MD, Deborah M. Stein, MD, Lindsay Cattin, MPH, Eileen M. Bulger, MD, Alison Wilson, MD, Vicente J. Undurraga Perl, MD, Martin A. Schreiber, MD, Jill R. Cherry-Bukowiec, MD, Hasan B. Alam, MD, *and* **John B. Holcomb, MD**, *Houston, Texas*

J Trauma Acute Care Surg 2018

TABLE 4. Outcomes

Outcomes	All Patients (n = 1,706)	ED SBP >90 (n = 1,253)	ED SBP ≤90 (n = 394)	*p*
Deaths	350 (21%)	145 (11%)	182 (46%)	<0.001
Time to death, h	4 (2–33)	5 (2–83)	3 (1–8)	<0.001
Cause of death				
Hemorrhage	210 (60%)	77 (53%)	119 (65%)	0.016
Traumatic brain injury	56 (16%)	22 (15%)	31 (17%)	
Multiorgan failure	28 (8%)	16 (11%)	11 (6%)	
Cardiac arrest	12 (3%)	4 (3%)	8 (4%)	
Respiratory failure	12 (3%)	9 (6%)	3 (2%)	
Sepsis	3 (1%)	3 (2%)	0 (0%)	
Other/unknown	29 (8%)	14 (10%)	10 (5%)	
Hospital-free days	15 (0–23)	19 (1–24)	0 (0–12)	<0.001

Continuous variables: median (IQR).

Massive transfusion protocol (MTP) template

The information below, developed by consensus, broadly covers areas that should be included in a local MTP. This template can be used to develop an MTP to meet the needs of the local institution's patient population and resources

Senior clinician determines that patient meets criteria for MTP activation

Baseline:
Full blood count, coagulation screen (PT, INR, APTT, fibrinogen), biochemistry, arterial blood gases

Notify transfusion laboratory (*insert contact no.*) **to:**
'Activate MTP'

Laboratory staff

- Notify haematologist/transfusion specialist
- Prepare and issue blood components as requested
- Anticipate repeat testing and blood component requirements
- Minimise test turnaround times
- Consider staff resources

Haematologist/transfusion specialist

- Liaise regularly with laboratory and clinical team
- Assist in interpretation of results, and advise on blood component support

Senior clinician

- **Request:**[a]
  - 4 units RBC
  - 2 units FFP
- **Consider:**[a]
  - 1 adult therapeutic dose platelets
  - tranexamic acid in trauma patients
- **Include:**[a]
  - cryoprecipitate if fibrinogen < 1 g/L

a Or locally agreed configuration

Bleeding controlled?

YES → **Notify transfusion laboratory to: 'Cease MTP'**

NO → Senior clinician

OPTIMISE:

- oxygenation
- cardiac output
- tissue perfusion
- metabolic state

MONITOR
(every 30–60 mins):

- full blood count
- coagulation screen
- ionised calcium
- arterial blood gases

AIM FOR:

- temperature > 35^0C
- pH > 7.2
- base excess < –6
- lactate < 4 mmol/L
- Ca^{2+} > 1.1 mmol/L
- platelets > 50 × 10^9/L
- PT/APTT < 1.5 × normal
- INR ≤ 1.5
- fibrinogen > 1.0 g/L

Research

Original Investigation

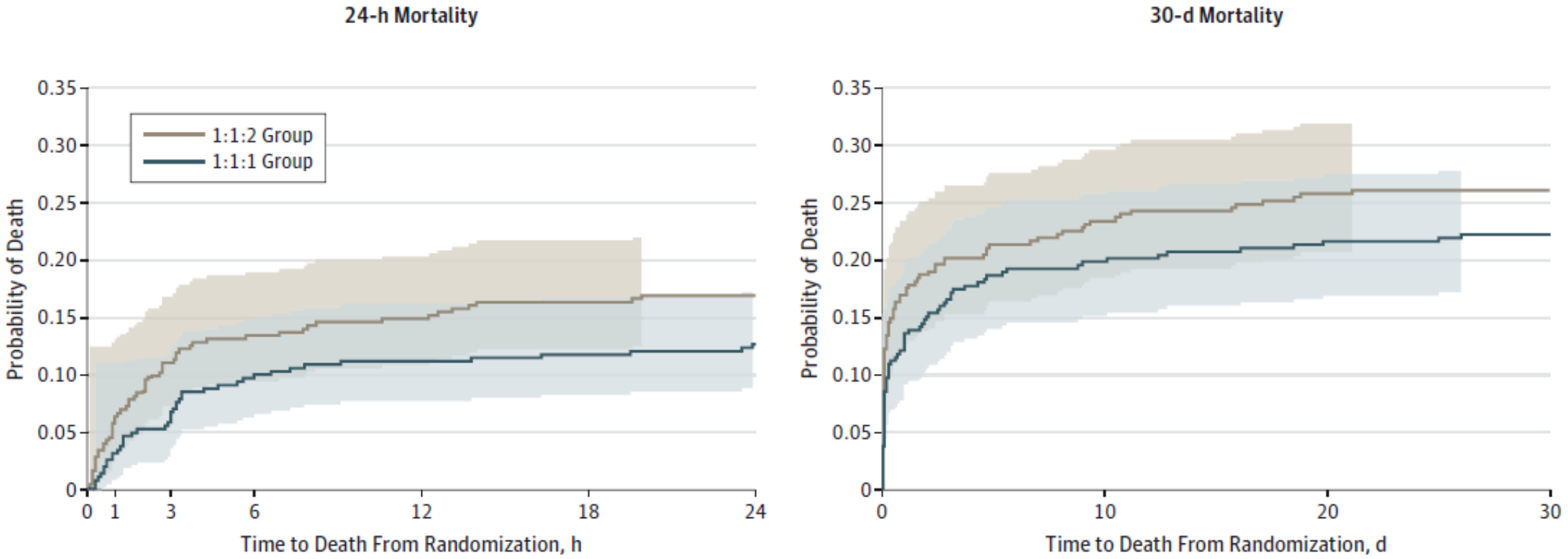
Transfusion of Plasma, Platelets, and Red Blood Cells in a 1:1:1 vs a 1:1:2 Ratio and Mortality in Patients With Severe Trauma

The PROPPR Randomized Clinical Trial

John B. Holcomb, MD; Barbara C. Tilley, PhD; Sarah Baraniuk, PhD; Erin E. Fox, PhD; Charles E. Wade, PhD; Jeanette M. Podbielski, RN; Deborah J. del Junco, PhD; Karen J. Brasel, MD, MPH; Eileen M. Bulger, MD; Rachael A. Callcut, MD, MSPH; Mitchell Jay Cohen, MD; Bryan A. Cotton, MD, MPH; Timothy C. Fabian, MD; Kenji Inaba, MD; Jeffrey D. Kerby, MD, PhD; Peter Muskat, MD; Terence O'Keeffe, MBChB, MSPH; Sandro Rizoli, MD, PhD; Bryce R. H. Robinson, MD; Thomas M. Scalea, MD; Martin A. Schreiber, MS; Deborah M. Stein, MD; Jordan A. Weinberg, MD; Jeannie L. Callum, MD; John R. Hess, MD, MPH; Nena Matijevic, PhD; Christopher N. Miller, MD; Jean-Francois Pittet, MD; David B. Hoyt, MD; Gail D. Pearson, MD, ScD; Brian Leroux, PhD; Gerald van Belle, PhD; for the PROPPR Study Group

JAMA 2015

Figure 2. Kaplan-Meier Failure Curves for Mortality at 24 Hours and 30 Days



No. at risk

1:1:2	342	322	304	296	291	286	284	342	261	253	252
1:1:1	338	327	318	305	300	297	295	338	269	263	260

Conclusion

- Among patients with severe trauma and major bleeding, early administration of plasma, platelets, and red blood cells in a 1:1:1 ratio compared with a 1:1:2 ratio did **not result in significant differences** in mortality at 24 hours or at 30 days.
- More patients in the 1:1:1 group achieved hemostasis and **fewer experienced death due to exsanguination by 24 hours**.

ACS TQIP MASSIVE TRANSFUSION IN TRAUMA GUIDELINES

American College of Surgeons
Inspiring Quality:
Highest Standards, Better Outcomes
100 years

Committee on Trauma

If standard thrombe (TEG®) is available, t cut-points for transf may also be used:

- Plasma for **r-valu**
- Plasma and/or cry (fibrinogen conce **k-time** >4 minute
- Cryoprecipitate (c concentrate) and/ **α-angle** <60°
- Platelets for **mA** <
- Anti-fibrinolytics f >7.5 percent

If rapid TEG is availab cut-points for transfu also be used:

- Plasma for **ACT** >12
- Plasma and/or cryo (fibrinogen concent >2.5 minutes
- Cryoprecipitate (fib concentrate) and/o **α-angle** <60°
- Platelets for **mA** <5
- Anti-fibrinolytics fo

If rapid TEG is available, the following cut-points for transfusion triggers may also be used:

- Plasma for **ACT** >128 seconds
- Plasma and/or cryoprecipitate (fibrinogen concentrate) for **k-time** >2.5 minutes
- Cryoprecipitate (fibrinogen concentrate) and/or plasma for **α-angle** <60°
- Platelets for **mA** <55 mm
- Anti-fibrinolytics for **LY30** >3 percent

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CONFERENCE REPORTS AND EXPERT PANEL

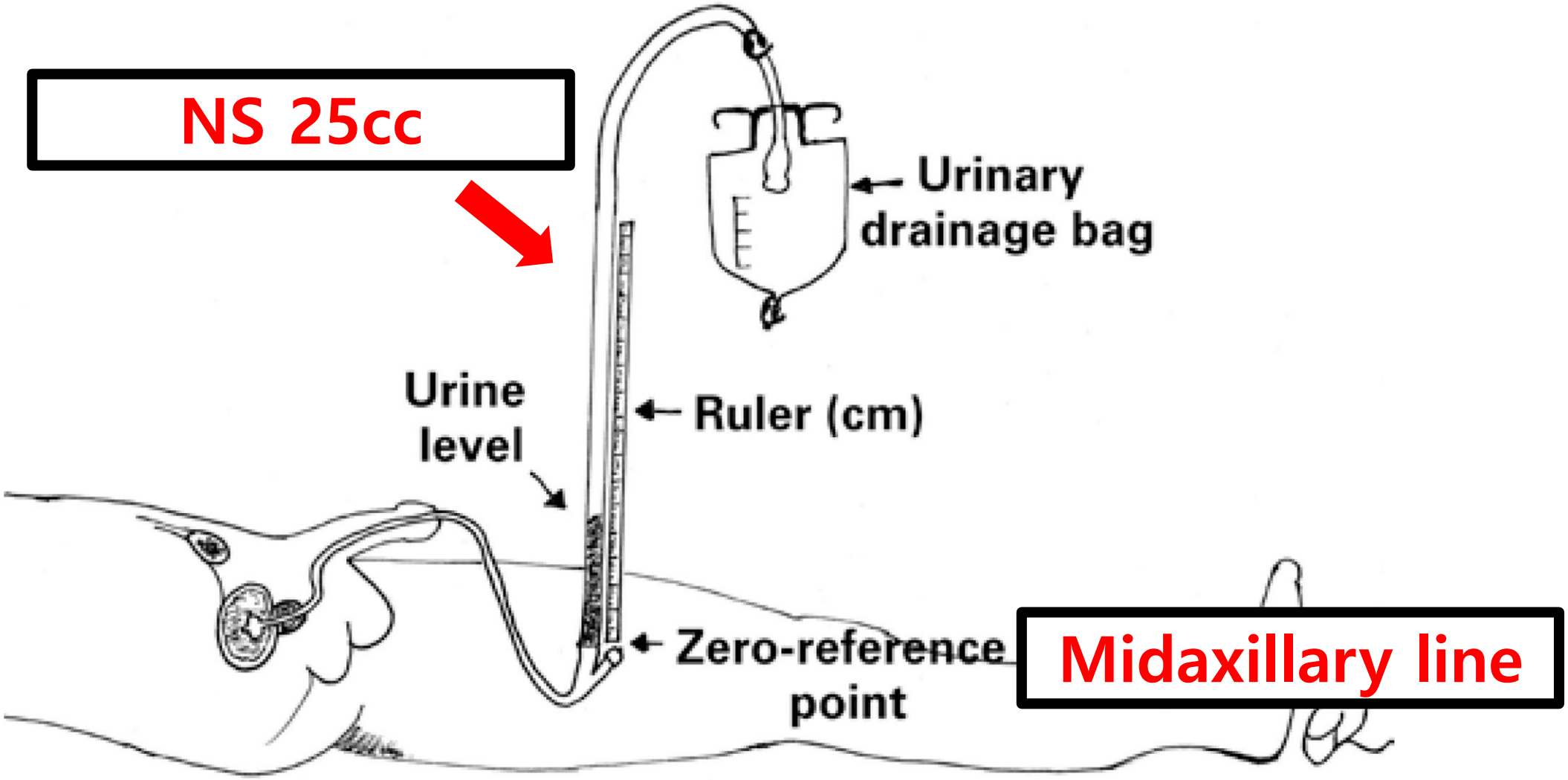
Intra-abdominal hypertension and the abdominal compartment syndrome: updated consensus definitions and clinical practice guidelines from the World Society of the Abdominal Compartment Syndrome

Intensive Care Medicine 2013

Definition of ACS

- Sustained Intra-abdominal Pressure(IAP)>20mmHg
- ± Abdominal Perfusion Pressure(APP)<60mmHg
- And new organ dysfunction/failure

IAP measurement



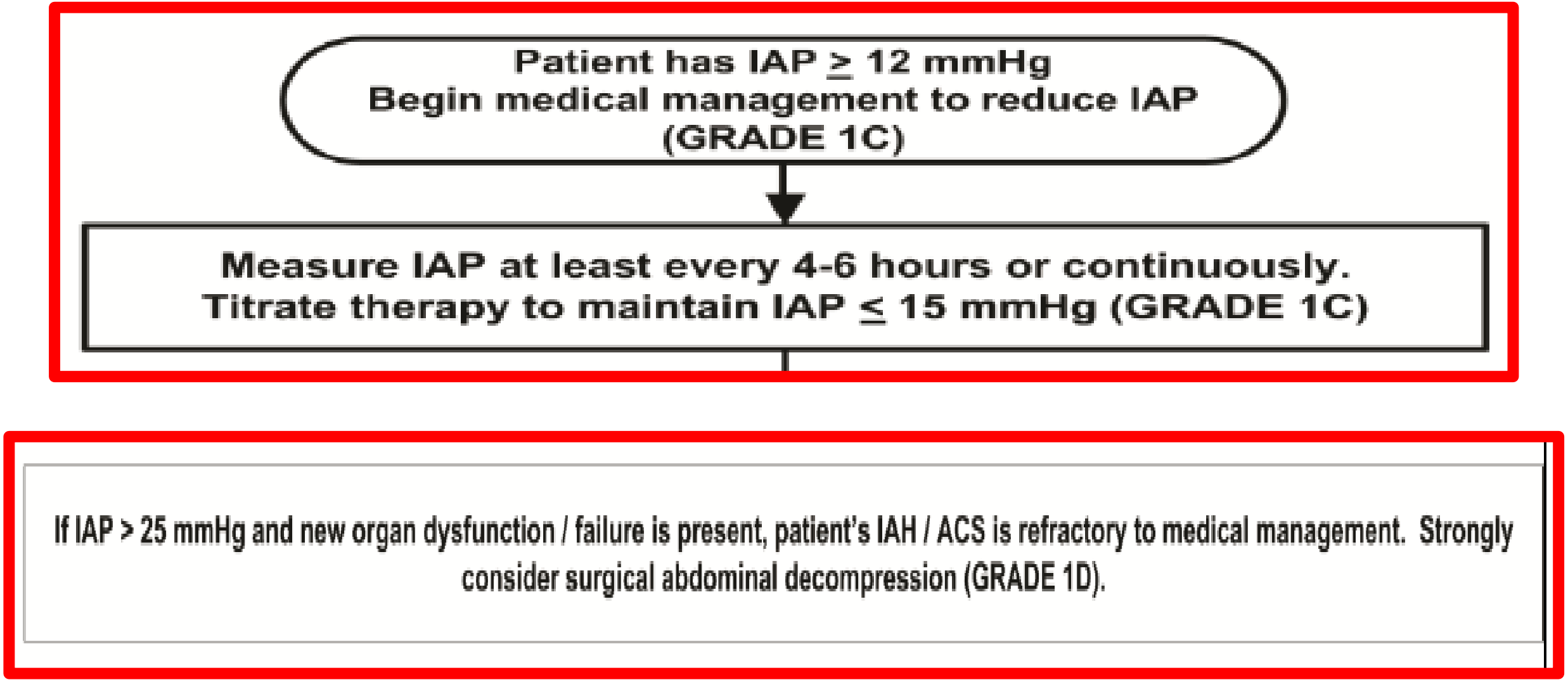
Most common manifestation

- Respiratory system
  - Increased peak airway pressure
- Cardiovascular system
  - Increased systemic vascular resistance
- Urinary system
  - Oliguria

Reduce IAP-Medical treatment

- Wall compliance
  - Sedation, analgesia, NM blocker, avoid head of be >30dgrees
- Intra-luminal contents evacuation
  - Nasogastric tube
  - Rectal decompression
  - Bowel prokintetics
- Evacuate abdominal fluid collection
  - Avoid excessive fluid resuscitation
  - Diuretics
  - Colloids/hypertonic fluid
  - Renal replace
- Organ support

Intensive Care Medicine 2013


Patient has IAP ≥ 12 mmHg
Begin medical management to reduce IAP
(GRADE 1C)
Measure IAP at least every 4-6 hours or continuously.
Titrate therapy to maintain IAP ≤ 15 mmHg (GRADE 1C)
If IAP > 25 mmHg and new organ dysfunction / failure is present, patient's IAH / ACS is refractory to medical management. Strongly consider surgical abdominal decompression (GRADE 1D).

Temporary abdominal closure

Hemo

Lapa ta

Bowel vinyl bag

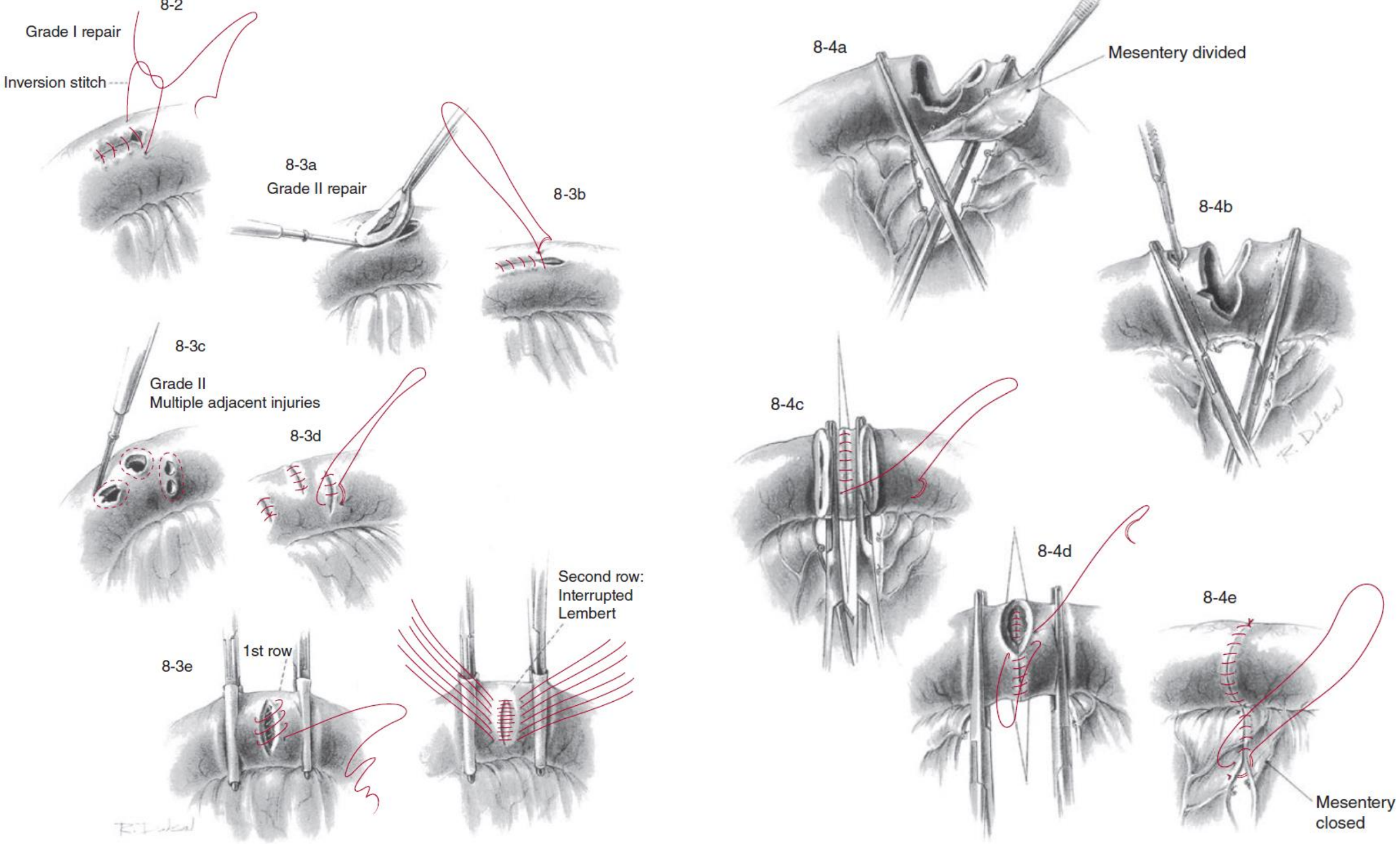
Contents

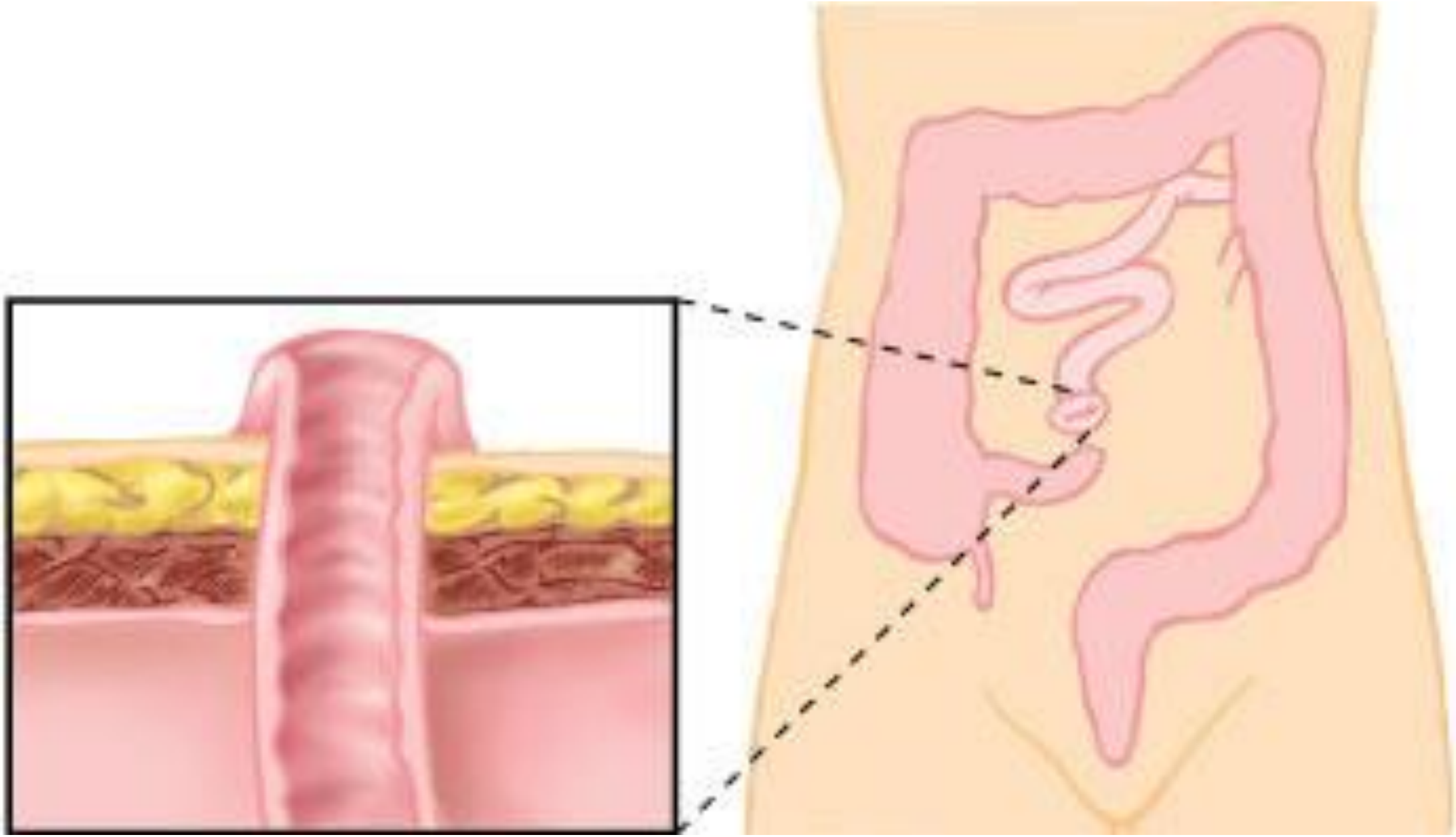
Absolute surgical indications of hollow viscus injury

- Hollow viscus **perforation**
  - Image findings: free gas, fluid collection, wall thickening etc.
- Hollow viscus **infarction**
  - High suspicion of index
  - Mesenteric injury
    - Image findings: fluid collection, hematoma, vascular occlusion, thrombosis etc.

Operations

- Primary repair
- Resection and anastomosis
- Enterostomy formation


8-2
Grade I repair
Inversion stitch
8-3a
Grade II repair
8-3b
8-3c
Grade II
Multiple adjacent injuries
8-3d
8-3e
1st row
Second row:
Interrupted
Lembert
8-4a
Mesentery divided
8-4b
8-4c
8-4d
8-4e
Mesentery
closed



Surgical observation in hollow viscus injury patients

ELSEVIER

Seminars in ULTRASOUND CT and MRI

Multidetector CT Imaging of Bowel and Mesenteric Injury: Review of Key Signs

Andrew E. Bennett, MD, PhD,* Robin B. Levenson, MD,† and Jon D. Dorfman, MD‡

In contemporary practice, multidetector computed tomography plays a critical role in the diagnostic evaluation of patients with suspected acute mesenteric and bowel trauma. Although less common than solid organ injuries, it may be seen in up to 5% of blunt trauma patients. Evaluation with CT remains challenging even with improvements in technology. The major imaging signs of mesenteric and bowel trauma and what is known about their applicability in clinical practice are reviewed here. Examples illustrate both the subtlety and variable significance of many of the key signs as well as how these are typically integrated into clinical practice.

Semin Ultrasound CT MRI 39:363-373

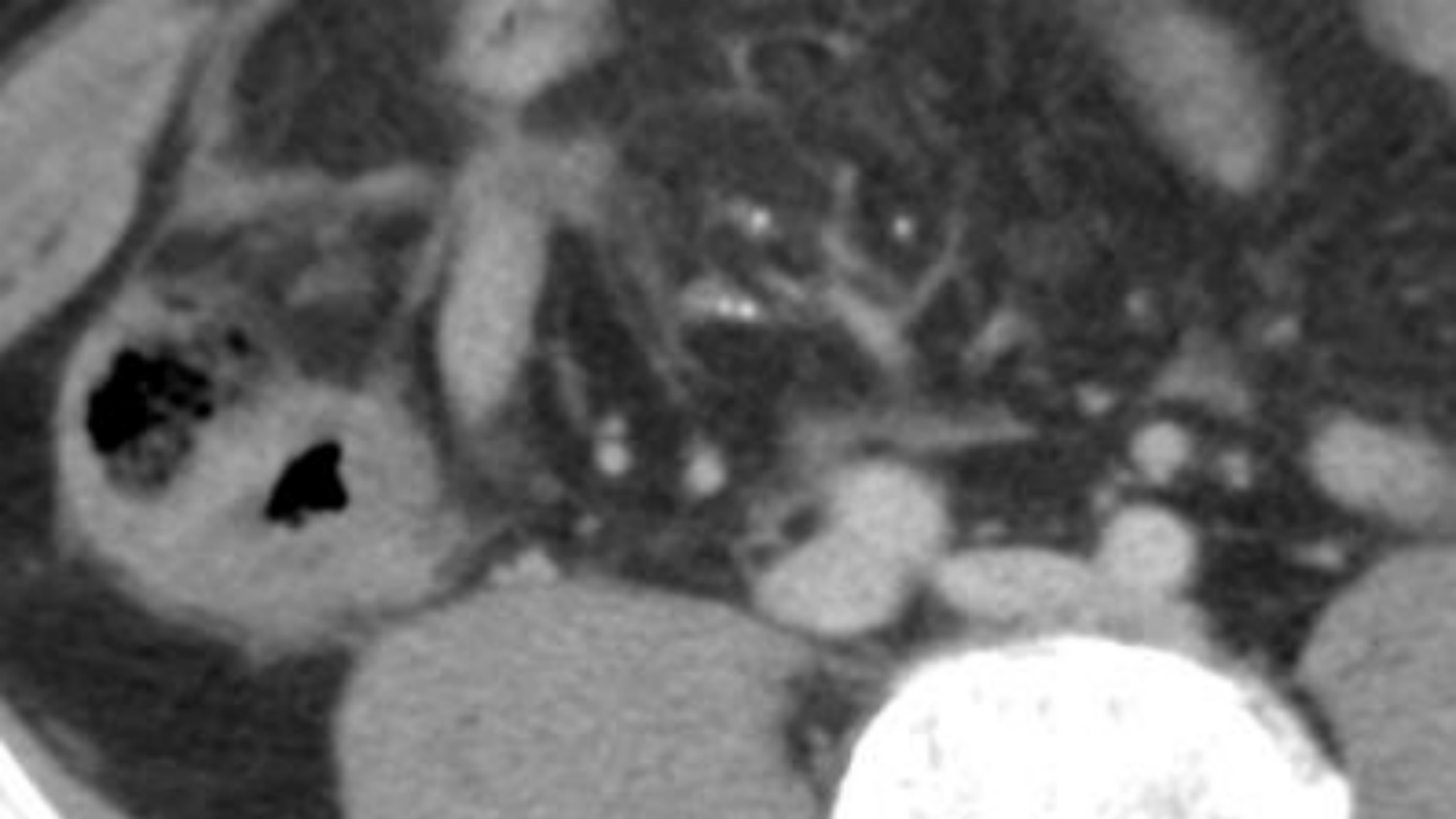
Table Major CT Signs of Surgical Mesenteric or Bowel Injury or Both in Blunt Trauma

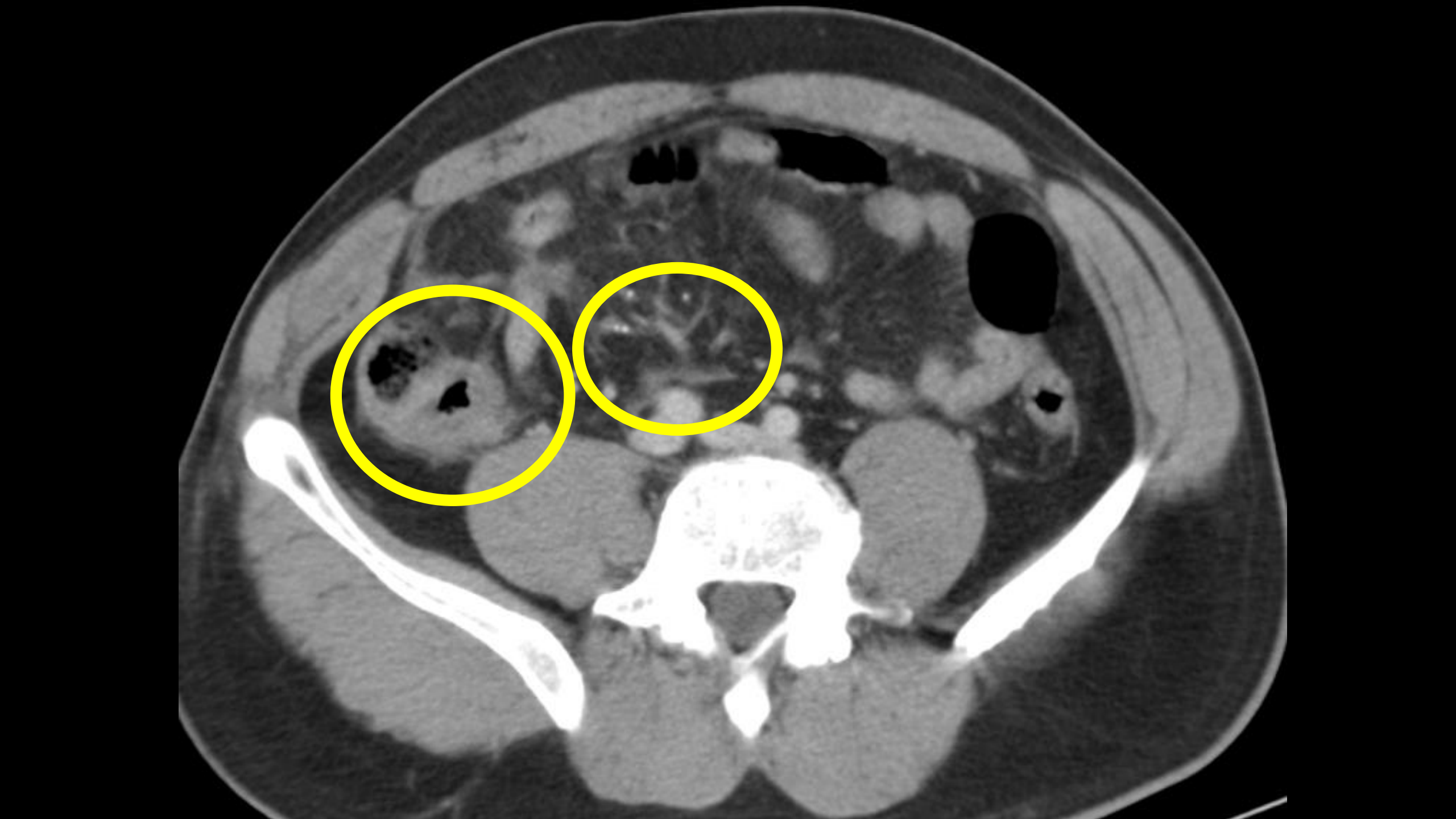
CT Finding	Sensitive (%)	Specificity (%)
Visible transmural defect[1,21,22,24,27-29]	5-34	100
Extraluminal gas[1,15,21,22,27,29]	20-30	95-99
Enteric contrast extravasation[1,21,22]	6-15	100
Small bowel wall thickening[21,22]	45-55	76
Large bowel wall thickening[21,22]	18-19	97
Abnormal bowel wall enhancement[1,21,22,27,29]	8-15	90*
IV contrast extravasation[1,5,21,22,24,27,29,34]	17-36	99-100
Vascular occlusion or thrombosis[1,21,22,24,29]	10-45	93-99
Beading of mesenteric vessels[21,22,24,29]	10-50	95-99
Mesenteric infiltration[1,2,21,29]	55-77	40-90
Mesenteric fluid[†,22]	84	66
Mesenteric hematoma[21,22,26,29]	45 or less	81-94
Intraperitoneal free fluid[1,2,21,22,27,36]	90-100	15-26
Overall[9]	70-95	92-100

*For reduced or absent bowel wall enhancement, specificity is higher, up to 99%.

†Sensitivity and specificity are given for either mesenteric infiltration or fluid.

Semin Ultrasound CT MRI 39:363-373





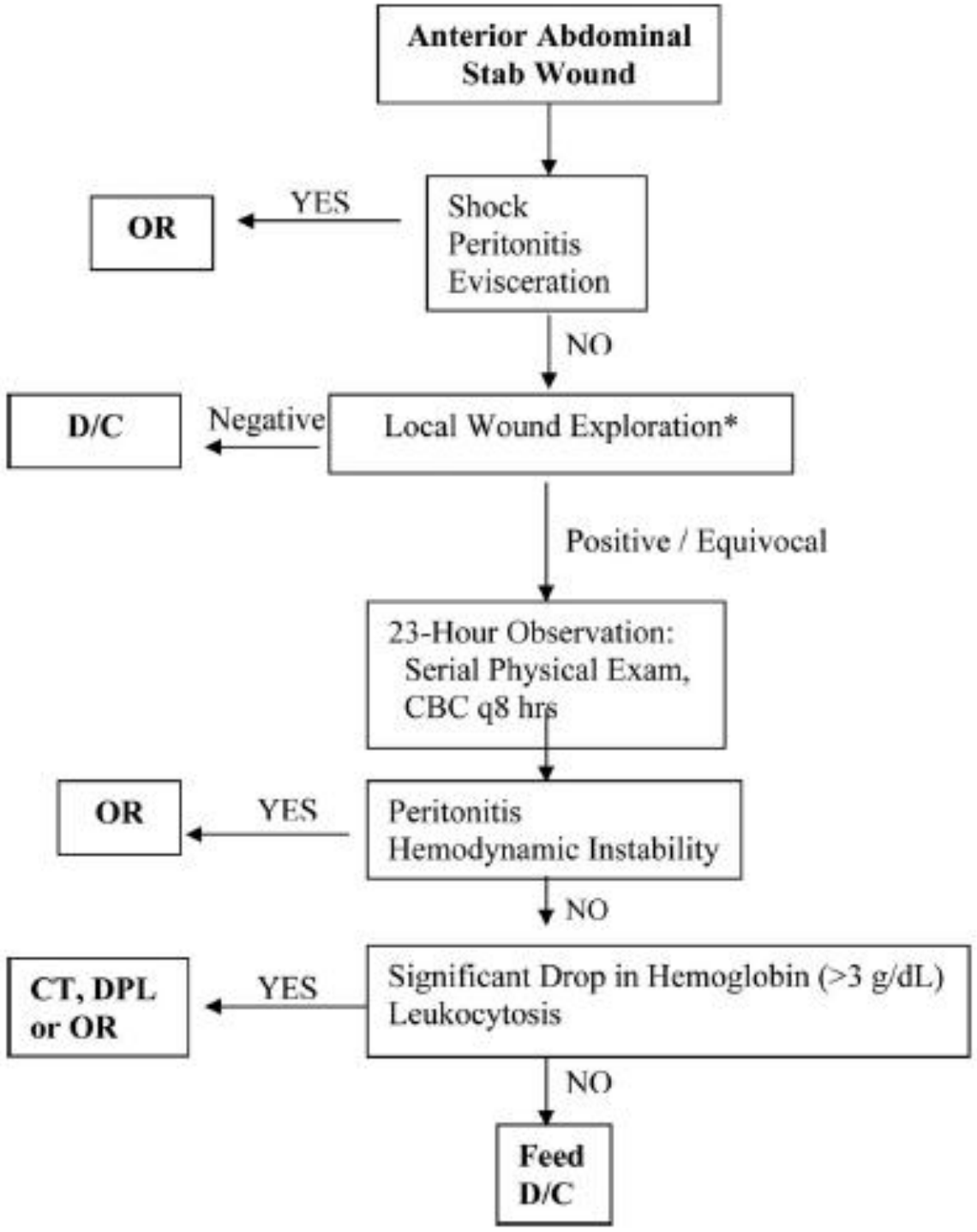
Surgical observation in hollow viscus injury patients

The Journal of TRAUMA® Injury, Infection, and Critical Care

Management of Patients With Anterior Abdominal Stab Wounds: A Western Trauma Association Multicenter Trial

Walter L. Biffl, MD, Krista L. Kaups, MD, C. Clay Cothren, MD, Karen J. Brasel, MD, Rochelle A. Dicker, MD, M. Kelley Bullard, MD, James M. Haan, MD, Gregory J. Jurkovich, MD, Paul Harrison, MD, Forrest O. Moore, MD, Martin Schreiber, MD, M. Margaret Knudson, MD, and Ernest E. Moore, MD

J Trauma 2009


Anterior Abdominal Stab Wound
Shock
Peritonitis
Evisceration
YES
OR
NO
Local Wound Exploration*
Negative
D/C
Positive / Equivocal
23-Hour Observation:
Serial Physical Exam,
CBC q8 hrs
Peritonitis
Hemodynamic Instability
YES
OR
NO
Significant Drop in Hemoglobin (>3 g/dL)
Leukocytosis
YES
CT, DPL or OR
NO
Feed
D/C

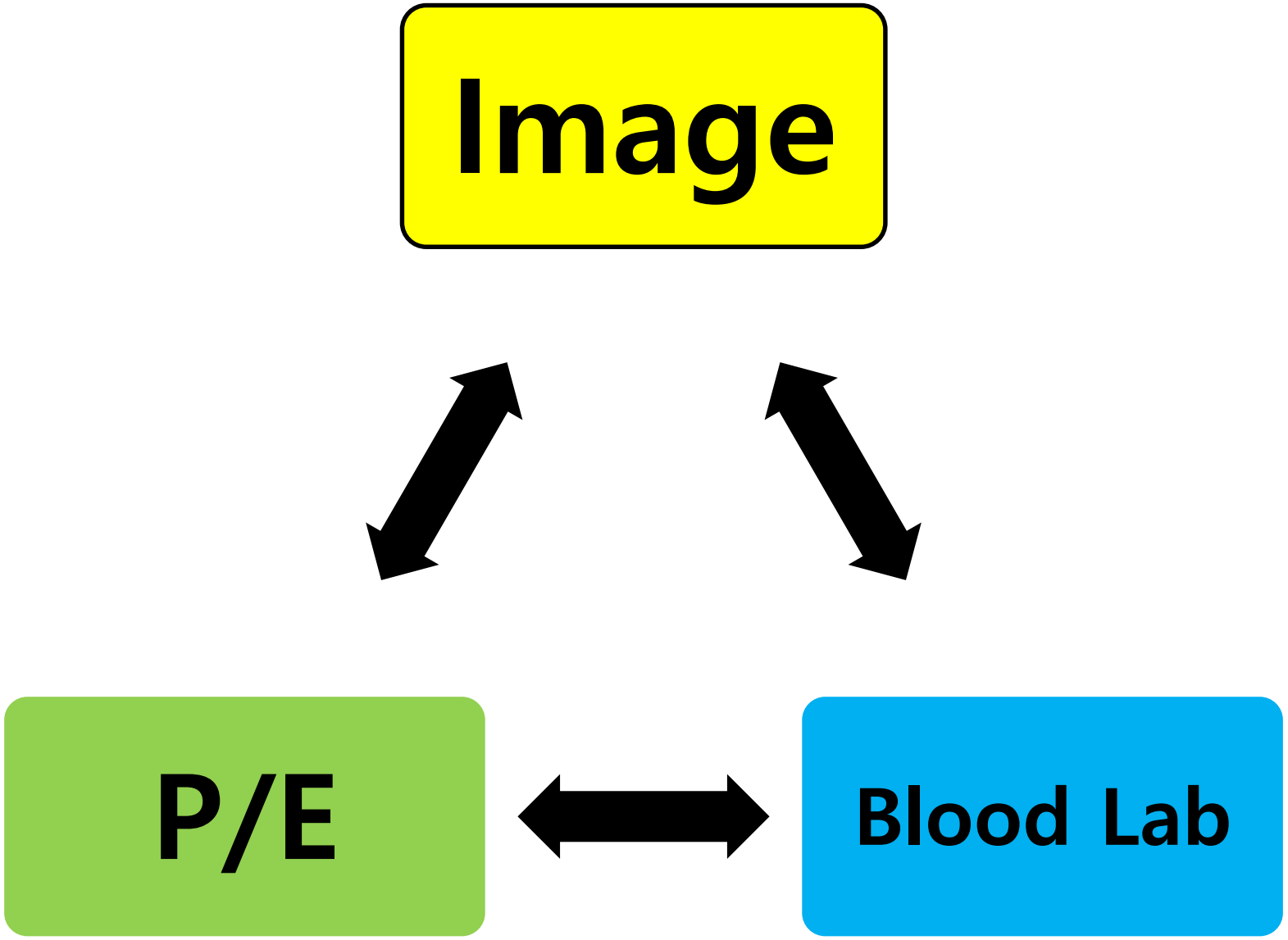


Image
P/E
Blood Lab

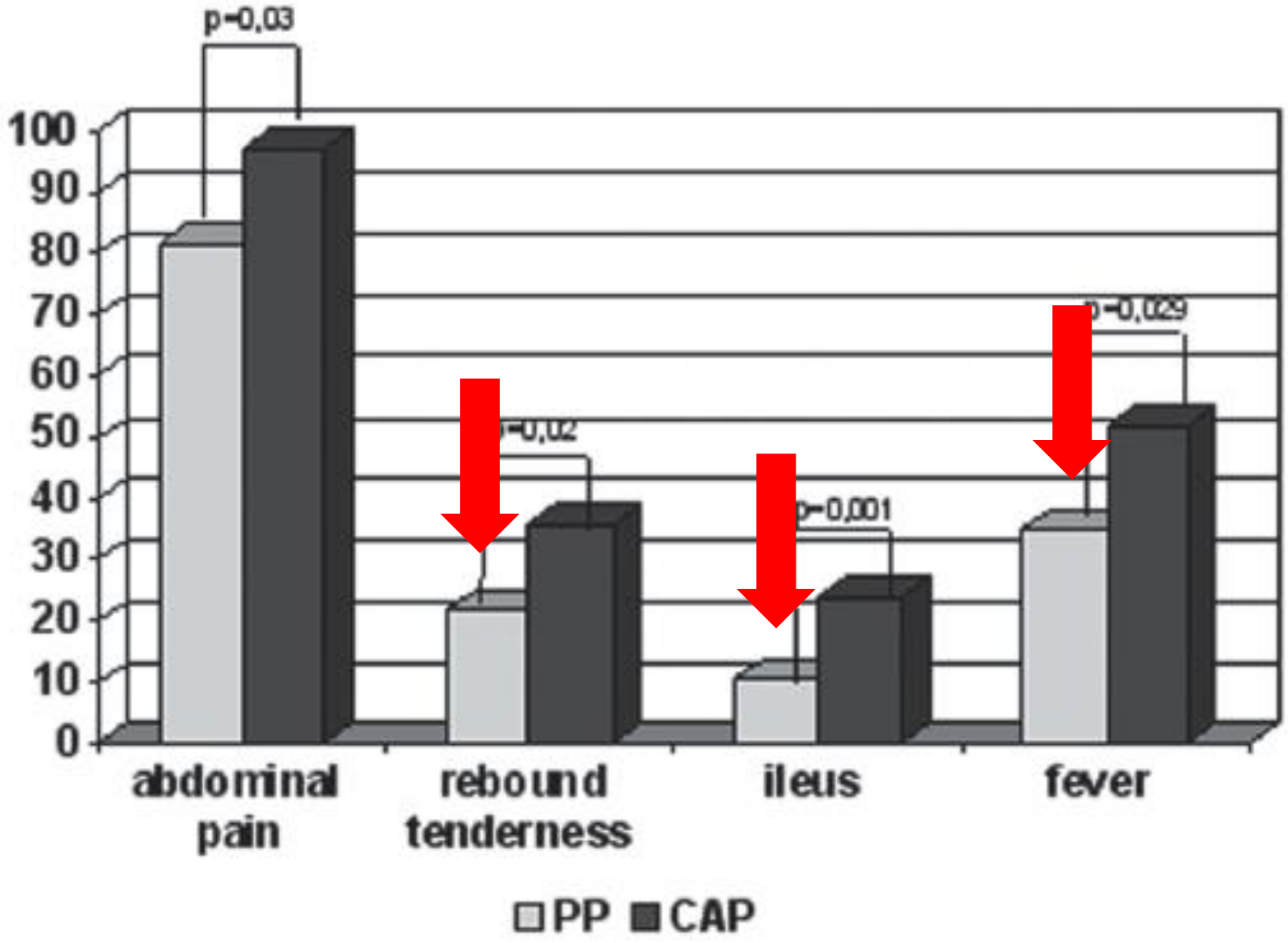
Eur J Med Res (2009) 14: 491-496

Diffuse Postoperative Peritonitis – Value of Diagnostic Parameters and Impact of Early Indication for Relaparotomy

F. G. Bader[1,2], M. Schröder[1], P. Kujath[1], E. Muhl[1,3], H.-P. Bruch[1], C. Eckmann[1]

[1]Department of Surgery, University of Schleswig-Holstein, Campus Lübeck, Lübeck, Germany
[2]Karolinska Institutet, Karolinska Biomics Center (KBC), Stockholm, Sweden
[3]Department of Surgery, Intensive Care Unit, University of Schleswig-Holstein, Campus Lübeck, Lübeck, Germany

Eur J Med Res 2009



PP : postoperative peritonitis

Eur J Med Res 2009

What is the most dreadful surgical complication after hollow viscus surgery?

Anastomosis(or primary repair site) leakage

Incidence of Anastomosis leakage

	Hollow Viscus Repairs (n = 222)			
	Stomach (n = 43)	Duodenum (n = 12)	Small Bowel (n = 101)	Colon (n = 66)
Breakdown (n)	0	4	4	3
Incidence (%)	0	33	3.9	4.8

Behrman et al. J Trauma 1998

Clinical presentations of anastomosis leakage

- Mean clinical presentation time
  - **6~12 days** *(Hyman N. et al. Ann Surg 2007)*
- Fever
- Sepsis
- Ileus
- Abdominal pain
- Abdominal tenderness/rebound tenderness

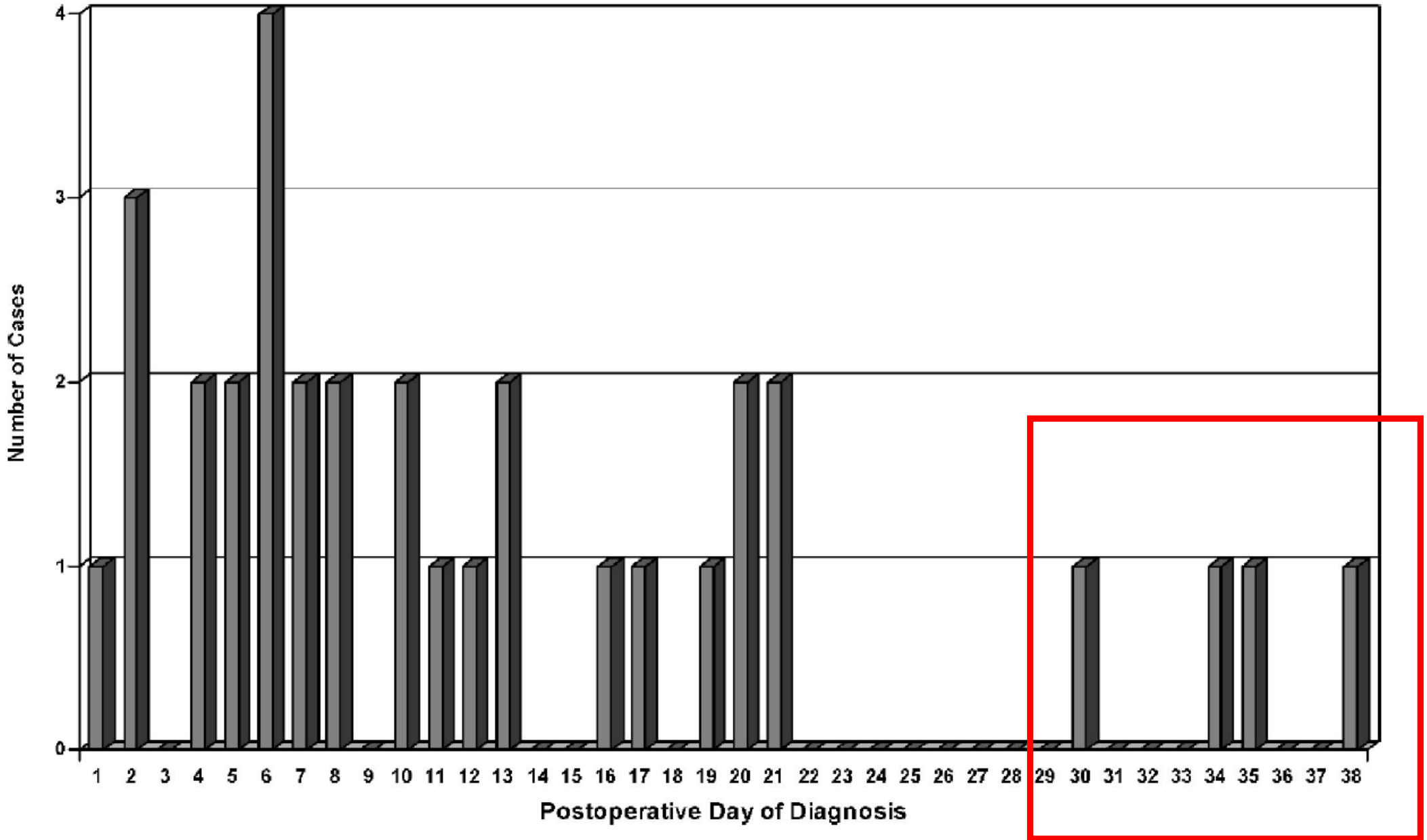


FIGURE 2. Leak by day of diagnosis.

Hyman N. et al. Ann Surg 2007

Detection of anastmosis leakage

- Drain
  - Bowel contents
  - Tirbidity
  - Foul ordor
- Sx & sign of peritonitis
  - Fever
  - Abdominal tenderness/rebound tenderness
- Lab
  - WBC
  - CRP
  - PCT
- Radiologic study

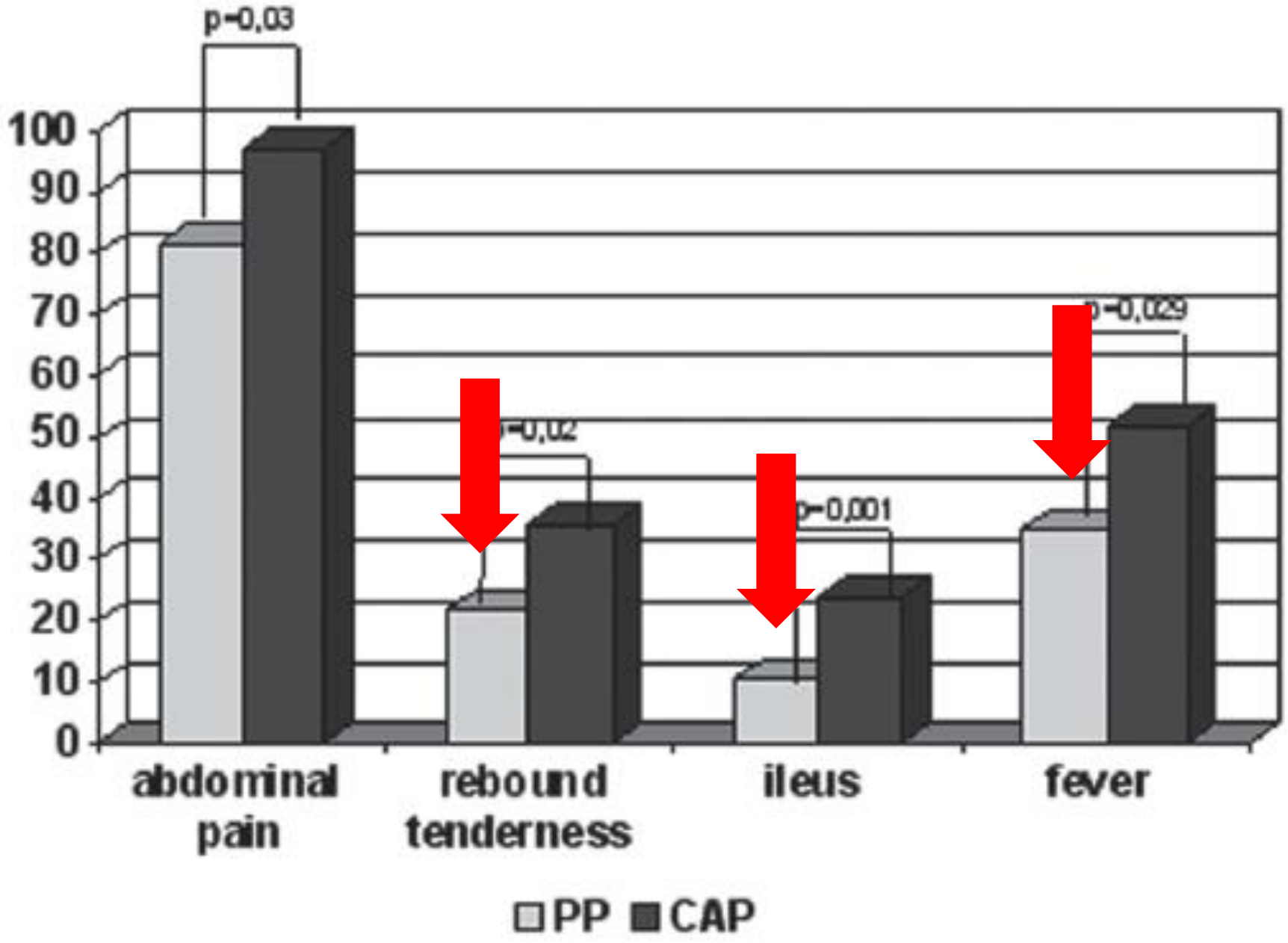
Eur J Med Res (2009) 14: 491-496

Diffuse Postoperative Peritonitis – Value of Diagnostic Parameters and Impact of Early Indication for Relaparotomy

F. G. Bader[1,2], M. Schröder[1], P. Kujath[1], E. Muhl[1,3], H.-P. Bruch[1], C. Eckmann[1]

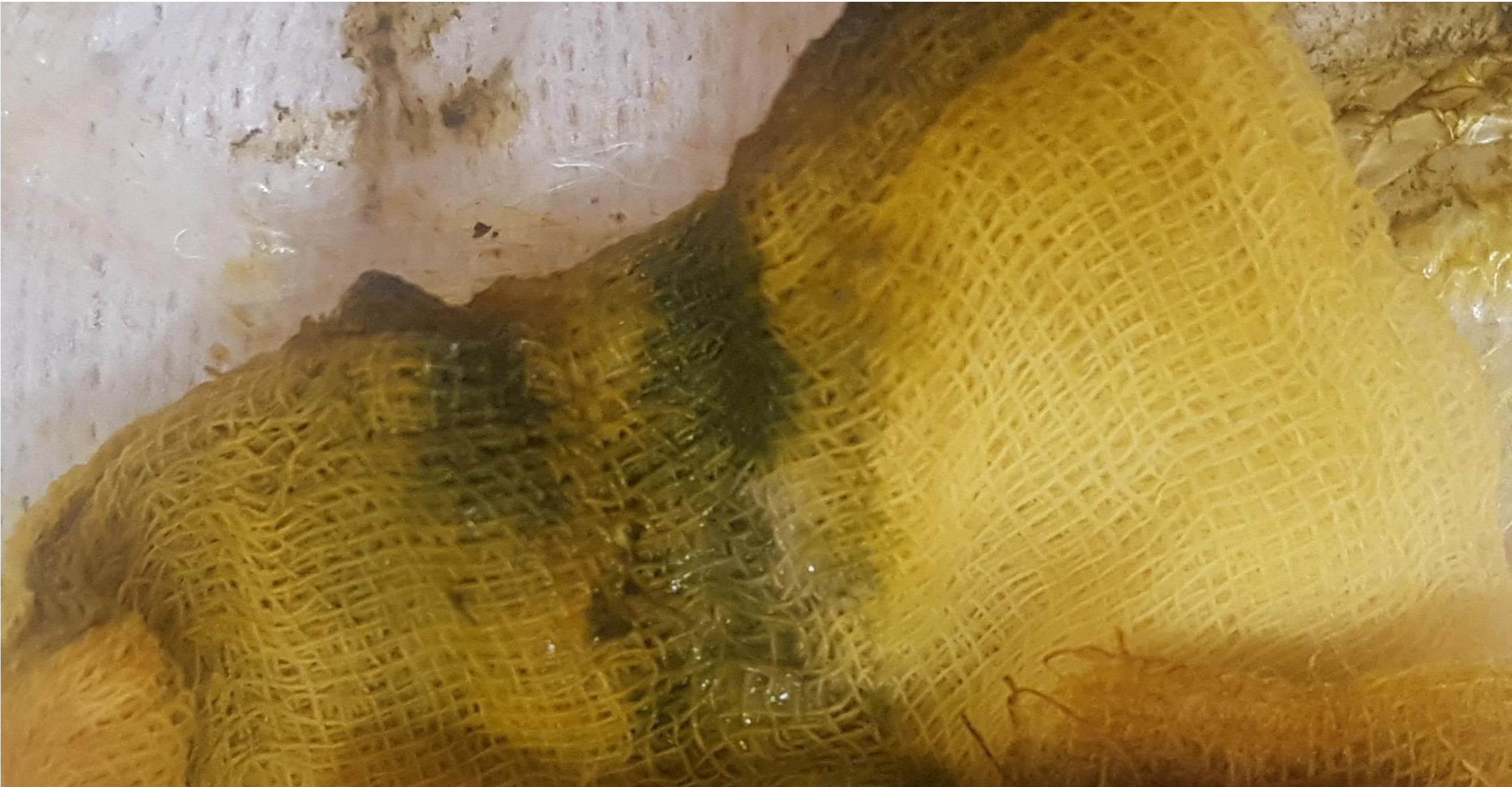
[1]Department of Surgery, University of Schleswig-Holstein, Campus Lübeck, Lübeck, Germany
[2]Karolinska Institutet, Karolinska Biomics Center (KBC), Stockholm, Sweden
[3]Department of Surgery, Intensive Care Unit, University of Schleswig-Holstein, Campus Lübeck, Lübeck, Germany

Eur J Med Res 2009



PP : postoperative peritonitis

Eur J Med Res 2009



World J Surg (2017) 41:56–63
DOI 10.1007/s00268-016-3648-1

World Journal of Surgery

CrossMark

ORIGINAL SCIENTIFIC REPORT

Natural History of Pneumoperitoneum After Laparotomy: Findings on Multidetector-Row Computed Tomography

Brice Malgras[1,5] · Vinciane Placé[2] · Anthony Dohan[2,3] · Réa Lo Dico[1,3] · Sandrine Duron[4] · Philippe Soyer[2,3] · Marc Pocard[1,3]

World J Surg 2017

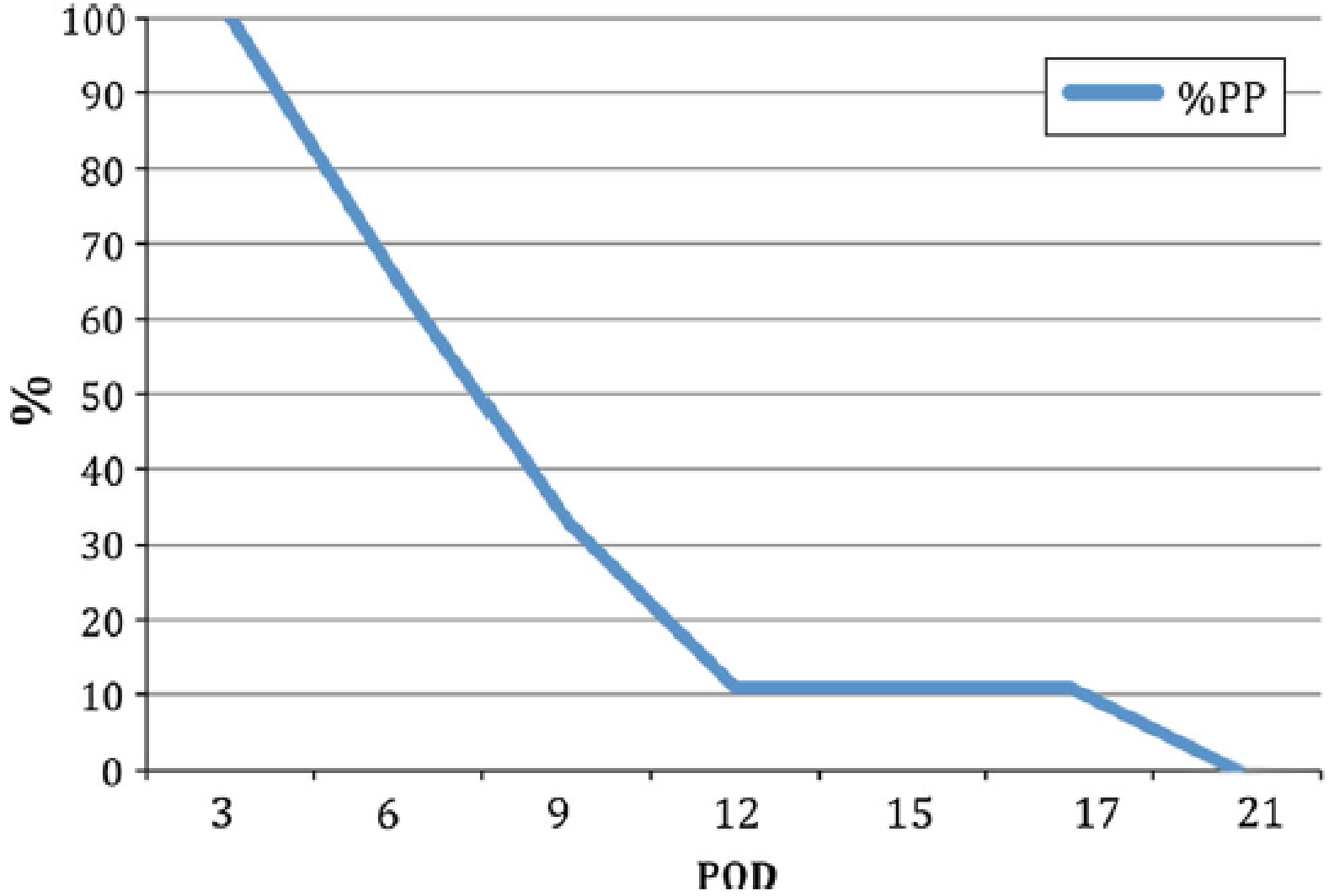


Fig. 1 Evolution of postoperative pneumoperitoneum in 80 patients with uneventful postoperative course after laparotomy. *PP* postoperative pneumoperitoneum, *POD* postoperative day, % percentage

How to detect in preclinical stage?

ORIGINAL ARTICLE

Validation of a score for the early diagnosis of anastomotic leakage following elective colorectal surgery

G. Martin*, A. Dupré, A. Mulliez, F. Prunel, K. Slim, D. Pezet

Service de chirurgie digestive, CHU Estaing 1, place Lucie-Aubrac, 63003 Clermont-Ferrand, France

Available online 7 January 2015

J Visc Surg 2015

Table 1 Calculation of the DULK-score every 24 h.

Temperature > 38°C	1 point
Pulse rate > 100	1 point
Respiratory rate > 30/min	1 point
Oliguria (diuresis < 700 mL/d)	1 point
Agitation or lethargy	2 points
Clinical deterioration	2 points
Ileus	2 points
Gastroparesia	2 points
Evisceration	2 points
Abdominal or parietal pain	2 points
Elevated WBC count (10^3/mL) or CRP (mg/L) > 5%	1 point
Elevation blood creatinine or urea > 5%	1 point
Enteral nutrition tube	1 point
OR	
Parenteral nutrition	2 points

WBC: white blood cell; CRP: C-reative protein.
If the patient requires enteral alimentation in addition to parenteral alimentation, only enteral alimentation is counted, i.e. one point.

Systematic review

Systematic review of the role of biomarkers in diagnosing anastomotic leakage following colorectal surgery

B. U. Su'a[1], H. L. Mikaere[1], J. L. Rahiri[1], I. B. Bissett[2] and A. G. Hill[1,3]

[1]Department of Surgery, South Auckland Clinical Campus, Middlemore Hospital, University of Auckland, [2]Department of Surgery, University of Auckland, and [3]Department of General Surgery, Middlemore Hospital, Counties Manukau District Health Board, Auckland, New Zealand

Correspondence to: Dr B. Su'a, South Auckland Clinical Campus, University of Auckland c/o Middlemore Hospital, Private Bag 93311, Otahuhu, Auckland, New Zealand (e-mail: b.sua@auckland.ac.nz)

BJS 2017

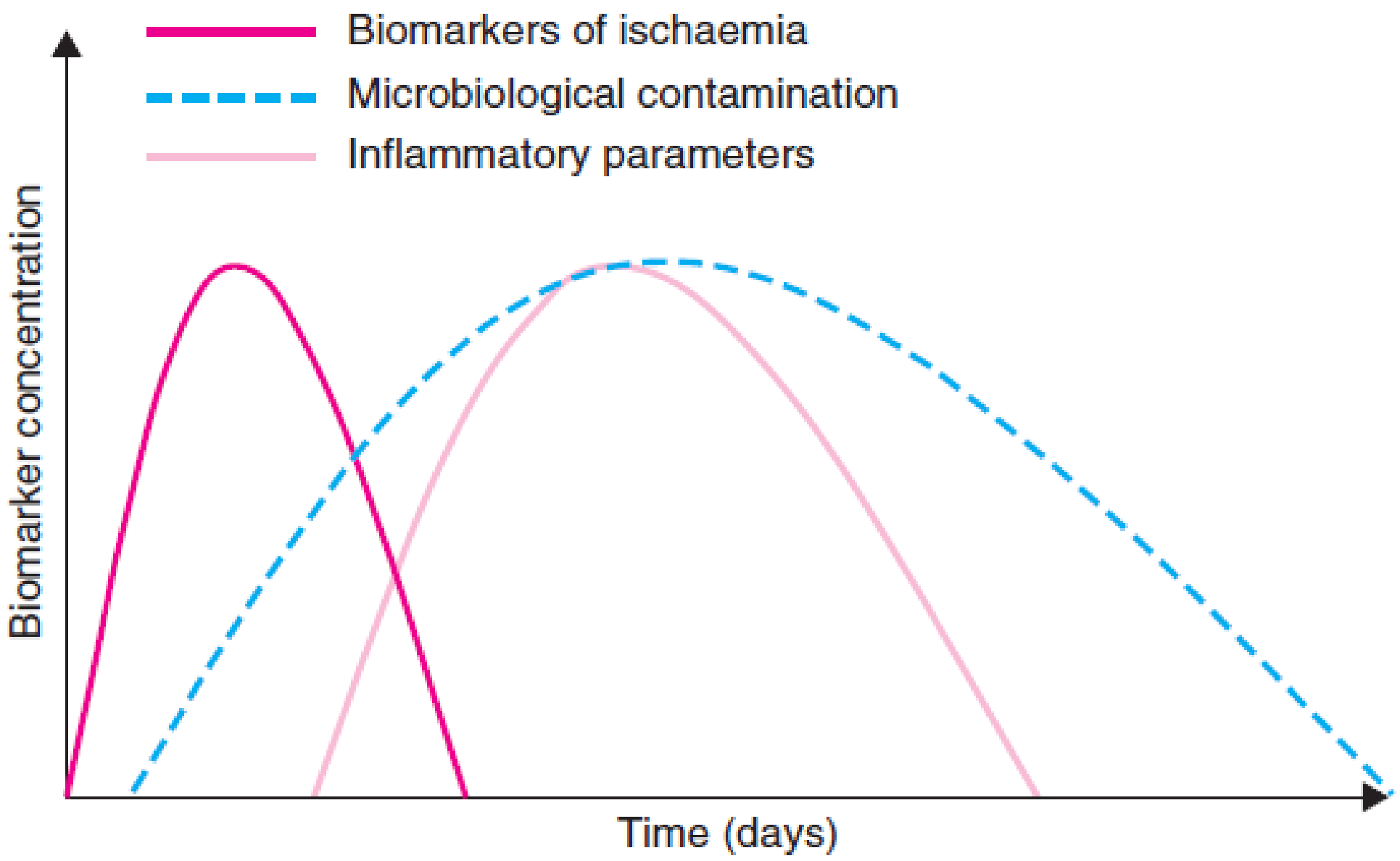
Table 1 Summary of included studies evaluating intraperitoneal biomarkers

Reference	Study design	Study period	Elective (%)	Open approach (%)	Operation for cancer (%)	*n*	AL rate (%)	Biomarker(s)	Biomarker study method
Alonso *et al.*[22]	Prospective matched	3 years	100	87	100	280	10·7	IL-6, VEGF	ELISA
Bertram *et al.*[23]	Prospective	6 months	100	100	100	25	12	IL-6, TNF-α	Chemiluminescence immunometric assay
Ellebaek Pederson *et al.*[24]	Prospective	–	–	100	100	45	9	Lactate, pyruvate, glucose, glycerol	Peritoneal microdialysis
Fouda *et al.*[25]	Prospective	33 months	100	–	100	56	14	IL-6, IL-10 TNF-α *Klebsiella*, *Escherichia coli*, *Pseudomonas* spp.	ELISA for cytokines Culture for microbiology
Herwig *et al.*[26]	Prospective matched	13 months	100	–	38	24	50 (matched)	IL-1β, IL-6, TNF-α	ELISA
Junger *et al.*[27]	Prospective randomized	–	–	–	100	43	19	Lysozyme	Testomar™ lysozyme kit
Komen *et al.*[28]	Prospective	35 months	100	62	84	243	7·8	CRP, LBP, PCT	LBP: IMMULITE 1000 CRP: Tina-quant assay PCT: LUMI-test PCT
Komen *et al.*[29]	Prospective	2 years	100	62	84	243	7·8	*E. coli* *Enterococcus faecalis*	PCR
Kostic *et al.*[30]	Prospective	19 months	100	–	100	150	10	MMP-9	ELISA
Matthiessen *et al.*[31]	Prospective	23 months	100	–	100	23	30	Glucose, pyruvate, lactate, IL-6, IL-10, TNF-α	Enzyme-labelled chemiluminescent sequential immunometric assay
Pasternak *et al.*[16]	Prospective	31 months	–	10	100	29	34	MMP-1, MMP-2, MMP-3, MMP-7, MMP-8, MMP-9, MMP-13, TIMP-1, TIMP-2	MMPs: particle-based flow cytometry using F-MAP kits TIMP-1 and TIMP-2: ELISA
Sammour *et al.*[32]	Prospective	7 years	100	–	65	206	8·3	IL-6, IL-10, TNF-α	ELISA
Ugras *et al.*[33]	Prospective	12 months	100	–	100	34	12	IL-6, IL-10, TNF-α	ELISA
Yamamoto *et al.*[34]	Prospective	–	100	100	100	100	7	IL-1β, IL-6, TNF-α	ELISA
Yang *et al.*[35]	Retrospective	7 years	–	88	100	753	7·6	pH levels	pH meter pp-15

BJS 2017

Reference	Study design	Study duration	Elective (%)	Open approach (%)	Colonic operation (%)	Operation for cancer (%)	*n*	AL rate (%)	Biomarker(s)
Almeida *et al.*[36]	Retrospective	22 months	95	82	80	75	173	13·9	CRP
Alonso *et al.*[22]	Prospective matched	3 years	100	87	80	100	280	10·7	IL-6, VEGF
Ellebaek *et al.*[37]	Prospective matched	–	100	100	0	100	50	8	Granulocyte–macrophage colony-stimulating factor, interferon-γ, IL-1, IL-1β, IL-2, IL-5, IL-6, IL-8, IL-10, TNF-α, mannin-binding lectin, membrane attack complex
Facy *et al.*[38]	Prospective	29 months	100	70·3	73·6	69·5	510	11·5	CRP, PCT
Garcia-Granero *et al.*[39]	Prospective	17 months	100	79	58·5	73·2	205	5·4	CRP, PCT, neutrophils
Giaccaglia *et al.*[40]	Prospective	21 months	100	25	65	100	504	5·6	CRP, PCT
Giaccaglia *et al.*[41]	Prospective	12 months	100	88	76	94	101	8·9	CRP, PCT, WCC
Iancu *et al.*[3]	Retrospective	4 years	77	–	100	100	993	3·2	Protein, haemoglobin
Iversen *et al.*[42]	Prospective matched	21 months	100	100	0	–	161	10·6	Prothrombin fragment 1 + 2, thrombin antithrombin complex, soluble fibrin, tPA, PAI-1
Kaser *et al.*[43]	Retrospective	60 months	–	–	–	43	1106	7·3	Na^+, WCC
Korner *et al.*[44]	Retrospective	12 months	77	76	–	63	201	8·9	CRP, WCC
Kostic *et al.*[30]	Prospective	20 months	100	–	56·7	100	150	10	CRP
Lagoutte *et al.*[8]	Prospective	13 months	100	65	68	55	100	13	CRP, PCT
Matthiessen *et al.*[2]	Prospective	19 months	100	–	0	97	33	27	CRP, WCC
Ortega-Deballon *et al.*[45]	Prospective	11 months	100	88	42	61·7	133	15·5	CRP, WCC
Pedersen *et al.*[46]	Retrospective	12 months	–	0	78	–	129	18	CRP, WCC
Platt *et al.*[47]	Retrospective	10 years	87	100	66·1	100	454	5·7	CRP, albumin, WCC
Ramanathan *et al.*[48]	Prospective	7 years	100	92	63	100	357	3·9	CRP
Reisinger *et al.*[49]	Prospective	26 months	100	57	77	100	84	10	CRP, calprotectin, IL-6, fatty acid-binding proteins
Slotwinski *et al.*[50]	Prospective matched	–	100	–	32	100	22	9	IL-1α, IL-1β, IL-1ra, IL-6, IL-8, IL-10, TNF-α, soluble TNF receptor 1
Sammour *et al.*[32]	Prospective	7 years	100	–	–	65	206	8·3	IL-6, IL-10, TNF-α
Warschkow *et al.*[51]	Retrospective	12 years	91·8	100	33·4	100	1115	8	CRP, WCC
Welsch *et al.*[52]	Retrospective	4 years	–	100	0	100	96	6	CRP, WCC, platelets
Woeste *et al.*[53]	Retrospective	3 years	88	72·8	83·6	48	342	7·6	CRP, WCC

BJS 2017


Biomarkers of ischaemia
Microbiological contamination
Inflammatory parameters
Biomarker concentration
Time (days)

BJS 2017

Conclusion

- **Peritoneal drain fluid and systemic biomarkers are poor predictors of AL after colorectal surgery. Combinations of these biomarkers showed improvement in predictive accuracy**

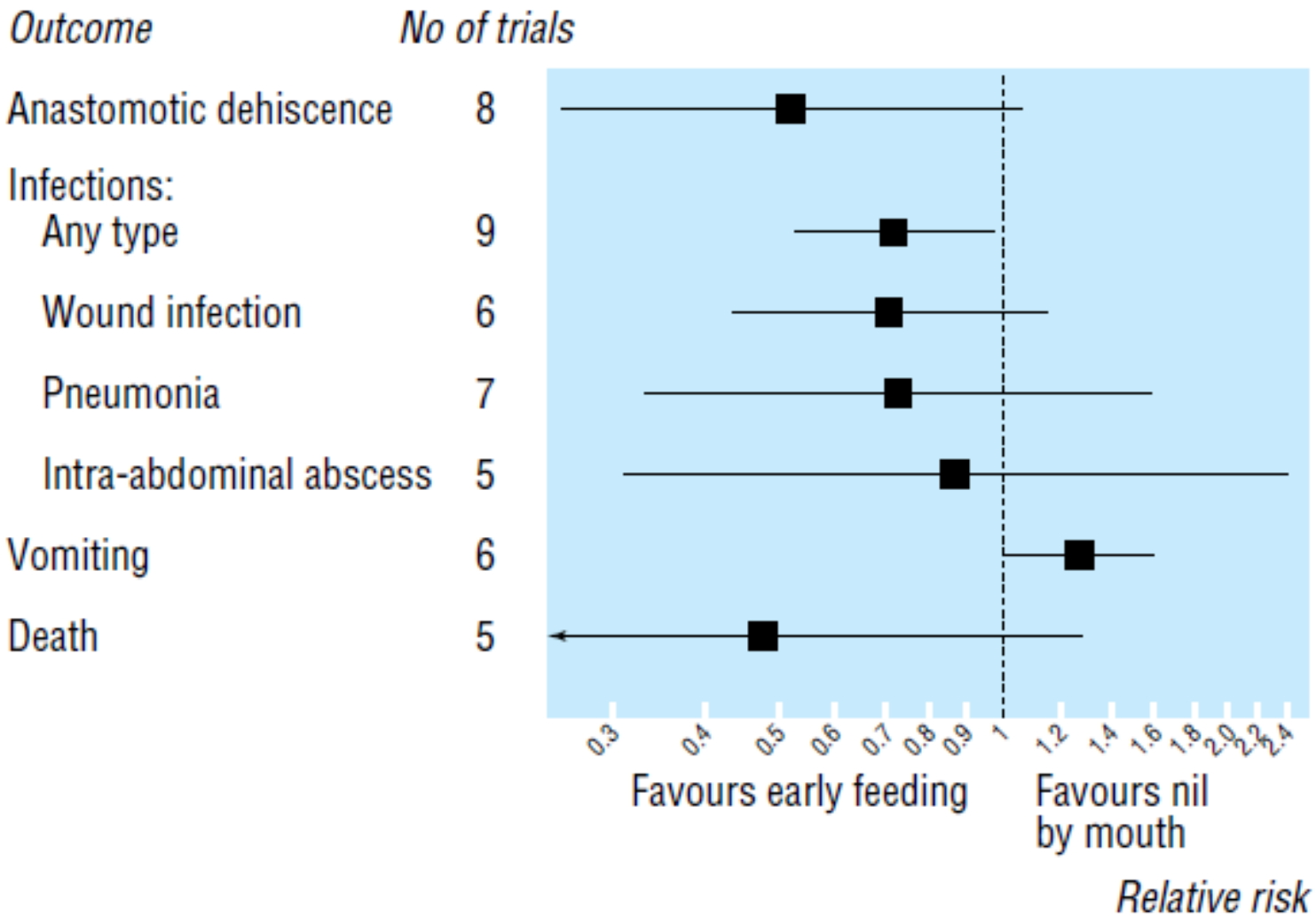
How to prevent anastomosis leakage?

Early feeding issue

Early enteral feeding versus “nil by mouth” after gastrointestinal surgery: systematic review and meta-analysis of controlled trials

Stephen J Lewis, Matthias Egger, Paul A Sylvester, Steven Thomas Topic: 33;92;153;299

BMJ 2001



Risk of anastomotic dehiscence, infections, vomiting, and death after elective gastrointestinal surgery: results from meta-analyses of randomised trials comparing early enteral feeding with regimen of nil by mouth

Cochrane Library

Cochrane Database of Systematic Reviews

Early enteral nutrition within 24 hours of lower gastrointestinal surgery versus later commencement for length of hospital stay and postoperative complications (Review)

Herbert G, Perry R, Andersen HK, Atkinson C, Penfold C, Lewis SJ, Ness AR, Thomas S

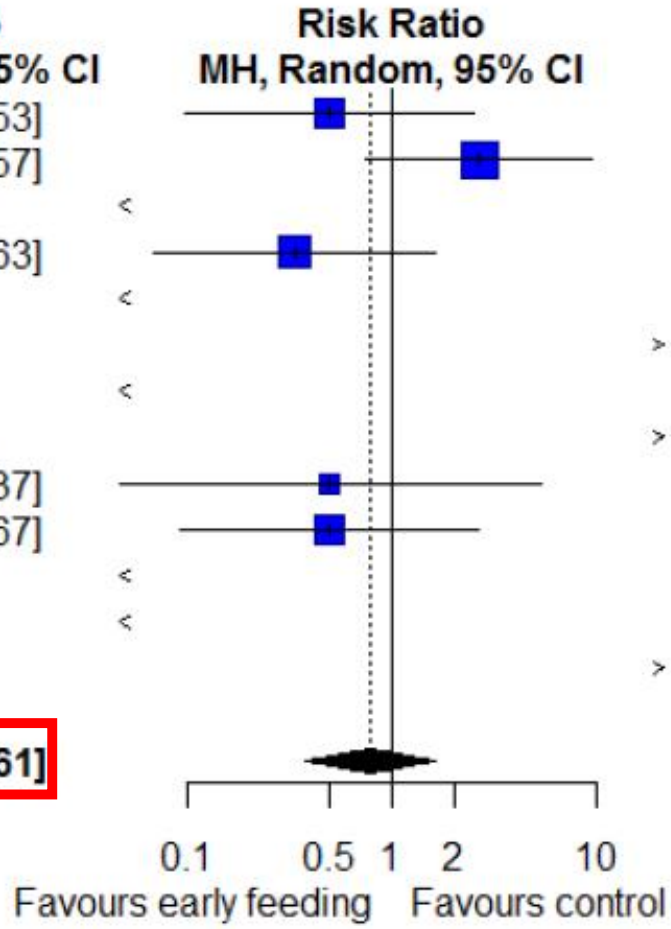
Cochrane 2018

Figure 10. Comparison: 1 Early enteral nutrition versus later commencement after gastrointestinal surgery, Outcome: 5 Anastomotic leakage

Study	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Risk Ratio MH, Random, 95% CI
Beier-Holgersen 1996	2	30	4	30	19.7%	0.50 [0.10; 2.53]
Chatterjee 2012	8	60	3	60	31.7%	2.67 [0.74; 9.57]
Da Fonseca 2011	0	24	4	26	0.0%	0.00
Dag 2011	2	99	6	100	20.9%	0.34 [0.07; 1.63]
Hartsell 1997	0	29	1	29	0.0%	0.00
Lucha 2005	1	26	0	25	0.0%	Inf
Minig 2009	0	18	3	22	0.0%	0.00
Mulrooney 2004	3	36	0	37	0.0%	Inf
Nakeeb 2009	1	60	2	60	9.2%	0.50 [0.05; 5.37]
Ortiz 1996	2	95	4	95	18.5%	0.50 [0.09; 2.67]
Reissman 1995	0	80	1	81	0.0%	0.00
Sagar 1979	0	15	1	15	0.0%	0.00
Stewart 1998	1	40	0	40	0.0%	Inf
Total (95% CI)	**20**	**612**	**29**	**620**	**100.0%**	**0.78 [0.38; 1.61]**

Heterogeneity: $Tau^2 = 0$; $Chi^2 = 5.43$, df = 12 (P = 0.94); $I^2 = 0\%$

Test for overall effect: Z = -0.67 (P = 0.51)



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https://doi.org/10.1007/s00268-018-4844-y

World Journal of Surgery

CrossMark

SCIENTIFIC REVIEW

Guidelines for Perioperative Care in Elective Colorectal Surgery: Enhanced Recovery After Surgery (ERAS®) Society Recommendations: 2018

U. O. Gustafsson[1] · M. J. Scott[2,3] · M. Hubner[4] · J. Nygren[5] · N. Demartines[4] · N. Francis[6,7] · T. A. Rockall[8] · T. M. Young-Fadok[9] · A. G. Hill[10] · M. Soop[11] · H. D. de Boer[12] · R. D. Urman[13] · G. J. Chang[14] · A. Fichera[15] · H. Kessler[16] · F. Grass[4] · E. E. Whang[17] · W. J. Fawcett[18] · F. Carli[19] · D. N. Lobo[20] · K. E. Rollins[20] · A. Balfour[21] · G. Baldini[19] · B. Riedel[22] · O. Ljungqvist[23]

World J Surg 2019

ERAS® Society

ABOUT | NEWS | NATIONAL | SPECIALTIES | PATIENT INFO | OUR OFFER

ERAS / SPECIALTIES / COLORECTAL

Colorectal

ERAS Society initiated its work with colorectal resections and the recommendations and guidelines have been updated three times since the start in 2005. There have been several publications from this group over the years and we continue to develop the protocols and guidance and drive ERAS forward not least by involvement in implementation programs in many countries.

In the postoperative phase, patients undergoing ERAS can drink immediately after recovery from anaesthesia and then eat normal hospital food

OPEN

Effects of Early Enteral Nutrition on Patients After Emergency Gastrointestinal Surgery

A Propensity Score Matching Analysis

Seung Hwan Lee, MD, Ji Young Jang, MD, Hyung Won Kim, MD, Myung Jae Jung, MD, and Jae Gil Lee, MD, PhD

Medicine 2014

TABLE 1. Baseline Characteristics of the Total Population and Matched Population

	Total Population			Propensity Matched Population		
Characteristic	**EEN (N = 77)**	**LEN (N = 407)**	***P* Value**	**EEN (N = 67)**	**LEN (N = 67)**	***P* Value**
Age, y	64 (50–75)	61 (50–71)	0.377	62 (49–74)	66 (54–74)	0.232
Sex, N (%)			0.765			0.859
M:F	50 (64.9): 27 (35.1)	257 (63.1): 150 (36.9)		41 (61.2): 26 (38.8)	42 (62.7): 25 (37.3)	
Body weight, kg	58.0 (49.6–67.3)	60.0 (53.1–66.4)	0.348	60.0 (55.0–65.0)	60.0 (54.0–68.0)	0.616
BMI, kg/m^2	21.7 (20.0–23.8)	22.2 (20.1–24.2)	0.567	22.0 (20.9–23.8)	22.8 (20.8–24.6)	0.265
ASA score	3 (2–3)	3 (2–3)	0.525	3 (2–3)	3 (2–3)	0.619
APACHE II score	18 (15–23)	17 (14–24)	0.482	19 (16–24)	19 (15–26)	0.997
Diagnosis, N (%)			0.131			0.294
Perforation	56 (72.7)	327 (80.3)		50 (74.6)	55 (82.1)	
Obstruction/strangulation	21 (27.3)	80 (19.7)		17 (25.4)	12 (17.9)	
Location of lesion, N (%)			0.679			0.833
Stomach and duodenum	18 (23.4)	115 (28.3)		18 (26.9)	15 (22.4)	
Small bowel	27 (35.1)	134 (32.9)		22 (32.8)	23 (34.3)	
Colon and rectum	32 (41.5)	158 (38.8)		27 (40.3)	29 (43.3)	
Stoma, N (%)	29 (37.7)	128 (31.4)	0.286	23 (34.3)	24 (35.8)	0.856
Postoperative shock, N (%)	14 (18.2)	71 (17.4)	0.876	13 (19.4)	8 (11.9)	0.235
Feeding routes, N (%)			0.007			0.274
Gastric: postpyloric	70 (90.9): 7 (9.1)	396 (97.3): 11 (2.7)		61 (91.0): 6 (9.0)	65 (97.0): 2 (3.0)	
Parenteral nutrition, N (%)	54 (70.1)	377 (92.6)	0.001	54 (80.6)	54 (80.6)	1.000
Achieving goal calorie, N (%)			0.824			0.531
<80%:≥80%	8 (10.4):69 (89.6)	38 (9.6):359 (90.4)		7 (6.1):60 (89.6)	4 (6.1):62 (93.9)	

ASA = American Society of Anesthesiologists, APACHE II = acute physiology and chronic health evaluation II, BMI = body mass index, EEN = early enteral nutrition, LEN = late enteral nutrition. Values are expressed as median (interquartile range).

TABLE 3. Outcome Characteristics in the Total Population and Matched Population

	Total Population			Propensity Matched Population		
	EEN (N = 77)	LEN (N = 407)	*P* Value	EEN (N = 67)	LEN (N = 67)	*P* Value
Length of hospital stay, d	16.0 (9.0–27.8)	20.0 (13.0–35.5)	0.006	14.0 (8.0–24.0)	17.0 (11.0–26.0)	0.048
ICU-free days, d	26.0 (18.5–27.0)	25.0 (19.0–26.0)	0.030	27.0 (25.0–27.0)	25.0 (22.0–27.0)	0.042
VFDs, d	27.0 (20.0–28.0)	27.0 (24.0–27.0)	0.274	27.0 (24.0–28.0)	27.0 (24.5–28.0)	0.295
Complications, N (%)						
Anastomotic leakage	4 (5.2)	21 (5.2)	0.990	1 (1.5)	1 (1.5)	1.000
Infectious	5 (6.5)	58 (14.3)	0.064	5 (7.5)	9 (13.4)	0.259
Wound complication	9 (11.7)	57 (14.0)	0.587	8 (11.9)	8 (11.9)	1.000
Newly developed sepsis	1 (1.3)	22 (5.4)	0.120	1 (1.5)	4 (6.0)	0.172
Pulmonary	3 (3.9)	49 (12.0)	0.034	3 (4.5)	13 (19.4)	0.008
Postoperative ileus	2 (2.6)	9 (2.2)	0.835	2 (3.0)	3 (4.5)	0.649
Overall complications, N (%)	28 (36.4)	196 (48.2)	0.057	14 (20.9)	23 (34.3)	0.082
Mortality, N (%)	3 (3.9)	50 (12.3)	0.031	3 (4.5)	13 (19.4)	0.008

EEN = early enteral nutrition, ICU = intensive care unit, LEN = late enteral nutrition, VFDs = ventilator-free days.
Values are expressed as median (interquartile range).

Intensive Care Med (2017) 43:380–398
DOI 10.1007/s00134-016-4665-0

CONFERENCE REPORTS AND EXPERT PANEL

Early enteral nutrition in critically ill patients: ESICM clinical practice guidelines

Annika Reintam Blaser[1,2*], Joel Starkopf[1,3], Waleed Alhazzani[4,5], Mette M. Berger[6], Michael P. Casaer[7], Adam M. Deane[8], Sonja Fruhwald[9], Michael Hiesmayr[10], Carole Ichai[11], Stephan M. Jakob[12], Cecilia I. Loudet[13], Manu L. N. G. Malbrain[14], Juan C. Montejo González[15], Catherine Paugam-Burtz[16], Martijn Poeze[17], Jean-Charles Preiser[18], Pierre Singer[19,20], Arthur R.H. van Zanten[21], Jan De Waele[22], Julia Wendon[23], Jan Wernerman[24], Tony Whitehouse[25], Alexander Wilmer[26], Heleen M. Oudemans-van Straaten[27] and ESICM Working Group on Gastrointestinal Function

ESICM recommendations

- We **suggest** delaying EN if shock is uncontrolled and haemodynamic and tissue perfusion goals are not reached, but **start low dose EN as soon as shock is controlled** with fluids and vasopressors/inotropes (Grade 2D).
- We **suggest** using EEN in patients with **abdominal trauma when the continuity of the GI tract** is confirmed/restored (Grade 2D).
- We **suggest** using EEN in patients **after GI surgery** (Grade 2C).
  - Including emergency op

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American Society for Parenteral and Enteral Nutrition

Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.)

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Volume 40 Number 2
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Stephen A. McClave, MD[1*]; Beth E. Taylor, RD, DCN[2*]; Robert G. Martindale, MD, PhD[3]; Malissa M. Warren, RD[4]; Debbie R. Johnson, RN, MS[5]; Carol Braunschweig, RD, PhD[6]; Mary S. McCarthy, RN, PhD[7]; Evangelia Davanos, PharmD[8]; Todd W. Rice, MD, MSc[9]; Gail A. Cresci, RD, PhD[10]; Jane M. Gervasio, PharmD[11]; Gordon S. Sacks, PharmD[12]; Pamela R. Roberts, MD[13]; Charlene Compher, RD, PhD[14]; and the Society of Critical Care Medicine[†] and the American Society for Parenteral and Enteral Nutrition[†]

Recommendations

- We **suggest** enteral feeding for many patients in difficult postoperative situations such as prolonged ileus**, intestinal anastomosis, open abdomen**, and need of vasopressors for hemodynamic support. Each case **should be individualized** based on perceived safety and clinical judgment.

Contents

Liver injury

GUIDELINE

Nonoperative management of blunt hepatic injury: An Eastern Association for the Surgery of Trauma practice management guideline

Nicole A. Stassen, MD, Indermeet Bhullar, MD, Julius D. Cheng, MD, Marie Crandall, MD, Randall Friese, MD, Oscar Guillamondegui, MD, Randeep Jawa, MD, Adrian Maung, MD, Thomas J. Rohs, Jr, MD, Ayodele Sangosanya, MD, Kevin Schuster, MD, Mark Seamon, MD, Kathryn M. Tchorz, MD, Ben L. Zarzuar, MD, *and* Andrew Kerwin, MD

Level 1

- Hemodynamic unstable➔Operation

Level 2

- No Routine laparotomy **without peritonitis**
- Angioembolization
  - 1st line intervention in transient responder to resuscitation as an adjunct to potential operative intervention
  - Should be considered in hemodynamic stable patients with extravasation on CT scan
- Severity of OIS, neurologic status, age>55 yrs, associate injuries➔ **no absolute contraindication of non operative management**

TABLE 29-1: Liver Injury Scale (1994 Revision)

Grade[a]		Injury description	ICD-9[b]	AIS90[c]
I	Hematoma	Subcapsular, nonexpanding <10 cm surface area	864.01	2
	Laceration	Capsular tear, nonbleeding ≤1 cm parenchymal depth	864.11	2
			864.02	
			864.12	
II	Hematoma	Subcapsular, nonexpanding, 10–50% surface area; intraparenchymal nonexpanding ≤10 in diameter	864.01	2
	Laceration		864.11	2
		Capsular tear, active bleeding; 1–3 cm parenchymal depth <10 cm in length	864.03	
			864.13	
III	Hematoma	Subcapsular, >50% surface area or expanding; ruptured subcapsular hematoma with active bleeding; intraparenchymal hematoma >10 cm or expanding	864.04	3
	Laceration		864.14	3
		>3 cm parenchymal depth		
IV	Hematoma	Ruptured intraparenchymal hematoma with active bleeding		4
	Laceration	Parenchymal disruption involving 25–75% of hepatic lobe or 1–3 Couinaud's segments within a single lobe	864.04	4
V	Laceration	Parenchymal disruption involving >75% of hepatic lobe or >3 Couinaud's segments within a single lobe	864.14	5
	Vascular			5
		Juxtahepatic venous injuries (ie, retrohepatic vena cava/central major hepatic veins)		
VI	Vascular	Hepatic avulsion		6

[a]Advance one grade for multiple injuries, up to grade III.
[b]International Classification of Diseases, 9th Revision.
[c]Abbreviated Injury Scale, 1990.

Trauma 9th ed.

Complications

- Bile leaks
  - Shpincteromtoy with biliary stent
- Bleeding
- Hemobilia
  - Related to pseudoaneurysm(PSA)
  - Small size PSA without septic focus: angioembolizataion
  - Large size PAS or with septic focus: formal liver resection
- Liver abscess
  - Percutaneous drainage and antibiotics
- Hepatic necrosis
- Delayed hemorrhage
- Liver compartment

Trauma 9th ed.

Bleeding

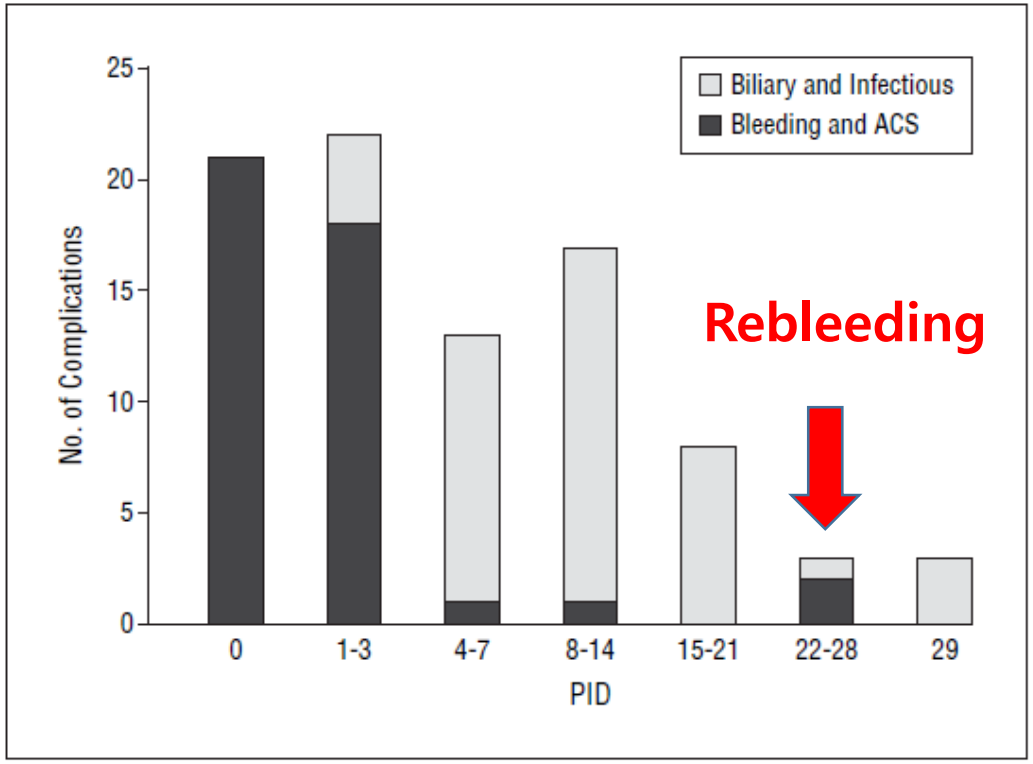

Figure 2. Temporal pattern for the development of complications. The presentation of bleeding complications and abdominal compartment syndrome (ACS) vs biliary and infectious complications over time are shown. Bleeding and ACS tended to develop within the first 3 days of injury while biliary and infectious complications developed in a delayed fashion. PID indicates postinjury day.

Kozar RA et al. Risk Factors for Hepatic Morbidity Following Nonoperative Management, Arch Surg 2006

Bile leakage

- Conservative
  - Minor leakage (<400cc/d or >50cc/d <u>not</u> longer than 2wks)
- Endoscopic sphincterotomy and internal temporary biliary stenting
  - Major leakage(>400cc/d or >50cc/d longer than 2wks)
  - Usually resolved<10 days after preocedure

Management of biliary complications in 412 patients with liver injuries, J Trauma 2014
Endoscopic sphincterotomy and temporary internal stenting for bile leaks following complex hepatic trauma, Br J Srug 2006.

Spleen injury

GUIDELINE

Selective nonoperative management of blunt splenic injury: An Eastern Association for the Surgery of Trauma practice management guideline

Nicole A. Stassen, MD, Indermeet Bhullar, MD, Julius D. Cheng, MD, Marie L. Crandall, MD, Randall S. Friese, MD, Oscar D. Guillamondegui, MD, Randeep S. Jawa, MD, Adrian A. Maung, MD, Thomas J. Rohs, Jr, MD, Ayodele Sangosanya, MD, Kevin M. Schuster, MD, Mark J. Seamon, MD, Kathryn M. Tchorz, MD, Ben L. Zarzuar, MD, *and* **Andrew J. Kerwin, MD**

J Trauma Acute Care Surg 2012

Level 1

- Hemodynamic unstable➔Operation

Level 2

- A routine laparotomy is not indicated
- Angioembolization
  - >Grade 3, contrast blush, moderate hemopertoneum, ongoing bleeding
- Severity of OIS, neurologic status, age>55 yrs, associate injuries➔**no absolute contraindication of non operative management**

Trauma 9th ed.

Level 3

- Contrast blush on CT scan alone is not an absolute indication for an operation or angiographic intervention

TABLE 30-1: The Splenic Organ in Jury Scaling System of the American Association for the Surgery of Trauma, 1994 Revision

Grade[a]		Injury description
I	Hematoma	Subcapsular, <10% surface area
	Laceration	Capsular tear, <1 cm parenchymal depth
II	Hematoma	Subcapsular, 10–50% surface area, <5 cm in diameter
	Laceration	1–3 cm parenchymal depth that does not involve a trabecular vessel
III	Hematoma	Subcapsular, >50% surface area or expanding; ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma >5 cm or expanding
	Laceration	>3 cm parenchymal depth or involving trabecular vessels
IV	Laceration	Laceration involving segmental or hilar vessels producing major devascularization (>25% of spleen)
V	Laceration	Completely shattered spleen
	Vascular	Hilar vascular injury that devascularizes spleen

[a]Advance one grade for multiple injuries up to grade III.

Complications

Non operative management(NOM)

- Hematocrit drop: 24~48hrs
- NOM failure
  - 60-70%→early, 10%→after 7days
- Pseudoaneurysm
- abscess/infarction

Operative management

- Splenorrhaphy
  - Rebleeding: 2%
  - Gastric greater curvature injury
  - Pancreatic injury
  - Arteriovenous fistula
- Total splenectomy
  - Thrombocytosis
  - Portal vein thrombosis(**abdominal pain**)
  - Gastric greater curvature injury
  - Pancreatic injury
  - Arteriovenous fistula

Trauma 9th ed.

Injury, Int. J. Care Injured 48 (2017) 142–147

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Thrombocytosis in splenic trauma: In-hospital course and association with venous thromboembolism

Tze L. Chia, MD[a,1], Tyler R. Chesney, MD MSc[b,1], David Isa, MD[c], Gevork Mnatzakanian, MD[a], Errol Colak, MD[a], Caio Belmont, MD[d], Dhruvin Hirpara, BHSc[e], Precilla V. Veigas, PhD[f], Sergio A. Acuna, MD[g], Sandro Rizoli, MD PhD[b], Joao Rezende-Neto, MD PhD[b,*]

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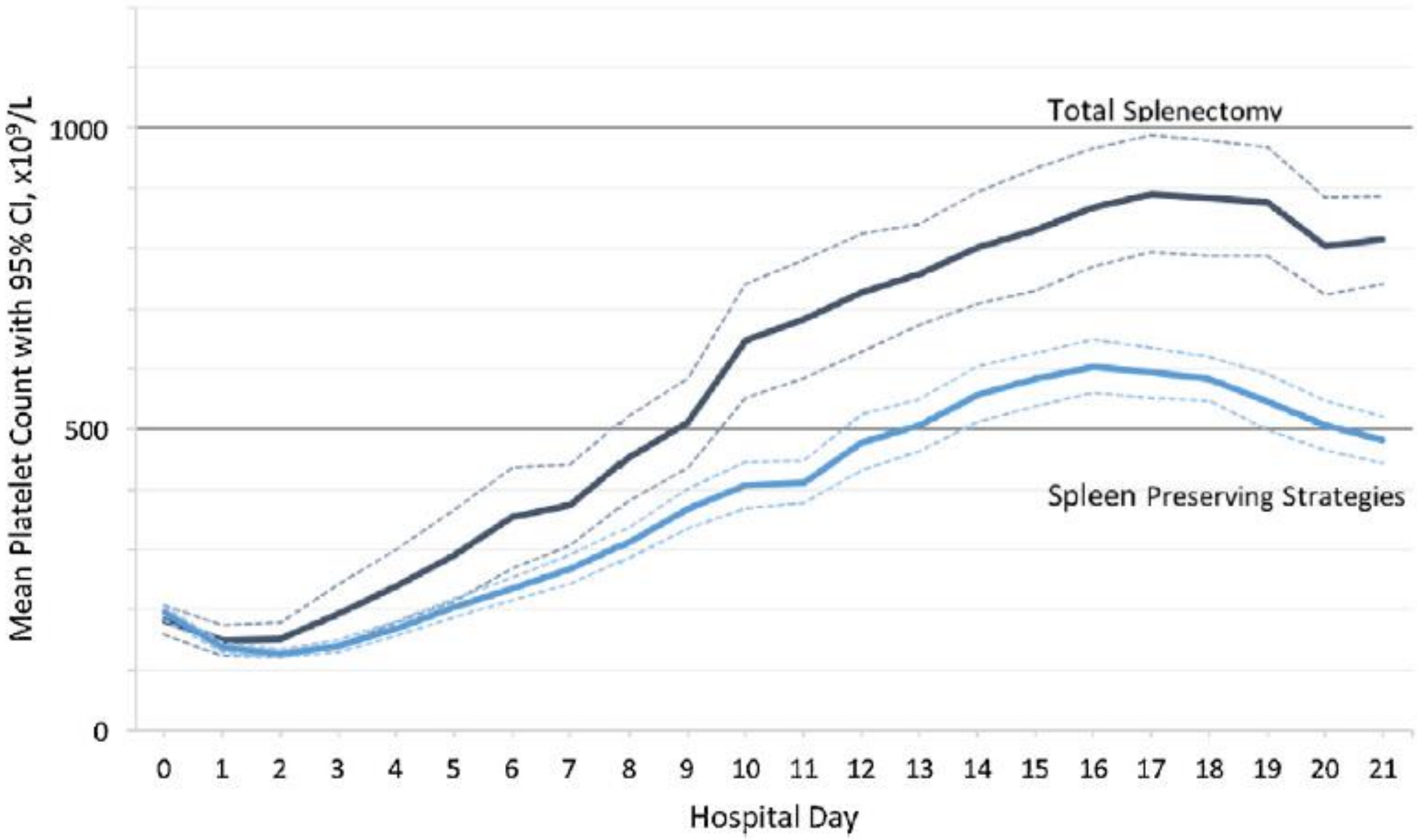

Total Splenectomy
Spleen Preserving Strategies
Mean Platelet Count with 95% CI, x10⁹/L
1000
500
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Hospital Day

Table 3

Association of Venous Thromboembolism with Thrombocytosis and Acetylsalicylic Acid Use.

Exposure	VTE	Unadjusted OR (95% CI)	p
	No./Total No. (%)		
Thrombocytosis vs. no thrombocytosis	10/64 (15.6) vs. 3/92 (3.3)	3.99 (0.98–16.14)	0.053
Extreme thrombocytosis vs. no extreme thrombocytosis	4/25 (16.0) vs. 9/131 (6.9)	1.56 (0.31–7.92)	0.59
Acetylsalicylic acid use vs. no acetylsalicylic acid use	1/11 (9.1) vs. 12/145 (8.3)	1.33 (0.15–11.61)	0.79

Abbreviations: CI, Confidence Interval; OR, Odds Ratio; VTE, Venous thromboembolism.

World J Surg (2018) 42:675–681
DOI 10.1007/s00268-017-4185-2

World Journal of Surgery

ORIGINAL SCIENTIFIC REPORT

Thromboembolic Events Following Splenectomy: Risk Factors, Prevention, Management and Outcomes

Amihai Rottenstreich[1] · Geffen Kleinstern[2,3] · Galia Spectre[4,5] · Nael Da'as[6] · Esther Ziv[4] · Yosef Kalish[1]

Table 1 Patient characteristics in relation to the development of VTE

	All patients ($n = 297$)	No VTE (1) ($n = 274$)	VTE (2) ($n = 23$)	PSMVT (3) ($n = 16$)	Other thrombotic events[a] (4) ($n = 7$)	*P* value 1 vs. 2	*P* value 1 vs. 3	*P* value 1 vs. 4
Gender M/F (%)	144/153 (48.5%, 51.5%)	131/143 (47.8%, 52.2%)	10/13 (43.5%, 56.5%)	9/7 (56.3%, 43.7%)	1/6 (14.3%, 85.7%)	0.83	0.61	0.13
Age at surgery-years	49 [30–65] (48)	50 [29–65] (48)	50 [36–66] (52)	50 [36–62] (50)	64 [39–73) (56)	0.47	0.86	0.29
Active malignancy (%)	134 (45.1%)	123 (44.9%)	11 (47.8%)	7 (43.8%)	4 (57.1%)	0.82	1	0.70
Splenomegaly (%)	41 (13.8%)	36 (13.1%)	5 (21.7%)	3 (18.8%)	2 (28.6%)	0.34	0.46	0.24
Charlson comorbidity index	2 [0–2] (1.4)	2 [0–2] (1.4)	2 [0–2] (1.3)	0.5 [0–2] (1.1)	2 [2–2] (1.9)	0.94	0.52	0.27
Elective surgery (%)	231 (77.8%)	211 (77.0%)	20 (87.0%)	14 (87.5%)	6 (85.7%)	0.43	0.54	1.0
Open/laparoscopic approach (%)	199/98 (67%, 33%)	182/92 (66%, 34%)	17/6 (74%, 26%)	11/5 (68.8%, 31.2%)	6/1 (85.7%, 14.3%)	0.64	1	0.43
Blood transfusion (%)	148 (49.8%)	135 (49.3%)	13 (56.5%)	8 (50.0%)	5 (71.4%)	0.5	1	0.28
Total units of packed cells transfused	0 [0–3] (2)	0 [0–3] (2)	1 [0–4] (3)	0 [0–4] (3)	2 [1–4] (2)	0.4	0.73	0.36
Peak postoperative platelet count (X 10^9/L)	607 [376–957] (689)	596 [376–957] (685)	734 [364–932] (736)	775 [324–912] (673)	734 [657–981 (880)	0.41	0.97	0.14
Δ Peak postoperative–preoperative platelet count (X 10^9/L)	421 [186–732] (495)	414 [183–719] (491)	502 [227–816] (544)	552 [234–772] (571)	453 [154–911 (496)	0.38	0.66	0.33
Extreme postoperative thrombocytosis (>1,000 × 10^9/L) (%)	69 (23.2%)	64 (23.3%)	5 (21.7%)	3 (18.8%)	2 (28.6%)	1	1	0.67
at discharge (%)								
Extended anticoagulation course at discharge (%)	116 (39.1%)	112 (40.9%)	4 (17.4%)	1 (6.3%)	3 (42.9%)	0.02	0.006	1

All continuous variables are expressed as medians (interquartile range) (mean). *P* value < 0.0167 indicates statistical significance

VTE venous thromboembolism, *M* male, *F* female

REVIEW

Medical complications following splenectomy

R. Buzelé [a,1], L. Barbier [b,2], A. Sauvanet [b], B. Fantin [a,*]

[a] *Université Paris Diderot-Paris 7, Hôpital Beaujon, Service de Médecine Interne, 100, boulevard du Général-Leclerc, 92110 Clichy, France*
[b] *Université Paris Diderot-Paris 7, Hôpital Beaujon, Service de Chirurgie Hépato-Bilio-Pancréatique, 100, boulevard du Général-Leclerc, 92110 Clichy, France*

J Visc Surg 2016

- Splenectomy **increase the risk of thromboembolic** complications in the immediate postoperative period but also in the long–term
- **No issued recommendation** of antithrombotic therapy

(French Society of Anesthesia Resuscitation, 2011)

OPsi

- Very rare with high mortality(50%)
- Initial clinical presentation
  - **Fever**, GI symptoms, diffuse pain, sore throat muscle ache
  - Progress rapidly to septic shock with coagulopathy
- Initial treatment
  - Ceftriaxone
  - levofloxacin

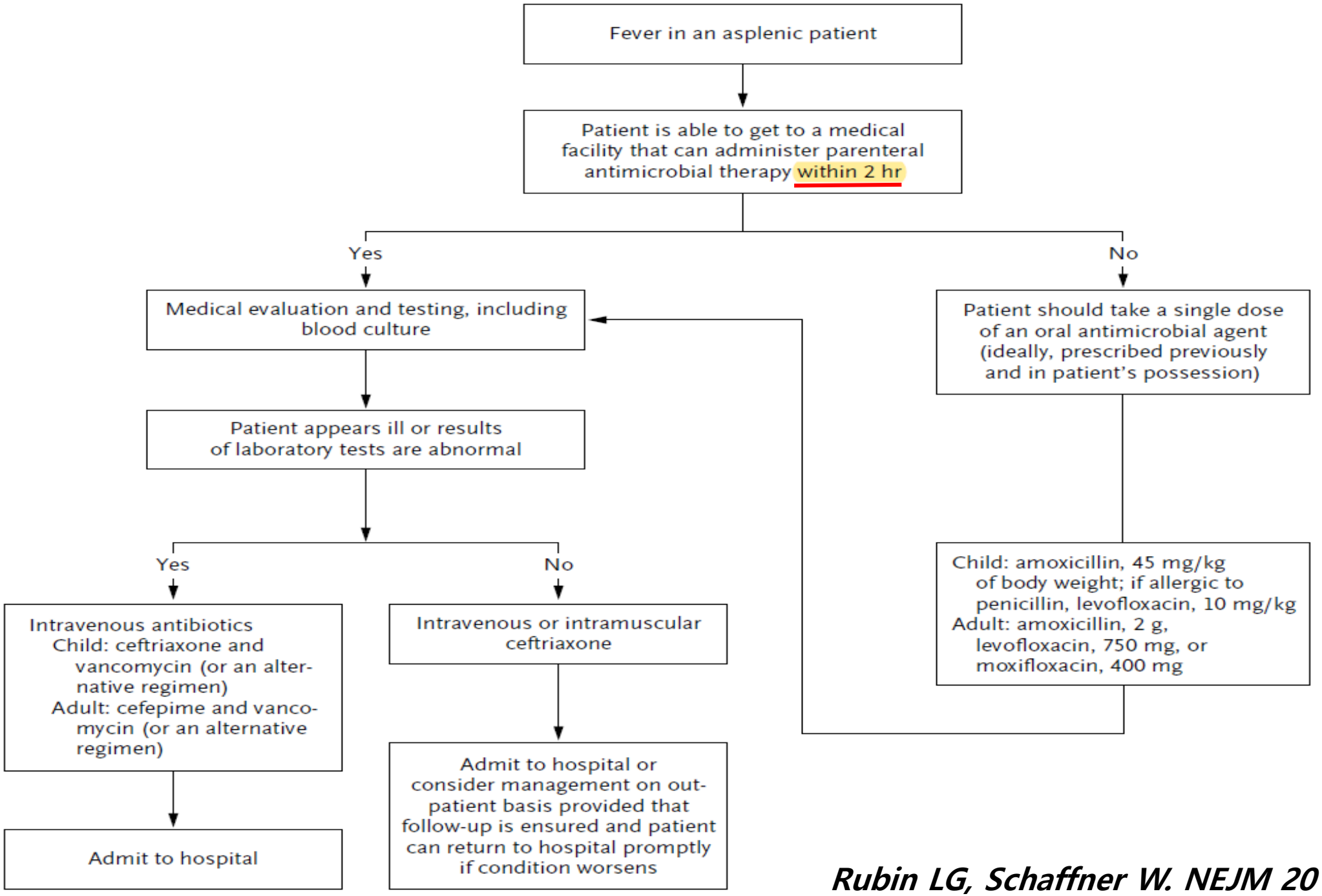
Trauma 9th ed.

KEY CLINICAL POINTS

CARE OF THE ASPLENIC PATIENT

- Asplenic patients are at risk for episodes of rapidly progressive septicemia that are fatal in up to 50% of cases.
- Asplenic patients should be informed that any illness with fever or severe symptoms without fever could indicate the onset of a life-threatening infection.
- Asplenic patients in whom fever develops should receive empirical antimicrobial therapy immediately.
- Vaccinations against pneumococci, *Haemophilus influenzae* type b, meningococci, and influenza virus are recommended for asplenic patients.
- Prophylactic antimicrobial therapy is generally recommended for asplenic children younger than 5 years of age and may be considered for older children and adults during the initial 1 to 2 years after splenectomy, with lifelong prophylaxis for persons who have had an episode of postsplenectomy sepsis.

Rubin LG, Schaffner W. Care of the Asplenic Patient. NEJM 2014



Rubin LG, Schaffner W. NEJM 2014

Pancreas and Duodenum

TABLE 32-7: AAST Duodenum Organ Injury Scale

Grade		Injury description
I	Hematoma	Involving single portion of duodenum
	Laceration	Partial thickness, no perforation
II	Hematoma	Involving more than one portion
	Laceration	Disruption <50% of circumference
III	Laceration	Disruption 50–75% circumference of D2
		Disruption 50–100% circumference of D1, D3, D4
IV	Laceration	Disruption >75% circumference of D2
		Involving ampulla or distal common bile duct
V	Laceration	Massive disruption of duodenopancreatic complex
	Vascular	Devascularization of duodenum

Adapted with permission from Moore EE, Cogbill TH, Malangoni MA, et al. Organ injury scaling II: pancreas, duodenum, small bowel, colon, and rectum. *J Trauma*. 1990;30:1427–1429.

Trauma 9th ed.

TABLE 32-9: AAST Pancreas Organ Injury Scale

Grade[a]		Injury description
I	Hematoma	Major contusion without duct injury or tissue loss
	Laceration	Major laceration without duct injury or tissue loss
II	Hematoma	Involving more than one portion
	Laceration	Disruption <50% of circumference
III	Laceration	Distal transection or parenchymal injury with duct injury
IV	Laceration	Proximal (to right of superior mesenteric vein) transection or parenchymal injury
V	Laceration	Massive disruption of pancreatic head

[a]Advance one grade for multiple injuries to the same organ.
Adapted with permission from Moore EE, Cogbill TH, Malangoni MA, et al. Organ injury scaling II: pancreas, duodenum, small bowel, colon, and rectum. *J Trauma*. 1990;30:1427–1429.

Trauma 9th ed.

Table 5
Sensitivity and specificity of diagnostic tests for pancreatic trauma

Diagnostic Modality	Utility
Amylase/lipase	85% Sensitive, 100% Specific
Computed tomography	>36% sensitive, >90% specific
MRI/MRCP	Accuracy approaches 100%
ERCP	Accuracy approaches 100%

Abbreviations: ERCP, endoscopic retrograde cholangiopancreatography; MRCP, magnetic resonance cholangiopancreatography.

Johnsen et al. Surg Clin N Am 2017

Role of CT in pancreatic trauma

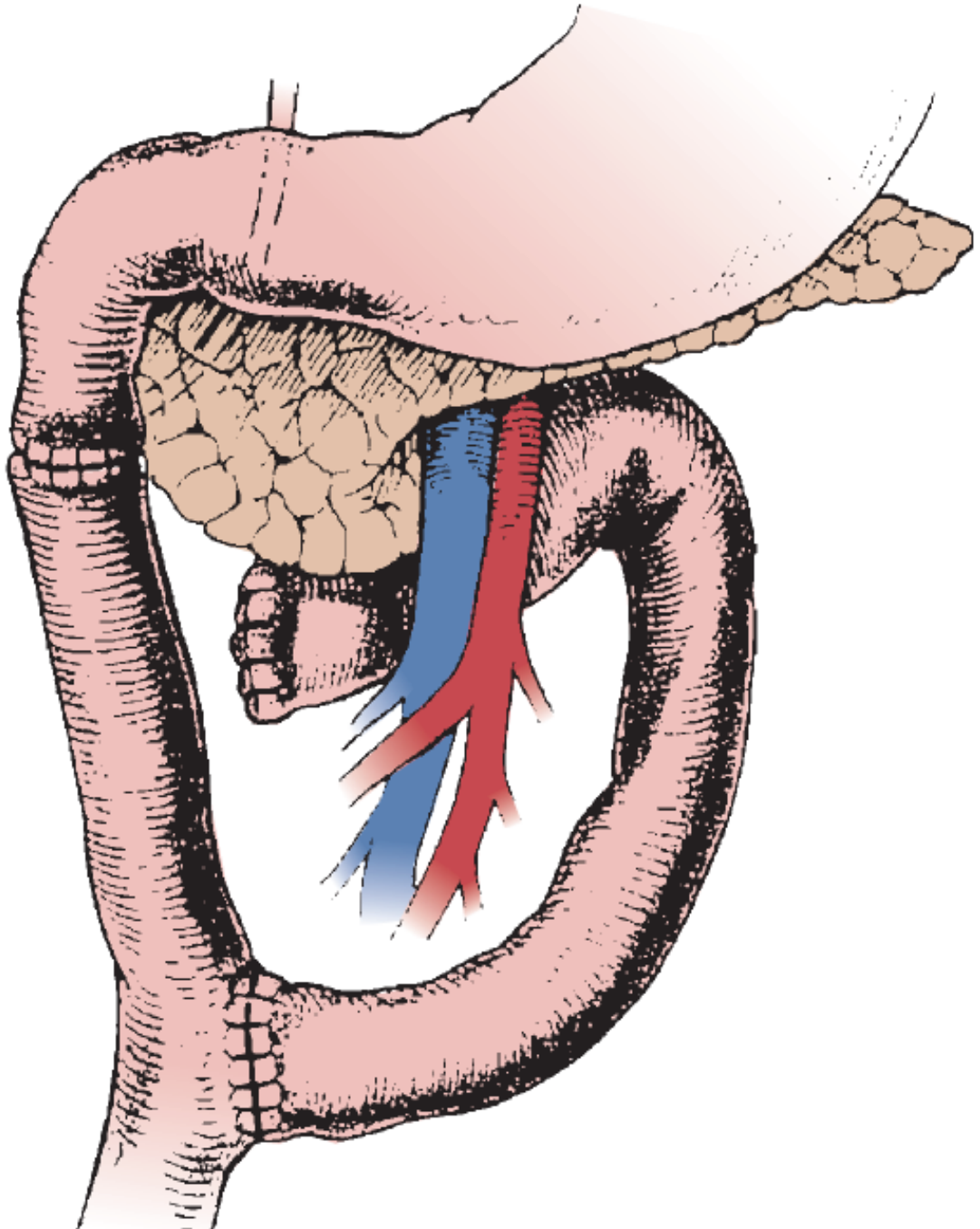
- Primary imaging modality
- Imperfect for the early diagnosis
- Sensitivity
  - Pancreas injury : 28~85%
  - Ductal injury: 42.9~70%
- **Repeat image**
  - Persistent symptoms of abdominal pain, tenderness, fever, nausea, or vomiting, hyperamylasemia

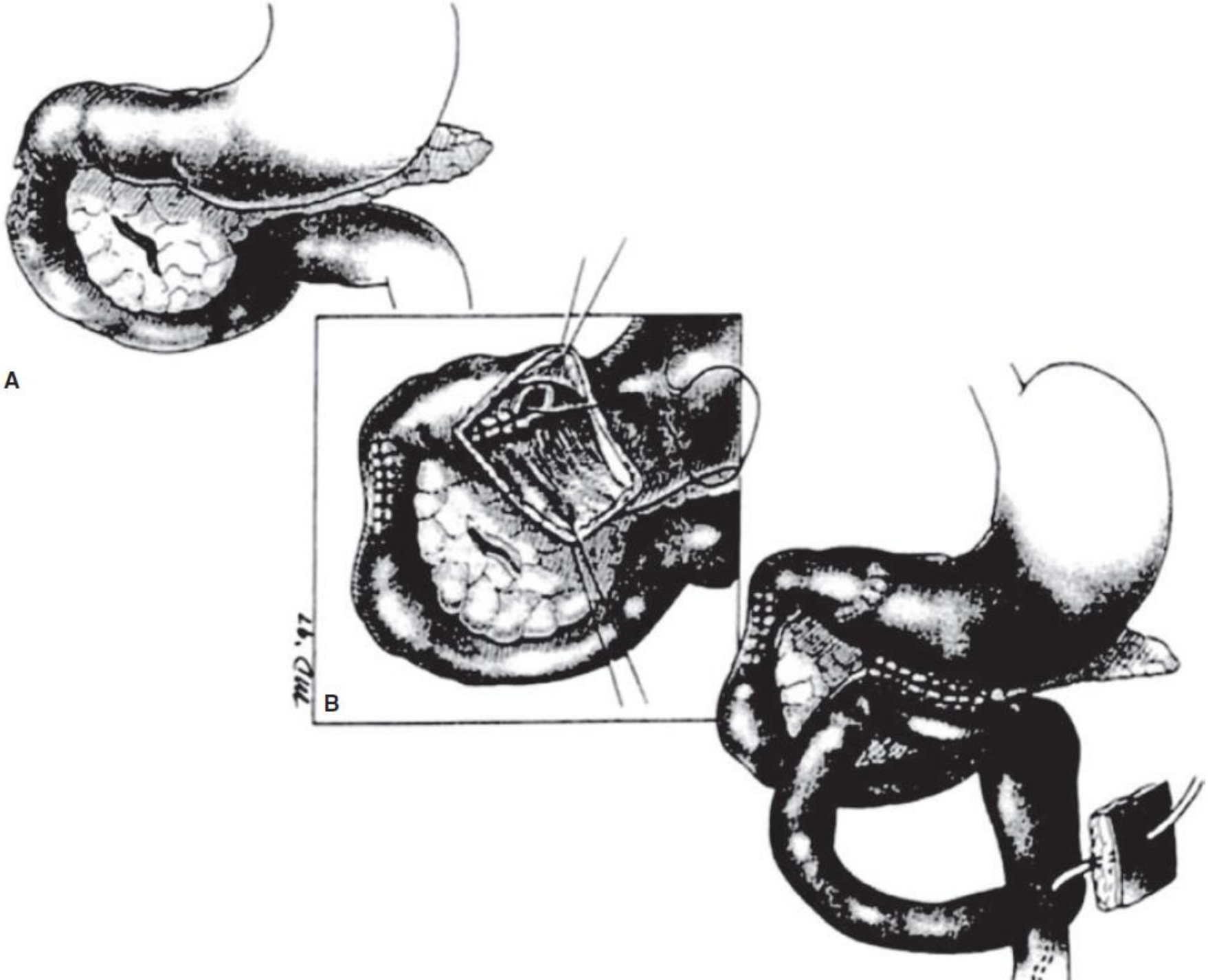
Management of blunt pancreatic trauma: what's new?
Potoka DA et al Eur J Trauma Emerg Surg. 2015

Table 6
Operative management of pancreatic trauma by AAST organ injury scale

AAST Grade	Preferred Treatment
I-II	Observation/Drainage
III	Distal pancreatectomy
IV-V	Drainage, endoscopic stenting, pancreaticoduodenectomy, enteral drainage options

Johnsen et al. Surg Clin N Am 2017




A
B
MD '97

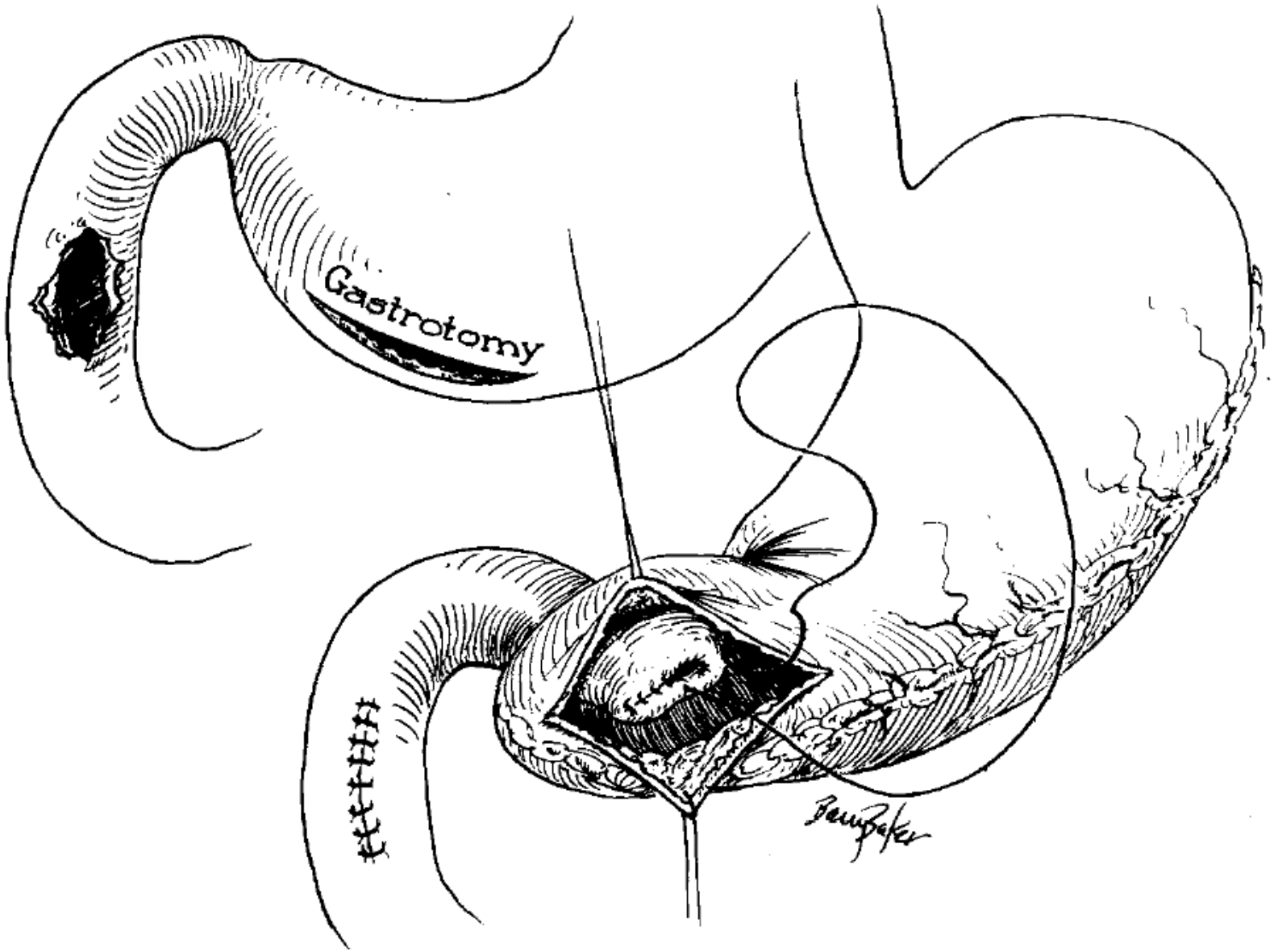


Figure 1. Duodenal injury and method of excluding the pylorus. (© 1977 Baylor College of Medicine.)

Surg Endosc (2006) 20: 1551–1555
DOI: 10.1007/s00464-005-0807-0

SURGICAL ENDOSCOPY
and Other Interventional Techniques

Long-term results of endoscopic stent in the management of blunt major pancreatic duct injury

B.-C. Lin,[1] N.-J. Liu,[2] J.-F. Fang,[1] Y.-C. Kao[1]

[1] Department of Trauma & Emergency Surgery, Department of Surgery, Chang Gung Memorial Hospital, Chang Gung University, 5, Fu-Hsing Street, Kwei-Shan, Tao-Yuan Hsien, 333, Taiwan, Republic of China
[2] Department of Gastroenterology, Chang Gung Memorial Hospital, Chang Gung University, 5, Fu-Hsing Street, Kwei-Shan, Tao-Yuan Hsien, 333, Taiwan, Republic of China

Table 2. Time to operation, type of procedures, complication, time to ERP and findings, hospital stay, outcome, and follow-up of six cases

Patient No.	Time to operation post-trauma; type of procedures	Complications	Time to ERP and first stenting post-trauma	ERP findings	Hospital stay (days)	Outcome	Follow-up and stent status (times of stenting)
1	42 hours; cholecystectomy and drainage of pancreatic hematoma	Fistula	22 days	Stricture at the head with contrast extravasation	36	Stent migration	17 months, stent dislodged into the distal duct (3)
2	Within 24 hours; distal pancreatectomy	Fistula, pseudocyst	19 days	Stricture at the head with contrast extravasation	45	Severe MPD stricture	30 months, stent removed (5)
3	Within 24 hours; drainage of pancreatic hematoma	Pseudocyst	8 days	Contrast extravasation at the body and tail	23	Severe MPD stricture (two sites)	43 months, stent removed (15)
4	60 hours; distal pancreatectomy with splenectomy (post-stenting)	Sepsis	28 hours	Contrast extravasation at the body with retroperitoneal spread	5	Death	(1)
5	No operation, stent therapy	Pseudocyst	8 hours	Contrast extravasation at the body	44	Severe MPD stricture (two sites)	26 months, stent removed (6)
6	No operation, stent therapy	Pseudocyst	16 hours	Contrast extravasation at the head	24	Mild MPD stricture	6 months, stent removed (2)

ERP, endoscopic retrograde pancreatography; MPD, major pancreatic duct

International Journal of Surgery 42 (2017) 152–157

Contents lists available at ScienceDirect

International Journal of Surgery

journal homepage: www.journal-surgery.net

Original Research

Diagnostic and therapeutic role of endoscopic retrograde pancreatography in the management of traumatic pancreatic duct injury patients: Single center experience for 34 years

Seongyup Kim, MD [a], Jae Woo Kim, MD, PhD [b], Pil Young Jung, MD [a], Hye Youn Kwon, MD [a], Hongjin Shim, MD [a], Ji Young Jang, MD [a], Keum Seok Bae, MD, PhD [a, *]

[a] Department of Surgery, Yonsei University, Wonju College of Medicine, Republic of Korea
[b] Department of Internal Medicine, Yonsei University, Wonju College of Medicine, Republic of Korea

Table 3
Treatment results by group.

	Operative group (n = 21)	Stent group (n = 15)	Conservative group (n = 7)	Overall *P* value[a]	Operative vs stent group *P* value[b]	Operative vs conservative group *P* value[b]	Stent vs conservative group *P* value[b]
Overall mortality	2 (9.52%)	2 (13.33%)	0 (0%)	1.000	1.000	1.000	1.000
Pancreas-related mortality	1 (4.76%)	2 (13.33%)	0 (0%)	0.745	0.559	1.000	1.000
Pancreas-unrelated mortality	1 (4.76%)	0 (0%)	0 (0%)	1.000	1.000	1.000	1.000
Overall complications	18 (85.71%)	11 (73.33%)	5 (71.43%)	0.532	0.418	0.574	1.000
Pancreas-related complications	16 (76.19%)	10 (66.67%)	5 (71.43%)	0.899	0.709	1.000	1.000
Pancreas-unrelated complications	6 (28.57%)	4 (26.67%)	0 (0%)	0.313	1.000	0.288	0.263
Follow-up duration (months)	39.7 ± 58.3	38.2 ± 52.8	51.1 ± 102.6				

[a] Statistics were analyzed by Kruskal-Wallis test.
[b] Statistics were analyzed by Mann-Whitney test.

Complications

- Hemorrhage
- Pancreatitis
- Pancreatic fistula
  - Incidence:14%
  - Close: within 8wks
  - Dx in Operative group: drain amylase x 3 > blood amylase (after 3 days)
- Duodenal fistula and stricture
- Abdominal abscess
- Pancreatic pseudocyst
- Pancreatic insufficiency

Trauma 9th ed.

Pseudoaneurysm rupture

- **Abominal pain**(M/C)
  - Retroperitoneal bleeding➔29.5%
- Bleeding into GI tract
- Haemosuccus pancreatiucs
- Bleeding in pseudocyst

World J Gastroenterol 2017 August 14; 23(30): 5460-5468 Pancreatitis: Preventing catastrophic haemorrhage

Renal Trauma

Table 2 AAST organ injury severity scale for renal trauma.

Grade	Description of injury
1	Contusion of subcapsular haematoma
2	Cortical laceration <1 cm deep
3	Cortical laceration >1 cm without urinary extravasation
4	Laceration into collecting system, segmental vascular injury
5	Shattered kidney, renal pedicle injury or avulsion

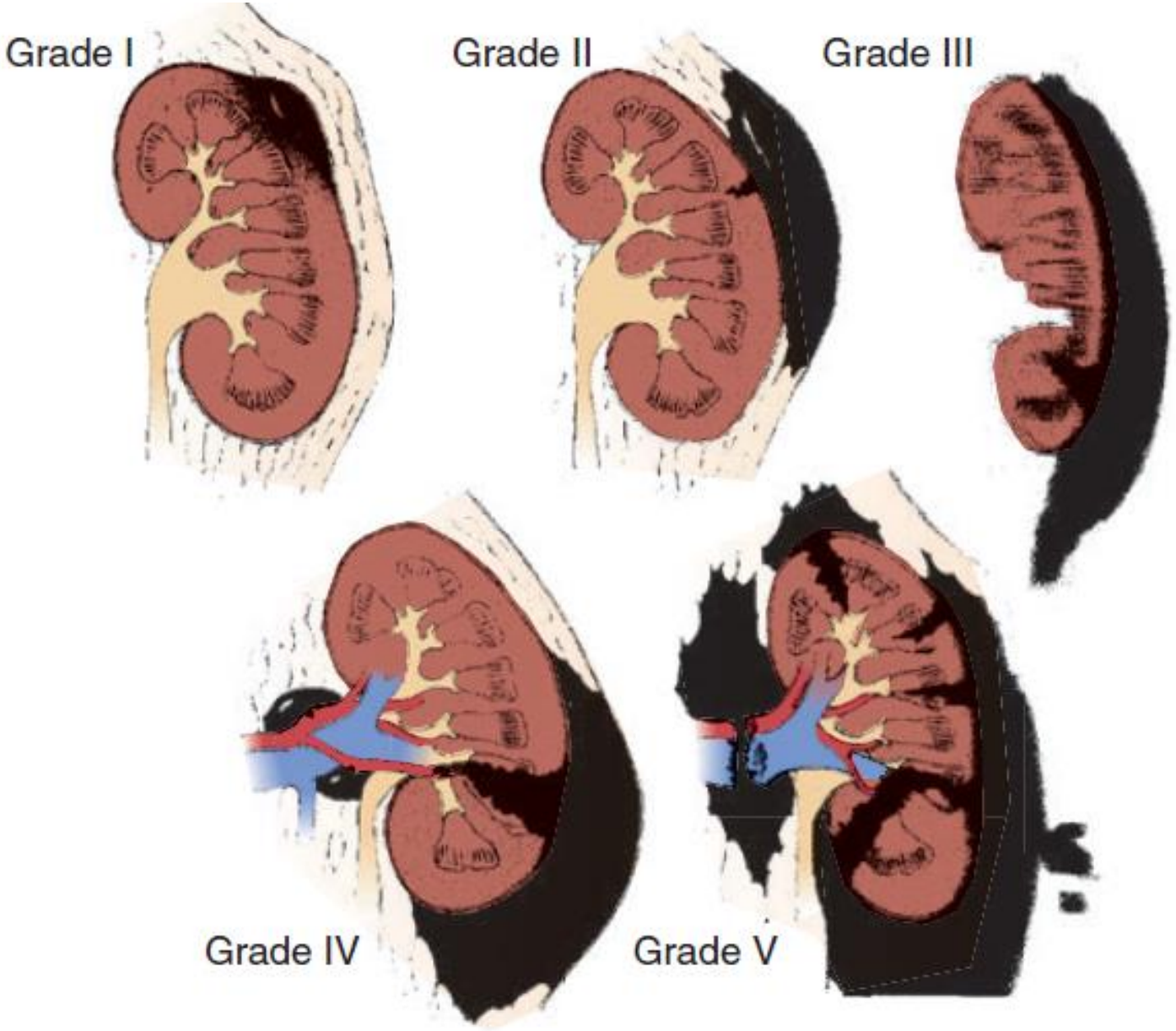
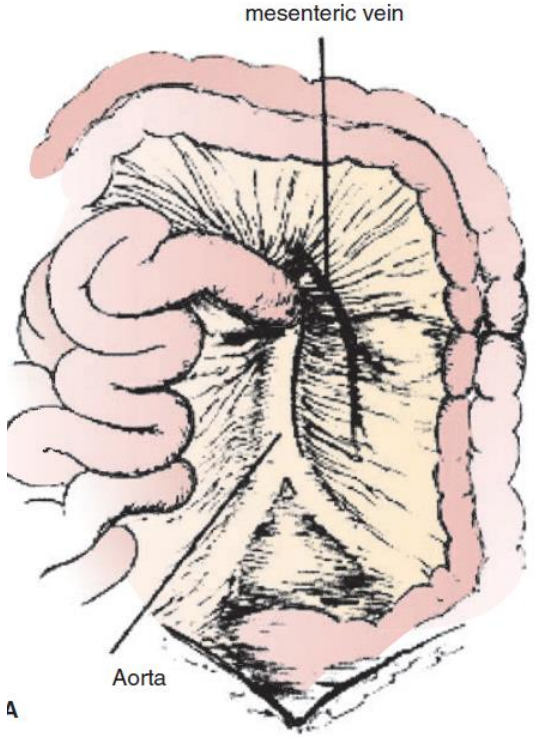
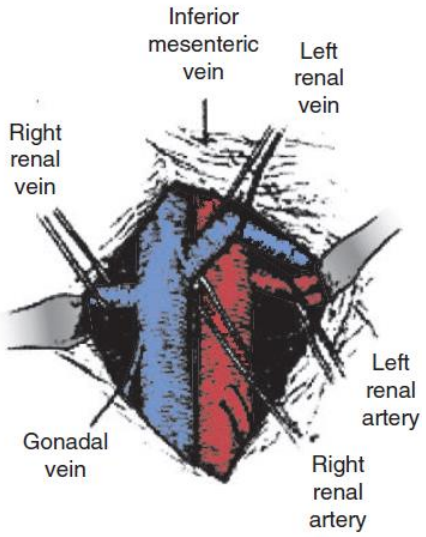
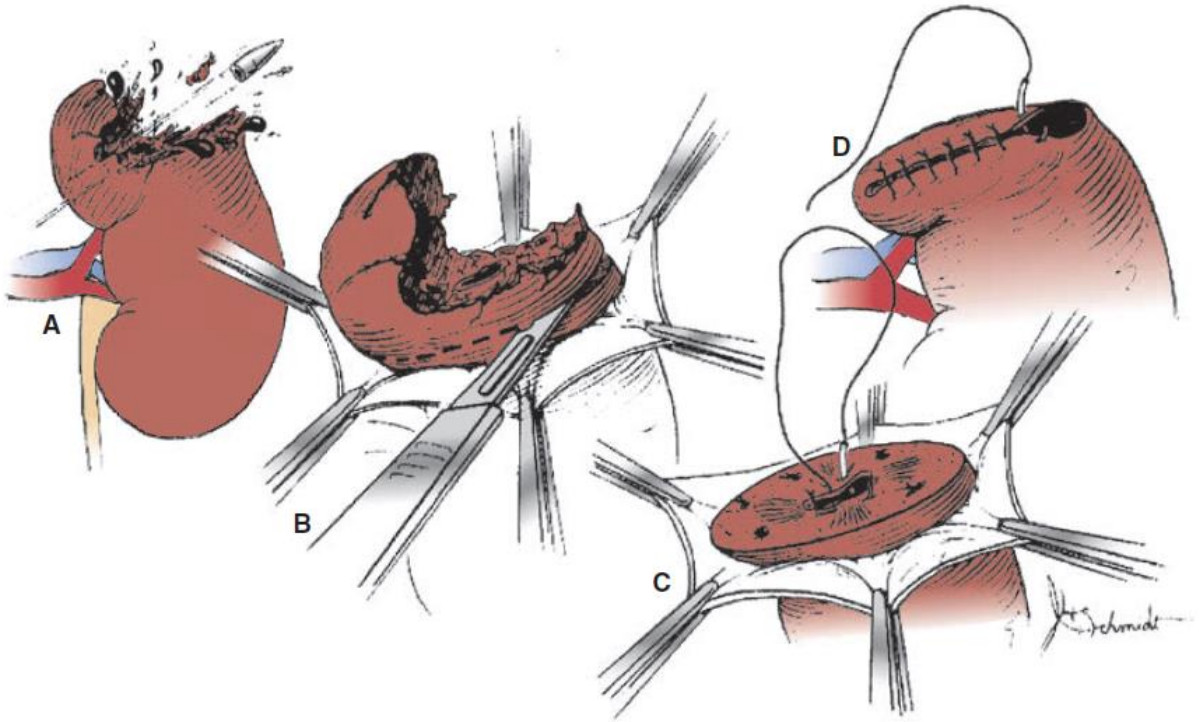
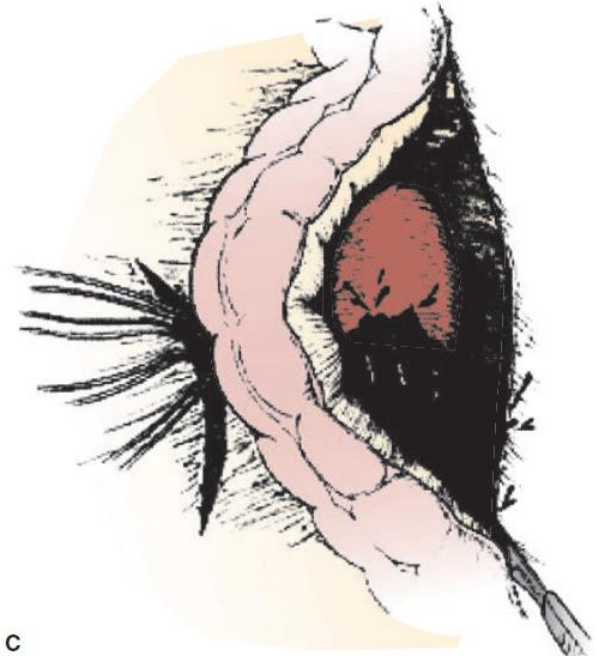


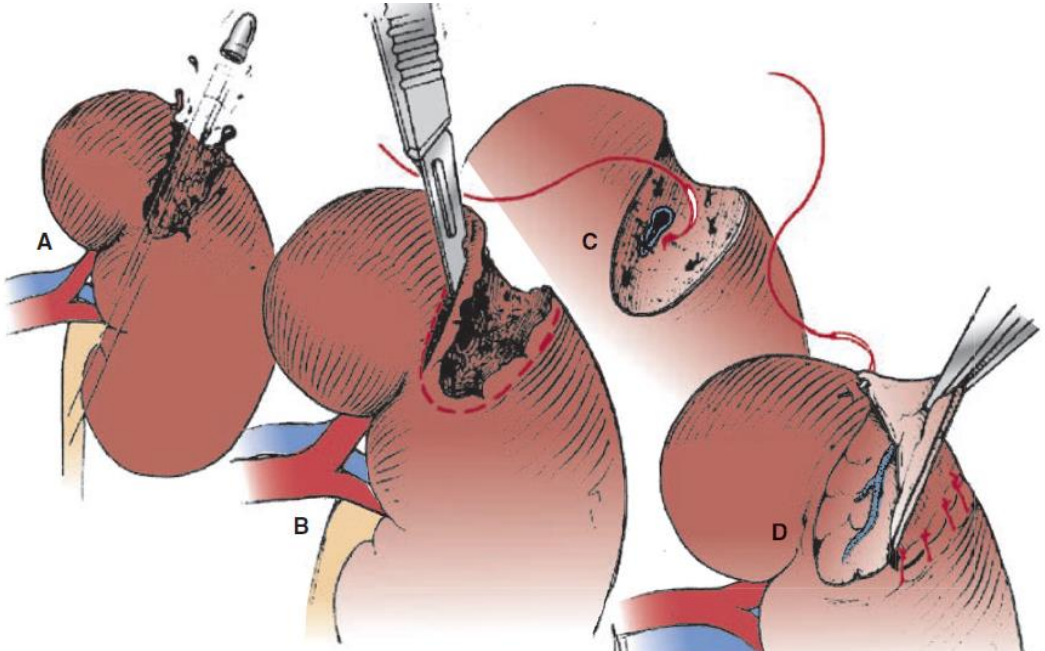
FIGURE 36-6 Organ injury scaling system for renal trauma.


mesenteric vein
Aorta
A


Inferior mesenteric vein
Left renal vein
Right renal vein
Left renal artery
Gonadal vein
Right renal artery
B


A
B
C
D


C


A
B
C
D

About European Association of Urology

For almost 40 years the EAU has addressed the most pressing issues of urological care in Europe, through its scientific and educational initiatives, as well as its publications. Become a member and get access to the benefits:

Treatment

Blunt renal injuries

- Grade 5 injuries often present with haemodynamic instability and major associated injuries. There is thus a higher rate of exploration and nephrectomy However several studies now support **expectant management in patients with Grade 4 and 5 injuries**

Penetrating renal injuries

- **Grade 3 or higher lesions due to stab wounds in stable patients can be managed expectantly**, but warrant closer observation as the clinical course is more unpredictable and associated with a higher rate of delayed intervention

Complication

- Bleeding
- Post-injury hypertension
- **Urinoma**
  - Clinical presentation
    - Worsening renal function
    - Worsening flank pain
    - Decreased urine output
    - Fever, leukocytosis
  - Treatment
    - PCD with ureteral stent(6wks)

Johnsen et al. Surg Clin N Am 2017

Contents

Table 4 AAST organ injury severity scale for bladder trauma.

Grade	Description of injury
1	Haematoma, partial thickness laceration
2	Extraperitoneal bladder wall laceration <2 cm
3	Extraperitoneal bladder (>2 cm) or intraperitoneal (<2 cm) bladder laceration
4	Intraperitoneal bladder wall laceration >2 cm
5	Intraperitoneal or extraperitoneal bladder wall laceration extending into the bladder neck or ureteric orifice

Bladder injuury

Intraperitoneal

- 30%
- **Surgical repair**

Extraperitoneal

- 60%
- **Drainage for 2-3wks**
- **Consider surgical repair**
  - **4wks**
- Complicated bladder injury
  - **exposed bone** within the bladder lumen, **rectal, vaginal lacerations**
  - Bladder **neck** injury

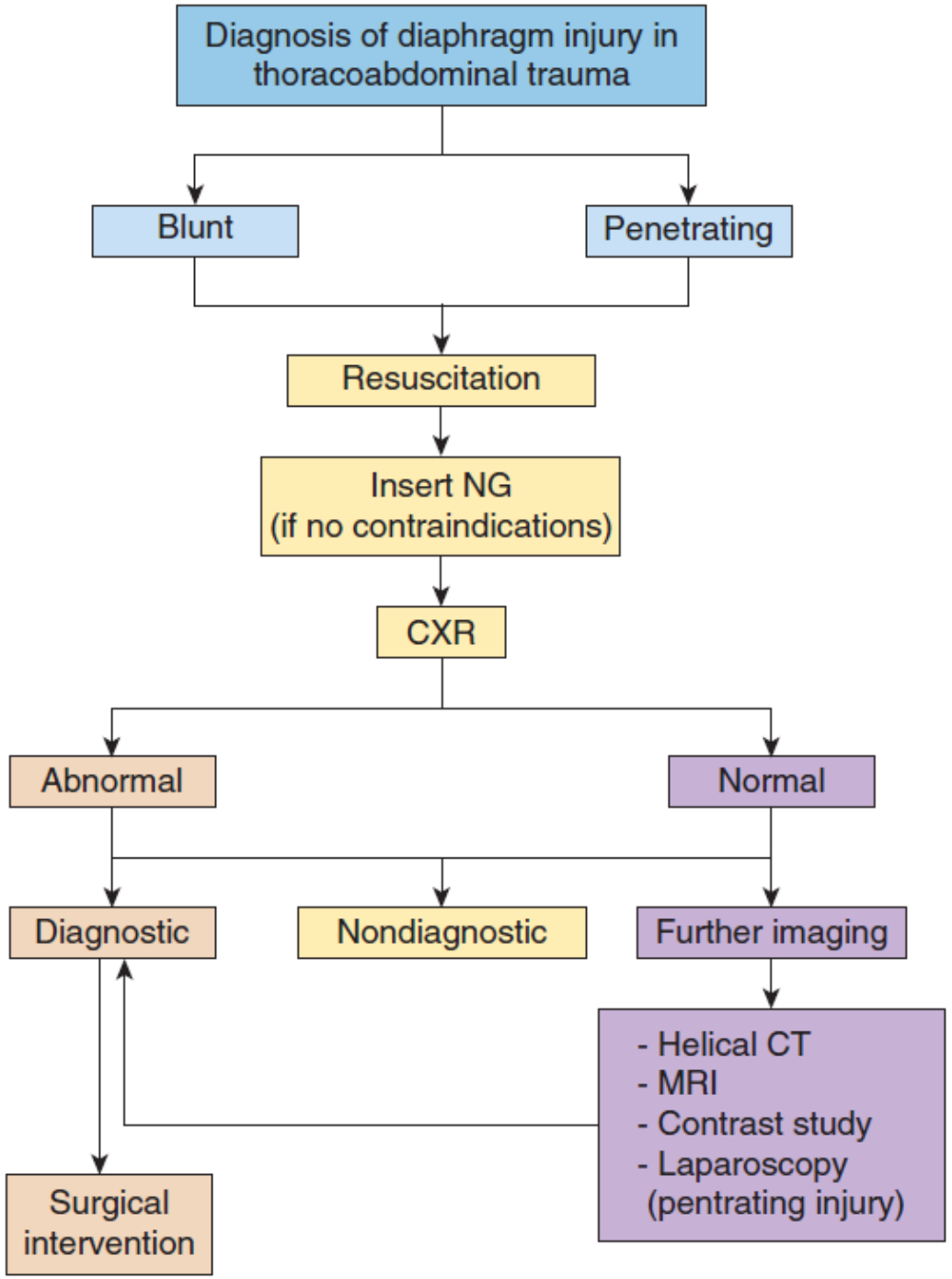
Bju international 2016

Contents

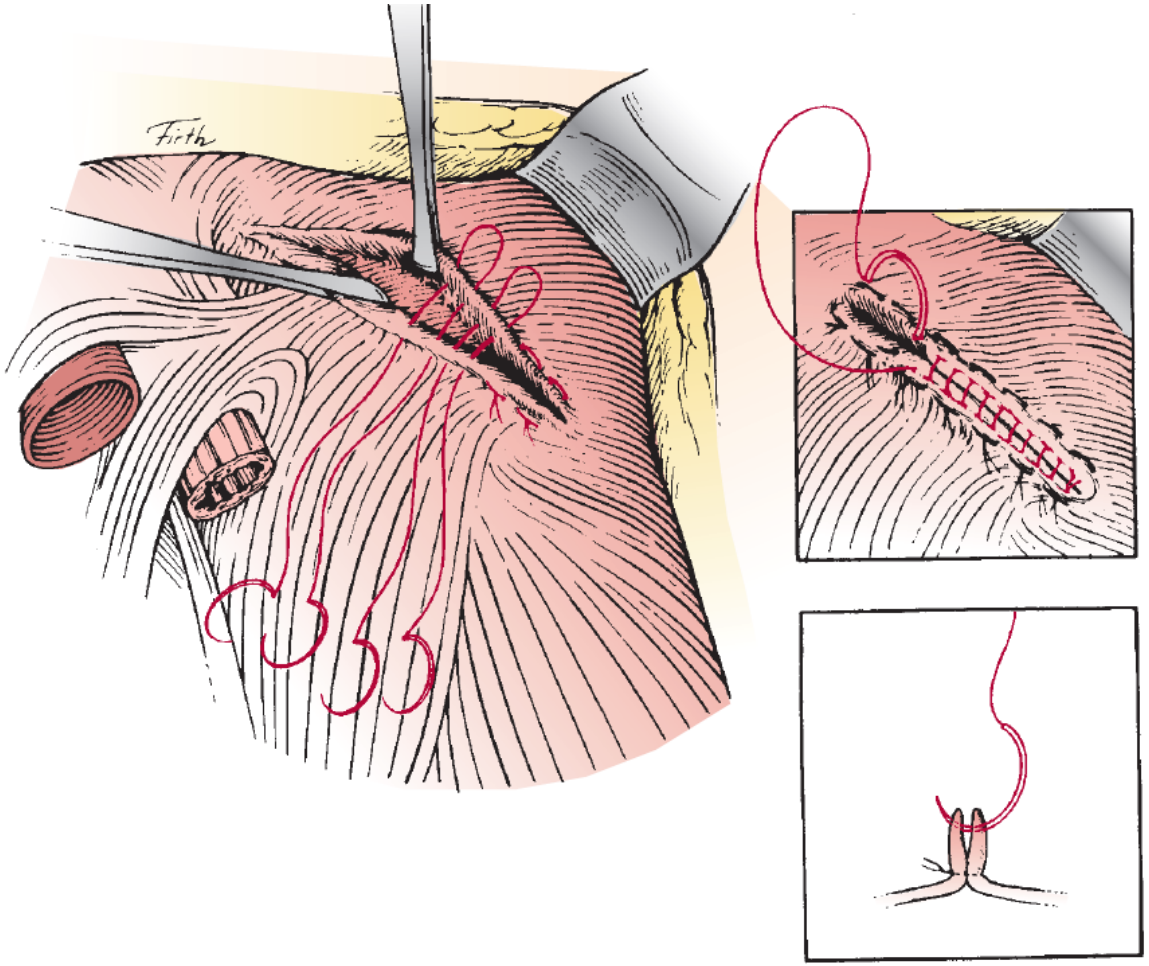
TABLE 28-3: Grading of Diaphragmatic Injuries

Grade	Description of injury
I	Contusion
II	Laceration ≤2 cm
III	Laceration 2–10 cm
IV	Laceration >10 cm with tissue loss ≤25 cm^2
V	Laceration with tissue loss >25 cm^2

Reproduced with permission from Moore EE, Malangoni MA, Cogbill TH, et al. Organ injury scaling IV: thoracic vascular, lung, cardiac and diaphragm. *J Trauma*. 1994;36(3):299–300.



Trauma 10th ed.



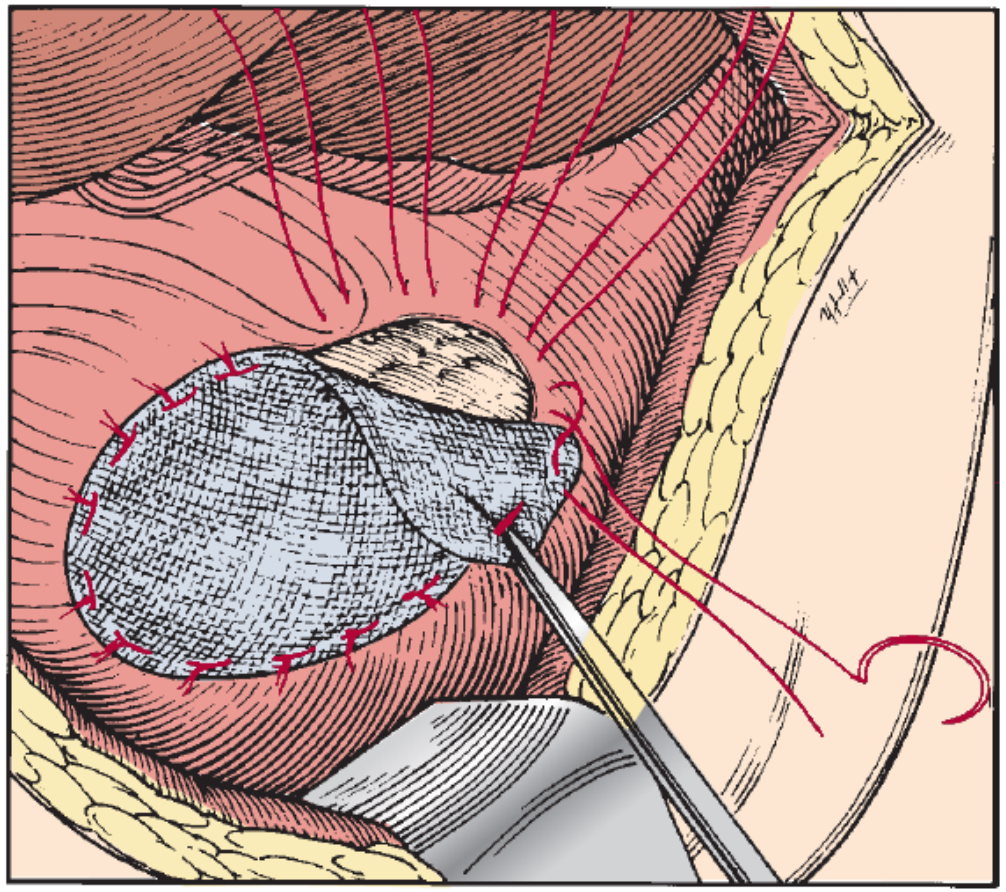


FIGURE 28-9 Technique for repair of the diaphragm using a prosthetic. (Reproduced with permission from Juan A. Asensio, MD, FACS, FCCM and Demetrios Demetriades, MD, PhD, FACS.)

Clinical Case Report

Medicine®

OPEN

Delayed traumatic diaphragmatic hernia

A case-series report and literature review

Jing Lu, MD[a], Bo Wang, MD[b], Xiangming Che, MD, PhD[a], Xuqi Li, MD[a], Guanglin Qiu, MD[a], Shicai He, MD[a], Lin Fan, MD[a,*]

Medicine 2015

Table 1

Summary of the 6 patients included in the study.

Patient no., sex/age	History	Type of injury	Initial treatment	Interval to TDH	Type of hernia	Herniated organs	Method of diagnosis
1, Male/51 y	Traffic accident	Multiple rib fracture splenic rupture	Splenectomy	11 y	Left hemidiaphragm	Splenic flexure of the colon	Barium enema CT scan
2, Male/45 y	Traffic accident	Multiple rib fracture splenic rupture	Splenectomy	5 y	Left hemidiaphragm	Stomach and small intestine	CT scan
3, Male/47 y	Traffic accident	Multiple rib fracture splenic rupture	Splenectomy	7 y	Left hemidiaphragm	Stomach and omentum	Chest x-ray gastrografin contrast
4, Male/30 y	Traffic accident	Hemopneumothorax pelvic fracture	Nonoperative treatment	4 y	Left hemidiaphragm	Stomach and omentum	Chest x-ray gastrografin contrast
5, Male/33 y	Traffic accident	Hemopneumothorax pelvic fracture	Nonoperative treatment	2 y	Left hemidiaphragm	Stomach and omentum	Chest x-ray gastrografin contrast
6, Male/29 y	Stab-penetrating trauma	Penetrating injury at the seventh intercostal space	Nonoperative treatment	5 y	Left hemidiaphragm	Stomach and omentum	Chest x-ray gastrografin contrast

TDH—traumatic diaphragmatic hernia

International Journal of Surgery 42 (2017) 178–182

Contents lists available at ScienceDirect

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Original Research

The clinical implications of severe low rib fracture in the management of diaphragm injury: A Case Control Study

Seongyup Kim, MD [a], Woo Jin Choi, MD [b], Kawng Ho Lee, MD, PhD [b], Chun Sung Byun, MD [c], Keum Seok Bae, MD, PhD [a], Il Hwan Park, MD, PhD [c, *]

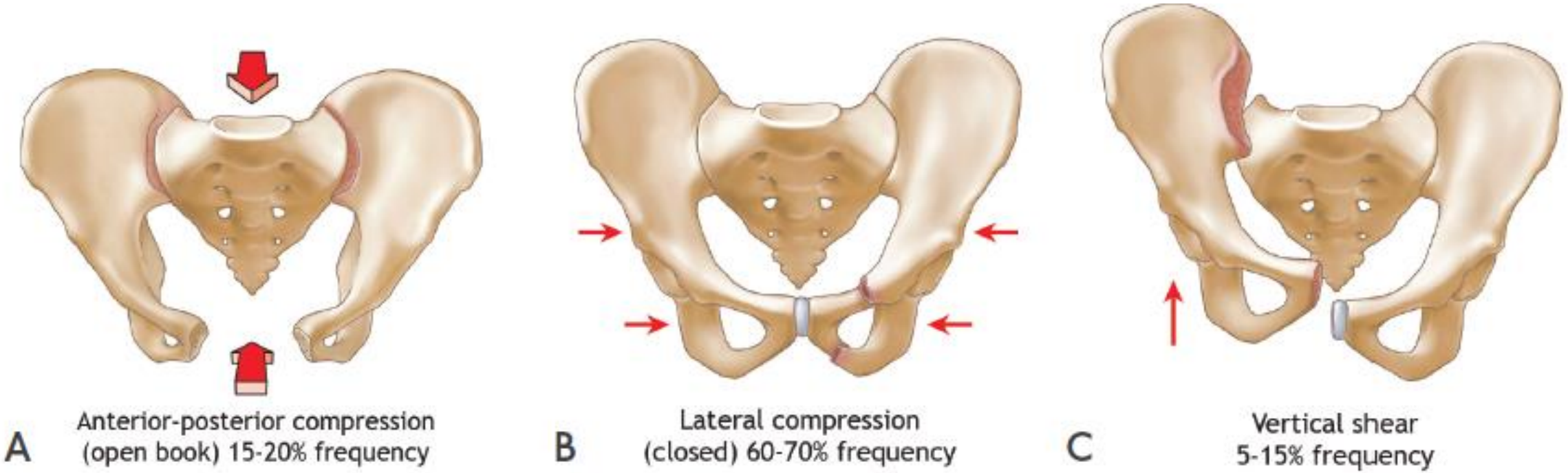
[a] Department of Surgery, Yonsei University, Wonju College of Medicine, Republic of Korea
[b] Department of Anesthesiology and Pain Medicine, Yonsei University, Wonju College of Medicine, Republic of Korea
[c] Department of Cardiovascular and Thoracic Surgery, Yonsei University, Wonju College of Medicine, Republic of Korea

Table 2
Differences in clinical presentation between the two groups.

	Severe group (n = 11)	Non-severe group (n = 19)	*p*-value
Delayed diagnosis	81.8% (n = 9)	36.8% (n = 7)	0.026[a]
Diagnostic method			
Initial chest X-ray at emergency department	9.1% (n = 1)	57.9% (n = 11)	0.018[a]
Follow up chest X-ray	9.1% (n = 1)	10.5% (n = 2)	1.000[a]
Initial chest computed tomography at emergency department	9.1% (n = 1)	10.5% (n = 2)	1.000[a]
Intraoperative diagnosis	72.7% (n = 8)	21.1% (n = 4)	0.009[a]
Initial indication of operation			
Intrathoracic visceral herniation	18.2% (n = 2)	78.9% (n = 15)	0.002[a]
Hemothorax	63.6% (n = 7)	5.3% (n = 1)	0.001[a]
Central type laceration in operative finding	18.2% (n = 2)	78.9% (n = 15)	0.002[a]
Length of diaphragmatic injury (cm), Mean ± SD	4.80 ± 3.60	9.70 ± 4.10	0.004[b]

[a] Statistics were analyzed using Fisher's exact test.
[b] Statistics were analyzed using Mann-Whitney test.

Contents


A
Anterior-posterior compression
(open book) 15-20% frequency
B
Lateral compression
(closed) 60-70% frequency
C
Vertical shear
5-15% frequency

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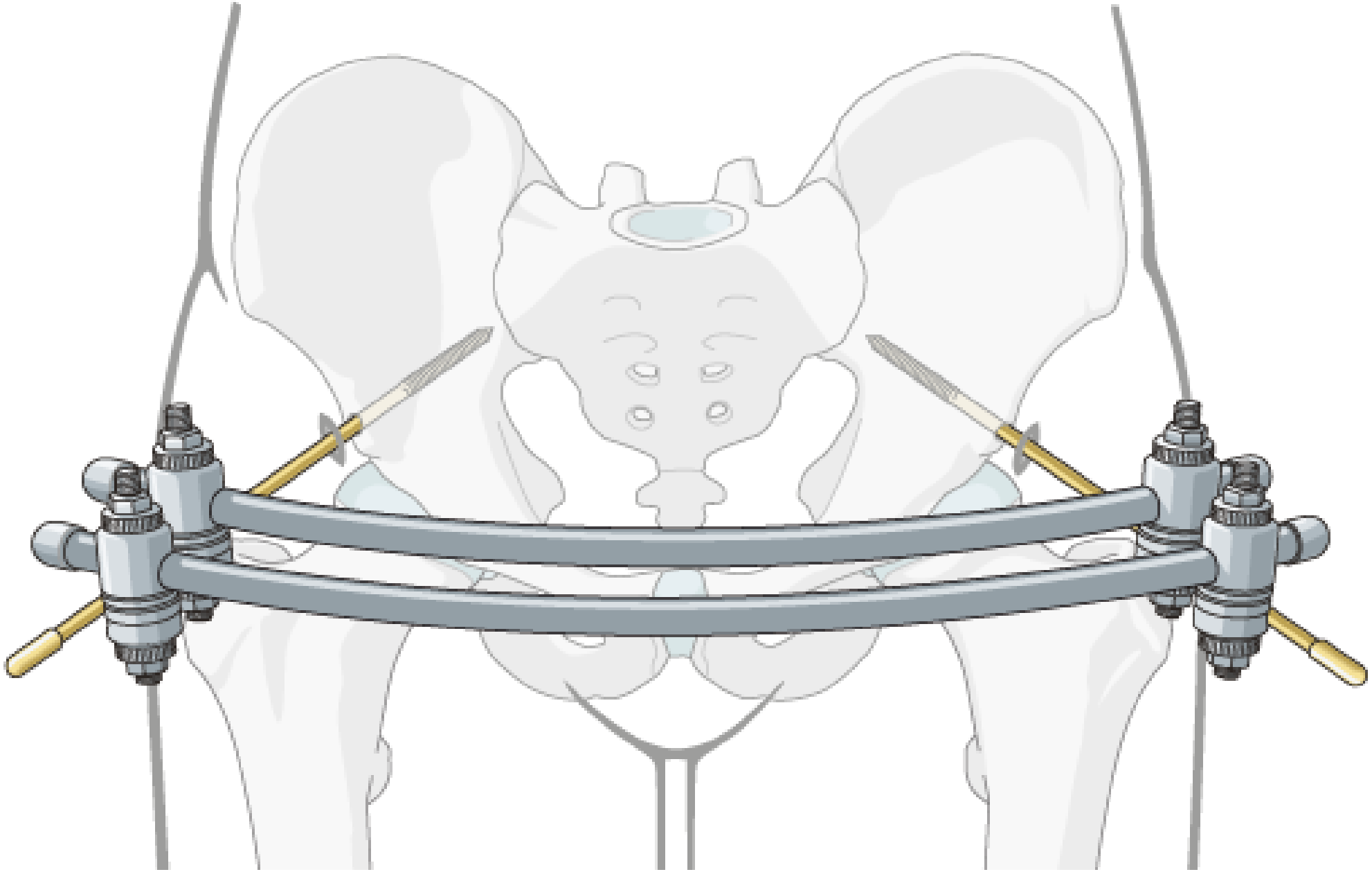
Initial treatment modality of hemodynamically unstable pelvic fracture

- Angioembolization
  - artery>vein
- External fixation
  - bone bleeding, reduce pelvic cavity(Tamponade)
- Preperitoneal pelvic packing(PPP)
  - vein>artery
- Pelvic binder
  - reduce pelvic cavity(Tamponade)
- REBOA
  - Temporary control for next step



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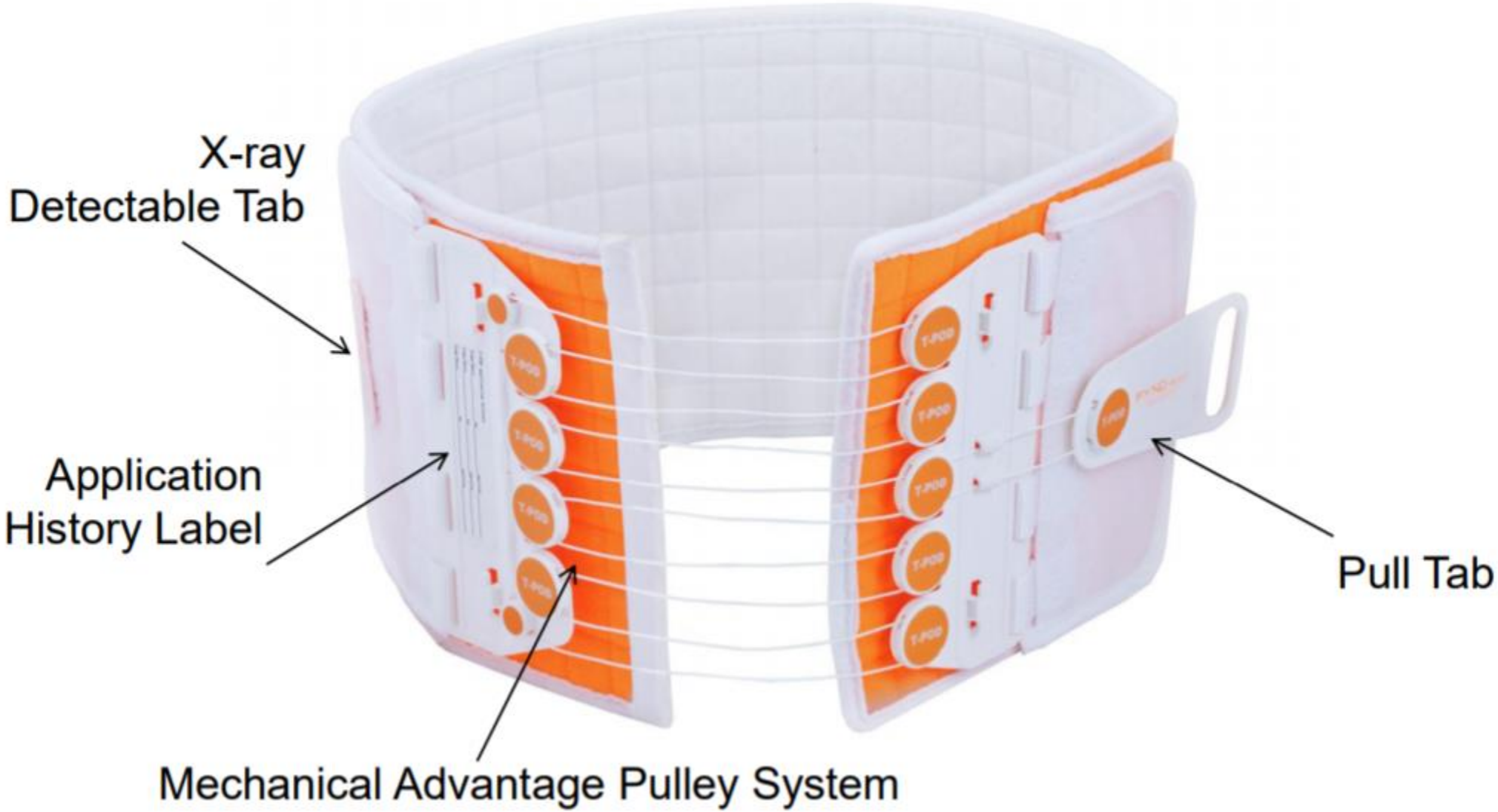
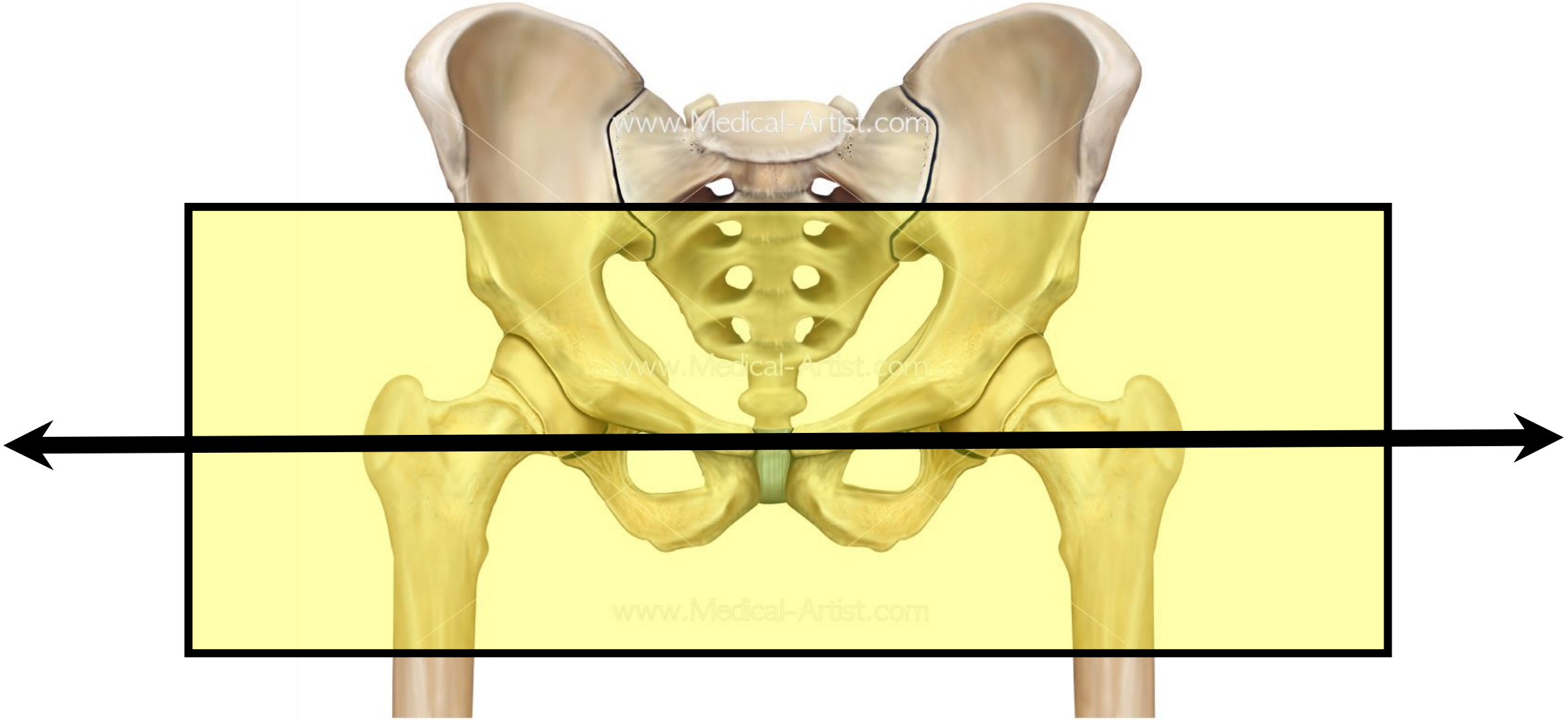

X-ray
Detectable Tab
Application
History Label
Mechanical Advantage Pulley System
Pull Tab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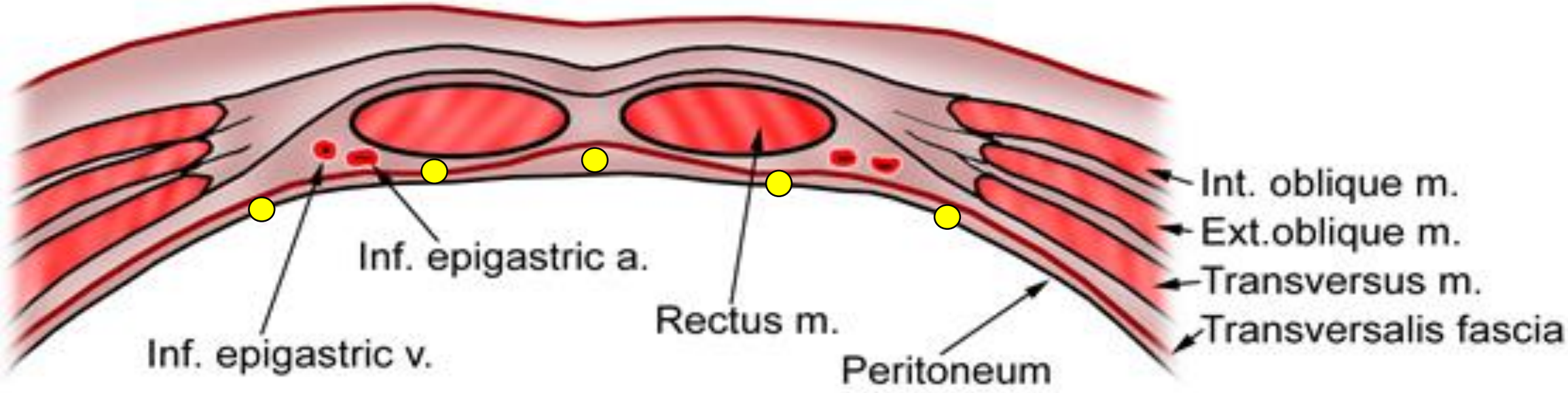
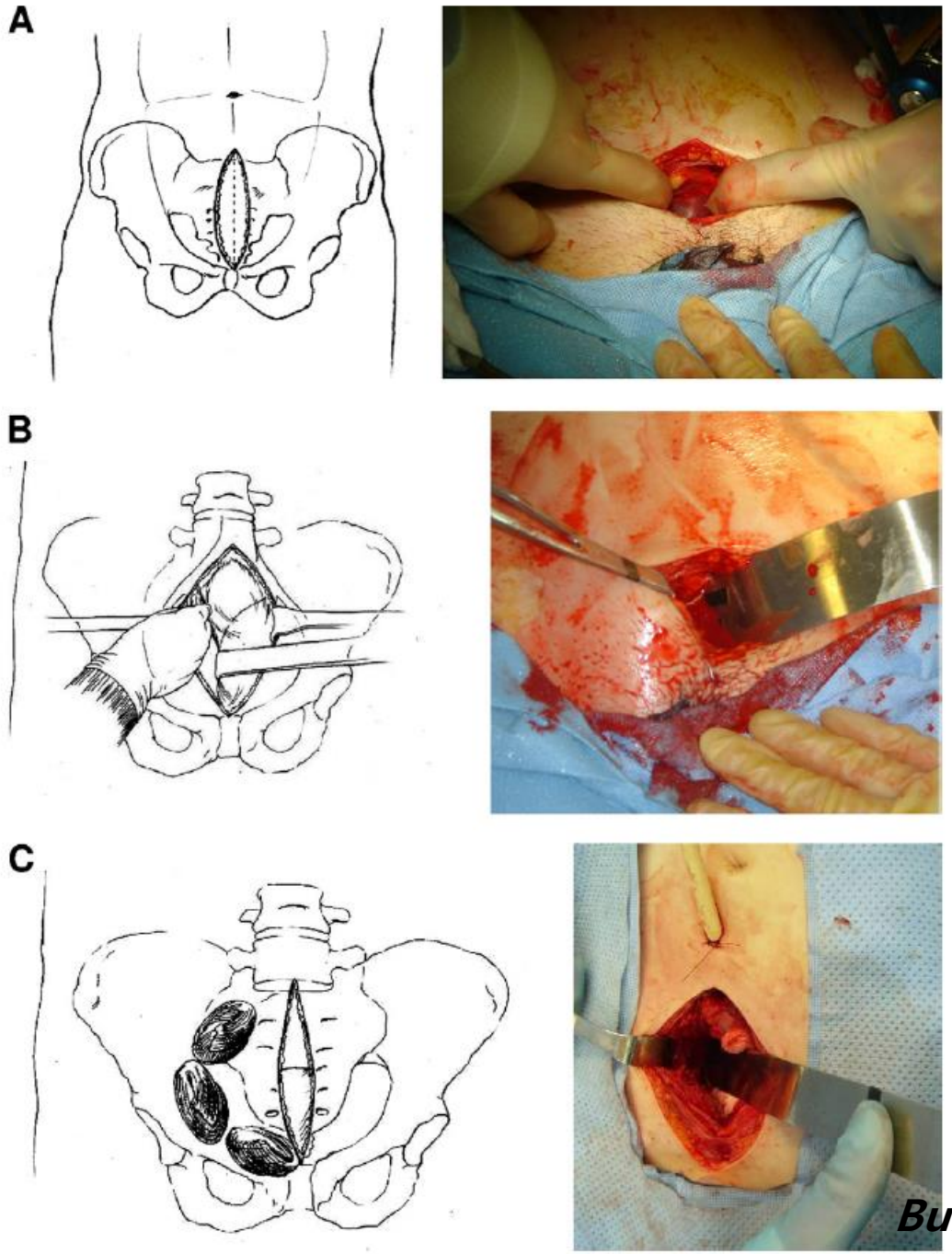

Int. oblique m.
Ext.oblique m.
Transversus m.
Transversalis fascia
Inf. epigastric a.
Rectus m.
Inf. epigastric v.
Peritoneum



Burlew CC et al. J Am Coll Surg. 2011

Associated injuries

- Head injury
  - 51%
  - Long-bone fracture: 48%
- Thoracic injury
  - 20%
- Thoracic aortic injury
  - 1.4~5.9%
- Intra-abdominal organ
  - Solid organ: 11%
  - Hollow viscus: 4.5%
- Diaphragmatic injury : 2%
- Bladder or urethral injury : 6%

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AAST 2015 PLENARY PAPER

Current management of hemorrhage from severe pelvic fractures: Results of an American Association for the Surgery of Trauma multi-institutional trial

Todd W. Costantini, MD, Raul Coimbra, MD, PhD, John B. Holcomb, MD, Jeanette M. Podbielski, Richard Catalano, MD, Allie Blackburn, MD, Thomas M. Scalea, MD, Deborah M. Stein, MD, MPH, Lashonda Williams, MD, Joseph Conflitti, MD, Scott Keeney, DO, Ghada Suleiman, Tianhua Zhou, Jason Sperry, MD, Dimitra Skiada, MD, Kenji Inaba, MD, Brian H. Williams, MD, Joseph P. Minei, MD, Alicia Privette, MD, Robert C. Mackersie, MD, Brenton R. Robinson, Forrest O. Moore, MD, *and* **the AAST Pelvic Fracture Study Group**, *San Diego, California*

J Trauma Acute Care Surg 2016

TABLE 4. Outcomes for Patients Admitted in Shock (SBP < 90 mm Hg or HR > 120 Beats per Minute or Base Deficit > −5)

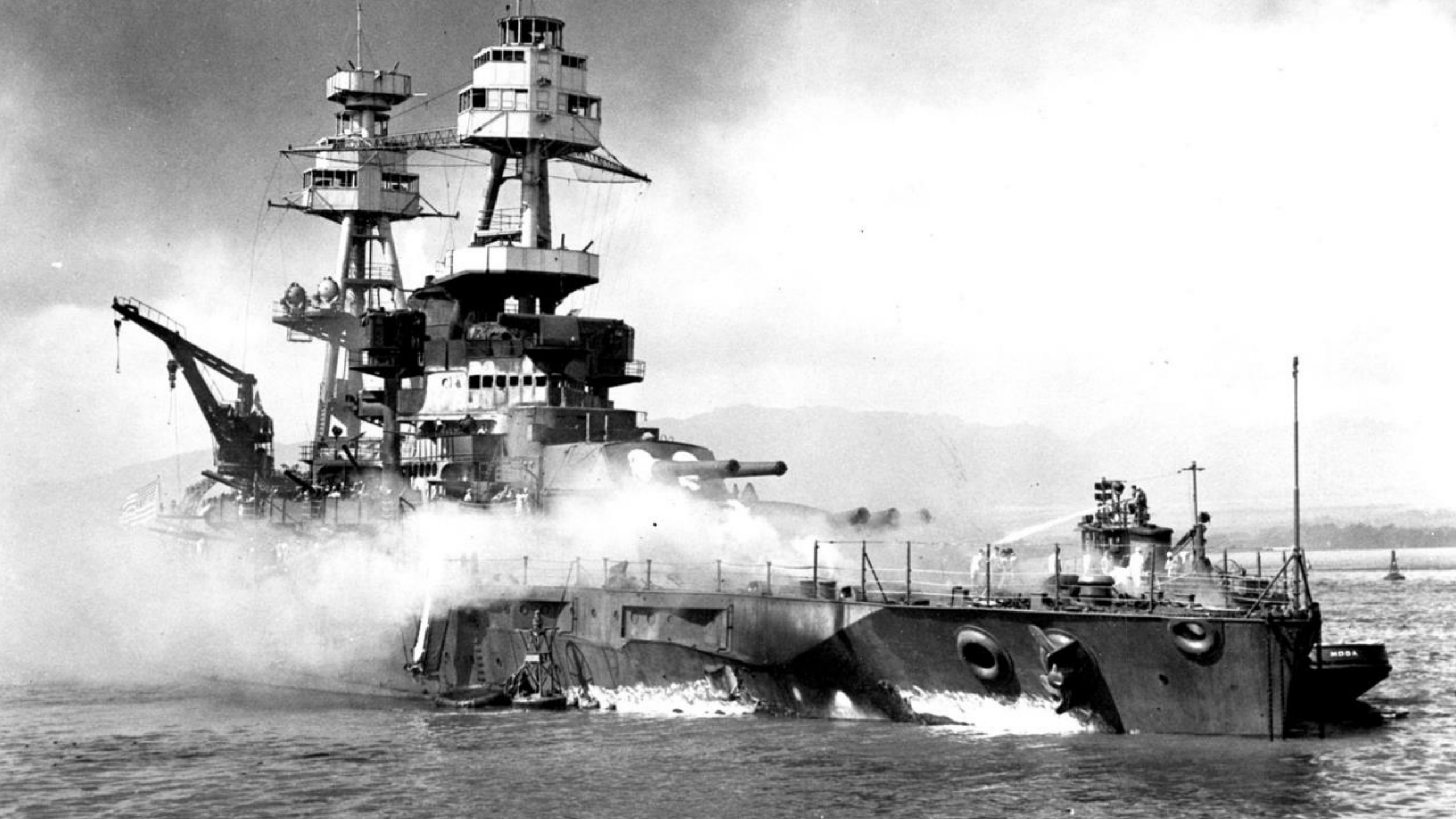
n, (%)	178 (13.3)
ICU LOS, d	7.0 (3.0–15.5)
Ventilator, d	5.0 (2.0–11.0)
Hospital LOS, d	13.0 (5.0–23.8)
Patients requiring transfusion products, n (%)	
PRBC	150 (84.3)
Fresh frozen plasma	125 (70.2)
Platelets	88 (49.4)
Median units transfused (IQR)	
PRBC	7.5 (4.0–16.0)
Fresh frozen plasma	6.0 (3.0–11.5)
Platelets	3.5 (1.3–7.8)
Discharge Disposition, n (%)	
Home	39 (21.9)
Rehabilitation facility	34 (19.1)
Skilled nursing facility	27 (15.2)
Acute care facility	12 (6.7)
Other	9 (5.1)
Mortality, n (%)	57 (32.0)

Mean ± standard deviation or Median (IQR) where appropriate.
IQR, 25th and 75th IQR.

TABLE 6. Pelvic Fracture Hemorrhage Control

	All Patients (N = 1,339), n (%)	Shock (n = 178), n (%)
No pelvic fracture intervention	1,156 (86.3)	121 (68.0)
Angioembolization alone	55 (4.1)	19 (10.7)
External fixator alone	78 (5.8)	17 (9.6)
Preperitoneal pelvic packing alone	20 (1.5)	6 (5.1)
Embolization + external fixator	11 (0.8)	6 (5.1)
Embolization + pelvic packing	6 (0.4)	2 (1.1)
External fixator + pelvic packing	3 (0.2)	1 (1.7)
Embolization + external fixator + pelvic packing	5 (0.4)	1 (0.6)
REBOA with or without any other	5 (0.4)	5 (2.8)

Contents


MOSA

Damage control surgery

- Abbreviated initial operation
- Resuscitation in ICU
- Reoperation(Definite operation)

Damage control surgery in abdomen

- The abbreviated laparotomy in “damage control” surgery **controls bleeding** and limits further **contamination** from the gastrointestinal tract before the patient is transferred to the intensive care unit (ICU).

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TABLE 38-1: Intraoperative Indications to Perform Damage Control Operations

Factor	Level
1. Initial body temperature	<35°C (95.0°F)
2. Initial acid-base status	
• Arterial pH	<7.2
• Base deficit	< –15 mmol/L in patient <55 years
• Serum lactate	>5 mmol/L
3. Onset of coagulopathy	INR and/or partial thromboplastin time >50% of normal

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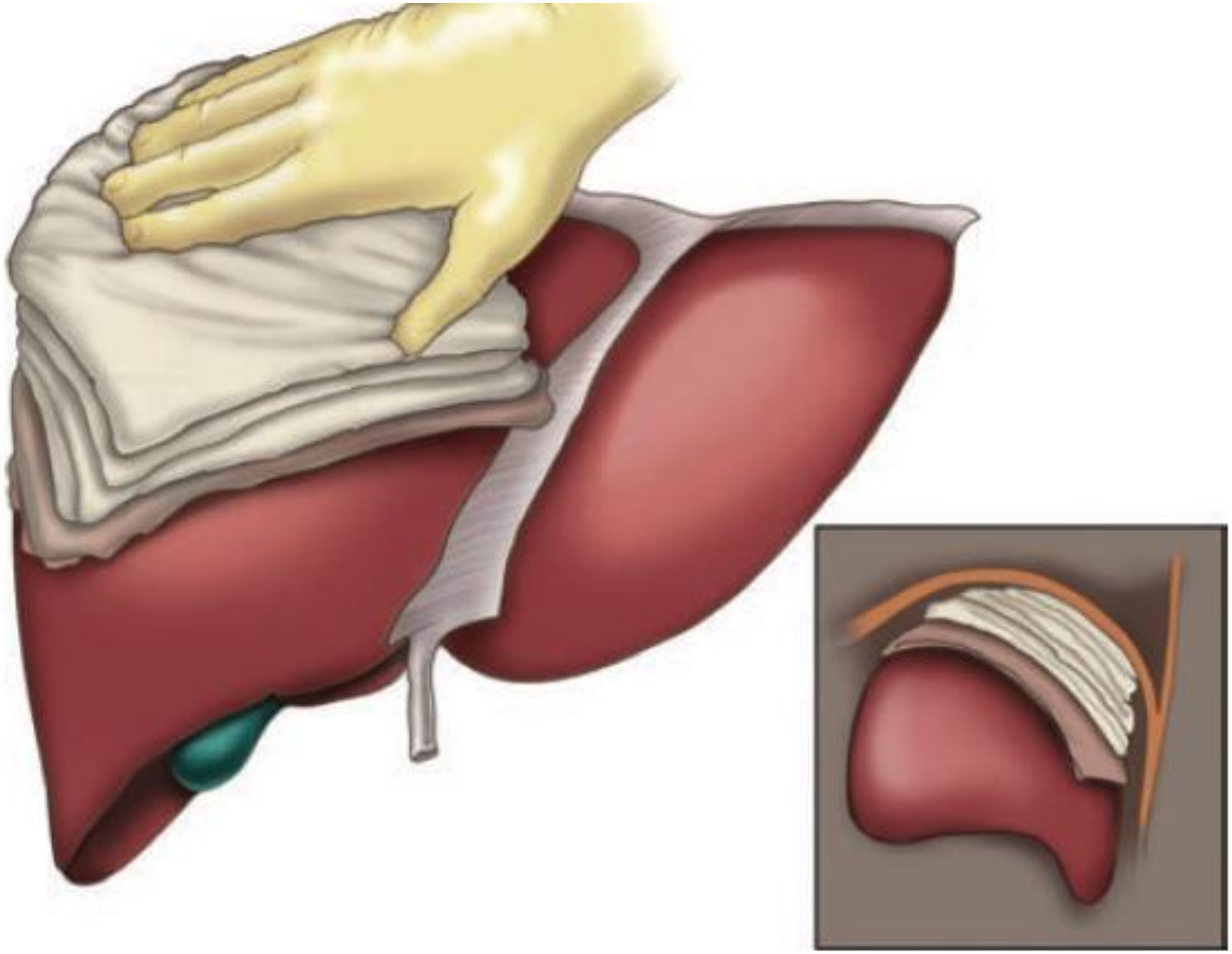
Operative procedure

- **Packing**
- Intravascular shunting
- Temporary closure or coverage of abdomen
- Drainage
- Enterostomy
- Bowel stapling



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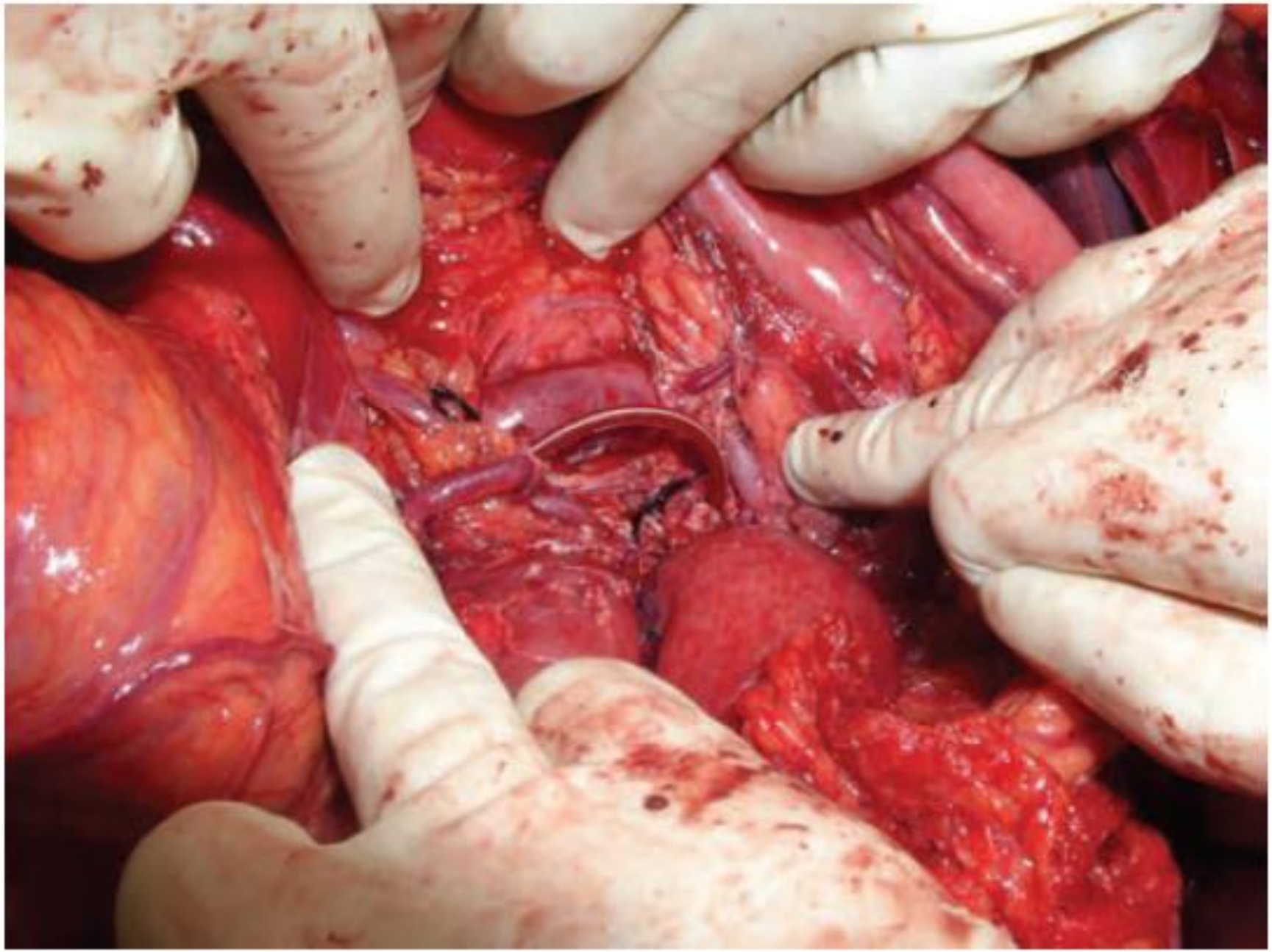

Trauma 10th ed

Injury, Int. J. Care Injured (2004) **35**, 713—722

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www.elsevier.com/locate/injury

Damage control surgery and intensive care

Michael J.A. Parr[a,b,*], Tareq Alabdi[a]

[a]*Department of Intensive Care, Liverpool Hospital, Sydney, Australia*
[b]*University of New South Wales, Sydney, Australia*

Table 1 Key issues for early ICU management

Identifying patients who may benefit from surgical re-exploration or radiology/angiographic guided haemorrhage control procedures
Correction of hypothermia
Correction of coagulopathy
Correction of acidosis
Fluid and blood product therapy
Monitoring resuscitation end points
Assessing for missed injuries (tertiary survey)
Planing return to OR
Initiating specific therapy to reduce complications (ACS, peptic ulceration, thrombo-prophylaxis, protective lung ventilation, infection control and appropriate antimicrobial therapy)
Maintaining effective communication

Table 5 Predictable complications seen in DCS patients

ACS
Peptic ulceration
Venous thromboembolism
ARDS
Nosocomial infection
Intra-abdominal infection, fistula, dehiscence
Nutritional failure
Critical illness myoneuropathy

Table 6 Strategies to reduce complications

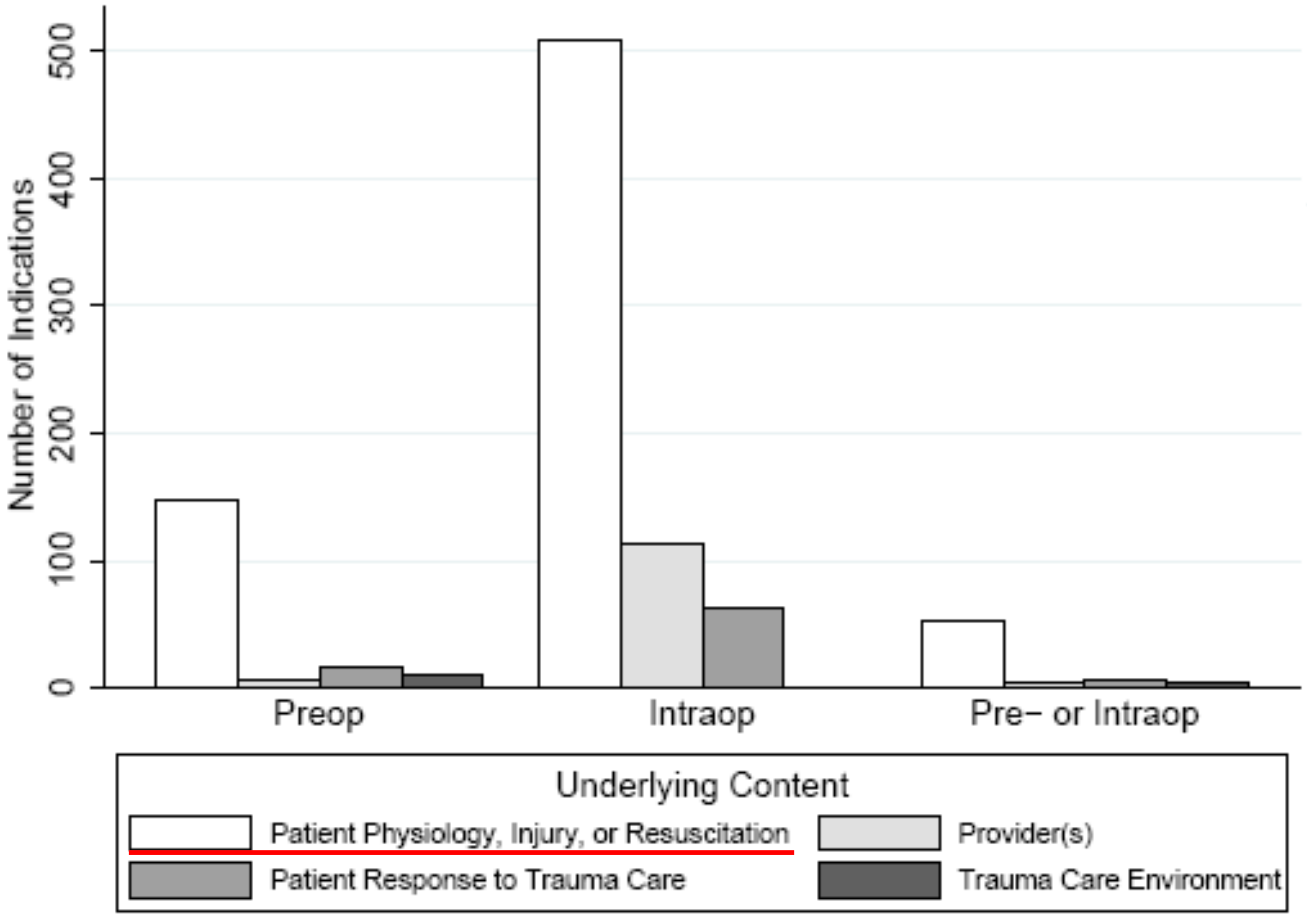
Measurement of IAP
Peptic ulceration prophylaxis
Thromboprophylaxis
Protective lung ventilation
Infection control and appropriate antimicrobial therapy
Early nutritional support (preferably enteral)

SYSTEMATIC REVIEW

Indications for use of damage control surgery and damage control interventions in civilian trauma patients: A scoping review

Derek J. Roberts, MD, Niklas Bobrovitz, MSc, David A. Zygun, MD, MSc, Chad G. Ball, MD, MSc, Andrew W. Kirkpatrick, MD, MHSc, Peter D. Faris, PhD, *and* **Henry T. Stelfox, MD, PhD,** *Calgary, Alberta, Canada*

J tTauma Acute Care Surg, 2015



Supplemental Digital Content 6. The Distribution of Reported Indications for Civilian Trauma Damage Control Surgery According to a Prespecified Conceptual Framework. Categories are not mutually exclusive. Providers include surgeons, anesthesiologists, other physicians, and allied health care workers.

Comment of Dr. Raul Coimbra

- *The dissemination of the damage control laparotomy approach was **not meant to avoid a longer operation**, to **get out of the operating room as quickly as possible**, or to transfer the **responsibility of the critical decision to somebody else** on the next day. Unfortunately, this is what is happening in civilian trauma centers today.*
- *Young civilian surgeons, **based on reports from the current military conflict**, are adopting this **dangerous surgical strategy** in many patients that **do not need it.***
- *Having visited many trauma centers **in the last five years** and seen that **one in three or four patients** in the ICU have an **open abdomen** suggests that something is **definitely wrong**.* ***-AAST 2011-***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