Por un niño sano
en un mundo mejor

TRAUMA ADBOMINAL

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Hospital Provincial de Neuquén

8° CONGRESO ARGENTINO
de Emergencias y Cuidados Críticos en Pediatría
BUENOS AIRES 2017

Semana de Congresos y Jornadas Nacionales

Epidemiología

- Trauma torso: 5-10% IAI
- 27% intervenciones agudas
- Mortalidad <1%
- Hasta 12% lesiones asociadas
- > 50% lesión vascular

Holmes JF. *Ann Emerg Med 2013*
Borgialli D. *Acad Emerg Med 2014*
Pariset JM. *Clin Pediatr (Phila). 2010.*

Etiología

Contusos (90)%

- Colisión vehicular
- Peatón
- Caídas
- Deportes
- Maltrato Infantil

Penetrantes (10%)

- Arma blanca
- Herida de arma de fuego

Rothrock SG,
Pediatr Emerg Care 2000

Anatomía y Mecanismos

Mecanismos de alta energía (colisión vehículo motor)

Golpe alta energía en abdomen

Aplastamiento contra columna

Caídas

Mecanismos con alto riesgo injuria

Blunt
Motor vehicle collision
Ejection from the automobile
Death of another passenger in same vehicle compartment
Vehicle roll over
High speed automobile crash
• Initial speed >40 mph (64 kph)
• Auto deformity >20 inches (50 cm)
• Intrusion into passenger compartment >12 inches (30 cm)
Extrication time >20 minutes
Motorcycle crash >20 mph (32 kph) or with separation of rider from bike
Motor vehicle pedestrian injury
Pedestrian thrown or run over
Automobile-pedestrian injury with >5 mph (8 kph) impact
Falls
Adult: >20 ft (6 m)
Child: >10 ft (3 m) or more than 2 to 3 times patient height
Penetrating
Any penetrating trauma to head, neck, chest, abdomen, or extremities proximal to elbow or knee

American College of Surgeons Committee on Trauma

Estabilización: ATLS

Timeline	Assessment	Management*
0 minutes		
	Mobilize trauma resources	Immobilize C-spine Assess vital signs
	Airway	
	Identify:	
	Obstruction	Open airway; suction secretions Administer 100 percent O2
	Midface fracture/difficult airway OR Direct airway injury	Surgical airway
	Breathing	
	Identify:	
	Tension pneumothorax	Needle decompression; place chest tube
	Massive hemothorax	Place chest tube
	Open pneumothorax	Apply 3-sided occlusive dressing
	Flail chest	Perform bag-valve-mask ventilation
	Impaired oxygenation/ventilation	Rapid sequence endotracheal intubation
	Circulation	
	Identify:	
	Absent circulation	Cardiac compressions, thoracotomy IF witnessed arrest
	External hemorrhage	Control external hemorrhage
	Signs of shock	Secure IV access; obtain laboratory studies Fluid resuscitation•
	Cardiac tamponade	Pericardiocentesis followed by thoracotomy
	Pelvic fracture	Wrap or bind pelvis
	Disability	
	Identify:	
	Level of consciousness (GCS)	Endotracheal intubation for rapidly declining GCS, GCS ≤8 or herniationΔ
	Pupillary response Signs of spinal cord injury	Elevate head of bed to 30° if no signs of shock
	Signs of impending herniation	Moderate hyperventilation (pCO2 30-35) Neurosurgical consultation Administer osmotic agents if normotensive
	Exposure	
	Identify:	
	Hypothermia	Remove clothing Initiate rewarming
5 minutes		

American College of Surgeons Committee on Trauma. *Chicago 2012.*

Estabilización: ATLS

Repeat vital signs every 5 minutes	Continue care of airway, breathing, circulation, and disability
Reassess response to interventions	Proceed to intraosseous or central venous access if peripheral IV access unsuccessful
Intubated patients:	
Monitor end-tidal CO2	Gastric tube placement
Obtain blood gas	Perform thoracotomy in patients who lose vital signs during resuscitation
15 minutes	
Reassess response to interventions	Continue care of airway, breathing, circulation, and disability
Reassess level of consciousness	Logroll patient and remove spine board
Examine head, neck, chest, abdomen, pelvis, and extremities	Provide analgesia
	Place urinary catheter IF no signs of urethral disruption
Obtain screening radiographs (lateral c-spine, AP chest, AP pelvis)	Operative management for patients who remain hemodynamically unstable despite rapid blood infusion per trauma surgeon
Persistently hypotensive patients:	
FAST examination, if available	
20 minutes	
Reassess response to interventions	Provide analgesia
	Splint fractures
Reassess level of consciousness	Update tetanus immunization, as needed
Perform complete PE (secondary survey)	Antibiotics for open fracture, contaminated wounds, or suspected bowel perforation
Repeat selected laboratory studies (eg, hematocrit, blood gas, glucose)	Determine need for emergent life or limb-saving operative procedures
Computed tomography of head, neck, chest, abdomen, or pelvis, as indicated by clinical findings	Transition to definitive care at a regional pediatric trauma center

American College of Surgeons Committee on Trauma. *Chicago 2012.*

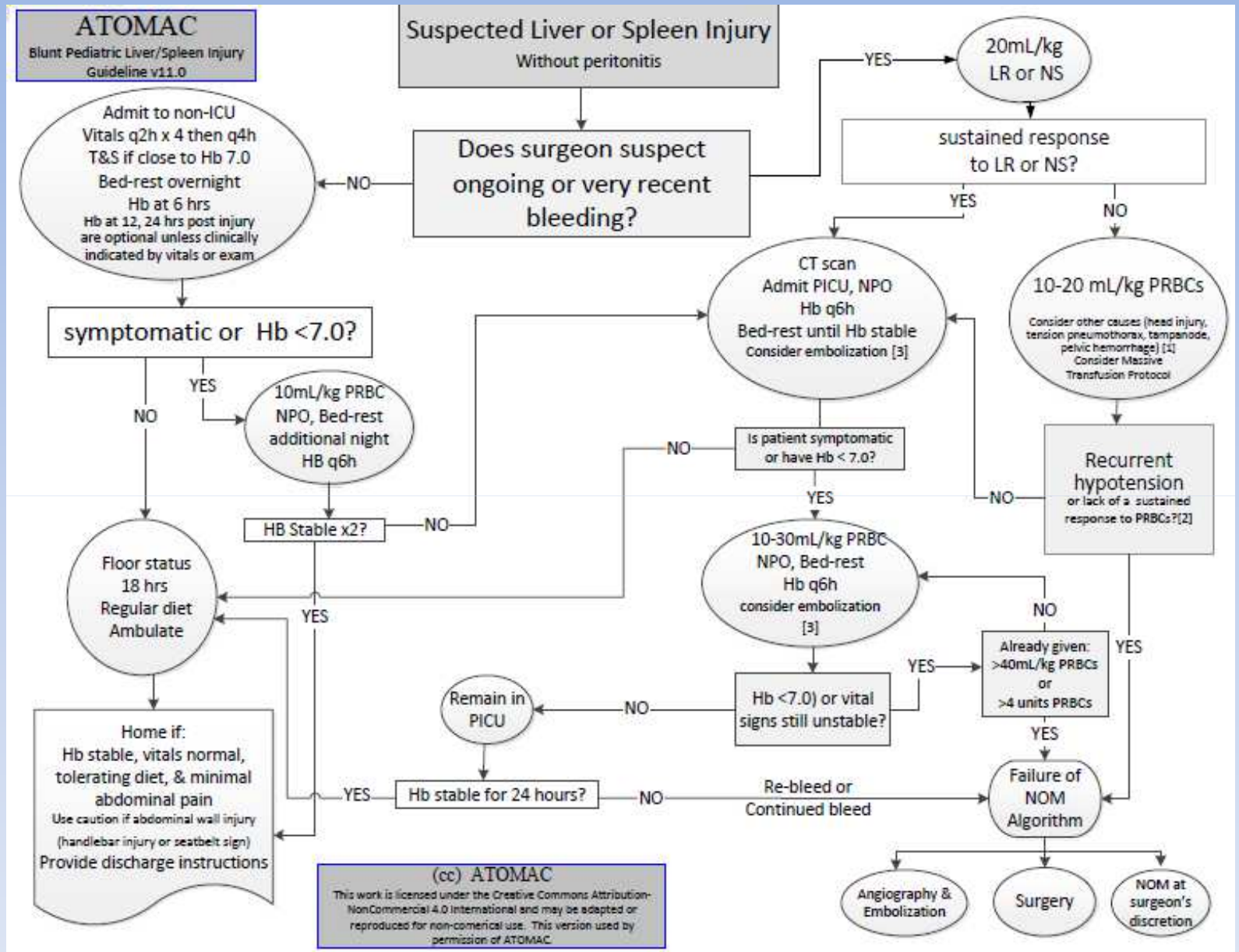
Estabilización

Sospecha IAI

No rta a fluidos
TGRS

Evaluado-Resucitado
Estabilizado

CENTRO TRAUMA
PEDIÁTRICO


ATOMAC
Blunt Pediatric Liver/Spleen Injury Guideline v11.0
Suspected Liver or Spleen Injury
Without peritonitis
Does surgeon suspect ongoing or very recent bleeding?
YES
20mL/kg LR or NS
sustained response to LR or NS?
YES
NO
NO
Admit to non-ICU
Vitals q2h x 4 then q4h
T&S if close to Hb 7.0
Bed-rest overnight
Hb at 6 hrs
Hb at 12, 24 hrs post injury are optional unless clinically indicated by vitals or exam
CT scan
Admit PICU, NPO
Hb q6h
Bed-rest until Hb stable
Consider embolization [3]
10-20 mL/kg PRBCs
Consider other causes (head injury, tension pneumothorax, tamponade, pelvic hemorrhage) [1]
Consider Massive Transfusion Protocol
symptomatic or Hb <7.0?
YES
NO
10mL/kg PRBC
NPO, Bed-rest
additional night
HB q6h
HB Stable x2?
NO
YES
Is patient symptomatic or have Hb < 7.0?
NO
YES
Recurrent hypotension
or lack of a sustained response to PRBCs?[2]
NO
Floor status
18 hrs
Regular diet
Ambulate
10-30mL/kg PRBC
NPO, Bed-rest
Hb q6h
consider embolization
[3]
NO
YES
Already given:
>40mL/kg PRBCs
or
>4 units PRBCs
YES
Remain in PICU
NO
Hb <7.0) or vital signs still unstable?
YES
YES
Home if:
Hb stable, vitals normal, tolerating diet, & minimal abdominal pain
Use caution if abdominal wall injury (handlebar injury or seatbelt sign)
Provide discharge instructions
YES
Hb stable for 24 hours?
NO
Re-bleed or Continued bleed
Failure of NOM Algorithm
Angiography & Embolization
Surgery
NOM at surgeon's discretion
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Evaluación

Dolor

Sensibilidad/Dolor a la palpación (S. de Kerh)

Equimosis/Abrasiones en flancos o peri umbilicales

Marcas de neumáticos o cinturón seguridad

Distensión abdominal

Signos irritación peritoneal

RHA disminuidos

Saladino R. *Ann Emerg Med 1991*

Borgialli DA. *Emerg Med 2014*

Adelgais KM. *J Pediatr. 2014*

Accuracy of the Abdominal Examination for Identifying Children with Blunt Intra-Abdominal Injuries

Adelgais et al. *J Pediatr 2014*

Table IV. Accuracy of abdominal pain and abdominal tenderness for identifying IAI

Characteristics	IAI, n/N (%)	No IAI, n/N (%)	RR (95% CI)
GCS score 15			
Any abdominal pain (≥2 y)	425/536 (79.3)	2978/8933 (33.3)	2.4 (2.3-2.5)
Mild	67/514 (13.0)	1288/8754 (14.7)	0.9 (0.7-1.1)
Moderate	201/514 (39.1)	1133/8754 (12.9)	3.0 (2.7-3.4)
Severe	135/514 (26.3)	378/8754 (4.3)	6.1 (5.1-7.2)
Any abdominal tenderness	439/556 (79.0)	2951/9687 (30.5)	2.6 (2.5-2.7)
Mild	79/554 (14.3)	1449/9652 (15.0)	0.9 (0.8-1.2)
Moderate	230/554 (41.5)	1208/9652 (12.5)	3.3 (3.0-3.7)
Severe	128/554 (23.1)	259/9652 (2.7)	8.6 (7.1-10.5)
GCS score 14			
Any abdominal pain (≥2 y)	26/51 (51.0)	107/472 (22.7)	2.2 (1.6-3.1)
Mild	1/47 (2.1)	43/453 (9.5)	0.2 (0.03-1.6)
Moderate	10/47 (21.3)	36/453 (7.9)	2.7 (1.4-5.0)
Severe	11/47 (23.4)	9/453 (2.0)	11.8 (5.1-27.0)
Any abdominal tenderness	30/53 (56.6)	121/604 (20.0)	2.8 (2.1-3.8)
Mild	6/53 (11.3)	50/599 (8.3)	1.4 (0.6-3.0)
Moderate	12/53 (22.6)	60/599 (10.0)	2.3 (1.3-3.9)
Severe	12/53 (22.6)	6/599 (1.0)	22.6 (8.9-57.8)
GCS score 13			
Any abdominal pain (≥2 y)	7/22 (31.8)	27/162 (16.7)	1.9 (0.9-3.9)
Mild	1/22 (4.5)	7/158 (4.4)	1.0 (0.1-7.9)
Moderate	3/22 (13.6)	12/158 (7.6)	1.8 (0.5-5.9)
Severe	3/22 (13.6)	4/158 (2.5)	5.4 (1.3-22.5)
Any abdominal tenderness	10/27 (37.0)	34/201 (16.9)	2.2 (1.2-3.9)
Mild	2/27 (7.4)	14/201 (7.0)	1.1 (0.3-4.4)
Moderate	5/27 (18.5)	13/201 (6.5)	2.9 (1.1-7.4)
Severe	3/27 (11.1)	7/201 (3.5)	3.2 (0.9-11.6)

Abdominal pain and/or tenderness:

8% (95% CI, 6%-9%) IAI

1% (95% CI, 1%-2%) IAI undergoing acute intervention

Accuracy of the Abdominal Examination for Identifying Children with Blunt Intra-Abdominal Injuries

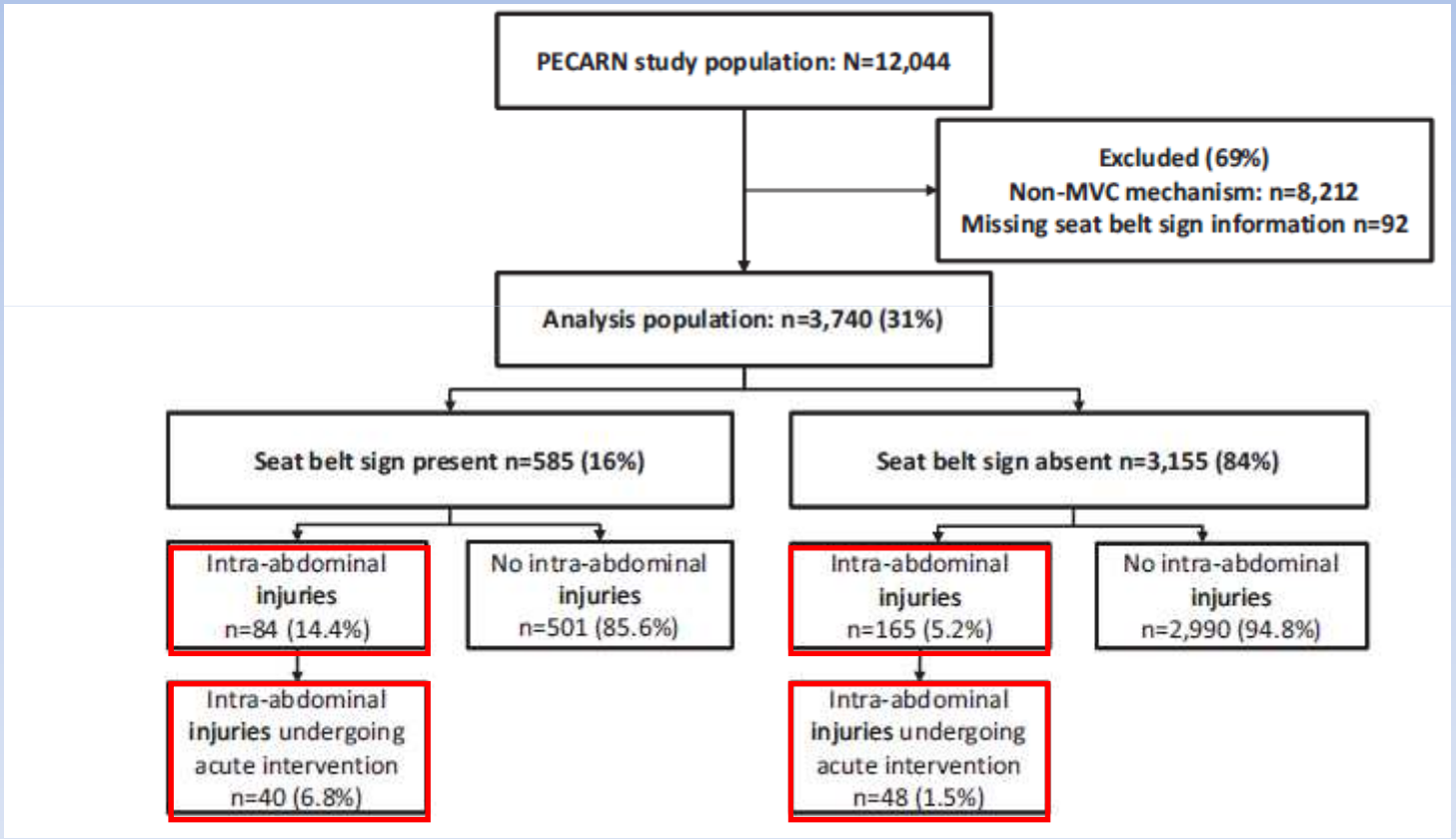
Adelgais et al. *J Pediatr 2014*

- *sensitivity of abdominal findings for IAI decreases as GCS score decreases*

- *the risk of IAI is sufficiently high that diagnostic evaluation is warranted*

Association Between the Seat Belt Sign and Intra-abdominal Injuries in Children With Blunt Torso Trauma in Motor Vehicle Collisions

Borgialli et al. *Acad Emerg Med 2014*



1,864 (50%) patients underwent definitive abdominal testing

Injury	Seat Belt Sign (n = 445)	No Seat Belt Sign (n = 1,419)	RR (95% CI)
Any IAI	84 (19)	165 (12)	1.6 (1.3–2.1)
Gastrointestinal	47 (11)	16 (1)	9.4 (5.4–16.4)
Solid organ	38 (9)	138 (10)	0.9 (0.6–1.2)
Spleen	22 (5)	75 (5)	0.9 (0.6–1.5)
Liver	19 (4)	71 (5)	0.9 (0.5–1.4)
Kidney	13 (3)	23 (2)	1.8 (0.9–3.5)
Pancreas	6 (1)	9 (1)	2.1 (0.8–5.9)

Data are reported as n (%)
IAI = intra-abdominal injury; RR = relative risk.
*Definitive abdominal test defined as abdominal CT, laparotomy, laparoscopy, or autopsy.

40 (9.0%, 95% CI = 6.5% to 12.0%) had intra-abdominal injuries undergoing acute intervention

Borgialli, D. *Acad Emerg Med 2014*

Characteristic	Multivariable Risk Ratio (95% CI)	p-value
Vomiting	1.4 (1.0–2.0)	0.06
Hypotension	2.4 (1.7–3.5)	< 0.01
GCS score < 14	2.5 (1.8–3.5)	< 0.01
Decreased breath sounds	1.6 (1.1–2.4)	0.01
Evidence of thoracic trauma	1.4 (1.1–1.8)	0.02
Costal margin tenderness	1.4 (1.0–2.0)	0.02
Abdominal pain and/or tenderness	1.6 (1.2–2.2)	< 0.01
Restrained	0.8 (0.6–1.0)	0.09
Abdominal abrasion/contusion		
Seat belt sign	1.8 (1.3–2.4)	< 0.01
Other abrasion/ contusion	1.3 (0.9–1.9)	0.11
None		Reference

GCS = Glasgow Coma Scale.
*Definitive abdominal test defined as abdominal CT, laparotomy, laparoscopy, or autopsy.

confirm independent association between the seat belt sign and intra-abdominal injuries in pediatric patients presenting to EDs after MVCs

Fuerte e independiente asociación con lesión abdominal significativa (víscera hueca)

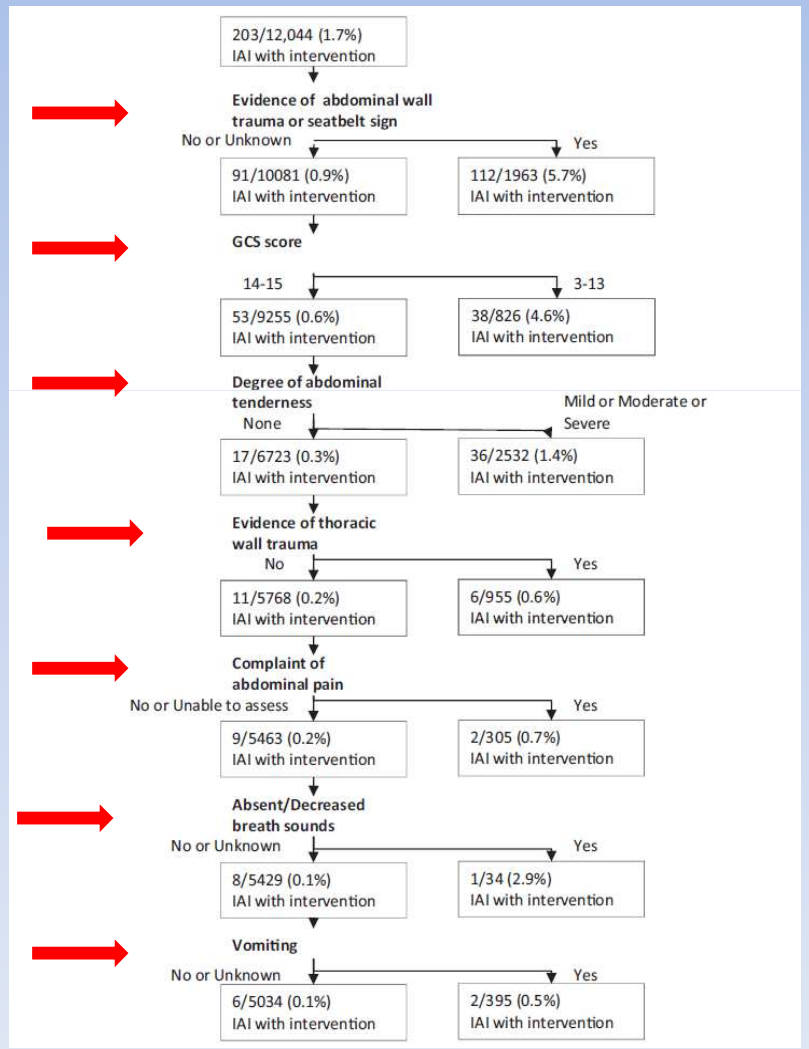
Considerar laparotomía en pacientes con inestabilidad hemodinámica

Considerar ampliar evaluación en pacientes estables (sin dolor abdominal)

Paris et al. *J Pediatr Surg 2010*
Sokolove et al. *Acad Emerg Med 2005*
Lutz et al. *J Pediatr Surg 2004*

Identifying Children at Very Low Risk of Clinically Important Blunt Abdominal Injuries

Holmes et al. *Ann Em Med 2013*



- 7 patient history and physical examination findings

- children with blunt torso trauma who are at very low risk for IAI undergoing acute intervention

Identifying Children at Very Low Risk of Clinically Important Blunt Abdominal Injuries

Holmes et al. *Ann Em Med 2013*

	Percent (95% CI)
Prediction rule sensitivity	97.0% (93.7, 98.9)
Prediction rule specificity	42.5% (41.6, 43.4)
Negative predictive value	99.9% (99.7, 1.00)
Positive predictive value	2.8% (2.4, 3.2)
Negative likelihood ratio	0.07 (0.03, 0.15)

Table 2. Risk of IAI undergoing acute intervention according to the number of prediction rule variables present.

Number of Variables Present	Patients (%)	IAI Acute Intervention	% (95% CI)
0	5,040 (41.9)	6	0.1 (0.04–0.3)
1	2,679 (22.2)	37	1.4 (1.0–1.9)
2	2,576 (21.4)	47	1.8 (1.3–2.4)
3	1,280 (10.6)	57	4.5 (3.4–5.7)
4 or more	469 (3.9)	56	11.9 (9.2–15.2)

6 pac FAST+/lab +

23% TC pac bajo riesgo

Laboratorio

Grupo Factor Compatibilidad

Laboratorio

Estable con EF -

• HTO-Hb	Anemia sin otra causa
• Ex Orina	Hematuria >50 GR/cga
• Transaminasas	AST > 200 UI/L ALT > 125 UI/L

Holmes JF. *Ann Emerg Med 2002*
Santucci RA. *J Urol 2004*
Wegner SD. *Pediatr Clin N Am 2006*

Multiple logistic regression model for intra-abdomina

Variable	OR (95% CI)	*P* Value	Bias-Corrected 95% CI*
Age <3 y	1.2 (0.5–2.5)	.70	0.5–2.5
Low systolic blood pressure	4.1 (1.1–15.2)	.03	0.8–13.7
Abdominal tenderness	5.8 (3.2–10.4)	<.001	3.1–10.8
Abnormal thoracic examination results	0.9 (0.5–1.5)	.62	0.5–1.5
Abnormal pelvic examination	0.6 (0.3–1.4)	.23	0.3–1.4
Femur fracture	1.3 (0.5–3.7)	.59	0.4–4.7
GCS score ≤13	1.7 (0.8–3.4)	.17	0.8–3.6
ALT >125 U/L or AST >200 U/L	17.4 (9.4–32.1)	<.001	7.7–32.1
Urinalysis >5 RBCs/hbf	4.8 (2.7–8.4)	<.001	2.5–8.4
Initial hematocrit <30%	2.6 (0.9–7.5)	.07	0.8–9.9

*In bootstrap validation, as described in "Materials and Methods" section.

Holmes JF. *Ann Emerg Med 2002*

Laboratorio

Estable con EF -

ALT > 104 UI/L injuria hepática con S:96%-E:80%; 100% y 70% (grados III-VI-V)

Bevan et al, *Emerg Med J 2009*

Sospecha MI: AST/ALT>80 UI/L TAC

Trout et al, *Pediatr Radiol 2011*
Lindberg et al, *Pediatrics 2009*

Laboratorio

Grupo Factor Compatibilidad

Enzimas pancreáticas

Adamson WT. *J Pediatr Surg 2003*

Mure AJ. *Am Surg 1991*

Hemograma

TP, KPTT, RIN

Urea Creatinina, gases, electrolitos, glucemia

Ecografía (FAST)

Mejores resultados en adultos con trauma torso.

Melniker L A. *Ann Emerg Med. 2006*

Menos uso en pacientes pediátricos.

Menaker J. *J Trauma Acute Care Surg. 2014*

Ecografía (FAST)

Hemoperitoneo: sensibilidad 66% (95% CI 56– 75%); especificidad 95% (95% CI 93%-97%); PLR: 14.5 (95% CI 9.5-22.1); NLR: 0.36 (95% CI 0.27-0.47).

Holmes JF. *J Pediatr Surg 2007*
Fox JC. *Acad Emerg Med 2011*

Perfomance mejor en pacientes hipotensos (S y E 100%)

Holmes JF. *J Pediatr Surg. 2001*

Ecografía (FAST)

- Inestabilidad hemodinámica con FAST positivo = LAPAROTOMÍA
- Paciente estable FAST positivo= evaluación adicional (naturaleza y extensión IAI)
- Paciente estable FAST negativo= no usar como única herramienta Dx para descartar IAI

Schonfield et al. *Em Crit Care Med 2012*

TAC Abdomen y Pelvis (contraste IV)

- Test de elección diagnóstico lesión abdominal
- ↑Sensibilidad y Especificidad en lesiones hepáticas, esplénicas, retroperitoneales
- Menor sensibilidad en injuria intestinal, pancreática y vesical
- Clasificación gravedad lesiones

Semin Pediatr Surg. 2010 Nov;19(4):252-6. doi: 10.1053/j.sempedsurg.2010.06.004.

Managing radiation risk in the evaluation of the pediatric trauma patient.

Scaife ER, Rollins MD.

Division of Pediatric Surgery, University of Utah, 100 N. Mario Capecchi, Salt Lake City, UT 84113, USA. Eric.scaife@hsc.utah.edu

Abstract

Pediatric trauma is usually a nonoperative experience for the pediatric general surgeon. The pediatric trauma surgeon resuscitates the child and then evaluates and triages the identified injuries. A common diagnostic tool is the computed tomography (CT) scan. Most children who require evaluation for significant trauma will get a CT scan, but there are no national guidelines directing the assessment. Injuries to the head, cervical spine, chest, and abdomen can all be imaged with a CT scan; the question is whether the liberal approach to imaging children is appropriate. Over the past decade, concern has arisen about the radiation dose delivered by CT. This concern has generated a national campaign to "image gently." This article reviews the data involving the risk of medical radiation exposure and discusses strategies for managing the risk.

- **Brenner et al**, “Computed tomography: an increasing source of radiation exposure”. N Engl J Med 2007.
- **Linet et al**,”Children’s exposure to diagnostic medical radiation and cancer risk: epidemiologic and dosimetric considerations”. Pediatr Radiol 2009
- **Tien et al**, “Radiation exposure from diagnostic imaging in severly injured trauma patients”. J Trauma 2007

CT scan and the pediatric trauma patient-are we overdoing it?

Fenton SJ. *J Pediat Surg 2004*

Background: Recent literature expresses concern for an increased risk of cancer in children exposed to low-dose radiation during computed tomography (CT). In response, children's hospitals have implemented the ALARA (as low as reasonably achievable) concept, but this is not true at most adult referring institutions. The purpose of this study was to assess the diagnostic necessity of CT in the evaluation of pediatric trauma patients.

Methods: A retrospective review was conducted of the trauma database at a large, level I, freestanding children's hospital with specific attention to the pattern of CT evaluations.

Results: From January 1999 to October 2003, 1,653 children with traumatic injuries were evaluated by the trauma team, with 1,422 patients undergoing 2,361 CT scans. Overall, 54% of obtained scans were interpreted as normal. Fifty percent of treated patients were transferred from referring hospitals. Approximately half arrived with previous CT scans with 9% of these requiring further imaging. Of the 897 patients that underwent abdominal CT imaging, only 2% were taken to the operating room for an exploratory laparotomy. In addition, of those patients who had abnormal findings on an abdominal CT scan, only 5% underwent surgical exploration.

Conclusions: CT scans are used with regularity in the initial evaluation of the pediatric trauma patient, and perhaps abdominal CT imaging is being used too frequently. A substantial number of these scans come from referral institutions that may not comply with ALARA. The purported risk of CT radiation questions whether a more selective approach to CT evaluation of the trauma patient should be considered.

INDEX WORDS: Computed tomography, trauma, abdominal trauma, radiation.

Table 2. Total CT Scans

	PCMC	Transferred Without Scans	Transferred With Scans	Repeat Scans	Total
Total (normal)	1,068 (708, 66)	540 (285, 53)*	689 (277, 40)*	64 (11, 17)	2361 (1281, 54)
Head (normal)	605 (375, 62)	302 (118, 39)*	401 (137, 34)*	53 (6, 11)*	1361 (636, 47)
Abdominal (normal)	437 (327, 75)	217 (157, 72)	243 (122, 50)*	10 (4, 40)*	907 (610, 67)
Chest (normal)	26 (6, 23)	21 (10, 48)	45 (18, 40)	1 (1, 100)	93 (35, 38)

NOTE. Data are listed as no. of scans (no. of normal scans, percent normal scans).
*$P < .05$ when compared with values in PCMC group.

A QUIEN TAC?

EXPOSICIÓN
SIGNIFICATIVA
RADIACIÓN

INDICACIONES CON
SUFICIENTE EVIDENCIA?

PROBABILIDAD
DETECCIÓN LESIÓN
SIGNIFICATIVA?

TAC Abdomen y Pelvis
Indicaciones

- Ex físico sugestivo de IAI: dolor, sensibilidad a la palpación, signo del cinturón de seguridad.
- AST>200 UI/L o ALT>125 UI/L
- Macrohematuria o >= 50 GR/CGA
- HTO inicial < 30% o descenso inexplicable
- FAST +
- Requerimiento de fluido IV o sangre de dudosa etiología
- Injurias asociadas (distracting injuries)
- Imposibilidad de adecuada evaluación clínica (GCS, intoxicac, edad, etc)

TAC Abdomen y Pelvis
Indicaciones

- Contraste VO no mejora sensibilidad del método (sólo aumenta levemente especificidad)

- Incrementa duración 12 minutos

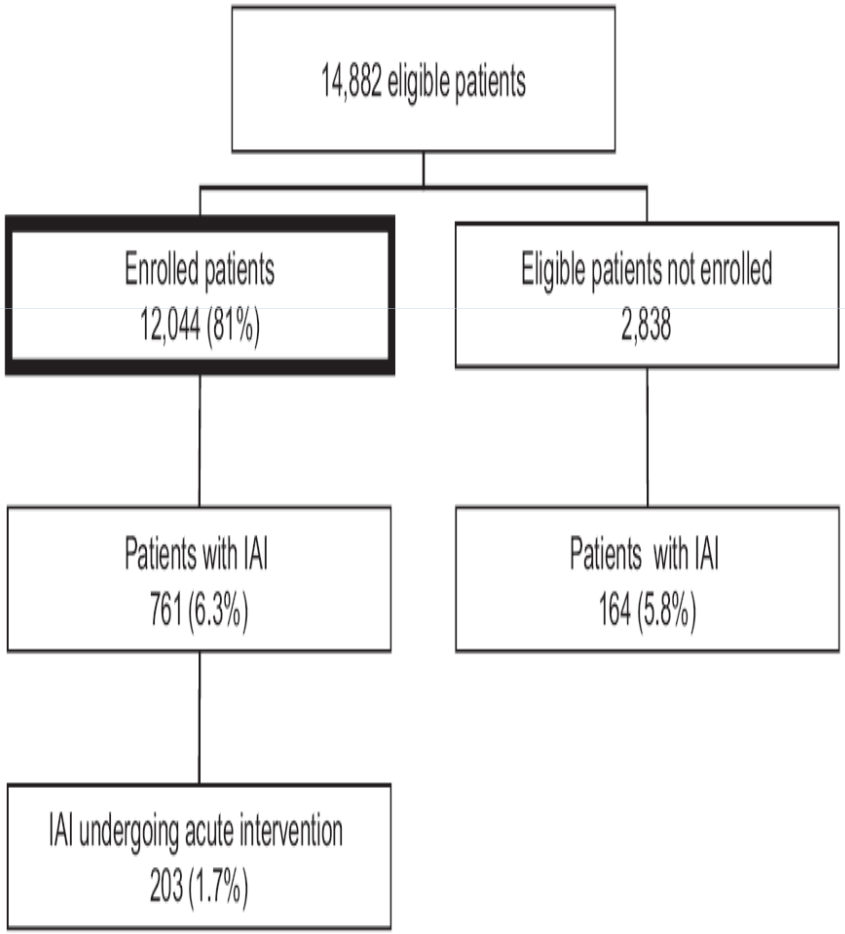
Ellison A M. *Ann Emerg Med 2015*

Identifying Children at Very Low Risk of Clinically Important Blunt Abdominal Injuries

Holmes et al

Ann Emerg Med.

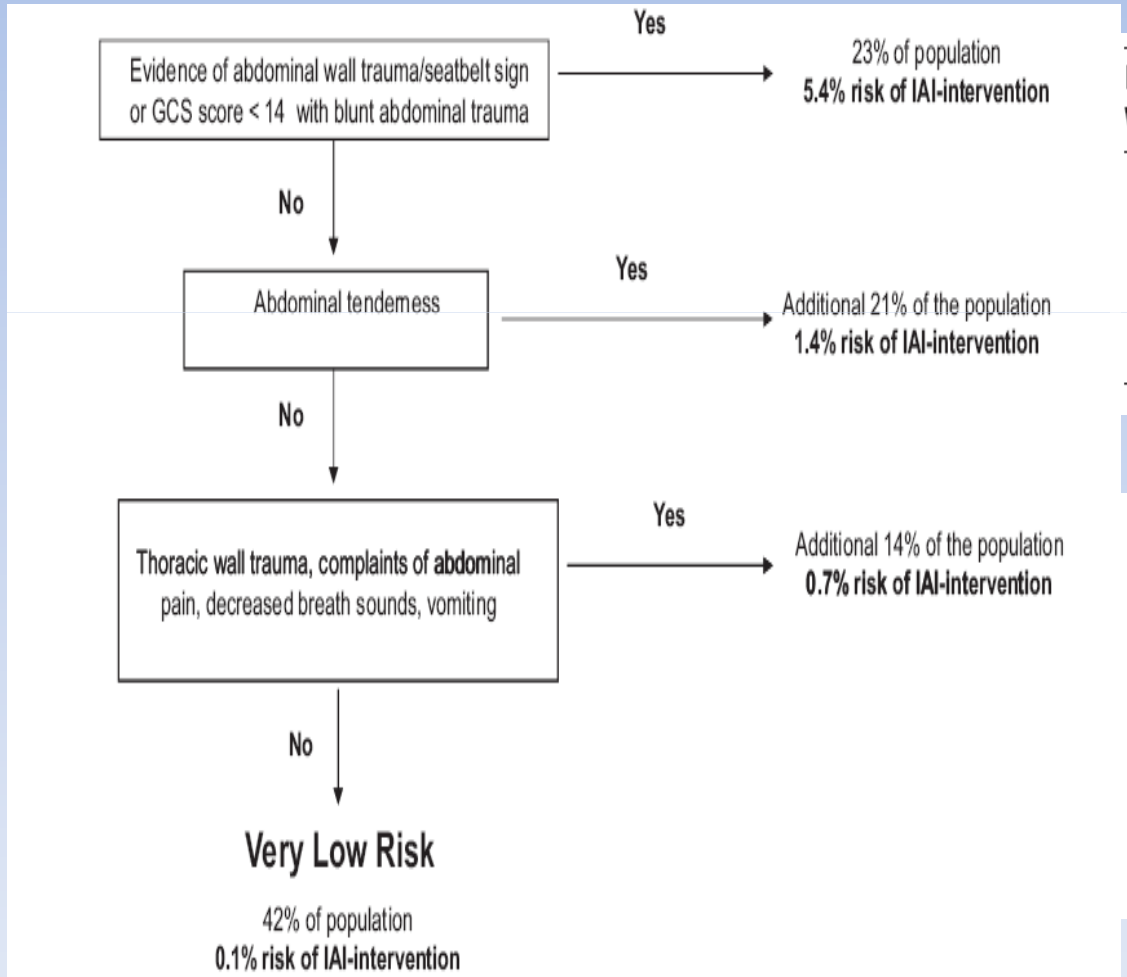
2013



Abdominal CT scans were obtained for 5,514 (46%) patients

1,254 CT scans in children at VLR

Clinical risk stratification



Number of Variables Present	Patients (%)	IAI Acute Intervention	% (95% CI)
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2	2,576 (21.4)	47	1.8 (1.3–2.4)
3	1,280 (10.6)	57	4.5 (3.4–5.7)
4 or more	469 (3.9)	56	11.9 (9.2–15.2)

	Percent (95% CI)
Prediction rule sensitivity	97.0% (93.7, 98.9)
Prediction rule specificity	42.5% (41.6, 43.4)
Negative predictive value	99.9% (99.7, 1.00)
Positive predictive value	2.8% (2.4, 3.2)
Negative likelihood ratio	0.07 (0.03, 0.15)

Ann Emerg Med. 2015 Aug;66(2):107-114.e4. doi: 10.1016/j.annemergmed.2015.01.014. Epub 2015 Mar 17.

Use of Oral Contrast for Abdominal Computed Tomography in Children With Blunt Torso Trauma.

Ellison AM[1], Quayle KS[2], Bonsu B[3], Garcia M[4], Blumberg S[5], Rogers A[6], Wootton-Gorges SL[7], Kerrey BT[8], Cook LJ[9], Cooper A[10], Kuppermann N[11], Holmes JF[12]; Pediatric Emergency Care Applied Research Network (PECARN); Pediatric Emergency Care Applied Research Network PECARN.

⊕ **Collaborators (23)**

⊕ **Author information**

Abstract

STUDY OBJECTIVE: We compare test characteristics of abdominal computed tomography (CT) with and without oral contrast for identifying intra-abdominal injuries.

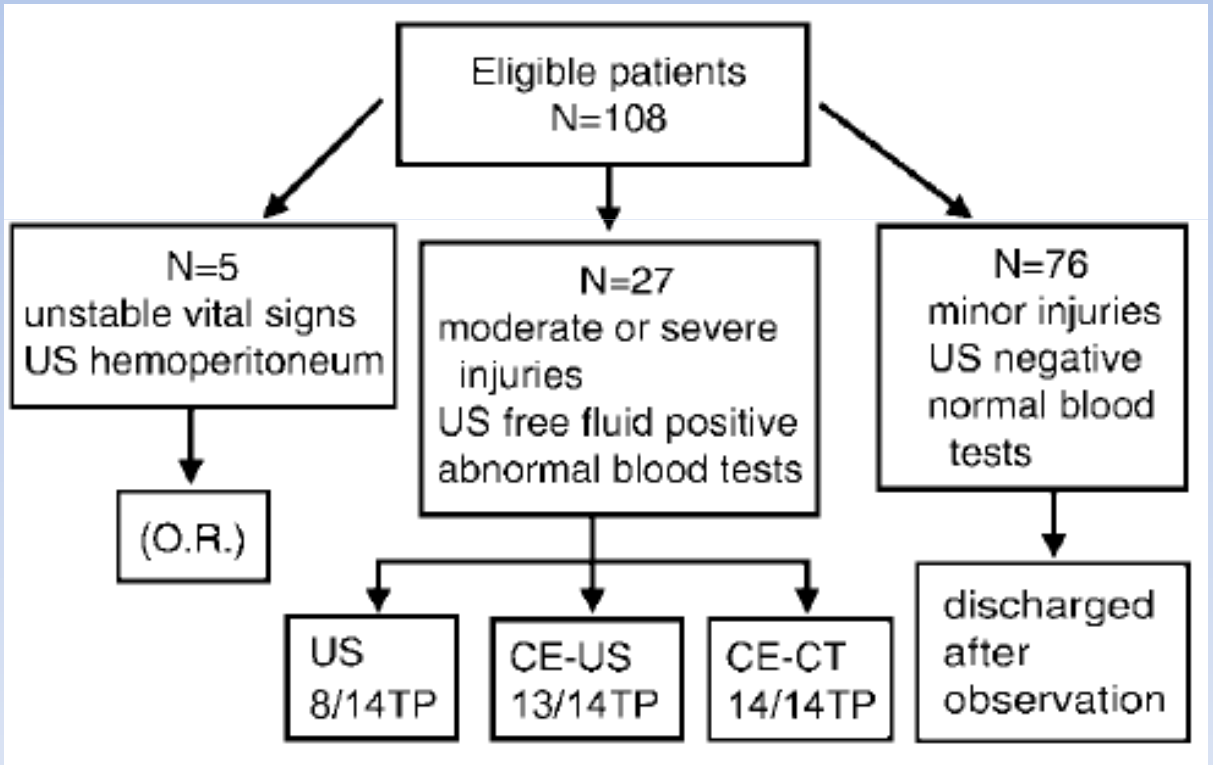
METHODS: This was a planned subanalysis of a prospective, multicenter study of children (<18 years) with blunt torso trauma. Children imaged in the emergency department with abdominal CT using intravenous contrast were eligible. Oral contrast use was based on the participating centers' guidelines and discretions. Clinical courses were followed to identify patients with intra-abdominal injuries. Abdominal CTs were considered positive for intra-abdominal injury if a specific intra-abdominal injury was identified and considered abnormal if any findings suggestive of intra-abdominal injury were identified on the CT.

RESULTS: A total of 12,044 patients were enrolled, with 5,276 undergoing abdominal CT with intravenous contrast. Of the 4,987 CTs (95%) with documented use or nonuse of oral contrast, 1,010 (20%) were with and 3,977 (80%) were without oral contrast; 686 patients (14%) had intra-abdominal injuries, including 127 CTs (19%) with and 559 (81%) without oral contrast. The sensitivity in the detection of any intra-abdominal injury in the oral contrast versus no oral contrast groups was sensitivitycontrast 99.2% (95% confidence interval [CI] 95.7% to 100.0%) versus sensitivityno contrast 97.7% (95% CI 96.1% to 98.8%), difference 1.5% (95% CI -0.4% to 3.5%). The specificity of the oral contrast versus no oral contrast groups was specificitycontrast 84.7% (95% CI 82.2% to 87.0%) versus specificityno contrast 80.8% (95% CI 79.4% to 82.1%), difference 4.0% (95% CI 1.3% to 6.7%).

CONCLUSION: Oral contrast is still used in a substantial portion of children undergoing abdominal CT after blunt torso trauma. With the exception of a slightly better specificity, test characteristics for detecting intra-abdominal injury were similar between CT with and without oral contrast.

Blunt Abdominal Trauma: Diagnostic Performance of Contrast enhanced US in Children—Initial Experience

Valentino M., et al. *Radiology 2008*



- S: 93%
- PPN: 94%

Comparison of US and Contrast-enhanced US

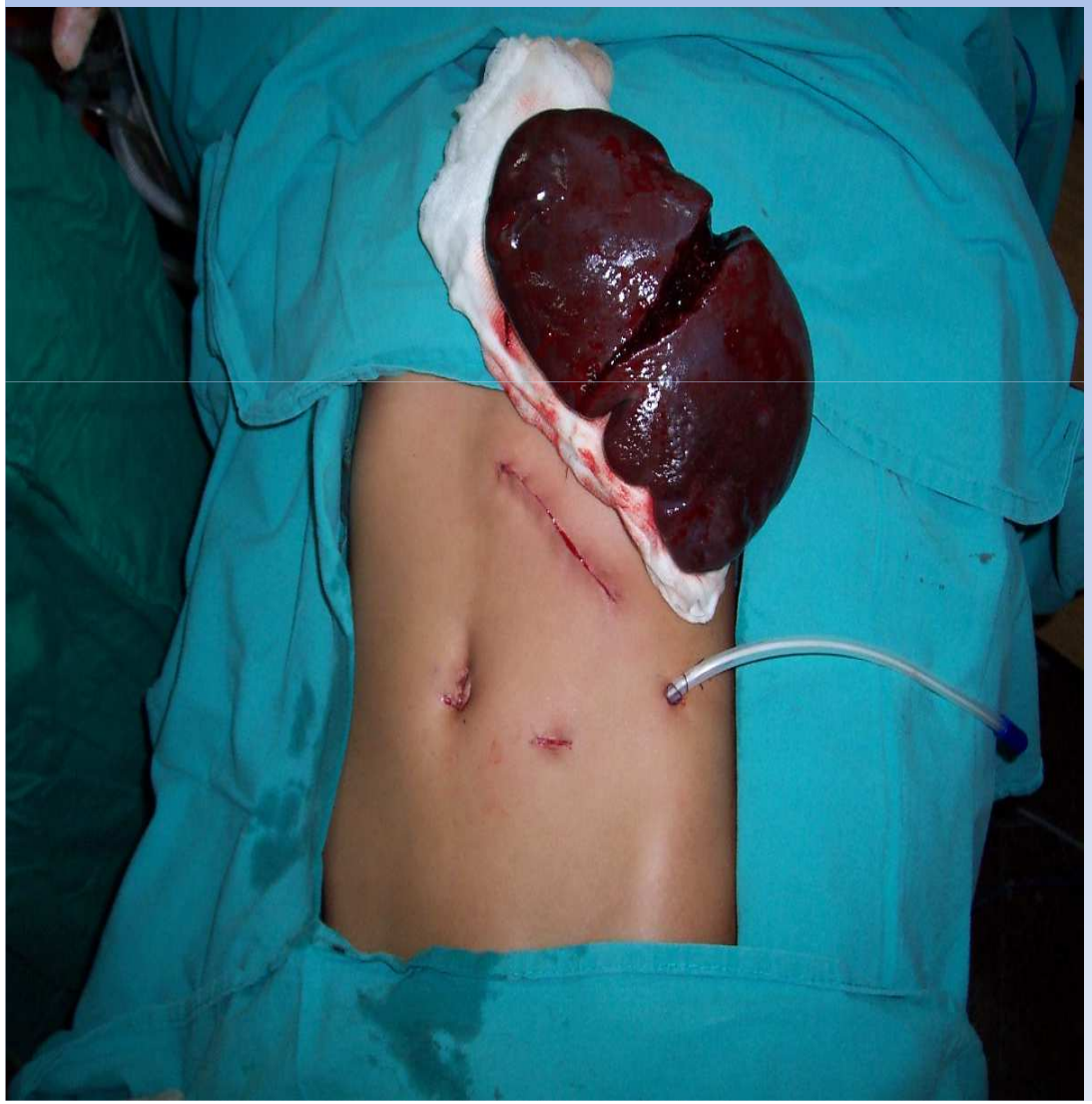
Statistic	US	Contrast-enhanced US	*P* Value
Specificity	13/15 (86.7)	15/15 (100)	.500*
Sensitivity	8/14 (57.1)	13/14 (92.9)	.125*
Negative predictive value	13/19 (68.4)	15/16 (93.8)	. . .
Positive predictive value	8/10 (80.0)	13/13 (100)	. . .
Lesions correctly identified	21/29 (72.4)	28/29 (96.6)	.039*
κ Value	0.442 ± 0.161†	0.931 ± 0.442†	.005‡
	0.719 ± 0.099	0.964 ± 0.041	.022‡
Accuracy	(0.526, 0.912)§	(0.884, 1.045)§	

- **CEUS is more accurate than US**
- **was almost as accurate as CT in depicting solid organ injuries in children**
- **useful alternative to CT in the follow-up of hospitalized children**

- **series was limited (one pancreas lesion)**
- **not all patients underwent CT**

Valentino M., et al. *Radiology 2008*

Tratamiento Definitivo
Laparotomía



Evidencia IAI
significativa
+
Inestabilidad
hemodinámica
persistente o recurrente

Sospecha lesión víscera
hueca
(neumoperitoneo)

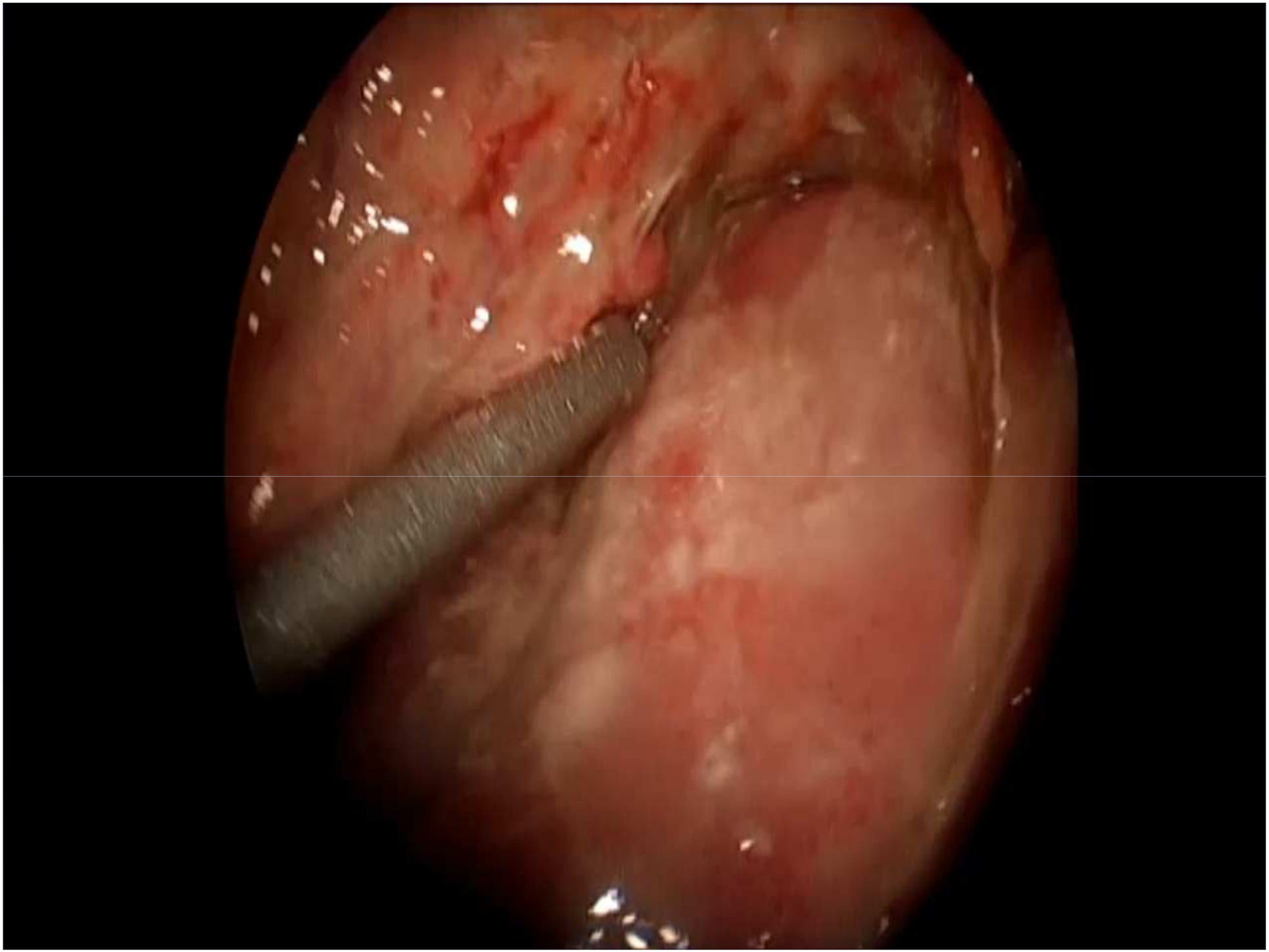
Tratamiento Definitivo
Laparotomía

Indicaciones relativas:

- Progresión irritación peritoneal/dolor abdom

Indicaciones por lesiones especificas:

- injuria órgano sólido con evidencia de sangrado continuo
- injuria pancreática con lesión mayor del parénquima o ductal
- injuria víscera hueca



Embolización Angiográfica

Limitada experiencia en pediatría (series de casos)

Alternativa al tto qco en persistencia de sangrado, preservando el bazo

Gross JL. *J Trauma Acute Care Surg 2013*
Kiankhooy A. *J Trauma 2010*

Tratamiento Definitivo
Manejo no operatorio

Práctica estándar en injuria órgano sólido.

Prácticas varían según centros de atención.

McDonald LA. *J Pediatr Surg. 2012*
Bowman SM. *JAMA 2005*
Mooney DP. *J Trauma 2006*
Bowman SM. *Med Care 2008*

Tratamiento Definitivo
Manejo no operatorio

- Terapia Intensiva: anemia o inestabilidad hemodinámica
- 5-13% IOS requieren transfusiones GR
- 18-50% lesiones pancreáticas requiere cirugía en algún momento de la evolución

St Peter SD. *J Pediatr Surg. 2013*
Davies DA. *J Pediatr Surg. 2009*

The Failure of Nonoperative Management in Pediatric Solid Organ Injuri: a Multi-Institutional Experience

Holmes JH. *J Trauma 2005*

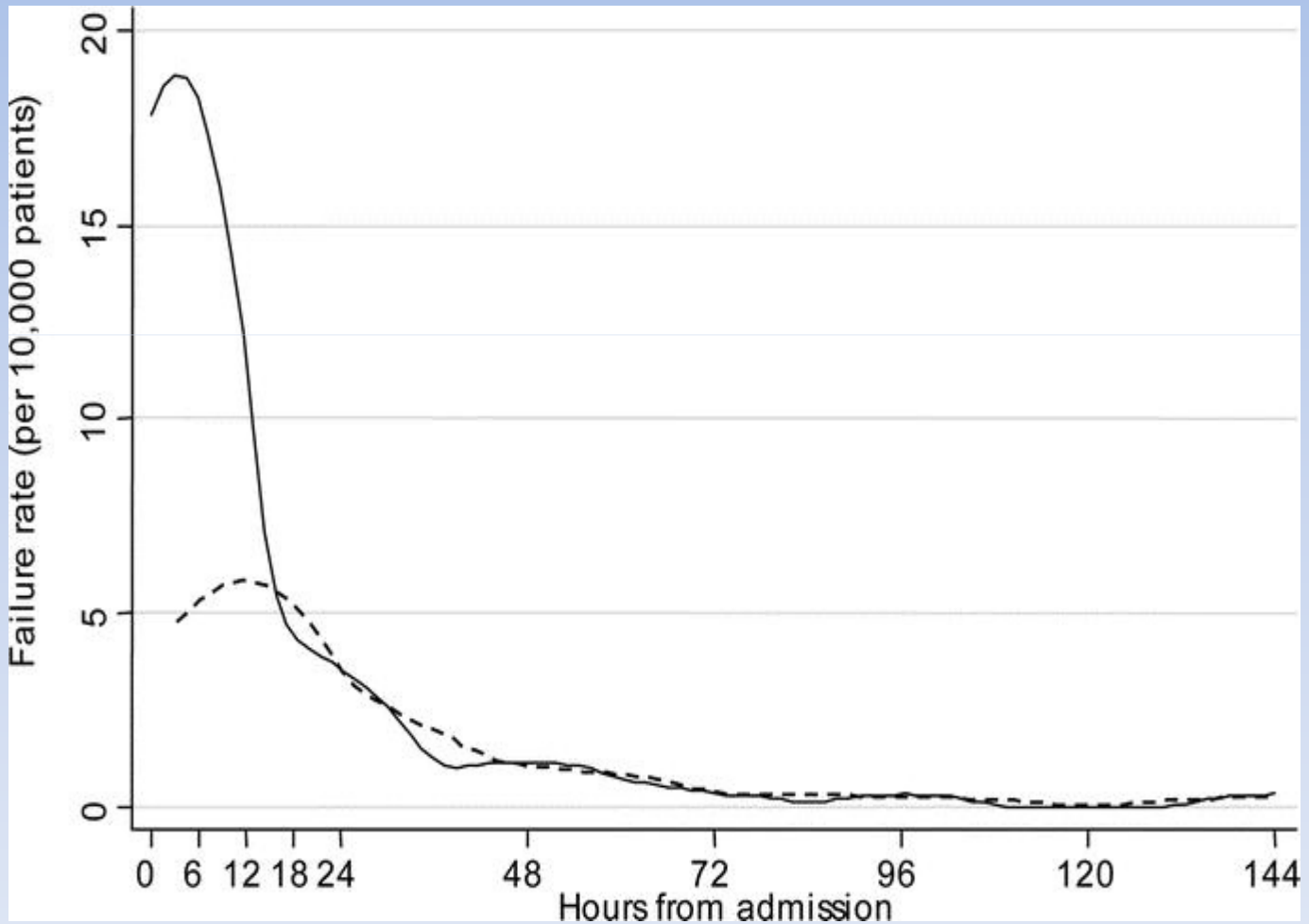
1818 IOS/89 (5%)

Table 1 Clinical Reasons for NOM Failure

Reason for Failure	Liver Injuries (n = 16)	Splenic Injuries (n = 21)	Renal Injuries (n = 6)	Pancreatic Injuries (n = 12)	All Injuries (n = 89)
Shock	8	5			29
Peritonitis	4	7	3	6	24
Persistent hemorrhage	1	5	3		14
Isolated pancreatic injury				4	7
Hollow visceral injury-related	3	4		2	13
Ruptured diaphragm					1

The Failure of Nonoperative Management in Pediatric Solid Organ Injuri: a Multi-Institutional Experience

Holmes JH. *J Trauma 2005*



The Failure of Nonoperative Management in Pediatric Solid Organ Injuri: a Multi-Institutional Experience

Holmes JH. *J Trauma 2005*

	Failures (n = 89)	Controls (n = 1729)	Relative Risk (95% CI)	*p*
Mean ISS ± STD	28 ± 17	14 ± 10		< 0.001
ISS ≥ 25	60%	16%	14.95 (7.5–29.79)	< 0.001
Mean GCS ± STD	12 ± 5	14 ± 3		< 0.001
GCS ≤ 8	28%	7%	5.09 (3.04–8.52)	< 0.001
Isolated Pancreas	22%	4%	7.49 (3.74–15.01)	< 0.001
Mean sAIS ± STD	5 ± 2	3 ± 1		< 0.001
sAIS ≥ 4	72%	27%	6.84 (4.26–10.99)	< 0.001
>1 organ	38%	13%	4.11 (2.62–6.45)	< 0.001

Pancreatic Organ Injury Scale

Grade*	Injury type	Injury description ¶
I	Hematoma	Minor contusion without duct injury
	Laceration	Superficial laceration without duct injury
II	Hematoma	Major contusion without duct injury or tissue loss
	Laceration	Major laceration without duct injury or tissue loss
III	Laceration	Distal transection or parenchymal injury with duct injury
IV	Laceration	Proximal$^{\Delta}$ transection or parenchymal injury involving ampulla
V	Laceration	Massive disruption of pancreatic head

* Advance one grade for multiple injuries to the same organ.
¶ Based on most accurate assessment at autopsy, laparotomy, or radiologic study.
Δ Proximal pancreas is to the patients' right of the superior mesenteric vein.

Moore, EE. *J Trauma 1990*

Operative vs nonoperative management of blunt pancreatic trauma in children

Wood JH. *J Ped Surg 2010*

Table 1 Patient data by pancreatic injury grade

	Grade I (n = 18)	Grade II (n = 6)	Grade III (n = 17)	Grade IV (n = 2)	*P*
Age (y)	7 ± 5	4.5 ± 2	8.9 ± 4	7.5 ± 3.5	.18
Male	67%	67%	61%	100%	.71
ISS	14 (6-22)	16 (10-22)	10 (10-10)	26 (10-42)	.34
LOS (d)	5.5 (3-9)	8.5 (6-9)	17 (11-22)	26 (10-42)	.0008
ICU (d)	0.5 (0-3)	1 (0-2)	0 (0-2)	10.5 (0-21)	.84
Nonop	0%	50%	41%	50%	.0002

pancreatic resection: 14 (33%)
without pancreatic resection: 29 (67%)

Operative vs nonoperative management of blunt pancreatic trauma in children

Wood JH. *J Ped Surg 2010*

Table 2 Operative vs nonoperative management outcomes in grades II to IV pancreatic injuries

	Operative (n = 14)	Nonop (n = 11)	*P*
LOS (d)	13 (8-24)	17 (9-25)	.82
Readmission	11%	40%	.5
Non-PC	57%	20%	.07
PC	21%	73%	.02

PC indicates pancreatic complication and includes pseudocyst, fistula, and leak. Data for LOS are presented as median and IQ.

Operative vs Nonoperative Management for Blunt Pancreatic Transection in Children: Multi-Institutional Outcomes

Iqbal et al. *J Am Coll Surg 2014*

167 grade II or III blunt pancreatic injuries

Table 1. Patient Characteristics

Characteristic	Operative resection (n = 57)	Nonoperative (n = 95)	Operative drainage (n = 15)	p Value*
Grade III injuries, %	95	27	27	<0.001
Age, y, mean ± SE	9.6 ± 0.7	8.8 ± 0.5	9.4 ± 1.5	0.7
Sex, %	39	32	54	0.9
Injury Severity Score, mean ± SE	17.5 ± 1.9	15.2 ± 1.5	11.9 ± 2.4	0.5
Associated injuries, %	46	61	73	0.6
Intensive care, %	43	37	64	0.8

*Three-way chi-square for nominal variables and ANOVA for continuous variables.

Operative vs Nonoperative Management for Blunt Pancreatic Transection in Children: Multi-Institutional Outcomes

Iqbal et al. *J Am Coll Surg 2014*

Table 2. Outcomes for Operative Resection vs Nonoperative Management

Characteristic	Operative resection (n = 57)	Nonoperative (n = 95)	p Value
Pseudocyst, %	0	18	0.001
Pancreatic leak, %	7	0	0.02
Overall morbidity rate, %	32	27	0.7
Need for repeat intervention, %*	2	26	0.002
Time to initial feeds, d, mean ± SE	4.5 ± 0.5	8.9 ± 1.3	0.002
Time to goal feeds, d, mean ± SE	7.8 ± 0.7	15.1 ± 2.5	0.007
Initial hospitalization, d, mean ± SE	11.9 ± 1.0	13.4 ± 1.3	0.4
Readmissions, %	20	16	0.7
Total days in-hospital, mean ± SE	13.1 ± 1.1	14.0 ± 1.1	0.6
Time to complete resolution, d, mean ± SE	22.6 ± 5.0	38.6 ± 6.4	0.05

*Excluding central venous access.

Operative vs Nonoperative Management for Blunt Pancreatic Transection in Children: Multi-Institutional Outcomes

Iqbal et al. *J Am Coll Surg 2014*

Grade III (main pancreatic duct injury)

Table 3. Outcomes for Grade III Injuries

Characteristic	Operative resection (n = 54)	Nonoperative (n = 26)	p Value
Pseudocyst, %	0	44	<0.001
Need for repeat intervention, %*	2	46	<0.001
Overall morbidity rate, %	33	61	0.05
Time to initial feeds, d, mean ± SE	4.4 ± 0.5	12.7 ± 2.9	0.01
Time to goal feeds, d, mean ± SE	9.4 ± 1.5	26.1 ± 6.4	0.01
Initial hospitalization, d, mean ± SE	11.9 ± 1.1	15.0 ± 1.5	0.1
Readmissions, %	19	33	0.3
Total days in-hospital, mean ± SE	12.6 ± 1.1	17.5 ± 1.9	0.03
Time to complete resolution, d, mean ± SE	19.3 ± 3.8	82.4 ± 20.3	0.006

*Endoscopy or interventional radiology (exclusive of vascular access).

Operative vs Nonoperative Management for Blunt Pancreatic Transection in Children: Multi-Institutional Outcomes

Iqbal et al. *J Am Coll Surg 2014*

Grade II (no main pancreatic duct injury)

- *Non OM (G II) vs all OM*
  no different outcomes

- *Non OM (G II) vs Non OM (GIII)* pseudocyst formation rate

  7% vs 44%
  p <0.001)

Operative vs Nonoperative Management for Blunt Pancreatic Transection in Children: Multi-Institutional Outcomes

Iqbal et al. *J Am Coll Surg 2014*

Table 4. Outcomes for Operative Drainage

Characteristic	Operative resection (n = 57)	Nonoperative (n = 95)	Operative drainage (n = 15)	p Value*
Pseudocyst, %	0	20	13	0.02
Need for repeat intervention, %†	7	0	0	0.02
Overall morbidity rate, %	2	26	33	0.002
Time to initial feeds, d, mean ± SE	4.5 ± 0.5	8.9 ± 1.3	9.3 ± 3.3	0.04
Time to goal feeds, d, mean ± SE	7.8 ± 0.7	15.1 ± 2.5	14.2 ± 3.8	0.001
Initial hospitalization, d, mean ± SE	11.9 ± 1.0	13.4 ± 1.3	21.0 ± 4.2	0.04
Readmissions, %	20	16	50	0.6
Total days in hospital, mean ± SE	13.1 ± 1.1	14.0 ± 1.1	27.3 ± 5.5	<0.001
Time to complete resolution, d, mean ± SE	22.6 ± 5.0	38.6 ± 6.4	100.5 ± 52.7	0.004

*Three-way chi-square for nominal variables and ANOVA for continuous variables.
†Excluding central venous access.

Pancreatic injury in children: good outcome of nonoperative treatment

I. de Blaauw et al. *J Pediatr Surg 2008*

Table 2 Grade of pancreatic injury of 17 of 34 patients of which CT scans were available

	n
Grade 1 (minor contusion)	8
Grade 2 (major contusion)	3
Grade 3 (distal transection or ductal injury)	5
Grade 4 (proximal transection injury involving ampulla)	1
Grade 5 (complete disruption pancreatic head)	-

Classification of injury according to the Organ Injury Scale [10].

Pancreatic injury in children: good outcome of nonoperative treatment

I. de Blaauw et al. *J Pediatr Surg 2008*

Table 3 Comparison of hospital stay, parenteral nutrition, and complications between operative and nonoperative treatment of children with pancreatic injuries

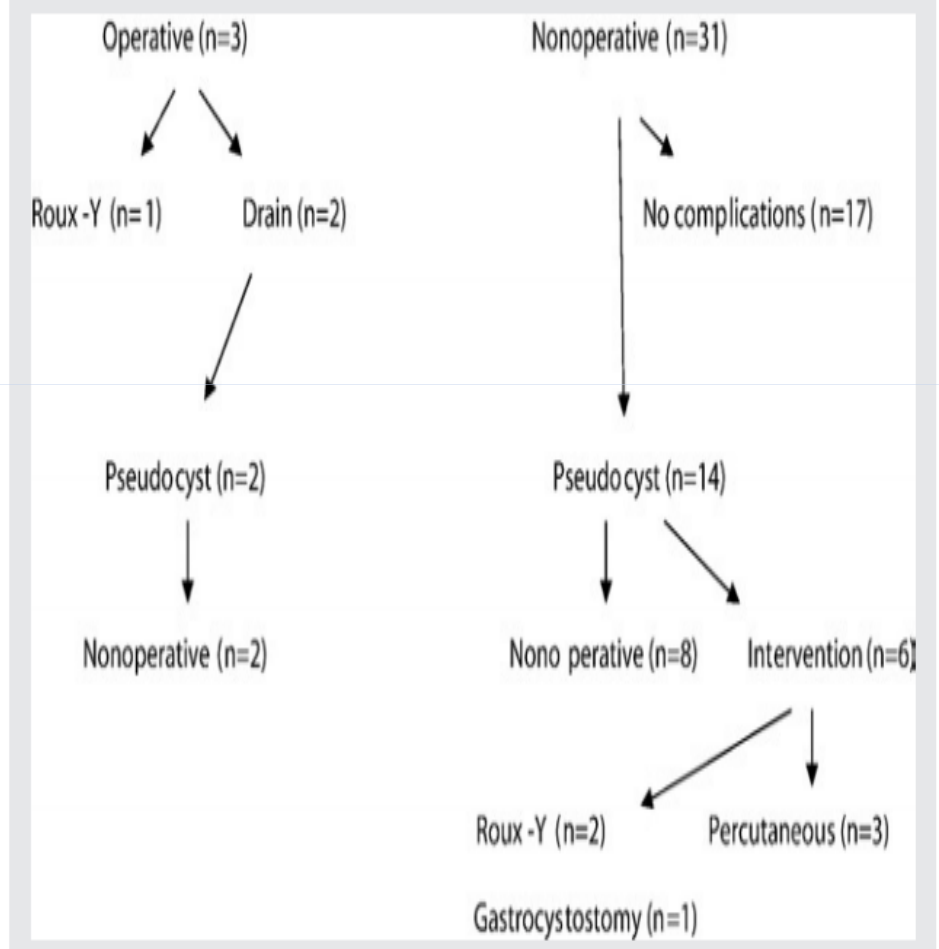
	Operative	Nonoperative
N	3	31
Mean hospital stay (d)	29 (15-69)	24 (2-70)
PICU stay (d)	2.4 (0-16) *	0.8 (0-7)
Total parenteral nutrition (patients)	3	16
Line sepsis	0	4
Pseudocysts	2	14
Long-term rest morbidity [a]	None	None
Mortality	None	None

* $P \leq .05$.

[a] Pancreatic insufficiency, nutritional disorders, abdominal complaints.

Pancreatic injury in children: good outcome of nonoperative treatment

I. de Blaauw et al. *J Pediatr Surg 2008*



- 44 % Pq
- el 60% (10/16) resolución espontánea
- Injuria grado 3 no implica cirugía
- sujeta a hemodinamia o extensa fuga fluido pancreatico

Lesiones Páncreas

- Sin compromiso conducto pancreático principal
- Lesión conducto pancreático principal
- Pseudoquiste

Liver Injury Scale

Grade*	Injury type	Injury description
I	Hematoma	Subcapsular, <10 percent surface area
	Laceration	Capsular tear, <1 cm parenchymal depth
II	Hematoma	Subcapsular, 10-50 percent surface area
		Intraparenchymal, <10 cm in diameter
	Laceration	1-3 cm parenchymal depth, <10 cm in length
III	Hematoma	Subcapsular, >50 percent surface area or expanding; ruptured subcapsular or parenchymal hematoma
	Laceration	Intraparenchymal hematoma >10 cm or expanding
		>3 cm parenchymal depth
IV	Laceration	Parenchymal disruption involving 25-75 percent of hepatic lobe or 1-3 Couinaud's segments within a single lobe
V	Laceration	Parenchymal disruption involving >75 percent of hepatic lobe or >3 Couinaud's segments within a single lobe
	Vascular	Juxtahepatic venous injuries; ie, retrohepatic vena cava/central major hepatic veins
VI	Vascular	Hepatic avulsion

* Advance one grade for multiple injuries, up to grade III.

Moore, EE. *J Trauma 1995*

Spleen Injury Scale

Grade*	Injury type	Injury description
I	Hematoma	Subcapsular, <10 percent surface area
	Laceration	Capsular tear, <1 cm parenchymal depth
II	Hematoma	Subcapsular, 10-50 percent surface area; intraparenchymal, <5 cm in diameter
	Laceration	1-3 cm parenchymal depth which does not involve a trabecular vessel
III	Hematoma	Subcapsular, >50 percent 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 percent of spleen)
V	Laceration	Completely shattered spleen
	Vascular	Hilar vascular injury which devascularizes spleen

* Advance one grade for multiple injuries, up to grade III.

Moore, EE. *J Trauma 1995*

Guidelines for resource utilization in children with isolated liver or spleen injury

	CT grade			
	I	II	III	IV
ICU stay (d)	None	None	None	1
Hospital stay (d)	2	3	4	5
Predischarge imaging	None	None	None	None
Postdischarge imaging	None	None	None	None
Activity restriction (wk)*	3	4	5	6

CT: computed tomography; ICU: intensive care unit.

* Return to normal age-appropriate activity; return to competitive contact sports should be individualized.

American Pediatric Surgical Association

GPC APSA

⇩Estadía en terapia y hospitalaria

⇩Seguimiento con Imágenes

⇩Restricción de actividad

Sin complicaciones

Leinwand MJ. *J Pediatr Surg. 2004*

Stylianos S. *J Pediatr Surg. 2002*

Follow up of prospective validation of an abbreviated bedrest protocol in the management of blunt spleen and liver injury in children

Peter SD. *J Pediatr Surg. 2013*

Abbreviated bedrest protocol for BSLI : 199 patients

Mean grade of injury: 2.7 ± 1.0

Mean bedrest: was 1.6 ± 0.6 nights.

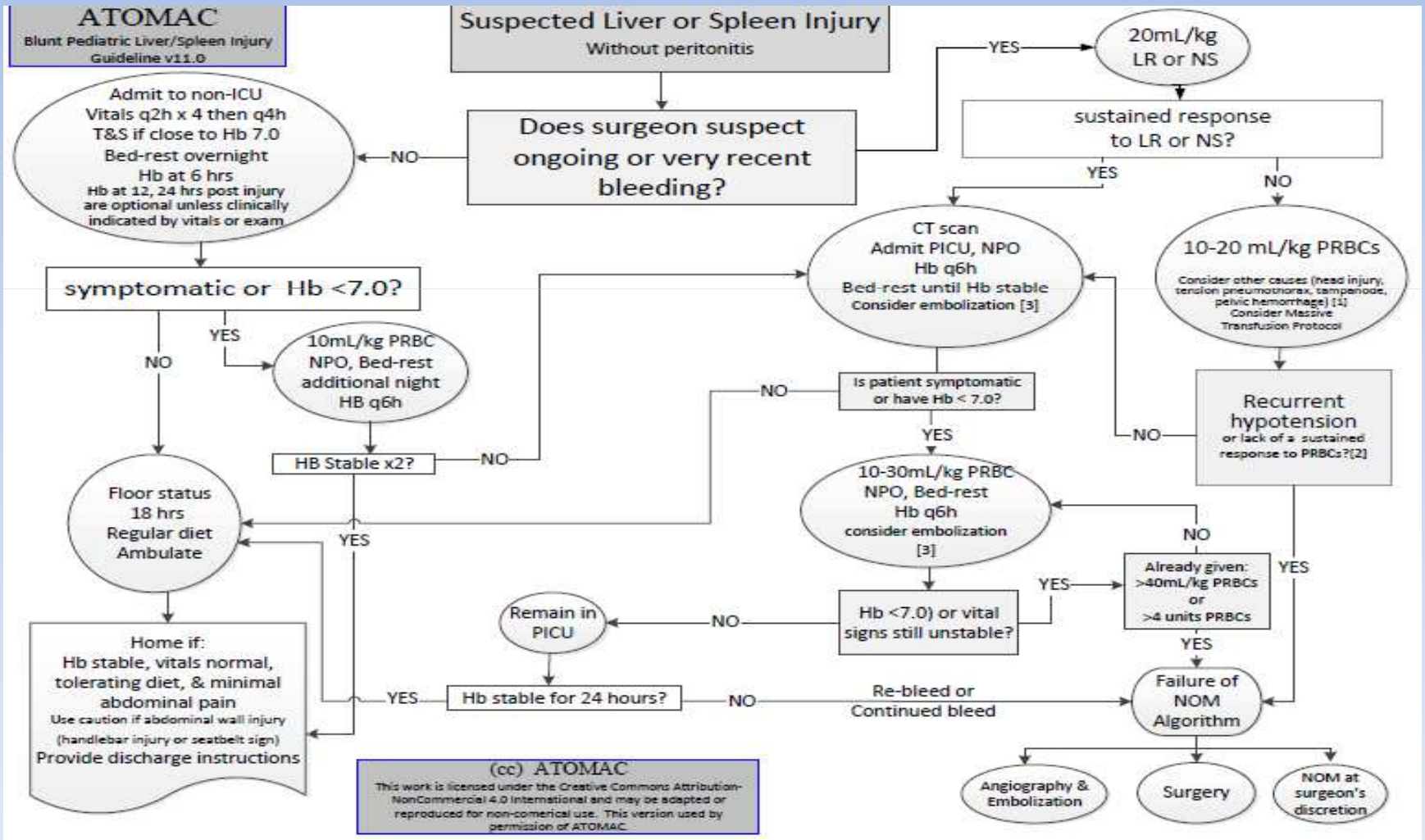
Mean days of hospitalization: 2.5 ± 1.9

APSA guidelines bedrest: 3.6 ± 1.0 nights ($P < 0.001$)

Dramatic decreases in hospitalization days

Nonoperative management of blunt liver and spleen injury in children: Evaluation of the ATOMAC guideline using GRADE

Notrica DM. *J Trauma Acute Care Surg. 2015*



Nonoperative management of blunt liver and spleen injury in children: Evaluation of the ATOMAC guideline using GRADE

Notrica DM. *J Trauma Acute Care Surg. 2015*

- *An abbreviated period of bed rest of 1 d or less for stable patients is unequivocally supported for children whose hemoglobin has been documented to be stable (1A)*
- *In children without signs of clinical bleeding at presentation and stable hemoglobin, discharge before 24 h seems to be safe (1B)*

Comparative effectiveness of treatment strategies for severe splenic trauma in the pediatric population

Rialon KL. *Am J Surg. 2016*

	Unadjusted analysis			IPW adjusted analysis		
Variable	**Splenectomy (n = 265)**	**SAE (n = 199)**	***P* value**	**Splenectomy (n = 265)**	**SAE (n = 199)**	***P* value**
ISS	30.5 ± 13.7	32.4 ± 15	.15	32 ± 14.5	31.5 ± 14.1	.74
GCS	11.7 ± 5.1	10.4 ± 5.4	.009	10.9 ± 5.5	11 ± 5.3	.92
Grade V splenic injury (%)	54.0	37.7	<.001	46.8	45.2	.77
RBC transfusion (%)	23.0	32.2	.03	26.1	30.0	.44
Platelet transfusion (%)	6.0	9.5	.17	7.5	9.9	.46
Complication (%)						
None	66.2	57.8	.15	63.3	64.4	.87
ARF	0	1.6	.16	0	1	.16
ARDS	7.9	20.3	.003	7.9	15.9	.056
Wound infection	4.0	3.1	.71	3.8	4.7	.76
DVT	2.6	5.5	.24	4.2	5.7	.68
PE	0	1.6	.16	0	1.1	.18
Pneumonia	9.9	11.7	.63	13.1	9.4	.51
Sepsis	3.3	.8	.13	2.7	.4	.083
LOS (days)	9.6 ± 10.6	11.6 ± 12.5	.079	9.9 ± 10.6	10.9 ± 11.1	.37
Mortality (%)	10.9	13.1	.49	13.4	10.0	.31

Muchas gracias por su atención!!