


Blunt Abdominal Trauma in Children – Not So **FAST**

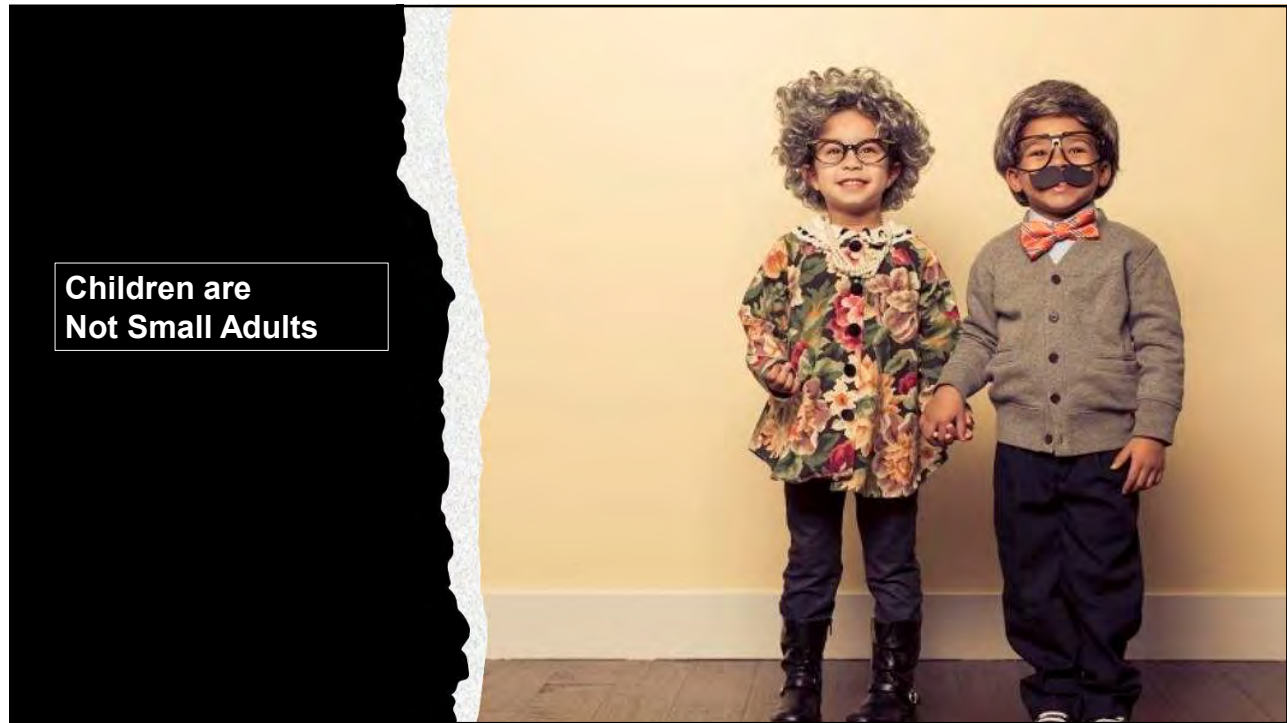
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10/7/2022
Pediatric Surgery Fellow
Children's Hospital & Medical Center

1



- I have no disclosures

2



**Children are
Not Small Adults**


3


RESEARCH ARTICLE

Systematic review and meta-analysis of appendiceal carcinoid tumors in children

Ike Njere¹ | Lisa Linnéa Smith¹ | Dushanthi Thurairasa¹ | Rubina Mallik² | Iona Jeffrey³ | Bruce Okoye¹ | Chandrasen Sinha¹

WILEY Pediatric Blood & Cancer





- Aim: Review the literature regarding past and current practices in managing incidental appendiceal carcinoid tumors
- 958 cases
- Appendicectomy alone is an adequate treatment for an appendicular carcinoid in children irrespective of:
 - Size
 - Position
 - Lymph node
 - Mesenteric involvement

4

Gastrointestinal Stromal Tumors

Pediatric / WT GIST

- Sex: 70% female
- Molecular: WT KIT / PDGFR 85%
SDH mutation/methylation 85%
- Primary site: Stomach 85%
- Lymph node mets: Common
- Histology: Epitheloid and mixed

Adult GIST

- Sex: Equal gender distribution
- Molecular: KIT mutation 85%
PDGFR mutation 5-10%
- Primary site: Stomach 50%
- Lymph node mets: Rare
- Histology: Spindle

5

Contents lists available at ScienceDirect

Journal of Pediatric Surgery

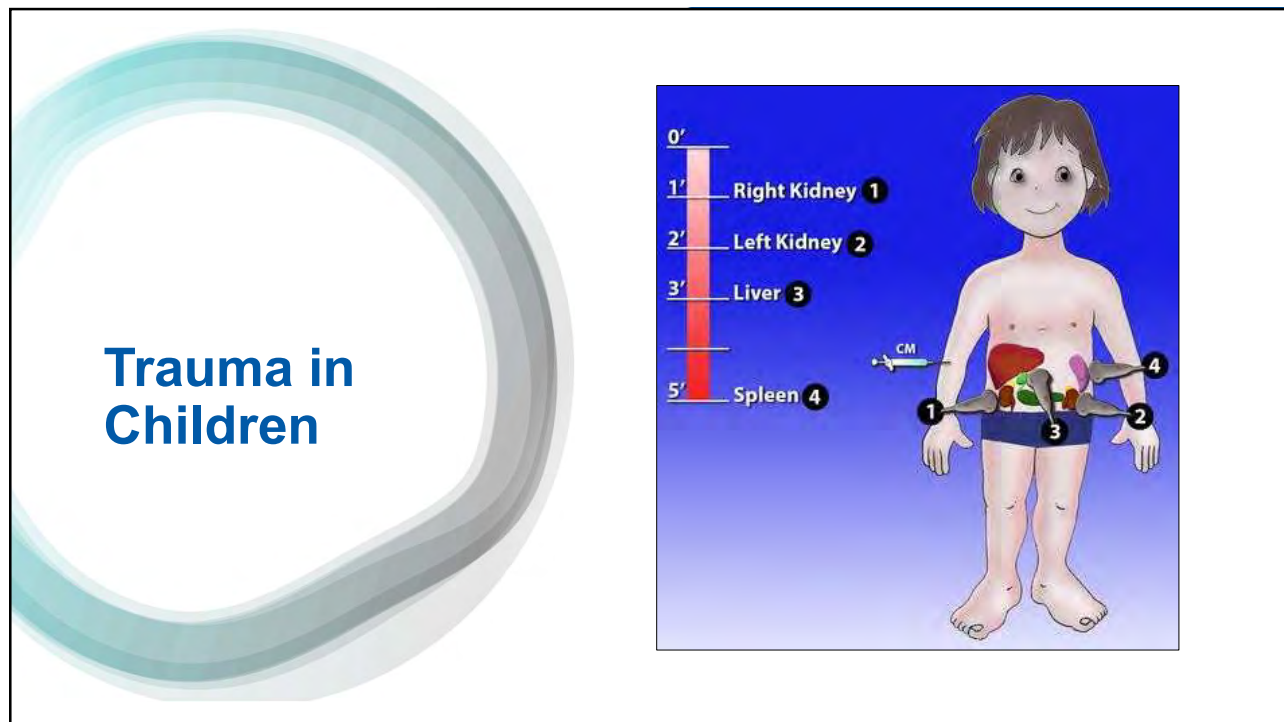
ELSEVIER journal homepage: www.elsevier.com/locate/jpedisurg

Management of pancreatic pseudocysts in pediatric oncology patients[☆]

Yousef El-Gohary ^a, Sara Mansfield ^a, Jessica Staszak ^b, Abdelhafeez Abdelhafeez ^{a,b}, Lindsay Talbot ^{a,b},
Ching-Hon Pui ^c, Robert Gold ^d, Andrew J. Murphy ^{a,b}, Andrew M. Davidoff ^{a,b,*}

^a Department of Surgery, St. Jude Children's Research Hospital, 262 Danny Thomas Pl, Memphis, TN 38105, USA
^b Division of Pediatric Surgery, Department of Surgery, University of Tennessee Health Science Center, Memphis, TN 38105, USA
^c Department of Oncology, St. Jude Children's Research Hospital, 262 Danny Thomas Pl, Memphis, TN 38105, USA
^d Department of Radiology, University of Tennessee Health Science Center, Memphis, TN, USA

6



7

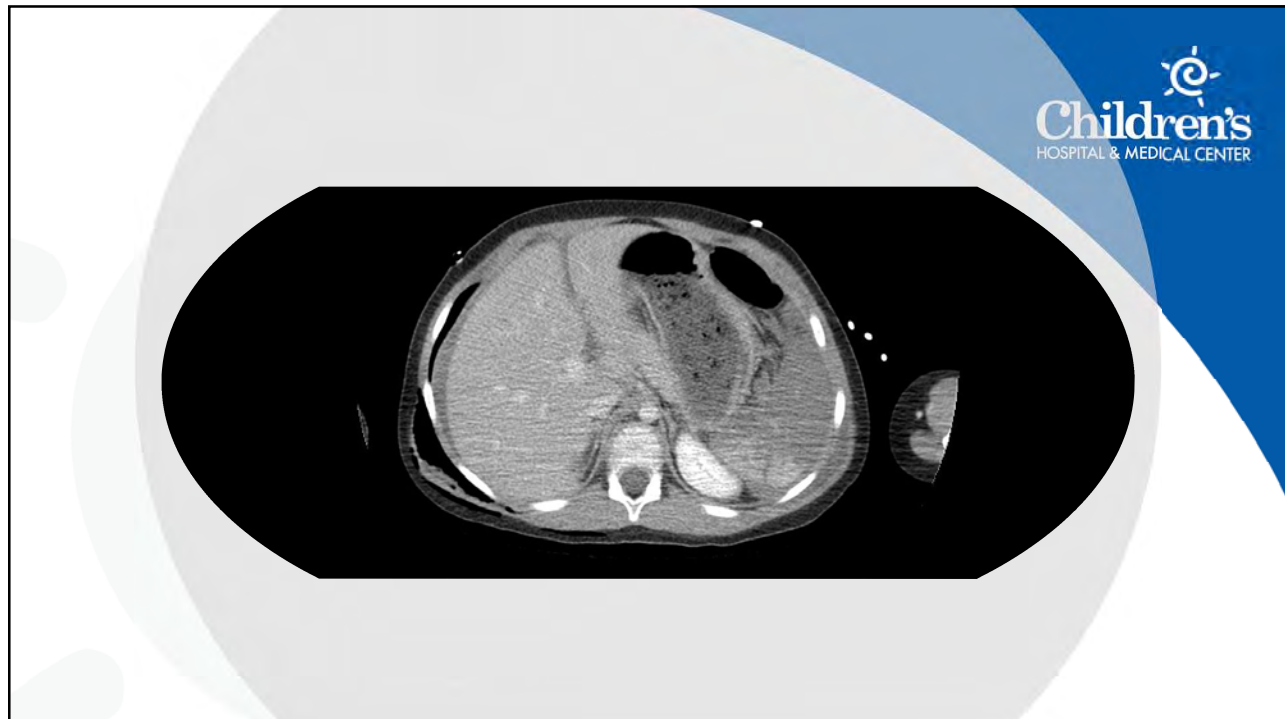
- Trauma is a leading cause of morbidity and mortality in childhood
- Blunt trauma accounts for 80–90 % of abdominal injuries
- The mechanism of trauma is quite similar to that of the adults, but there are **important physiologic differences** between children and adults:
 - smaller blood vessels
 - high vasoconstrictive response
- Leading to the spreading of a non-operative management

8

Nonoperative SOI Pediatrics


- Overall: > 95% organ salvage
 - **Regardless of injury grade**
- Higher success at NOM than adults- why?
 - **Physiologic differences** :
 - smaller blood vessels between children and adults
 - high vasoconstrictive response

9



10

American Pediatric Surgical Association (APSA) GUIDELINE



APSA 2000

- A child presenting to a PTC with a grade 5 splenic laceration:
 - mandatory ICU admission
 - extended periods of bed rest
 - nothing per os (NPO)
- HD unstable + blush on CT= IR
- HD unstable after 4 u RBC – CT blush = OR
- Grade +1 = days of bedrest in hospital
- Grade + 2 = weeks activity restriction

APSA 2019


- A child presenting to a PTC with a grade 5 splenic laceration may be:
 - admitted to the general inpatient ward
 - be observed for 24–48 h
 - discharged with **no further imaging****

11

Updated APSA Blunt Liver/Spleen Injury Guidelines 2019

<h3 style="text-align: center; color: red;">Admission</h3> <ul style="list-style-type: none"> • ICU Admission Indicators <ul style="list-style-type: none"> • Abnormal vital signs after initial volume resuscitation • ICU <ul style="list-style-type: none"> • Activity - Bedrest until vitals normal • Labs – q6hour CBC until vitals normal • Diet – NPO until vital signs normal and hemoglobin stable • Ward <ul style="list-style-type: none"> • Activity - No restrictions • Labs - CBC on admission and/or 6 hours after injury • Diet – Regular diet 	<h3 style="text-align: center; color: red;">Procedures</h3> <ul style="list-style-type: none"> • Transfusion <ul style="list-style-type: none"> • <u>Unstable vitals after 20 cc/kg bolus of isotonic IVF</u> • <u>Hemoglobin < 7</u> • Signs of ongoing or recent bleeding • Angioembolization <ul style="list-style-type: none"> - Signs of ongoing bleeding despite pRBC transfusion - Not indicated for contrast blush on admission CT without unstable vitals • Operative exploration with Control of Bleeding <ul style="list-style-type: none"> - Unstable vitals despite pRBC transfusion - Consider massive transfusion protocol
<h3 style="text-align: center; color: red;">Set Free</h3> <ul style="list-style-type: none"> • <u>Based on clinical condition NOT injury severity (grade)</u> • Tolerating a diet • Minimal abdominal pain • Normal vital signs 	<h3 style="text-align: center; color: red;">Aftercare</h3> <ul style="list-style-type: none"> • Activity Restriction <ul style="list-style-type: none"> • <u>Restricting activity to grade plus 2 weeks is safe</u> • <u>Shorter restrictions may be safe but there is inadequate data to support decreasing these recommendations</u> • Follow up Imaging <ul style="list-style-type: none"> • Risk of delayed complications following spleen and liver injuries is low • Consider imaging for symptomatic patients with prior high grade injuries

12



The American Journal of Surgery 224 (2023) 13–17

Contents lists available at ScienceDirect

The American Journal of Surgery

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

Featured Article


Adolescent blunt solid organ injury: Differences in management strategies and outcomes between pediatric and adult trauma centers

S. Christopher Derderian^{a,*}, Maxene Meier^b, Denis D. Bensard^{a,c}, David A. Partrick^a, Shannon N. Acker^a

^a Division of Pediatric Surgery, Children's Hospital Colorado, Aurora, CO, USA
^b Center for Children's Surgery, Children's Hospital Colorado, Aurora, CO, USA
^c Department of Surgery, Denver Health Medical Center, Denver, CO, USA

- Children NOM 95% success regardless of injury grade
- Adult **failure rate** of NOM **2 – 40%** and increase with increasing injury grade
 - Grade I 4.8%
 - Grade II 9.5%
 - Grade III 19.6%
 - Grade IV 33.3%
 - **Grade V 75%**

13



- The American College of Surgeons defines a pediatric trauma patient as:
 - A child age 15 years or younger
- However adolescents between 16 and 19 years of age are cared for at both pediatric and adult trauma centers

14

- The approach to management of BSOI varies significantly between adult and pediatric trauma centers
- Child presenting to a PTC with a grade 5 splenic laceration may be admitted to the general inpatient ward, be observed for 24–48 h, and be discharged with no further imaging
- Conversely, adults presenting to an ATC with a grade 5 splenic laceration are taken directly to the IR suite for angioembolization of the spleen, regardless of hemodynamic status at presentation

15

- Aim: compare both management strategies and outcomes between adolescents with BSOI cared for at PTC and ATC



16

Results



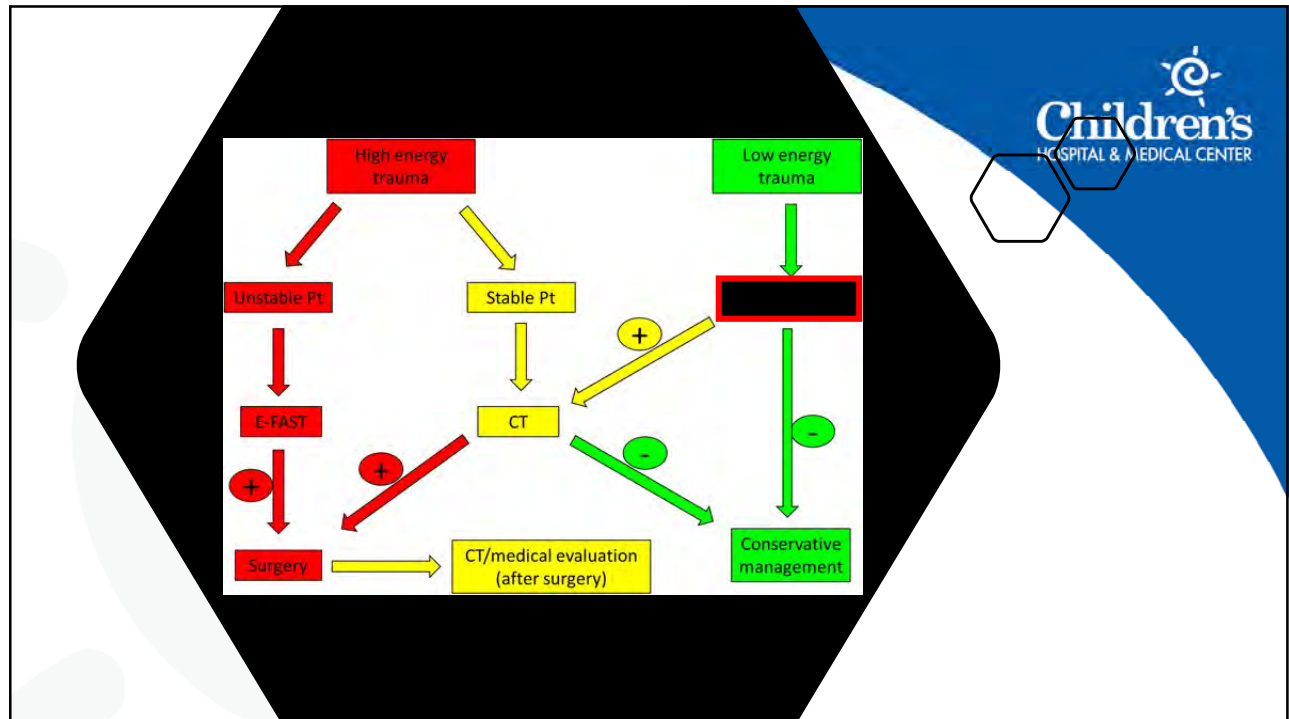
Pediatric Trauma Center

- Lower ISS mean 14.1
- Lower GCS mean 12.1
- Lower % admitted to ICU
- Rate of NOM was higher 69%
- Less received a blood transfusion within 4 h, 6.3%

Adult Trauma Center

- Higher ISS mean 25.4, $p < 0.001$
- Lower GCS mean 13.6, $p < 0.001$
- Higher % admitted to the ICU
- Rate of NOM was lower 60%, $p < 0.001$
- More received a blood transfusion within 4 h, 23.7%

17



18

FAST in Pediatric Blunt Abdominal Trauma



- Alternative to DPL in patients with hemodynamic instability with concern for Intra-Abdominal Injury
 - has become widely accepted and has replaced DPL
- Several studies have demonstrated the high sensitivity and specificity of FAST in **adults**
 - sensitivity 80% - 88%
 - specificity 98.3% - 100%
 - PPV 73% - 83.3%
 - NPV 84% - 98.9%
 - accuracy 97% - 99%
- **Why don't we do it?**

19

ORIGINAL ARTICLE

Focused assessment with sonography for trauma in children after blunt abdominal trauma: A multi-institutional analysis

Bennett W. Calder, MD, Adam M. Vogel, MD, Jingwen Zhang, MS, Patrick D. Mauldin, PhD, Eunice Y. Huang, MD, Kate B. Savoie, MD, Matthew T. Santore, MD, Kuolen Tsao, MD, Tiffany G. Ostovar-Kermani, MD, Richard A. Falcone, MD, M. Sidney Dassinger, MD, John Recciar, Jeffrey H. Haynes, MD, Martin L. Blakely, MD, Robert T. Russell, MD, Binli J. Naik-Mathuria, MD, Shawn D. St Peter, MD, David P. Mooney, MD, Chiawenda Onwabiko, MD, Jeffrey S. Upperman, MD, Jessica A. Zagory, MD, and Christian J. Streck, MD, Charleston, South Carolina



- **Aim:** Investigate the role of FAST for intra-abdominal injury (IAI) and IAI requiring acute intervention (IAI-I) in children after blunt abdominal trauma (BAT)

J Trauma Acute Care Surg. 2017 Aug;83(2):218-224

20

FAST in Pediatric Blunt Abdominal Trauma



- 14 level 1 pediatric trauma centers
- 1 year period prospective
- 2188 pts ≤16 yrs (excluded isolated head injury, penetrating trauma)
 - 829 (37.9%) FAST
 - 340 (41%) underwent subsequent CT
 - 97 (29%) had IAI and 27 (7.9%) received acute intervention
- Frequency of FAST utilization: 0.84% - 94%
- CT without FAST 46%
- CT after FAST was 41% (slight decrease)
- Higher frequency of FAST did not equal more accurate
- All patients had CT before an intervention

21

FAST in Pediatric Blunt Abdominal Trauma



- FAST for IAI:
 - **Sensitivity:** 27.8%
 - Specificity: 91.4%
 - PPV: 56.2%
 - NPV: 76.0%
 - Accuracy: 73.2%.
- 81 injuries among the 70 false-negative FAST.

22

FAST in Pediatric Blunt Abdominal Trauma



- FAST for IAI-requiring acute intervention:
 - Sensitivity: 44.4%
 - Specificity: 88.5%
 - **PPV: 25%**
 - NPV: 94.9%
 - Accuracy: 85%
- 15 pts with a negative FAST received acute interventions
- 27 pts with true positive FAST examinations, 12 received intervention.

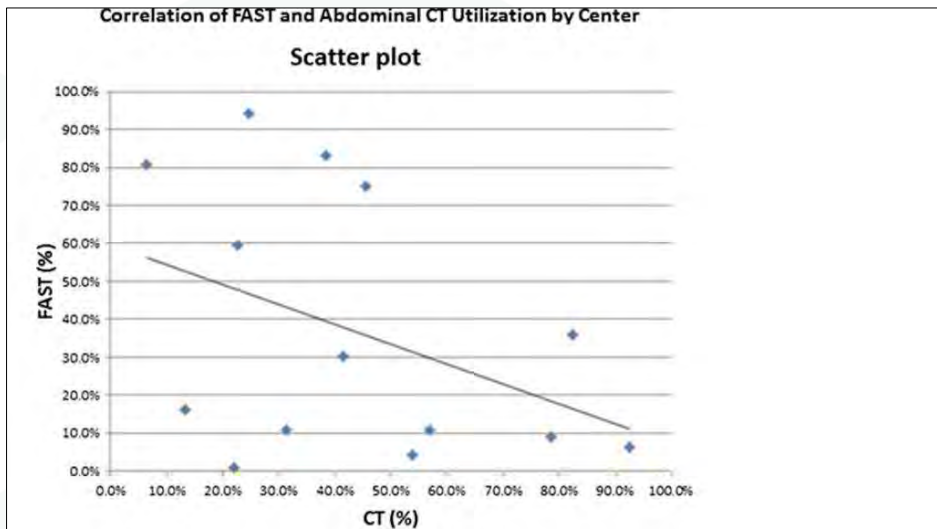
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- 33 (78.6%) of 42 **liver** injuries and 17 (56.7%) of 30 **spleen** injuries were missed by FAST
- When limiting the evaluation to higher grade injuries (grades 3–5):
 - 80% (19 of 24) of high-grade liver injuries
 - 47% (8 of 15) of high-grade spleen injuries were missed by FAST

24

Negative Correlation

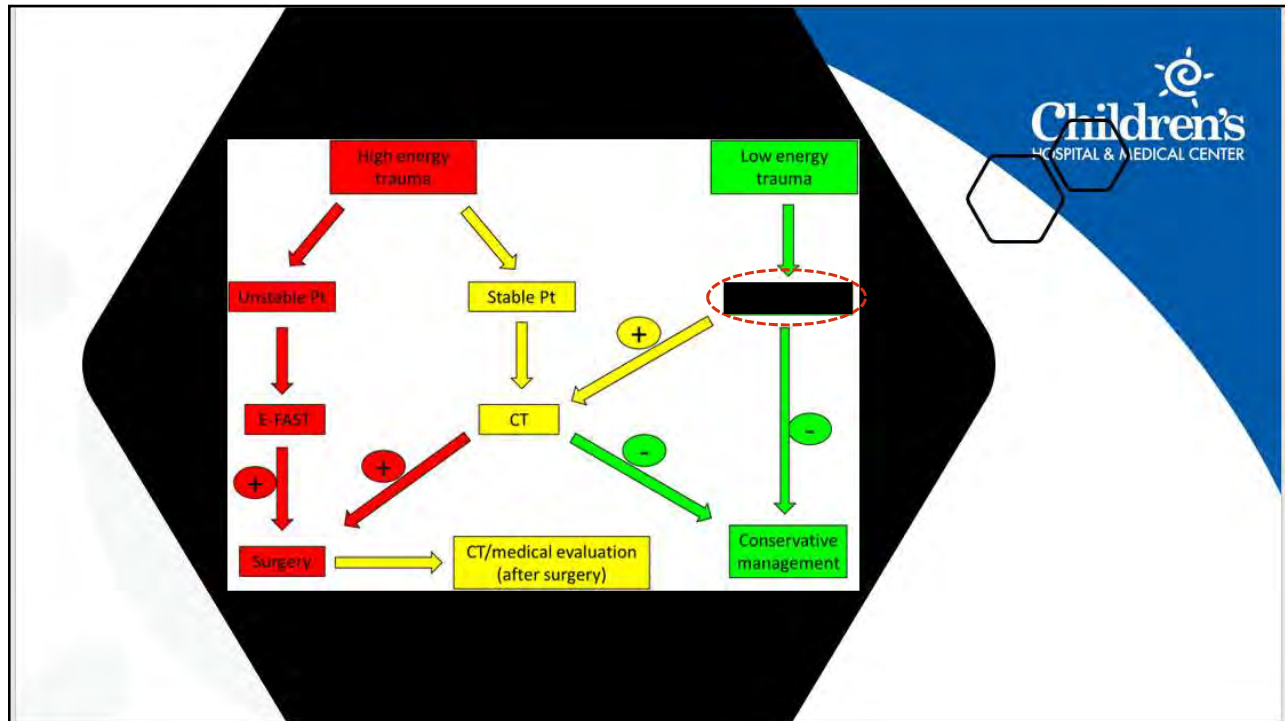


25

FAST in Pediatric Blunt Abdominal Trauma

- FAST has a low sensitivity for IAI
- FAST misses IAI-requiring intervention
- No correlation between reduction in CT and FAST utilization at the level of the 14 centers
- FAST rarely impacts management in pediatric BAT

26



27

Radiol med (2016) 121:409–430
DOI 10.1007/s11547-016-0637-2

PAEDIATRIC RADIOLOGY

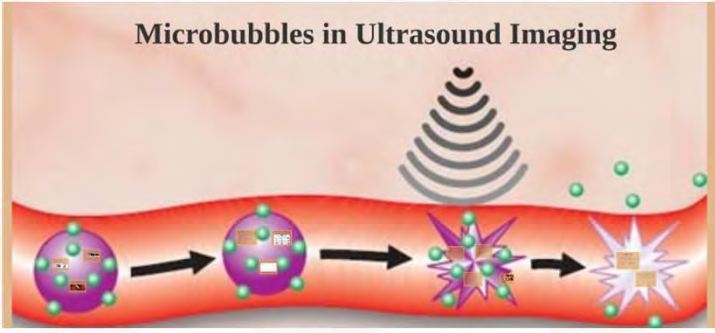
Diagnostic imaging of blunt abdominal trauma in pediatric patients


Vittorio Miele¹ · Claudia Lucia Piccolo² · Margherita Trinci¹ · Michele Galluzzo¹ · Stefania Ianniello¹ · Luca Brunese²

- The early imaging of children undergoing a low-energy trauma can be performed by CEUS, a valuable diagnostic tool to demonstrate solid organ injuries with almost the same sensitivity of CT scans
- US diagnostic accuracy is highly improved because of the introduction of CEUS
- CEUS has sensitivity and specificity values very similar to those of CT, which is the gold standard

28

Microbubbles in Ultrasound Imaging

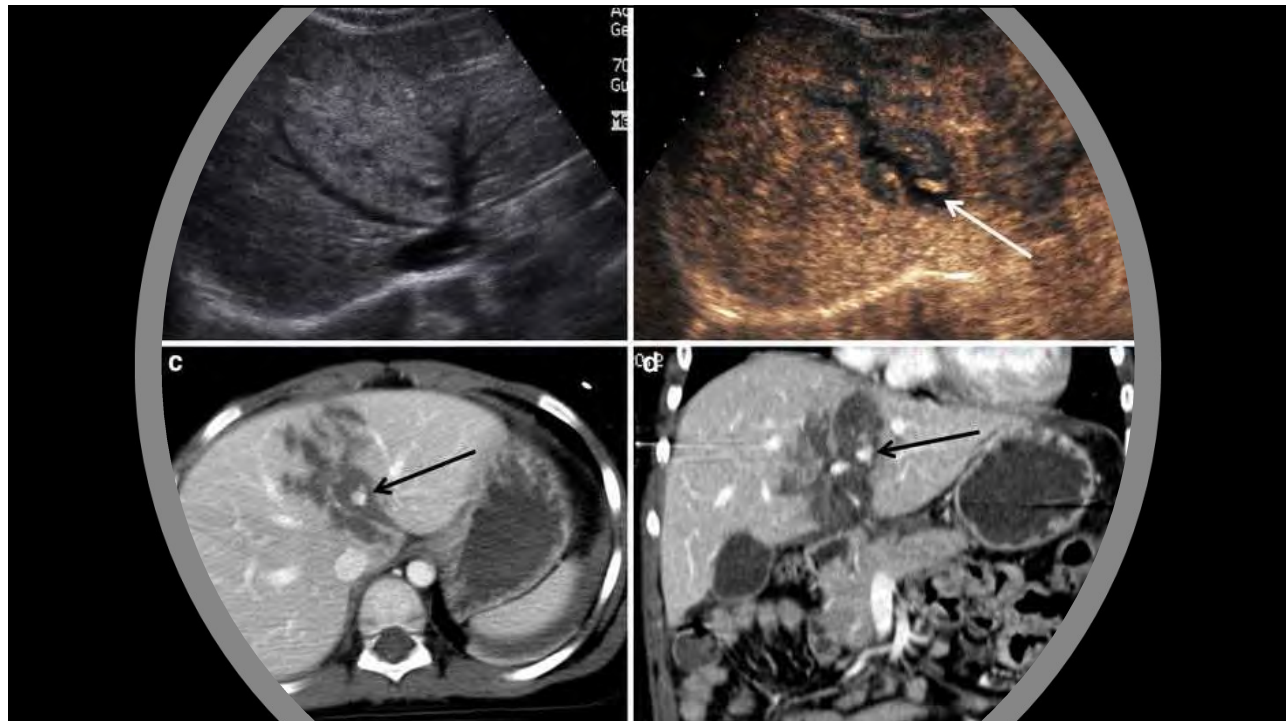




- Injection of US contrast medium, consisting in perfluorocarbon or sulfur hexafluoride, encapsulated by a very resistant phospholipid shell, composed by stabilized gas microbubbles (1–7 micron), which are blood-pool agents with a non-linear reverberation. They remain intravascular and produce a non-linear harmonic response that can be separated from the tissue signal using contrast harmonic US
 - Kidney -> Liver -> Spleen (5 min)

- The US contrast medium elimination is rapid: after around 15 min all the microbubbles break and the sulfur is eliminated through the lungs. US contrast medium has **no nephrotoxic effect**

29



30

- Valentino et al. assessed CEUS on 133 hemodynamically stable patients with blunt abdominal trauma
- CEUS revealed:
 - 81/84 traumatic injuries identified at CT
 - Ruled out traumatic injuries in 48/49 negative at CT
- Demonstrating the high accuracy of CEUS with respect to US

31

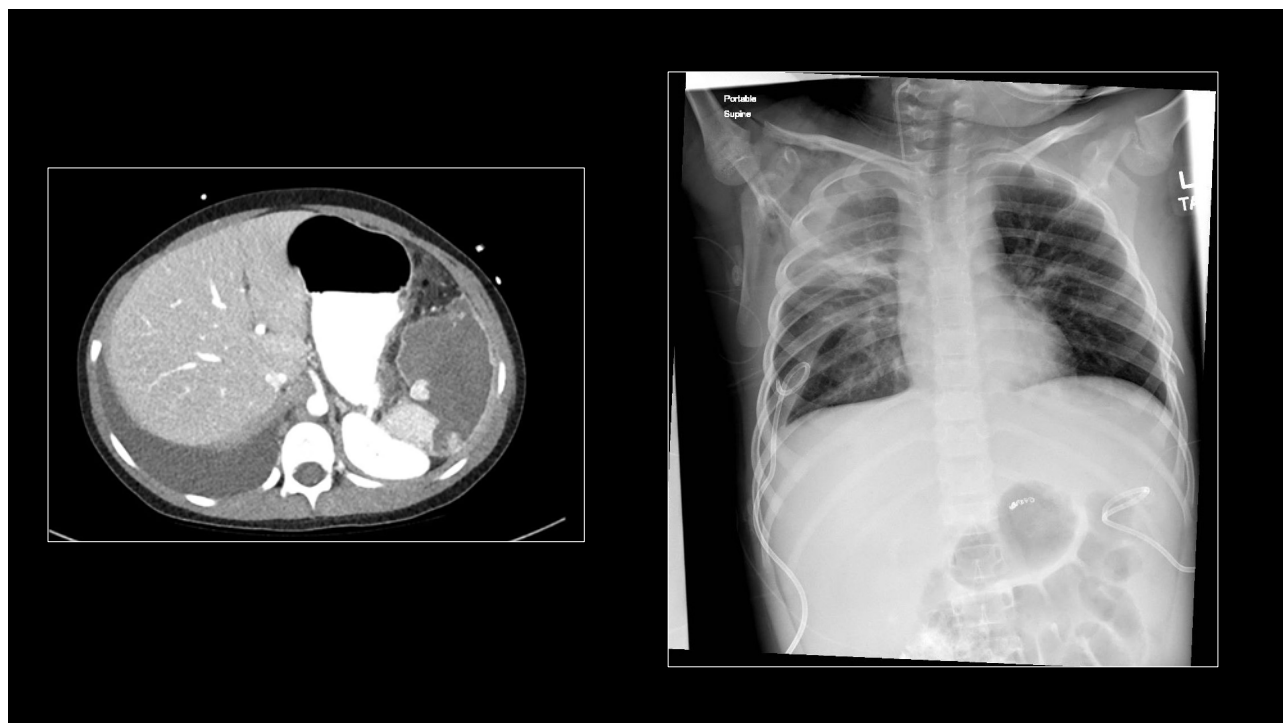
Limitations of CEUS

- Cost of contrast media
- Need for scanners with dedicated software's
- Longer examination times
- Lack of full and wide view
- It is strongly operator-dependent
- Does not allow a complete abdominal survey because of problems related to lesion location (such as pancreas, aorta in obese patients, a fatty liver)
- **Poor ability to detect active bleeding and injuries to the urinary tract**

32



33



34

Blunt Abdominal Trauma Pediatrics



- Most SOI in pediatrics can be managed nonoperatively with high rate of success
- FAST exam does not change need for CT imaging or management of SOI in pediatrics
- CEUS?
 - valuable diagnostic tool to demonstrate solid organ injuries with almost the same sensitivity of CT scans

35



36