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

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Introduction

- Intraabdominal injury (IAI) is a leading cause of morbidity in children
- Computed tomography (CT) provides detailed and useful information
  - **↑ risk of radiation-induced malignancy**

Goal

- **Prediction rule** to identify children with **blunt torso trauma** who are at **very low risk for IAI** undergoing acute intervention, whom **CT would NOT be indicated**

Materials & Methods

- Blunt torso (thorax & abdomen) trauma
- ED at 20 PECARN participating centers
- May 2007 ~ Jan 2010

Inclusion Criteria

1. Decreased level of consciousness (GCS score <15 or neurologic/behavioral status not age-appropriate) in association with blunt torso trauma (but not isolated head trauma).
2. Blunt traumatic event with either of the following (regardless of the injury mechanism):
   - Paralysis
   - Multiple nonadjacent long bone fractures (eg, tibia fracture, ulna fracture)
3. Blunt torso trauma due to any of the following mechanisms of injury:
   - Motor vehicle crash: high speed (≥40 mph), ejection, or rollover
   - Automobile versus pedestrian/bicycle: automobile moderate to high speed (≥5 mph)
   - Falls ≥20 ft in height
   - Crush injury to the torso
   - Physical assault involving the abdomen
4. Physician concern for abdominal trauma resulting in any of the following diagnostic or screening tests:
   - Abdominal CT or ultrasound (FAST)
   - Laboratory testing to screen for intra-abdominal injury
   - Chest or pelvic radiography

Exclusion Criteria

- > 24 hours before presentation
- Penetrating trauma
- Preexisting neurologic disorders impeding reliable examination
- Transfer from another hospital with previous CT or DPL

Patient history variables

- Mechanism of injury
- Complaints of abdominal pain: including location and severity
- History of vomiting at any time after injury

Physical examination variables

- Initial ED heart rate
- Initial ED systolic blood pressure: categorized as hypotensive if the initial systolic blood pressure was low after age adjustment. [32]
- Initial ED respiratory rate (categorized as age-adjusted tachypnea)
- Initial GCS score in children ≥2 years of age[33]
- Initial Pediatric GCS score in children <2 years of age[34]
- Evidence of thoracic wall trauma: erythema, abrasion, ecchymosis, subcutaneous air, or laceration to the anterior or posterior chest wall
- Chest auscultation for absent or decreased breath sounds
- Thoracic tenderness
- Costal margin tenderness: tenderness to any of ribs 7–12
- Evidence of abdominal wall trauma: erythema, abrasion, ecchymosis, laceration, "seat belt sign" to the abdominal wall
- Abdominal tenderness, including severity (mild, moderate, or severe)
- Abdominal distention
- Abdominal auscultation for bowel sounds
- Peritoneal irritation: rebound tenderness on palpation or abdominal pain with cough tenderness
- Flank tenderness
- Pelvic bone tenderness or instability on palpation
- Femur fracture
- Clinical evidence of alcohol intoxication
- Presence of a distracting painful injury as determined by the treating physician (not further defined)

Figure 2. Patient history and physical examination variables collected.

Outcome Measures

- IAI undergoing ***acute intervention***
  - **Death** caused by IAI
  - **Laparotomy**
  - Angiographic **embolization**
  - **Blood transfusion**
  - **Intravenous fluids for > 2 nights** in pancreatic or gastrointestinal injuries

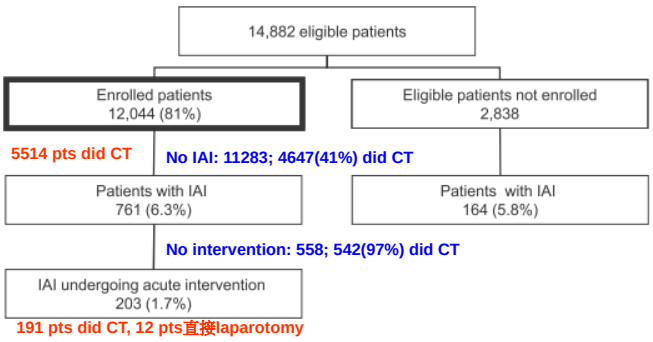
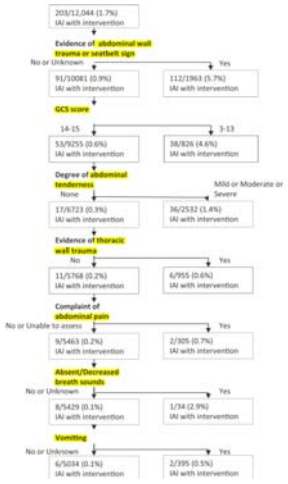


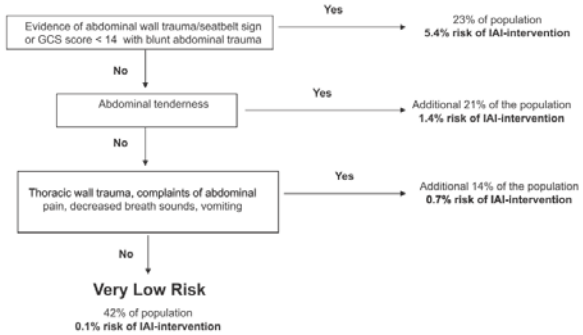
Table 1. Baseline characteristics of study population.

Characteristic	IAI Undergoing Intervention (n=203)	No IAI Undergoing Intervention (n=11,841)	Total (n=12,044)
Age (SD), y	9.9 (5.3)	10.3 (5.4)	10.3 (5.4)
Age <2 y (%)	10 (5)	1,157 (10)	1,167 (10)
Sex (% male)	125 (62)	7,259 (61)	7,384 (61)
Ethnicity (%)			
Hispanic	18 (9)	1,273 (11)	1,291 (11)
Non-Hispanic	119 (59)	7,537 (64)	7,656 (64)
Unknown	66 (33)	3,031 (26)	3,097 (26)
Race (%)			
American Indian or Alaska Native	0	85 (1)	85 (1)
Asian	4 (2)	218 (2)	222 (2)
Black	45 (22)	3,699 (31)	3,744 (31)
Native Hawaiian or other Pacific Islander	0	38 (0)	38 (0)
White	123 (61)	6,366 (54)	6,489 (54)
Unknown	30 (15)	976 (8)	1,006 (8)
Other	1 (0)	459 (4)	460 (4)
Mechanism of injury (%)			
Motor vehicle crash	91 (45)	3,739 (32)	3,830 (32)
Fall from an elevation	11 (5)	1,612 (14)	1,623 (13)
Fall down stairs	4 (2)	277 (2)	281 (2)
Pedestrian or bicyclist struck by moving vehicle	34 (17)	2,238 (19)	2,272 (19)
Bicycle collision or fall from bicycle while riding	19 (9)	739 (6)	758 (6)
Motorcycle/ATV/ motorized scooter collision	9 (4)	593 (5)	602 (5)
Object struck abdomen	10 (5)	783 (7)	793 (7)
Other	18 (9)	1,673 (14)	1,691 (14)
Unknown	7 (3)	187 (2)	194 (2)
High-risk mechanism of injury (%)	72 (35)	2,646 (22)	2,718 (23)

IAI, intra-abdominal injury; ATV, all-terrain vehicle.



	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)



Among enrolled (n=12044),

	IAI with intervention	No IAI with intervention	Total	
Any Predictors present	197	6813	7010	58%
No Predictors present	6	5028	5034	42%
Total	203	11841		

1254/5034 (23%) did CT;
1254/5514 (25%) among all CT done

Limitations

- Did not include laboratory testing or FAST
- Miss minor, clinically silent IAI
- Highly specialized trauma referral centers with pediatric trauma expertise

Discussion

- Abdominal CT NOT warranted for very low risk (0.1%) of IAI
  - Less than risk of radiation-induced malignancy
- NOT intended that CT for ≥ 1 positive for rule variables
  - Observation without CT
  - Lab tests or FAST
    - Normal FAST + 1% risk ➔ Low risk

Conclusion

- Prediction rule consisting of 7 patient history and physical examination variables identifies a population of children with blunt torso trauma at very low risk for intraabdominal injury undergoing acute intervention
- Require external validation before implementation