

Development of a systematic protocol to identify victims of non-accidental trauma

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Background

- 48% child fatalities each year are a result of physical abuse1
- The majority of these children are < 4 years old¹
- Only 56% of cases are evaluated by a pediatric surgeon²
- · Identification of risk factors and systematic screening programs may help avoid escalation injuries^{3,4}
- 1) US Department of Health and Human Services. Child maltreatment 2011. Washington, DC: Administration on Children, Youth and
- Families, Children's Bureau (2012).
 Larimer EL, Fallon SC, Westfall J, Frost M, Wesson DE, Naik-Mathuria BJ. The importance of surgeon involvement in the evaluation of non-accidental trauma patients. J Pediatr Surg 2013 Jun;48(6):1357-62.
- 3) Hurme T, Alanko S, Anttila P, Juven T, Svedstrom E. Risk factors for physical abuse in infants and toddlers. Eur J Pediatr Surg. 2008 Dec;18(6):387-91.

 4) Martrille L, Cattaneo C, Dorandeu A, Baccin E. A multicentre and prospective study of suspected cases of child physical abuse. *Int J*
- Legal Med. 2006 Mar;120(2):73-8



Escalation injuries

 Approximate 30 % of children with abusive head trauma are evaluated by a physician and NAT is not recognized

Jenny et al JAMA 1999

- Recurrent NAT children significantly higher mortality 24.5% vs 9.9% for initial episode of NAT Deans et al J Trauma Acute Care Surg 2013
- Approximate 50% of abused patients had previous concern in a UK trauma research audit of abdominal injuries

Barnes et al Lancet 2005



Timeline

- Q2 2012: Team of concerned physicians, led by pediatric surgery, begin ad-hoc meetings to discuss improving management of NAT cases
- Q3 2012: NAT Subcommittee formalized under MBCH Pediatric Trauma Committee
- Q1 2013: Hospital Practice Committee, Emergency Services Committee, and Quality Steering Council endorse system-wide initiative to address suspected NAT
- Q2 2013: Review of literature and development of standardized assessment tool begins
- Q3 2013: System-wide training about NAT and management of suspected NAT commences for emergency department staff
- Q4 2013: Philanthropic funds (\$10,000) committed to retrospective analysis of NAT management in the absence of a standardized evaluation process in collaboration with MultiCare Institute for Research & Innovation
- Q1 2014:
 - System-wide implementation of standardized NAT assessment tool for suspected NAT
 - Retrospective review of NAT cases managed between 2010-2013 without standardized tool begins
- Q3 2014: Philanthropic funds (\$30,000) committed to prospective analysis of NAT management using the standardized assessment tool (Heidner Charitable Trust and the MultiCare Health Foundation)

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Red Flags

Thorough literature review identified three types of red flags:

MEDICAL/SOCIAL HISTORY

- Missing/inconsistent history
- · Unwitnessed injury
- · Delay in seeking care
- Prior ED visit(s)
- Domestic violence in home
- Premature infant
- Low birth weight or IUGR
- Chronic medical condition(s)

PHYSICAL EXAM FINDINGS

- · Torn frenulum
- Failure to thrive
- · Large head in infant
- Bruises on non-ambulating child
- Bruises in non-exploratory location (torso, ears, neck) in children < 4 years
- Bruises, marks, or scars in patterns suggesting hitting with an object
- · Perineal bruising or injury

RADIOGRAPHIC FINDINGS

- Fractures in children < 2 years
- Rib fractures in infants
- Any fracture in nonambulating children
- Undiagnosed, healing fractures
- Subdural or subarachnoid hemorrhage in children < 1 year



Adapted from Children's Hospital of Pittsburgh of UPMC Clinical Guidelines © 2010

"Red Flag" History of Present Injury

- No history or inconsistent history
- Changing history
- · Unwitnessed injury
- Delay in seeking care
- · Prior ED visit
- · Domestic violence in home
- Premature infant (<37 weeks)
- Low birth weight/IUGR
- Chronic medical conditions



"Red Flag" Physical Exam Findings

- Torn frenulum
- FTT (weight, length, head circumference)
- Large heads in infants (consider measuring of OFC in children <1yr)
- Any bruise in any non-ambulating child "if you don't cruise you don't bruise:
- Any bruise in a non-exploratory location TEN < 4
 <p>Torso area covered by a girl's bathing suit
 Ears
 Neck
- Bruises, marks, or scars in patterns that suggest hitting with an object



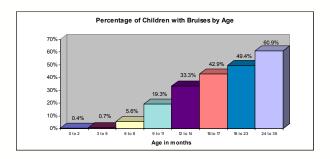
Sentinel Injuries

- Type of injury: Bruising 80%, intraoral injury 11% and other 7%.
- Occurred early in infancy: 66% at <3 months and 95% at or before 7 months of age.





"If you don't cruise, you don't bruise."



Sugar, NF et al. Bruises in Infants and Toddlers: Those Who Don't Cruise Rarely Bruise. Archives of Peds and Adol Med 153(4): 399-403, 1999 April.

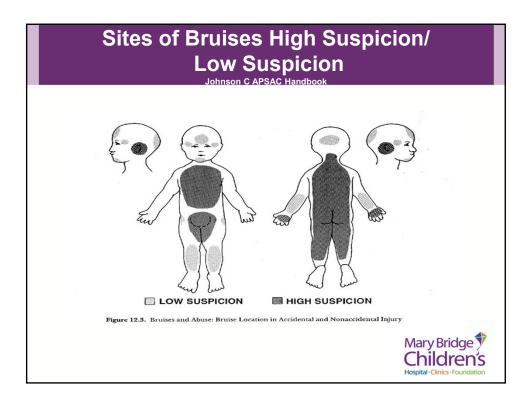


TEN-4

- Torso
- Ears
- Neck
- At or under 4 years of age
- Any region for infants under 4 months of age
- 97% sensitivity and 84% specificity

Pierce, MC et al. *Bruising Characteristics Discriminating Physical Child Abuse From Accidental Trauma*. Pediatrics 2010 Jan; 125 (1): 67-74.





Bruises

- Bruises are the most common indication of physical abuse.
- Normally active children are likely to have bruises over bony prominences such as knees, shins, elbows, chin and forehead.









Bruising

- · Age of child
- History
- · Site of bruises
- · Ages of bruises
- Pattern





Bruises

 Finger marks on slapped cheek





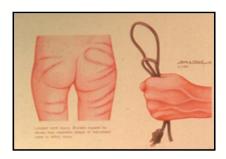
Bruises

 Bruises to side of face and neck



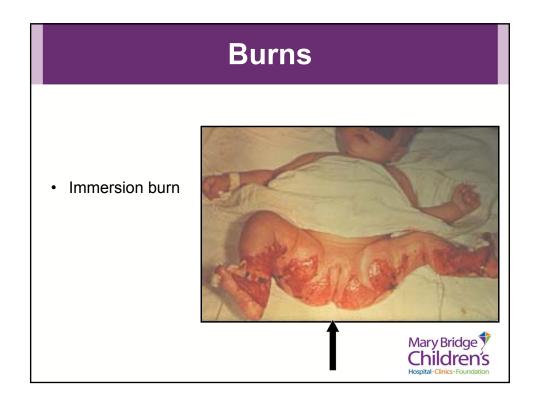
Bruises

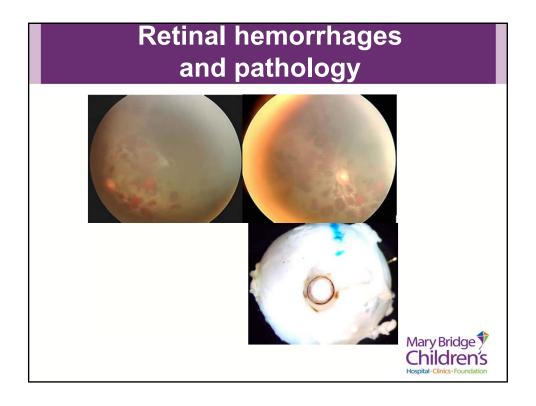
 Some injuries are pathognomonic for child abuse











"Red Flag" Radiographic Findings

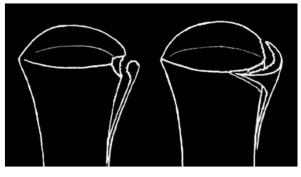
- Metaphyseal fractures (corner)
- Rib fractures (especially posterior) in infants
- Any fracture in a non-ambulating infant
- · An undiagnosed healing fracture
- SDH and/or SAH on neuro-imaging in young children, particularly in the absence of skull fracture < 1 year

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Fractures

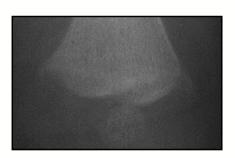
• Corner or "bucket handle" fractures = avulsion of a metaphyseal fragment overlying the lucent epiphyseal cartilage secondary to a sudden twisting motion of the extremity

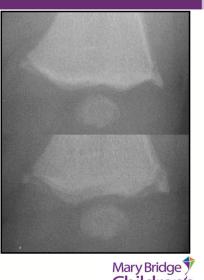




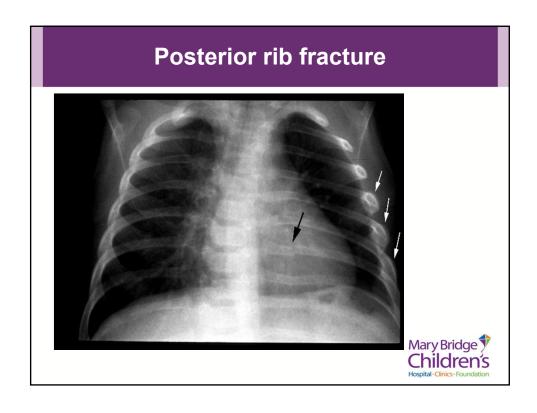
Fractures

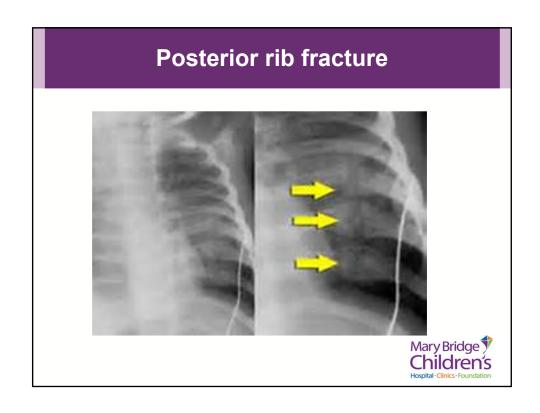
"Bucket handle" fractures





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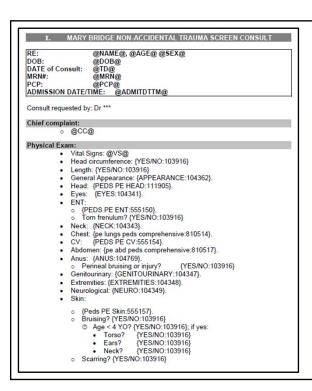




Standardized NAT Assessment Tool

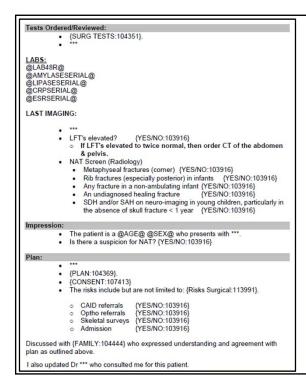
- Consult form built into the electronic medical record
- · Prompts providers suspecting NAT to:
 - Collect data on all red-flags
 - Complete a standardized history & physical exam
 - Order a standard set of labs & skeletal surveys
 - Create referrals to ophthalmology (< 1year old), child abuse intervention department, and pediatric surgery
- Put into system-wide use January 1, 2014





NAT Consult Form Sample Screen Shot





NAT Consult Form Sample Screen Shot



Discharge

- PRIOR TO HOSPITAL DISCHARGE: CARE TEAM "HUDDLE INLUDING ALL MEMBERS INVOLVED IN THE PATIENT'S CARE."
- Phone communication team may be utilized as necessary
- Outpatient CAID (Child Abuse Intervention Department) follow-up as needed



Communication

- Inform parents if a CPS referral has been filed and/or if Child Advocacy is consulted
- Be direct and objective. Inform parents inflicted trauma is part of diagnostic consideration
- Keep the focus on the child. Avoid appearing judgmental.
 Assure parents of thoroughness of evaluation.
- If you are unable to have this conversation with the parents, ask SWS or a senior colleague to do so.



Retrospective Data Review

- 117 NAT patients seen from 2010 2013
- 37% (N=43) female, 63% (N=74) male
- 68% (N=80) of cohort < 1 year old
- 92% (N=108) of cohort < 4 years old



Medical/Social History

- Inconsistent or missing history provided by the caregivers in 89% of cases (N=104)
- Injury reported as unwitnessed in 79% of cases (N=88; NA=6)
- 38% of patients had a prior ED visit (N=43; NA=3)
 - 58% of these patients were < 1 year old (N=25)
- 41 73% of patients missing social history data



Physical Exam Findings

- Bruising present in 57% of cohort (N=67)
 - 34% of these patients < 6 months old (N=23)
 - 45% of these patients < 9 months old (N=30)
 - 54% of these patients < 1 year old (N=36)</p>
- Bruising in non-exploratory location (torso, ears, neck) present in 43% of patients < 4 years old (N=46)
- Perineal bruising or injury in 9% of cohort (N=11)
 - 73% of these patients < 4 years old (N=8)
 - 27% of these patients died from NAT injuries (N=3)



Radiographic Findings

- New fractures in 60% of the cohort < 1 year old (N=48)
- Undiagnosed, healing fractures in 29% of the cohort (N=32; NA=5)
- Of 50 patients with a subdural or subarachnoid hemorrhage (44% of cohort; NA=3), 86% < 1 year old (N=43)
 - » NA = MISSING DATA. Percentages are calculated with denominators based on available data



Rib fractures in patients < 1 year old

- 33% of patients < 1 year old had rib fractures (N=26)
- Of these patients:
 - 88% also had undiagnosed healing fractures (N=23)
 - 77% male (N=20)
 - $-77\% \le 6$ months old (N=20)
 - 54% also had extremity fractures (N=14)
 - 50% had an Injury Severity Score ≥ 16 (severe) (N=13)

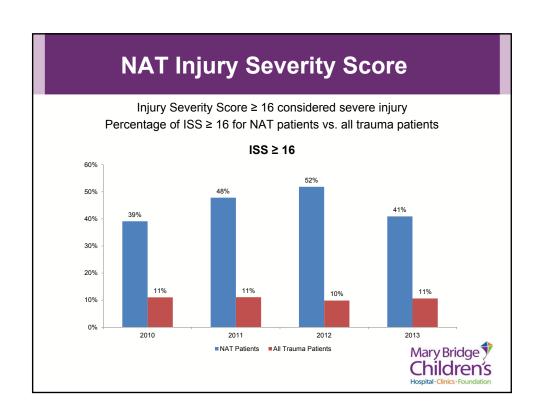


Mortality

 9 fatalities (7.7%) (8/9 bruising, 8/9 no or inconsistent history)

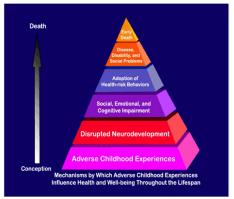
Discharged Dead									
Age	Sex	Prior ED Visits	CPS History	Domestic Violence	Fractures	Hemorrhaging	Surgery	ED LOS (hours)	Hospital LOS (days)
2-3 mo	F	No	No	Yes	None	NA	No	1.2	1
4-5 mo	М	No	Yes	Yes	Yes	Yes	Neuro	0.6	5
4-5 mo	М	Yes	Yes	NA	None	Yes	No	0	2
8-9 mo	F	Yes	Yes	NA	None	Yes	No	1.6	3
1.7 yr	F	Yes	Yes	No	NA	NA	No	3.1	1
2.1 yr	М	Yes	No	NA	NA	NA	No	1.9	1
2.1 yr	М	No	NA	NA	NA	NA	No	1.8	1
2.1 vr		Voc	Voc	NA	NA	NA.	No	3.3	N/A





ACE – Adverse Childhood Event

- Repetitive abuse may be verbal, visual, physical, sexual
- · Altered cortisol levels
- Altered development of the amygdala and hipocampus





Future Research

- Prospective study to evaluate standardized tool currently underway
- System-wide evaluation of current practice related to NAT
- Evaluation of association between hospital and emergency department length of stay and use of standardized tool



Conclusions

- The majority of patients < 1 year old had prior ED visit(s), providing at least one earlier instance in which intervention could have changed the child's outcome
- 2. In the absence of a standardized process we are not consistent in obtaining a thorough social history
- 3. Perineal bruising, though rare, was an ominous finding associated with high mortality
- 4. Nearly 1/3 of patients had undiagnosed healing fractures, justifying routine use of skeletal surveys
- Anecdotal evidence suggests that implementation of a standardized tool has raised system-wide awareness of NAT.
 We hope to present data from future work to support this observation.

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Acknowledgements

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