Incorporating PECARN for mTBI

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Nov 13, 2019

- NO FINANCIAL COI

Objectives

- 1-Understanding PECARN
- 2-How to use PECARN in mTBI
- 3-Why PECARN, not CATCH or CHALICE
- 4-CDC incorporates PECARN into evaluation and treatment of minor TBI(JAMA Peds, 2018)
- 5-Be able to define a mTBI
- 6-Define the scope of this illness.

mild TBI

- CDC has adopted this name
- Maybe not the best way to discuss with parents??

- OK to stick with concussion!

context/classification

- TBI a leading cause of Morbidity & Mortality

HI context

- 600,000 HI's USA/yr in kids
- 10%/60,000 →hospitalized
- 1%/6,000 → death

- 90%/540,000 will do fine

- All ages →4 million sports/rec related concussions/yr USA

HI Peds GCS

- Eyes: spont-4; speech-3; pain-2; none-1

- Verbal:coos-5; cries/consolable-4; cries/pain-3; moans pain2; none-1

- Motor: spontan-6; WD touch-5; WD pain-4; abnl flex-3; abnl ext-2; none-1

Dealing with the 540,000

mTBI

- Risk stratification use of CDIs
- CATCH who needs CT
- CHALICE who needs CT
- PECARN who doesn't need a CT

CDI's

- CATCH-Canadian Assessment for Tomography in Childhood Head injury
- CHALICE-Childhood Head injury ALgorithm for the prediction of Important Clinical Events
- PECARN-Pediatric Emergency Care Applied Research Network

CATCH-Osmond et al

- Designed to determine need for Head CT
- 3866 pts , age <16; 2010
- Secondarily evaluated scalp hematomas
- All but frontal, > 3 cm, boggy→ assoc with ci HI

High & Mod risk factors

CATCH Predictors for Clinically Significant TBI

GCS Less than 15 at 2 hours post trauma

Suspected open or depressed skull fracture

History of worsening headache

Irritability on exam

Any Sign of Basal Skull Fracture

Large, boggy scalp hematoma

Dangerous mechanism of injury defined as MVC, fall from > 3 ft or 5 stairs, fall from bicycle with no helmet

CATCH

- For any high risk factor-100% predictive for neurosurgical intervention

- For any moderate risk factor-98.1% Sensitive for predicting ci TBI on CT

CHALICE-Dunning et al

- Also designed to see who needs Head CT
- Less sensitivity than PECARN
- Age inclusive to <16, all HIs, 2006
- Prospective multicentre cohort study-2006
- 22,772 kiddos

CHALICE Predictors of Clinically Significant Head Injury

History	Witnessed LOC > 5min History of Amnesia >5 min duration Abnormal drowsiness ≥ 3 vomits after head injury Suspicion of non-accidental injury Seizure after head injury in a patient with no history of epilepsy
Exam	GCS < 14 or GCS < 15 in a patient under 1 year of age Suspicion for penetrating or depressed skull injury or tense fontanelle Signs of Basal skull fracture Presence of a bruise, swelling, or laceration > 5 cm if <1 year old
Mechanism	High speed accident (> 40 mph) as either a pedestrian, cyclist, or occupant Fall > 3 m High speed injury from projectile or object

CHALICE

- Any one of predictors present→CT
- Sens-98% for detection of ci TBI
- Spec-87%

PECARN

- 42,000 pts (derivation and validation cohorts)
- Isolated LOC→low rate ci TBI(0.5%)
- Isolated emesis→ciTBI less common with V
- Isolated HA→ciTBI did not occur in any
- Isolated severe MOI→ci TBI 0.8%
- Divided into two age groups; <2 and 2-18

PECARN ci TBI

- Death
- Neurosurgery intervention
- Intubated > 24 hours
- Admission >2 nights

PECARN severe MOI

- Rollover MVC
- Pt ejection
- Death of another in MV
- Pedestrian struck by MV
- Nonhelmeted bicyclist struck by MV
- Fall >3 ft→<2 yrs
- Fall>5 ft→2-18 yrs
- Head struck by high impact object

What is PECARN?

- Country divided into 7 regional research nodes, based out of 7 academic medical centers
- Collection of data from multiple institutions in prospective cohort trials
- Began in 2001; low risk head injury one of the studies from PECARN
- 2004-2006-data for low risk HI collected
- 2009-Nathan Kuppermann publishes his derivation and validation studies in Lancet 2009

CDC adopts 2018

Lumba-Brown, A et al.

Centers for Disease Control and Prevention Guidelines on the diagnosis and management of mild traumatic brain injury among children.

PECARN

Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study.

Kuppermann N, et al Pediatric Emergency Care Applied Research Network (PECARN).

PECARN

- 42,412 pts, multicentre prospective cohort
- 33,785 derivation cohort(8,502 <2 yrs and 25,283 2- 18 yrs old)
- 8,627 validation cohort (2,216 < 2 yrs and 6411 2-18 yrs)

PECARN Exclusions

- Trivial mechanism of injury
- Penetrating trauma
- Known brain tumor
- Pre-existing neuro disorder
- Any neuro-imaging from an outside hospital

PECARN low risk HI rule

- <2 years...8,502 pts

- 1-AMS
- 2-scalp hematoma
- 3-LOC> 5 seconds
- 4-Severe mechanism
- 5-Palpable skull fx
- 6-Abnormal behavior per parent(s)

- 2 - 18 years...25,283 pts

- 1-AMS
- 2-LOC
- 3-Hx emesis
- 4-Clin signs basilar skull fx
- 5-severe mechanism
- 6-severe HA

PECARN

- <2 yrs

- No risk factor
- Risk of ci TBI-<0.02%

- 2-18 yrs

- No risk factor
- Risk of ci TBI <0.05%

- Missed 2/3698 with no risk factor

PECARN ci TBI

- What was the clinically important TBI??

- 1-death
- 2-NSG intervention
- 3-intubation due to TBI
- 4-admission for >2 nights due to TBI on CT

PECARN

Children Under 2 Years of Age	
Predictor	Risk of Clinically Significant TBI
GCS ≤ 14 Altered Mental Status Palpable skull fracture	4.4%
Scalp hematoma Severe Mechanism LOC for more than 5 seconds Abnormal behavior per parent	0.9%
No predictors present	<0.02%

PECARN

Children Between 2 and 18 Years Old	
Predictor	**Risk of Clinically Significant TBI**
GCS ≤ 14 Altered Mental Status Signs of basilar skull fracture	4.3%
LOC History of Vomiting Severe headache Severe Mechanism	0.8%
No predictors present	<0.05%

PECARN

- <2 yrs
- High risk

    GCS<14, AMS, palpable skull fx

- Moderate risk

    Scalp hematoma,severe MOI, LOC>5 seconds, abnormal behavior

- Low risk

    No predictors

- Risk ci TBI
- 4.4%→CT

- 0.9%→+/- CT vs obs

- <0.02%

PECARN

- 2-18 yrs
- High risk

  GCS<14, AMS, Signs basilar skull fx

- Moderate Risk

  LOC, Hx vomiting, severe HA, severe MOI

- Low Risk

  No predictors

- Risk ci TBI
- 4.3%$\rightarrow$CT

- 0.8%$\rightarrow$+/- CT vs obs

- <0.05%$\rightarrow$ no CT

PECARN

- Whether original or subsequent validation studies PECARN consistently approaches 100% sensitivity

Pediatric Emergency Care Applied Research Network head injury clinical prediction rules are reliable in practice.

Schonfeld D1, Bressan S, Da Dalt L, Henien MN, Winnett JA, Nigrovic LE.

Schonfeld et al

- External validation of PECARN
- 2 PEM Depts, 1 USA and 1 Italy
- 2439 pts, applied PECARN
- Sensitivity 100%...Spec 55%, NPV 100%

**Validation of the PECARN clinical decision rule for children with
minor head trauma: a French multicenter prospective study.**

Lorton F1,2, Poullaouec C3, Legallais E3, Simon-Pimmel J3, Chêne
MA4, Leroy H5, Roy M3, Launay E6, Gras-Le Guen C3,7.

Lorton et al, 2016

- External validation, multicentre, prospe ctive cohort study
- 1499 kids <16
- GCS 14-15
- 3 EDs
- S-100%, Sp-69.9%, NPV 100%

Accuracy of PECARN, CATCH, and CHALICE head injury decision rules in children: a prospective cohort study.

Babl FE1, et al Paediatric Research in Emergency Departments International Collaborative (PREDICT).

Babl et al, 2017

- Prospective cohort
- 20,137 kids, <18
- HI of any severity

Babl, et al 2017

- PECARN→ 100% Sensitivity(<2);99%(2-18)

- CATCH → 95% Sensitivity

- CHALICE → 92.3% Sensitivity

Comparison of PECARN, CATCH, and CHALICE rules for children with minor head injury: a prospective cohort study.

Easter JS1, Bakes K2, Dhaliwal J3, Miller M3, Caruso E2, Haukoos JS4

Easter et al

- Single center study, out of Denver
- 1009 pts

Easter et al

Decision Rule	Sensitivity	Specificity
PECARN	100%	62%
CHALICE	84%	85%
CATCH	91%	44%
Physician Judgement	95%	68%
Physician CT Practices	100%	50%

Conclusion

- Several CDIs available for us to use
- PECARN, CATCH, CHALICE-most studied
- PECARN-who doesn't need a head CT
- PECARN-only CDI to approach 100%
- PECARN adopted by CDC
- These 'rules', instruments should not supersede physician judgement

The End