



Head Injury: Cognitive Care

Current research indicates that “minor head injury” may not be so minor in certain circumstances. Serious occult pathology may be present with a relatively normal examination. This course will review current literature regarding indications for and limitations of observation, scanning, admission, and referral. In addition to an analysis of the usual head trauma patient, special presentations in the pediatric and geriatric patient will be discussed.

- Describe the clinical presentations associated with minor head injury.
- Distinguish between those patients with low, moderate and high probabilities of serious intracranial pathology.
- List the advantages and limitations of clinical examination, plain radiographs and scanning.

TU-93
Tuesday, October 12, 1999
1:30 PM - 2:25 PM
Room # N212
Las Vegas Convention Center

FACULTY

Peter Viccellio, MD, FACEP

Associate Professor, Emergency
Medicine; Vice Chairman, SUNY at
Stony Brook School of Medicine,
Stony Brook, New York

Terminology

- 1 Primary brain injury - actual blow to the head
- 1 Secondary brain injury

Mechanism of injury

- 1 blow to skull motion of brain
- 1 in *general* epidurals are caused by fractures (something hits head), subdurals by acceleration/deceleration injuries (head hits something);
- 1 LOC by rotational forces applied to brainstem
- 1 primary injury - no deterioration

Your job

- 1 Was the skull fractured?
- 1 Were veins or arteries torn?

Key Issues in Evaluation

History

- 1 description of accident
- 1 amnesia/change in mental status
- 1 PMH
- 1 allergies, medication

Memory and loss of consciousness

- 1 "concussion"
- 1 LOC vs. syncope
- 1 amnesia for the event
- 1 short term and long term memory

Perform an exam appropriate to the patient

- 1 frontal lobe
- 1 temporal lobe
- 1 hippocampus
- 1 parietal lobe
- 1 occipital lobe

Other aspects of physical examination

- 1 CSF rhinorrhea
- 1 ear and mastoid
- 1 eyes
- 1 pupils
20 and 4
the driver's license

"CSF" rhinorrhea

- 1 50 patients with rhinorrhea (- trauma)
68% + for glucose
26% + in same range as CSF
CSF RHINORRHOEA: SIGNIFICANCE OF THE GLUCOSE OXIDASE STRIP TEST Steedman, D.J., et al, Injury 18(5):327, September 1987
CURRENT MANAGEMENT OF CEREBROSPINAL FLUID RHINORRHEA Park, J.I., et al, Laryngoscopy 93(10):1294, October 1983

The Ring Test

Basilar skull fracture

- 1 168 patients (15.6%) of 1071 skull fx (Dagi et.al. (MGH) Am J Emerg Med 1983; 1:295)
- 1 Hemotympanum 80.9%
- 1 Battle's sign 11.9%
- 1 Rhinorrhea 10.7%
- 1 Otorrhea 10.1%
- 1 Fx on SXR 48.8%
- 1 Raccoon's eyes 7.7%
- 1 Anosmia 2.4%
- 1 CN VII 3.6%
- 1 CN VIII 1.2%

Auscultatory percussion!!

- 1 180 patients
- 1 44 of 51 (+)
- 1 2 of 38 false (+)
AUSCULTATORY PERCUSSION OF THE HEAD Guarino, J.R., Br Med J 284(6322):1075, April 10, 1982
HEAD INJURY AND THE DILATED PUPIL Byrnes, D., Amer Surg 45(3): 139, March 1979

Glasgow Coma Scale

Teasdale and Jennett. Lancet 1974; 1:81-83.

- 1 Eye opens
 - Spontaneously 4
 - to speech 3
 - to pain 2
 - none 1
- 1 Verbal ability
 - oriented 5
 - confused 4
 - inappropriate 3
 - incomprehensible 2
 - none 1
- Motor ability**
 - obeys 6
 - localizes pain 5
 - withdraws 4
 - flexion 3
 - extension 2

Perilymphatic fistula

- 1 implosion or explosion
 - 1 round or oval window
 - 1 vertigo > hearing loss
 - 1 stiff neck, difficulty concentrating, etc.
 - 1 intermittent symptoms
 - 1 PLF - 0.03cc
 - 1 fistula test
 - 90% specific
 - 50% sensitive
- Arch Phys Med Rehab 1995;76:1017

Secondary brain injury

- 1 Subdural
- 1 Epidural
- 1 Intracerebral hemorrhage
- 1 Intracerebral swelling
- 1 Secondary ischemic injury

Importance of early diagnosis

- 1 Mortality Rate for ICH: Impact of clinical presentation
- 1

	Alert	Unconscious
1 Study 1	10	40
1 Study 2	0	50
1 Study 3	0	16

- What do you expect the initial exam to be?
- How fast can they go down?

Appearance of intracerebral hematoma may be (and usually is) delayed, but the good news is...

- 1 Soloniuk et.al. J. Trauma 26:787
- 1 35 patients with neurosurgical procedures
- 1 Intracerebral hematoma appeared:

0-3 hr	20%
3-6 hr	6%
6-24 hr	29%
>24 hr	46%
- 1 1/2 of patients of GCS >8
- 1 1/2 of patients died, proportional to GCS

Delayed extradurals can happen but

- 1 Ashkenzi et. al. J Trauma 1990; 30:613-615
- 1 45 EDH over 3 years
- 1 6 with initial CT negative
 - 3 of 6 without neuro, but severe headache

Patients with delayed EDH - no problem(?)

- 1 1 - initial GCS 14, improved; worsening HA day 6
- 1 2 - no LOC, hit by stone; GCS 14, improved; worsening HA day 4
- 1 3 - GCS 7, improved to 15; worsening HA day 5
- 1 4 - GCS 7; ICP increase at 48 hours
- 1 5 - GCS 5, decreased to 3 at 48 hours
- 1 6 - GCS 4, decreased to 3 at 6 hours

More on delays

- 1 similar findings in other studies
- 1 slower evolution
- 1 ??if you CT them too quickly?

Skull x-rays

- 1 Skip them yourself. But worry about the positive one that someone else obtained.

Skull Fractures

- 1 skull withstands 400-800 lb/in²
- 1 importance of intact scalp
- 1 linear
- 1 depressed
- 1 basilar

What's the utility of skull x-rays?

- 1 fracture substantially increases probability of IC bleed
 - 15 x
 - 200 x
- 1 possible utility in highly localized injury - too many missed in peds literature

Mendelow, et. al. Br. Med. J. 1983; 287:1173

What to do and whom to do it to

- 1 What is your acceptable miss rate?

Should we worry about the patient with a normal exam after head trauma?

- 1 Is CT a waste of time?
- 1 Remember! Until big enough, epidurals and subdurals are problems *around* the brain, not of the brain.

The "low risk" patient

- 1 Klauber et al. Neurosurg 1989;24:31-36.
- 1 Variations in death rate in trauma centers
- 1 43% below to 52% above
- 1 primarily from "low risk" patients

What constitutes concern for the "normal" patient?

- 1 Deceleration injury
- 1 Potential for fracture
- 1 Confounding variables
 - 1 intoxic
 - 1 coumadin
- 1 Age
- 1 Obvious symptoms

Step one

- 1 Normal GCS

A normal GCS means nothing

- 1 650 patients admitted for "mild" head trauma (GCS > 12, + LOC or amnesia)

GCS	15	14	13	Total
# patients	454	142	62	658
Positive CT	59	32	25	116
% positive	13	22	40	17%
Needed op	17	8	8	33

- 1 5% required surgery, half of whom had GCS 15
- 1 Negative CT: 542. All OK at discharge

Stein and Ross (NJ) Neurosurg 26:638-640, 1990

Step two

- 1 Symptoms (or absence thereof)

What about other symptoms?

- 1 Simple punchline:
 - nl exam + no symptoms = ALMOST good enough

Length of LOC is not helpful

- 1 Mikhail et. al. Am J EM 1992; 10:24-26.
- 1 112 patients, GCS > 12, ?consecutive patients, ?entry criteria
- 1 prospective
- 1 35 with CT, 8 +
 - 3 neurosurg
 - all 8 + CT with GCS 15
 - 4 LOC (1 < one min, 1 for 1-5 min, 2 > 5 min)

Evaluation of the Patient with Head Trauma

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Peter Viccellio, MD, FACEP
Dept. of Emergency Medicine
SUNY at Stony Brook

4 no LOC (c/o headache)

1 95 followed up, 17 phony addresses/phone number

Minor head injury - Jeret

1 Prospective - Neurosurgery 1993; 32:9-16

1 712 patients

1 GCS 15

1 clinical variables, formal neurological examination.

1 67 (9.4%) CT positive

1 2 needed neurosurgery (0.3%)

Results - Jeret

1 What mattered?

Older age

signs basilar skull Fx

mechanism of injury (pedestrian struck, assault)

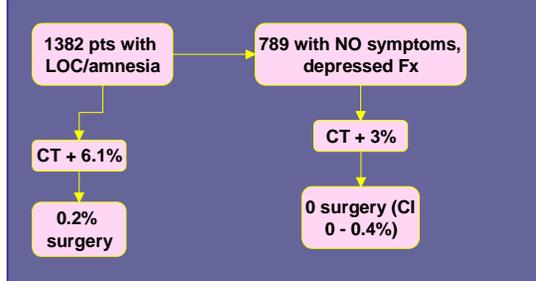
1 what didn't matter

subjective complaints - everyone had them

performance on neuro exam

CT vs. GCS: 15 + symptoms??

Miller et. al. Ann Emerg Med 1996;27:290-294



“Minor” problems (from Miller)

1 The 3%:

Subarachnoid/intraventricular hemorrhage

contusion

skull Fx

1 if “none” deteriorated of 47 patients, 95% confidence interval is ~6% (for pts with + CT, “stable”

1 how soon were patients seen?

1 Why so many with no symptoms?

Summary

1 Odds are obviously low if you look OK

1 Is “not needing neurosurgery” enough?

1 If your practice is driven by LOC, take a good history

1 Overlapping confidence intervals

Step three

Alcohol

Scan the drunk ones. Period.

1 Cook, et. al. Acad. Emerg. Med. 1994:227-234

1 Prospective. 107 consecutive patients with EtOH and minor head trauma

1 GCS, neuro exam score, clinical variables

1 8.4% + CT

1 1.9% neurosurgical intervention.

1 No variables worked

Interlude: Seizures and head trauma spell trouble

- 1 25 seizures head trauma
8% skull Fx
8% ICH
- 1 29 head traumas seizure
34% skull Fx
34% ICH

Desai et.al. Ann Emerg Med 1983; 12:543

Step four

- 1 Mechanism of Injury

Falls

- 1 angular acceleration (strain) rate higher with falls vs. MVA's
- 1 higher incidence contact phenomena
- 1
Gennarelli and Thibault, J Trauma 1982; 22:680-686
MacPherson, P., et al, Clin Radiol 40(1):22, January 1989

Falls can be worse than MVA's

- 1 prospective - Gutman et. al., Toronto. J Neurosurg 1992; 77:9-14
- 1 1039 admissions to tertiary referral center for LOC or skull fracture
- 1 2/3 referred, 1/3 direct
- 1 276 ICH - falls > MVA's for all ages, all GCS's

Step four summary

- 1 Did you jiggle your bridging veins or bump your brain?
- 1 Did you fracture your skull?

Step five - age

Older ages

- 1 Multiple studies all with same conclusion, e.g. Stiell abstract
Mikhail et al. Am J Emerg Med 1992;10:24-26

Considerations in Pediatrics

What's different about kids?

- 1 difficult neuro exam
- 1 Different injuries from adults
6% neurosurg vs. 30% adults

Falling out of bed - don't worry?

- 1 161 outpatients
- 1 85 inpatients
- 1 80% nothing
- 1 17% minor
- 1 3% serious (2 skull fractures)
Helfer R et. al. Injuries resulting when small children fall out of bed. Pediatrics 1977. 60:533.
(Retrospective)

Short distance falls - benign??

- 1 Studies:
3 foot drop onto stone, carpet, foam-backed linoleum
all fractures
25 dropped onto double-folded camel hair blanket four fractures
2 foot fall = 7.7 MPH; 3 foot fall = 9.4 MPH
average adult running at top speed = 9-12 MPH

Weber W. Z Rechtmed 1985;94:93-101

Playground Materials

<u>Material</u>	<u>Critical Height</u>
Wood Mulch	7-11 feet
Uniform wood chips	6-12 feet
Fine sand	5-9 feet
Coarse sand	5-6 feet
Fine Gravel	6-10 feet
Medium gravel	5-6 feet

US Consumer Product Safety Commission. GPO: 1995 O - 164-557.

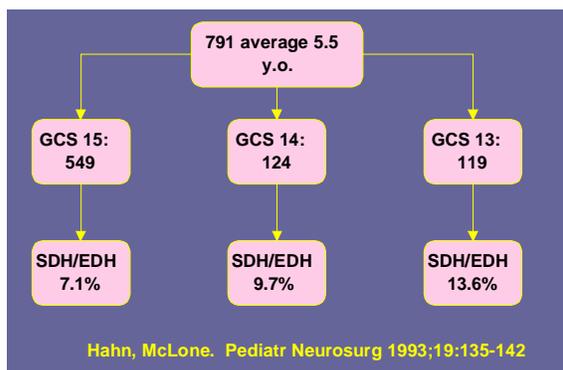
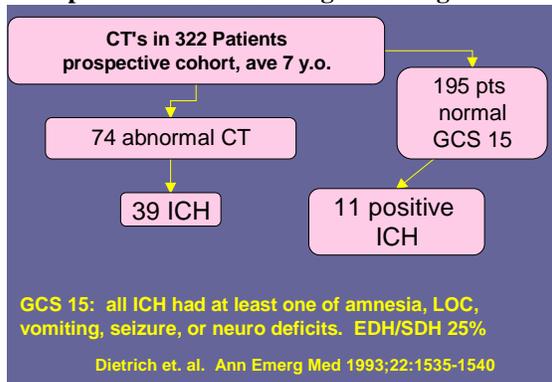
Playground Materials

<u>Material</u>	<u>Critical Height</u>
Asphalt	2 inches
Concrete	1 inch

US Consumer Product Safety Commission. GPO: 1995 O - 164-557.

Kids - who to scan?

First punchline: GCS isn't good enough



Punchline number two - the bad news

1 A normal exam isn't enough either, sometimes.

Epidural hematomas in children

1 Children's Hospital, Boston

1 53 children with epidural hematomas

1 13 < 2 y.o.

1 no LOC in 31

1 24 of 53 from falls less than 5 feet

1 40% alert when first seen

1 66% diagnosed at the initial hospital visit

1 26% diagnosed on the return visit

Schutzman et. al. Ann Emerg Med 1993;22:535-541

Who needs CT?

1 Prospective - Quayle et. Al. Pediatrics 1997: 99(5),
e11

1 322 children

1 27 + ICH: 16 (59%) nl MS, no focal

1 of 16, 6 younger than 1 (all with SFX)
5 scalp contusion without other symptoms
other 10: 2-12 years: all had *some* Sx

1 13 of 27 + ICH + skull fx

1 Key predictors: AMS, focal neuro, basilar skull,
seizure (misses 15 of 27)

1 Add: LOC, vomit, HA, sleepy >2 y.o.

Pedi punchline number three

1 Watch out for infants with swelling of the scalp,
particularly the parietotemporal region

More on scalp bruises

1 prospective

1 431 infants with head injury, no symptoms

1 181 were imaged

1 28% skull fracture

1 risk of fracture proportional to size of hematoma

1 parietal and temporal hematomas the worst

1 14 intracranial hemorrhages

Greenes DS et al. Ann Emerg Med 1997;30:253-259

see also Greenes DS and Schutzman Ann Emerg Med
1998; 32:680-686

Vomiting and pediatric head injury

1 44 children observed for head injury; ave. 7.4 yr.

1 29 vomited. Hx motion sickness - all 15 vomited

1 History of

recurrent headache (p+ 0.05)

if migraine, p=0.002

FHx migraine, p=0.001.

If more than one variable, 100% vomited.

1 If LOC, LESS of a chance of vomiting, p=0.003.

Mohammed MS et. al. J Ped 1997;130:134-7.

Pedi punchline number 4

1 Vomiting might not be such a big deal

So far, we know:

- 1 GCS 15 and skull x-rays are not enough
- 1 things can happen quickly, particularly early on
- 1 studies to define the utility of specific subsets of symptoms in the face of a “normal” exam have contradictory, but hopeful findings
- 1 the following things are expensive:
 - CT scanning
 - admission
 - missing a diagnosis

The Standard

Skull x-ray examination for trauma

- 1 Skull X-ray Referral Criteria Panel
- 1 Center for Devices and Radiological Health (FDA)
- 1 Radiologic Health Sciences Education Project
- 1 American College of Radiology
- 1 based on studies of 22,058 patients
 - all retrospective
 - all chart review
 - no follow-up

US Dept. of HHS, June 1986

Low risk group

- 1 asymptomatic
- 1 headache
- 1 dizziness
- 1 scalp hematoma
- 1 scalp contusion/abrasion
- 1 absence of moderate or high risk criteria

Low risk group

- 1 Observation alone
- 1 discharge with head sheet to reliable environment
- 1 watch for signs of high or moderate risk groups.

Moderate risk group

- 1 history of change of consciousness at time of injury or subsequently
- 1 history of progressive headache
- 1 alcohol or drug intoxication
- 1 unreliable or inadequate history of injury
- 1 age less than 2 years (unless injury very trivial)
- 1 posttraumatic seizure
- 1 vomiting
- 1 posttraumatic amnesia
- 1 multiple trauma
- 1 serious facial injury
- 1 signs of basilar fracture
- 1 possible skull penetration or depressed fracture
- 1 suspected physical child abuse

Moderate risk group

- 1 Extended close observation
- 1 Watch for signs of high risk group
- 1 Consider for CT examination or plain film SXR
- 1 May require neurosurgical consultation

High risk group

- 1 depressed level of consciousness not clearly due to alcohol, drugs, or other cause
- 1 focal neurological signs
- 1 decreasing level of consciousness
- 1 penetrating skull injury or palpable depressed fracture
- 1 neurosurgical consultation and CT scan

THE paper

- 1 17 authors
- 1 NEJM, 1987
- 1 7035 patients
- 1 31 ED's
- 1 prospective
- 1 criteria worked perfectly

The study

- 1 7035 patients
- 1 4673 agreed to participate
- 1 follow-up data on 3658
- 1 1015 patients:
 - National Center for Health Statistics
 - search for match in Natl Death Index
 - 18 matches
 - MD review : not us, baby

What's missing

- 1 Focal blows to the head
- 1 the elderly

If you CT

- 1 Simple punchline: normal exam plus normal CT - send home

Can patients with a normal CT be discharged?

- 1 1538 records of admitted patients
- 1 LOC
- 1 normal/near normal exam
- 1 265 + CT
- 1 58 surgery
- 1 1339 with normal CT, none deteriorated

Stein & Ross J Trauma 33:11-13, 1992

How safe is it to treat and street?

- 1 1000 patients
- 1 967 consented; 886 classified as "low risk" by Fed. criteria
- 1 follow-up on 895 (93%)
 - 2 of 72 lost to follow-up + death certificates
- 1 no missed intracranial injury
- 1 95% confidence interval: 0.4% or less have injury

Richless et. al. Am J Emerg Med 1993; 11:327-330.

Treat and street - kids' version

- 1 Dahl-Grove et al. Ped Emerg Care 1995; 11:86-88
- 1 Davis RL et. al. Pediatrics 95;95:345-349

Evaluation of the Patient with Head Trauma

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Peter Viccellio, MD, FACEP
Dept. of Emergency Medicine
SUNY at Stony Brook

Now, where are we?

- 1 there is no “zero” chance option
- 1 the lower the GCS, the higher the chance of + CT
- 1 the incidence of deterioration in patients with GCS 15 is small, but not zero
- 1 if the patient and the scan are negative, send them home
- 1 LOC plus a normal exam has a low, but non-zero yield
- 1 scan drunks and seizure patients with head injuries
- 1 infants with hematomas - be afraid
- 1 what’s the significance of ditzels?

Finally, a recommendation

- 1 Take a CAREFUL history
- 1 Ask two simple questions:
 - could there be a fracture?
 - did the brain experience enough deceleration to tear or rip something?
- 1 always give head injury instructions
 - warn of post traumatic symptoms which *aren't* significant as well
 - if you want them to wake up every hour, just go on and scan them

Have an open mind

- 1 adequacy of history and examination
- 1 availability and interpretation of radiologic studies
- 1 limitations of literature
 - how does it apply to your particular patient?
 - ultralite
 - 12 hours after trauma
 - vomit at home, now OK

Please. If you have any questions, comments, or inquiries, please contact me at avicellio@epo.hsc.sunysb.edu. I will post these notes as well as additional references at www.viccellio.com/lectures/headtrauma.html.

