

Subdural haematoma and effusion in children aged < 2 years

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on behalf of the Subdural Haematoma study group

1. Australian Paediatric Surveillance Unit
2. The University of Sydney
3. The Children's Hospital at Westmead



- Subdural haematoma, other intracranial bleeding and effusion cause significant morbidity and mortality in childhood
- Seen mainly in infants under 24 months
- More common in boys
- Incidence reported Britain ~12/100,000 (1998-1999)
New Zealand~14/100,000 (2000-2002)
- No national estimates for Australia
~ 65 cases per year based on overseas estimates
- A lot of controversy



Australian data

one paediatric neurosurgical centre

- The Children's Hospital at Westmead 1995-2001
- 65 consecutive cases confirmed as 'non-accidental injury'
- 35 had seizures at or before admission
- 17 (26%) required surgical intervention
- 33 had evidence of skeletal injuries - 22 subclinical
- Delay in diagnosis: median 5 days from admission
- Delays in determining the cause - admission to non-accidental injury was made in only 14 cases

APSU study

- 169 cases reported in 2 ½ years (2010-2012)
- Suspected inflicted head injury 124
 - 12.4 per 100,000
- Not inflicted injury 37
- Unsure 8
- All States represented

Demographics

	Not IHI (37)	IHI (124)	Significance
ATSI	3 (8.1%)	14 (11.3%)	P<0.05
Gender male	19 (51.4%)	76 (61.3%)	NS
Age of child (median, months)	4.9 (0-20.6)	4.5 (0-23.3)	NS
Premature birth	3 (8.1%)	14 (11.3%)	NS
VLBW	2 (5.4%)	3 (2.4%)	NS
Age biological mother (median, years)	30 (21-43)	22.5 (16-48)	P<0.01
Age biological father (median, years)	31 (27-42)	28 (17-47)	NS

Presenting symptoms

	Not IHI (37)	IHI (124)	Significance
Unsettled crying	5 (13.5)	46 (37.1)	P<0.01
Irritability	18 (48.6%)	66 (53.2%)	NS
Poor feeding	6 (16.2%)	48 (38.7%)	P<0.05
Vomiting	8 (21.6%)	54 (43.5%)	P<0.05
Pallor	8 (21.6%)	43 (34.7%)	NS
Breathing Difficulty	6 (16.2)	38 (30.6%)	NS
Apnoea	6 (16.2)	23 (18.5)	NS
Sudden Collapse	1 (2.7%)	31 (25%)	P<0.01
Floppiness	7 (18.9%)	45 (36.3%)	NS
Seizures	10 (27.0%)	56 (45.2%)	P<0.05
Drowsiness / unconscious	12 (32.4)	66 (53.2)	P<0.05
Concerns re Head size	6 (16.2)	27 (21.8)	NS

Findings

	Not IHI (37)	IHI (124)	Significance
Facial Bruising	2 (5.4)	38 (30.6)	P<0.01
Scalp swelling or bruising	22 (59.5)	25 (20.2)	P<0.05
Bulging fontanelle	0	11 (8.9)	NS

No history of trauma

Not IHI (37)	IHI (124)	Significance
7 (18.9%)	67 (54%)	P<0.01

Subdural collections

	Not IHI (37)	IHI (124)	Significance
Type of subdural collection			
Haemorrhage	30 (80.1)	98 (79.0)	NS
Effusion	4 (10.8)	6 (4.8)	NS
Both	0	18 (14.5)	P<0.05
Location			
Unilateral	22 (59.5)	35 (28.2)	P<0.01
Bilateral	12 (32.4)	87 (70.2)	P<0.01
Interhemispheric	1 (2.7)	29 (23.4)	P<0.05
Age of Collection			
Acute	31(83.8)	50 (40.3)	P<0.05
Chronic	1 (2.7)	18 (14.5)	P<0.01
Both	0	45 (36.3)	P<0.01

Other findings

	Not IHI (37)	IHI (124)	Significance
Retinal Haemorrhages	2 (5.4)	71 (57.3)	P<0.01
Fractures			
Skull	17 (45.9)	34 (27.4)	P<0.05
Rib	0	42 (33.9)	P<0.01
Metaphyseal	1	21 (16.9)	P<0.01
Other	0	34 (27.4)	P<0.01
Abdominal Injury	0	9 (4.8)	NS

ICU and ventilation

	Not IHI (37)	IHI (124)	Significance
ICU	15 (40.5)	53 (42.7)	NS
Need for Ventilation	7 (18.9)	40 (32.3)	NS
Birth Trauma removed (15)	Not IHI (22)	IHI (124)	
ICU	9 (40.9)	47(37.9)	NS
Need for ventilation	5 (22.7)	36 (29.0)	NS

Psychosocial problems

	Not IHI (37)	IHI (124)	Significance
Maternal Mental Health	2(5.4)	31(25)	P<0.05
Paternal Mental Health	0	16(12.9)	P<0.05
History of Domestic Violence	0	31 (25.0)	P<0.01
Substance abuse by carer	0	32 (25.8)	P<0.01

Referral

	Not IHI (37)	IHI (124)	Significance
CPU	20(54.1)	123(99.2)	P<0.01
SCPA	6 (16.2)	118 (95.2)	P<0.01
Police	4(10.8)	108 (87.1)	P<0.01

Outcomes

	Not IHI (37)	IHI (124)	Significance
Foster Care	1(2.7)	33(26.6)	P<0.01
Parents	33(89.2)	59(47.6)	P<0.01
Relative	0	19(15.3)	P<0.05
Died	0	6 (4.8)	NS

Follow up data

- 149 (88.2%) of all cases
- 112 (90.3%) of IHI
- 30 (81.1%) of not IHI
- 7 (87.5%) of the unsure

- 7 children in the IHI died
- None in the not IHI died

Children resided with ...

	Not IHI (30)	IHI (112)	Significance
Parent(s)	25(83.0)	52 (46.4)	P<0.05
Parent(s) + Relatives	0	2 (1.7)	NS
Relatives	0	38 (34.0)	P<0.05
Parent+ Partner	1	2 (1.7)	NS
Care facility#	0	2 (1.7)	NS
Don't know	6	22	

60 (53%) of IHI were living with a different carer at follow up

Neurological problems

	Not IHI (30)	IHI (112)	Significance
Yes	6(20.0)	25(22.3)	NS
Cerebral Palsy	0	5	
CP + Epilepsy	0	4	
CP + Hemiplegia	1	0	
Epilepsy	0	3	
Hemiplegia	3	3	
Motor problems (spasm, posturing, delay)	0	5	
Macrocephaly	1	0	
Visual problems	1	0	
Hearing loss	0	1	
Multiple neurological problems	0	2	

Outcomes

	Not IHI (30)	IHI (112)	Significance
Needed neurosurgery	3 (10.0)	19 (17.0)	NS
Vision Impairment	2(6.7)	11(9.8)	NS
Developmental Delay§	6 (20.0)	28 (25.0)	NS
Other Problems#	0	8 (7.0)	NS

§ Developmental delay included: Global Developmental delay, Gross motor delay, Speech and language delay

Other problems included: Behavioural problems, hearing loss, speech delay, NGT feeds, Sleep disturbance, plagiocephaly

Child protection and legal involvement

	Not IHI (30)	IHI (112)
CPU still involved	1 (3.3)	51 (45.5)
Court involved	0	40 (35.7)
Police Involved	0	17 (15.2)
Criminal Proceedings	0	15 (13.4)

Discussion

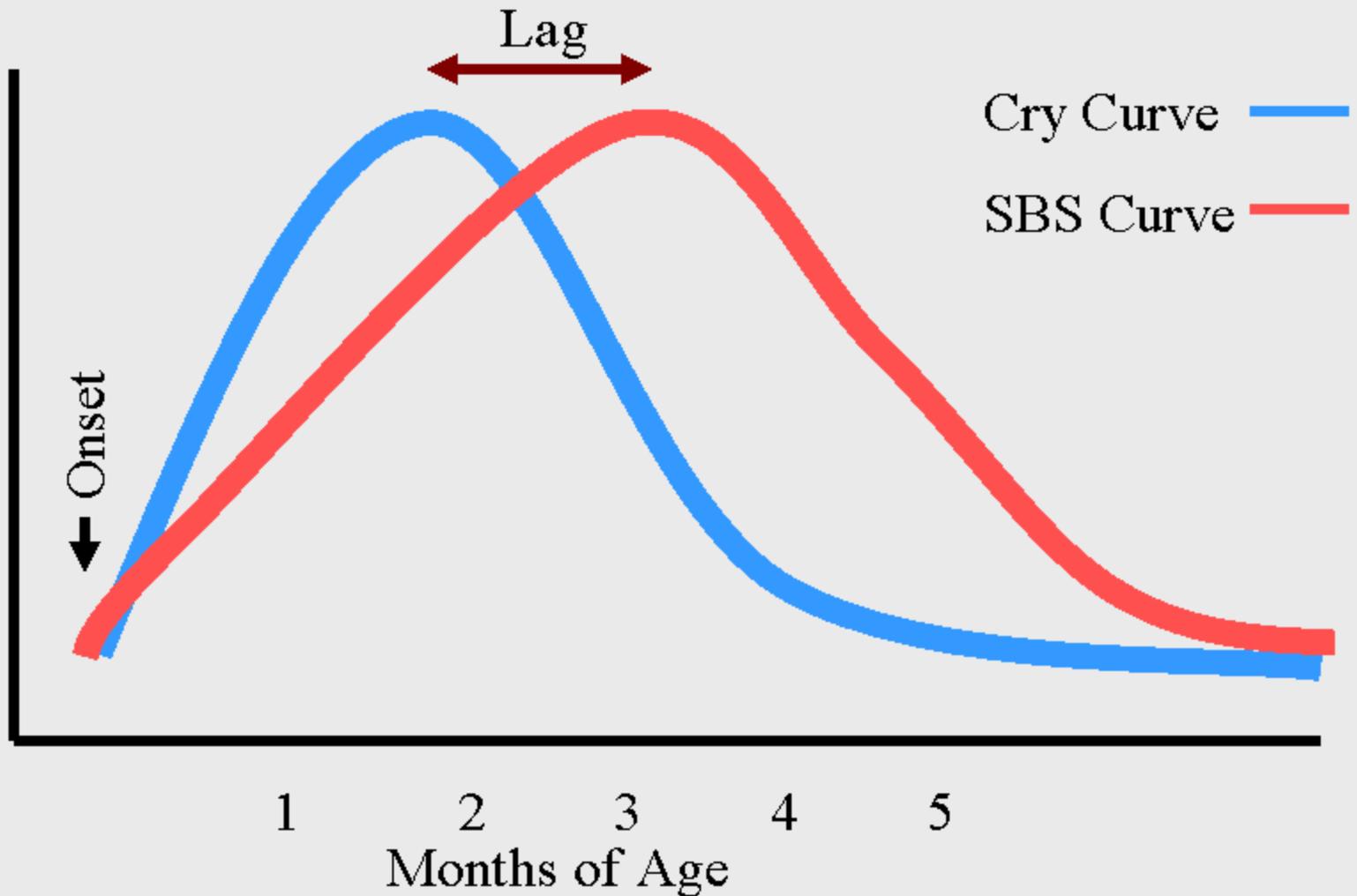
- Presenting symptoms
- Mechanism
- Age
- DDx
- Spinal injury
- Outcomes

Presenting symptoms

- Crying
- Poor feeding
- Vomiting

- Sudden collapse
- Seizures
- Drowsiness/ unconscious

Curves of Early Crying and SBS Incidence



7 week old baby

- Presented to Emergency
- Immunised the day before
- Crying episode – abnormally high pitched cry for 2-3 minutes (not unusual as bedtime)
- Then became floppy with shallow breaths
- Not fixing with eyes or turning to voice
- No fevers, feeding well
- Ambulance called

- Admitted to hospital and observed for two days – no concerns
- Discharged home

Follow up

- Outpatient EEG and ultrasound of head

Ultrasound

- Bilateral extra-axial collections overlying the cerebral hemispheres

MRI

- Suboptimal study due to movement artefact. Bilateral fronto-parieto-temporal subdural collections containing haemorrhages of different ages.

Choice of imaging

- CT first
- MRI (if done) under GA – looking for shearing injury – not possible to detect if any movement artefact

Inflicted injury

- Preferred terminology
- May involve shaking
- Other possible mechanisms
- SBS terminology outdated

Shaking?

- Biron and Shelton 2005
 - Qld cases over 10 years
 - Suspected abusive infant head trauma - 52
 - No evidence of impact - 13
 - Statement about shaking - 5
 - statement by the perpetrator to the effect that the infant was subjected to a shaking event

Adamsbaum et al 2010

- 29 cases where someone confessed
- No statement during hospitalisation
- Confessions weeks or months later
- Described shaking the infant violently
- Repeated episodes of shaking in 16 cases (55%)

Starling 2004

Perpetrator admissions

- 55 of 81 perpetrators admitted shaking their babies
- Impact not described in 44

Most common initial symptoms

Starling – 81 cases

- Loss of muscle tone – became limp 29
- Seizures 25
- Vomiting 24
- Lethargy 23
- Apnea (stopped breathing) 21

Timing of symptoms

- In 91% (52) of the 57 cases where a time interval between injury and the appearance of symptoms could be determined, the perpetrators said the symptoms appeared “immediately” after the injury
- None of the children were described as behaving normally after the event
-

Just one shake?

Jenny et al 1999

- Retrospective chart review
- 173 cases of non-accidental head injury in children <3 years:
 - 54 (31%) children had been seen by doctor shortly after the injury and diagnosis missed
 - Diagnosis given: otitis media, gastroenteritis, gastro-esophageal reflux, viral illness,
 - 15/54 (28%) were re-injured during period of diagnostic delay (after diagnosis missed)
 - 22 (41%) had medical complications related to the missed diagnosis
 - 4/5 deaths among missed cases could have been prevented.

Jenny

- Vomiting, fever, irritability and lethargy are common symptoms of a host of diseases seen in children, including head trauma.
- When caretakers do not give a history of injury, and when the victim is pre-verbal, an abusive head injury can be mistakenly diagnosed as a less serious condition.
- Not known how many cases of abusive head trauma are never detected.
- Parents who confess to shaking or hitting the heads of their children frequently report doing the same thing previously.
- In one of study cases, an infant was hospitalized three times after violent shaking before someone witnessed the abuse.

Older children

Metabolic

- One child found to have glutaric aciduria type I on neonatal metabolic screen
- No injury
- Clinical suspicion due to head size and underlying condition
- Ultrasound of head showed localised unilateral collection

Spinal imaging

Medical Outcomes

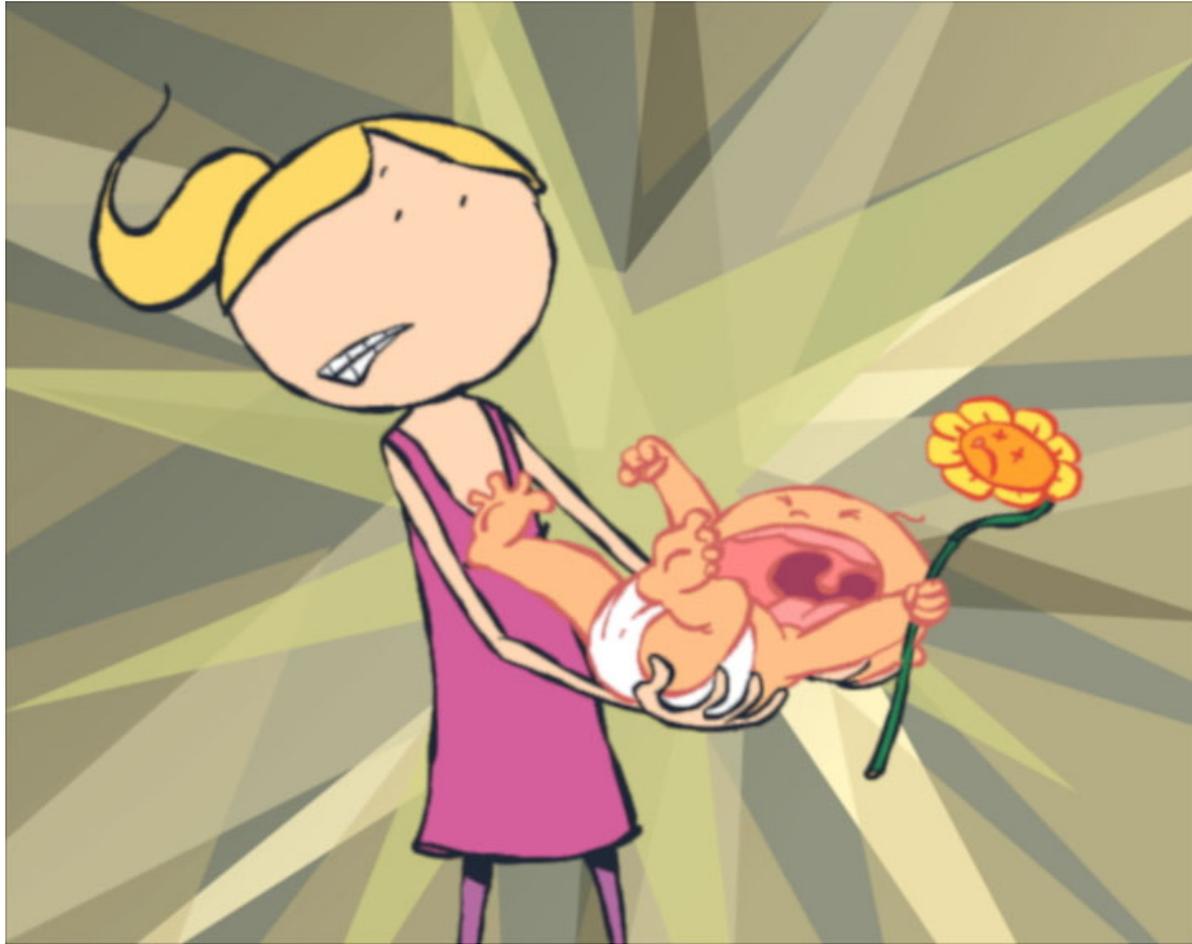
- Dr Amanda Stephens - research
- Follow-up data available for 42/64 surviving children
 - Median follow-up period 5.5 years
 - Average age at last appointment 6.3 years
- 4/68 children died (6%)
- 39/42 suffered some form of morbidity
 - Most commonly 'higher' executive functions
 - New study planned
- 3/42 'normal'
 - 2 lost to follow-up before 3 years old (2.0 and 2.8 years)
 - 1 child followed-up to 6.6 years, low-average language and intellectual skills

Conclusions of Amanda's research

- Extremely complex cases
- Poor medical outcomes
- Poor social outcomes
- Different perspectives of law and medicine result in multiple inconsistencies in the legal outcomes

Prevention is the key

Shaking the Baby is just not the Deal



What was heard

- Normal infants cry 2-3 hours a day
- Changes in attributions – what might cause a baby to cry (not because they are spoilt)
- Shaking a baby is harmful

Key messages

- SDH and suspected inflicted head injury are still a problem in Australia
- Crying infants
- Missed diagnosis - Presenting symptoms and high level of suspicion
- Choice of imaging – CT
- Spinal imaging
- Not just babies
- “Settling technique”

INVESTIGATORS

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Think of head injury

Irritability/ **crying**

Poor feeding

Vomiting

Pallor

Breathing difficulty

Apnoea

Sudden collapse

Floppiness

Seizures

Drowsy/ unconscious



Impact of video

Key learning messages:

1. Normal infants cry 2-3 hours a day



What
might
cause a
baby to
cry?

Pre %

Post %

Significance

	Pre %	Post %	Significance
Sick	87	88	
Tired	71	67	
Hungry	95	94	
Spoilt	19	9	$\chi^2=5.22$ $p<0.05$
Wet/ dirty nappy	94	91	
In pain	82	78	
Wrong formula	23	17	
Naughty	10	3	
Bad tempered	19	11	
Demanding	20	13	
Bored	20	14	
Unhappy	45	41	
Whinges	15	9	
Stubborn	8	4	
Babies just cry sometimes	35	34	
Impatient	12	8	
Babies cry for no reason	14	16	
Wants to be held	65	55	
Parent/Carer is distressed	26	26	
Environment is noisy	47	42	

Change in
attribution

...

Negative
attributions
decreased

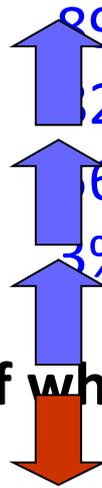
Key learning messages

2. Shaking a baby is harmful

Awareness of effects:

• Brain damage	60% Pre	↑	89% Post	$\chi^2=29.83$ $p<0.0001$
• Death	17%	↑	82%	$\chi^2=96.99$ $p<0.0001$
• More distressed	4%	↑	56%	$\chi^2=57.85$ $p<0.0001$
• May settle	64%	↑	3%	$\chi^2=97.99$ $p<0.0001$

“I have a better understanding of why babies should not be shaken.” Agree = 106 (91%)



Key learning messages

3. Alternative management strategies

“I have learned some ways of managing when a baby is crying.”

Agree = 109 (94%)

The Postcard Project



A crying baby
can be
stressful.



Ask for help
when you need it.



You're a
new dad

You're a
fun dad

You're a
strong dad

You're a
gentle dad



Never shake your baby!

HOW TO COPE WITH A CRYING BABY *Step Back, Stop and Think!*

If you have made all the obvious checks (hunger, change, thirst) and your baby just won't stop crying, try:

- Another feed – your baby may still be hungry.
- Offer your baby a dummy.
- If you are feeling calm, rock your baby close to your chest so the baby can feel your heart beating.
- Sing or talk to your baby.
- Gently rub or massage your baby.
- Take your baby for a walk in the fresh air.
- Wrap your baby in a small soft sheet so the baby feels secure and try to settle your baby in a dark and quiet place.

Remember...

no matter how
upset you feel,
shaking your baby is
just not the deal!

Asking for help is a sign of coping.

Mensline 1300 78 99 78
www.mensline.org.au

Health Direct Australia 1800 022 222
www.healthdirect.org.au

For more information, or to view an animated film, visit the Shaken Baby Prevention website
www.chw.edu.au/parents/kidshealth/crying_baby