ORIGINAL ARTICLES

Neonatal head injuries

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Abstract

A retrospective case note review of head injuries in neonates admitted to the Neonatal Surgical Unit in Glasgow between 1990 and 1996 (n=25) was carried out. Most injuries were caused by a fall (68%) and resulted in scalp haematomata and associated skull fractures in the majority of patients. Three neonates were involved in high speed road traffic accidents, and these infants all had intracranial pathology identified by computed tomography. Isolated skull fractures were common and did not appear to be associated with any neurological deficit. Non-accidental injury was uncommon in this age group. Outcome was excellent in the majority of patients (92%).

(*J Accid Emerg Med* 2000;17:334–336)

Keywords: head injuries; neonates

There is a great deal of information in the paediatric literature on head injuries and their management in children.^{1–7} However, very little has been written on the presentation and outcome of neonates with head injuries in the United Kingdom. These infants are frequently dealt with by junior doctors in accident and emergency (A&E) and paediatric departments, with little experience of paediatric head injury. We undertook this retrospective study to determine the number, nature, management and sequelae of head injuries in neonates requiring admission in Glasgow and sought any deficiencies in their management.

Methods

The Royal Hospital for Sick Children (RHSC) in Glasgow is the only tertiary referral centre for patients under the age of 13 years in Glasgow. At the time of the study, all paediatric patients sustaining head injuries who required admission in the City of Glasgow and the nearby town of East Kilbride (total population approximately 1 million) were transferred to RHSC for continuing care. All neonates admitted to RHSC with surgical conditions (including head injuries) are admitted to a dedicated neonatal surgical unit. Neonates were defined as infants who were less than 44 completed post-menstrual weeks of age at the time of injury. Thus for term babies, this represents a post-natal age of up to four completed weeks.

Neonates with a diagnosis of “head injury” or “skull fracture” were included in the study. The written patient log book for the neonatal surgical unit was manually searched to identify patients and the computer records for the unit were also checked to identify all possible patients. All patients admitted between 1 January 1990 and 31 December 1996 were included. Only those neonates who were admitted were included in the study. This was because RHSC is a regional referral centre and given the retrospective nature of the study, it would have been extremely difficult to identify other neonates sustaining head injuries and being discharged from the six referring A&E departments over the seven year period of interest. A structured proforma was completed for each identified patient, showing the length of stay, mechanism of injury, site and type of injury, presence or absence of a skull fracture, investigations performed and management undertaken. The patient outcome was defined as the infant's neurological status at the time of final outpatient assessment after discharge.

Results

A total of 25 patients were identified over the seven year period (11 males, 14 females). Twenty four of these babies were admitted to RHSC initially; one child was initially transferred to the regional neurosurgical centre from a local district general hospital after a high speed road traffic accident and was returned to RHSC when his condition improved. This child was intubated and ventilated for transfer and had a biparietal vault fracture with cerebral oedema identified by computed tomography (CT). One of the RHSC children was urgently transferred to the regional neurosurgical centre after CT; this child had been savaged by a dog and had multiple depressed skull fractures requiring operative debridement and elevation. The majority were previously healthy, with only one suffering from lactose intolerance before injury. Mean length of stay was five days (range 1–20 days, mode one day).

The mechanism of injury was a fall in 17 (68%), involvement in a road traffic accident in three (12%), non-accidental injury in two (8%) and one each of savaging by a dog, an accidental impact with a door and being struck by falling glass. The average height of fall was estimated at 0.9 metres. Injuries sustained included a scalp haematoma in 20 (80%), skull vault fracture in 18 (72%), a scalp laceration in

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Accepted 29 February 2000

Table 1 Location of injuries

Location of injuries	Haematoma	Skull fracture
Frontal	6	1
Temporal	4	1
Parietal	18	15
Occipital	3	1

Six neonates had haematomata at two sites, making total number of haematomata = 31.

Table 2 Scalp haematoma compared with skull fracture

	Haematoma yes (%)	Haematoma no (%)	Total (%)
Fracture yes (%)	17 (68)	1 (4)	18 (72)
Fracture no (%)	2 (8)	5 (20)	7 (28)
Total (%)	19 (76)	6 (24)	25 (100)

two and intracranial injuries in four. Of these four, two infants had cerebral oedema alone; both were passengers in vehicles involved in high speed road traffic accidents. One child sustained multiple depressed skull fractures after being savaged by a dog (see above). The remaining child had cerebral oedema, a small right temporal cerebral contusion, a subarachnoid haemorrhage and a small right temporal haematoma; this was after a rear end collision to the vehicle in which the baby was strapped into the rear seat. This baby was intubated and ventilated before transfer to the neurosurgical unit because of lethargy and intermittent apnoea in the referring A&E department. All intracranial abnormalities were diagnosed by CT in these three infants.

Seven neonates vomited once or twice after their head injury and only one of these had intracranial pathology (cerebral oedema). Investigations included skull radiography (24 of 25), ultrasound scan of brain (11 of 25) and CT of brain (8 of 25). All skull radiographs were done at the time of admission. The location of scalp haematomata and vault fractures are shown in table 1. There is a strong association between parietal haematomata and vault fractures (positive predictive value 83%) compared with other regions (frontal 17%, temporal 25%, occipital 33%). The χ^2 analysis of table 1 shows there is no significant statistical association (χ^2 value 3.44 with 3 degrees of freedom, $p=0.33$). Table 2 shows the overall association between fractures and haematomata.

Ultrasound scans of the brain and CT were done at various times after admission at the discretion of the consultant surgeon supervising the child's care. Ultrasound of the brain was used to follow up injuries diagnosed by CT in two patients and as an initial screening test to exclude intracranial pathology in a further nine patients. Two of these nine patients subsequently had CT; both had sustained non-accidental injuries and both showed no intracranial abnormality. CT was used in a further four children in isolation (one road traffic accident, one dog savaging and two falls). Ten children had no intracranial imaging done and all 10 had no neurological impairment at final follow up.

Management consisted of clinical neurological observations (25 of 25), wound suture (2 of 25), intravenous infusion (5 of 25), intubation

and ventilation (2 of 25, both road traffic accidents, as seen above) and various other treatments in seven patients. Most neonates (23 of 25) had normal neurology at the last recorded assessment. The child who was savaged by the dog had seizures but was otherwise normal. The child with the major intracranial pathology (temporal haematoma, temporal contusion, subarachnoid haemorrhage and cerebral oedema) after a road traffic accident had impaired neurology with seizures. No child in the series had specific cervical spine radiology done as part of the initial assessment. There was no clinical evidence of spinal cord injury in any of these infants.

Discussion

Falls were the commonest reason for head injury in neonates in this series, mostly from the arms of the mother or other close relative (for example, aunt). The average estimated height of the fall was approximately the distance to fall to the ground from a carer's arms. Non-accidental injury was confirmed in only two cases in this series (8%). It was considered in a further three cases but discounted after further investigation. Both cases of non-accidental injury took the form of vault fractures with no intracranial abnormality on either ultrasound scanning or CT.

The presence of an overlying scalp haematoma was strongly predictive of an underlying vault fracture in that region (positive predictive value 89%; sensitivity 94%, specificity 71%) (table 2). A previous study of skull radiography showed that a scalp haematoma increased the odds of finding a vault fracture by a factor of 1.5.⁴ In comparison, basal fractures did not feature at all in our series.

Other injuries were also uncommon (one case of subconjunctival haemorrhage in non-accidental injury). However, coincidental medical problems occurred in five babies (conjunctivitis in one, urinary tract infections in two and upper respiratory tract infections in two). Isolated vomiting was not associated with intracranial pathology in our series.

These results are consistent with other recent series of head injuries in infants.⁵⁻⁷ None of these series have specifically looked at neonates. Falls are the commonest mechanism of injury in these series and the majority of infants have good neurological outcomes. Occult intracranial injury (CT verified intracranial injury in the absence of symptoms) has been reported as more common in the 0-6 months age group, but no serious neurological deterioration or need for surgical intervention was identified.⁷

Infants with isolated skull fractures can appear well and asymptomatic, as seen in the current series. A recent American paper stated that infants with isolated skull fractures (that is, with normal CT scans) could be allowed home to sensible caregivers without the need for hospitalisation.⁵ Our series would support the concept that neonates with isolated skull fractures who are clinically well at the time of presentation are unlikely to deteriorate. However, if CT is unavailable, a short period of

hospital observation (looking for abnormal behaviour, abnormal feeding, seizures, abnormal posturing, etc) is recommended to ensure that intracranial sequelae do not develop.

CT is the imaging modality of choice in neonates with head injuries who are symptomatic (apnoea, lethargy, recurrent vomiting); it is more widely available than ultrasound examination of the brain and can demonstrate more subtle intracranial pathology than ultrasound (which can only reliably exclude subdural or intraventricular haemorrhage).

It should be remembered that in children the association between skull fracture and intracranial pathology (particularly haematoma) is not as strong as that found in adults.⁶ It is reassuring to see that the majority of neonates attain a normal outcome neurologically after their head injury. Poor outcome, along with significant intracranial injuries, seems to be associated with high speed road traffic accidents. The solution to these injuries is likely to lie in their prevention. No infant appeared to come to any harm despite not having any imaging done of the cervical spine. Further work is required to define the importance of cervical spine protection⁸ and imaging in head injured patients in this age group. Prospective studies of infants (and neonates) sustaining head inju-

ries in the UK are required to identify which clinical features are associated with poor outcome to allow evidence based management guidelines to be developed.

Contributors

Colin Graham initiated the study, discussed core ideas, participated in data collection, analysed the results and wrote the paper. Stuart O'Toole discussed core ideas, participated in data collection and contributed to the paper. Graham Haddock discussed core ideas, participated in data collection and contributed to the paper. Colin Graham and Graham Haddock are the guarantors for the paper.

Funding: none.

Conflicts of interest: none.

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