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Mild closed head injury in children compared to traumatic fractured bone; neurobehavioural sequelae in daily life 2 years after the accident

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Abstract Two years after an accident resulting in either a mild head injury or a fractured bone, two groups of 22 children each, aged 4–14 years, were examined for the existence of any neurobehavioural symptoms by means of a standardized questionnaire filled out by their caretakers. Selection of the children was based on reports of the Accident and Emergency Department in 1 year. Significantly more symptoms were reported after mild head injury. The main symptoms reported were headache, dizziness, fatigue and memory problems. The total number of symptoms in the children with mild head injury exceeded four times this in the group of children with a fractured bone.

Conclusion Even 2 years after a mild head injury there are still residual symptoms in daily life.

Key words Mild head injury · Fractured bone · Late sequelae · Children

Abbreviation CHI closed head injury

Introduction

Head injury in children and young adults represents a significant cause of morbidity and mortality. In 1990 in The Netherlands (population 15 millions), 2839 children aged 0–14 years were admitted to hospital because of a pedestrian/vehicle accident. A large percentage suffered from head injury. The exact incidence of mild head injury in children is unknown. Children sustaining mild head injury usually are not admitted to hospital, however they are frequently seen for a short period of time on an outpatient basis, subsequently discharged and they never seek medical attention for the head injury again.

Most head injuries in children are closed head injuries (CHI). A problem in reviewing the literature on paediatric CHI is that various definitions for mild, moderate or severe head injury have been used. Although definitions about minor head injury vary somewhat, the terminology minor or mild is generally used when a patient has either one of the following characteristics after a head injury: (1) Glasgow Coma Scale, or its paediatric version, greater than 12 on hospital admission; (2) loss of consciousness, or post-traumatic amnesia, not to exceed 20 min; (3) hospitalization less than 48 h; and (4) no clinical evidence of brainstem or cortical contusion [17, 18, 20, 21].

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Most studies concentrate on moderate and severe head injury [2, 4, 11, 14]. The effects of mild head injury are less well established [1, 3, 5]. While the general prognosis for patients following mild head injury has been considered good, the current literature presents increasing evidence suggesting long-term neuro-behavioural symptoms [7, 10, 13, 15, 16]. If memory or behavioural symptoms are present some time after the accident, the accident will only rarely be reported as a probable cause. Only systematic follow up of patients with a mild head injury would give further information on this. Follow up in adult patients shows that neuropsychological and other sequelae may be present 3 months after the accident. In individual patients these symptoms may persist for up to 3 to 5 years following injury, resulting in significant social and professional disability [9, 10, 18]. The sequelae of mild head injury in childhood are less well documented [11]. A full, rapid recovery is usually assumed, however, the exact effect of mild head injury on neuropsychological functions is unknown [15].

We systematically examined the existing long-term symptoms in daily life of children having suffered mild CHI as reported by their caretakers. The reports were evaluated 2 years after a mild head injury. To rule out

the possibility that the traumatic incident itself could have caused problems, we included children with a traumatic fractured bone as a control group.

Material and methods

In the Accident and Emergency Department of the Academical Medical Centre of Amsterdam, a short report of every patient is made. In 1995 we selected from the reports of 1992 (26,317 patients in total), children born between 1 January 1978 and 31 December 1988 with a first mild head injury or a fracture of one of the bones of the clavicle, upper or lower arm.

We used the following definition for mild head injury: the selected child meets at least one of the three following criteria: (1) loss of consciousness less than 20 min immediately after the accident, (2) post traumatic amnesia less than 15–20 min, (3) presence of at least two of the following symptoms: (a) headache, (b) nausea and vomiting, (c) decline of consciousness after a lucid interval.

A total of 50 children met these criteria for mild head injury and 244 children were found with a fractured bone, 50 of whom were randomly selected, yielding two groups of 50 patients. The accidents in both groups were caused by pedestrian/vehicle accidents or accidents during playing outdoors, at home or in school. The socio-economic background of the children in both groups was comparable.

Letters with a request to participate in the study were sent to the parents or carers of the selected children. A reminder was sent after

Table 1 Results of the questionnaire, sent to the caretakers of 44 children having suffered an accident 2 years before resulting in either a head trauma or a fractured bone (If significantly different, *P* value is shown)

Type of symptoms (new after the accident)	Head trauma (<i>n</i> = 22)	Fractured bone (<i>n</i> = 22)	<i>P</i> -value
Headache	10	1	<.01
Dizziness	7	0	<.02
Depressed mood	5	1	
More anxious	4	1	
Intolerance of light	2	0	
Intolerance of loud noises	0	0	
Bothered by external stimuli	2	0	
Fatigue	10	2	<.05
Absence-like behaviour	4	0	
Mental slowing	3	1	
Avoiding social contact	1	0	
Poor concentration	7	2	
Problems in selective attention	3	1	
Memory difficulties	9	1	<.02
Comprehension disturbances	2	0	
Increased need for sleep	2	0	
Dependent behaviour	2	3	
Irritability	5	1	
Aggressive behaviour	3	0	
Childish behaviour	2	1	
Crying more readily	3	1	
Speech problems	3	0	
Reading problems	3	1	
Writing problems	4	1	
Problems in mathematics	0	2	
Language problems	3	2	
Gymnastics problems	3	1	
Problems in other school subjects	1	1	
Loss of initiative	0	0	
Indifference	0	1	
Other complaints	2	0	
Referred to special education	0	0	
Total number of symptoms	105	25	<.001

1 month. Those who agreed on participation by letter or telephone received a multiple choice questionnaire, based on the model of Van Balen and adapted for clarity and ease in use [22]. The questionnaire followed the work on long-term follow up of persons having suffered head injury.

This questionnaire contains yes or no questions related to the existence of any learning, behavioural, concentration or physical problems since the accident. The questions are listed in Table 1. After having answered a question positively, further information was obtained about the occurrence, frequency and severity of these problems and their possible effects on daily life.

For statistical analysis the Chi-square Test for two independent samples was used [19]. A two-tailed P value of 5% ($P = <.05$) was considered significant. As the non-response rate was high ($>50\%$), testing used the assumption that all non-responders had no symptoms. Thus, in Table 1 the comparison of headache (10 vs 1) was carried out with 40 and 49 respectively as the denominator. This approach is more conservative compared to the use of responders only.

The Ethical Committee of the Academical Medical Centre gave permission for this study.

Results

Out of a total of 100 parents, 55 did not participate. Reasons for this were change of address, no telephone number, refusals, or forgetting to return the questionnaire although informed consent had been given. This left us with 45 questionnaires, a response rate of 45%, 22 children with head injury and 23 children with a fractured bone. To make the two groups equal, one questionnaire was randomly withdrawn from the bone fracture group. In Table 1 the total number of symptoms in the two groups are listed. The total number of symptoms in the head trauma group significantly exceeded those in the group with bone fracture: (105 vs 25 = $P < 0.001$). Headache (20 vs 1; chi-squared value = 6.537; $df = 1$; $P = <.01$), dizziness (7 vs 0; chi-squared value = 5.539; $df = 1$; $P = <.02$), fatigue (10 vs 2; chi-squared value = 4.640; $df = 1$; $P = <.05$) and memory (9 vs 1; chi-squared value = 5.444; $df = 1$; $P = <.02$) complaints were significantly more often reported in the head trauma group. In the group of children with a fractured bone, no symptoms were reported for a total of 13 areas, while in the head trauma group for only four areas no complaints were reported. The difference in symptoms in the other areas was not statistically significant.

Discussion

The response rate to the questionnaire was high considering the interval between the investigation and the accident of the child. At the time of the trauma the caretakers did not know a questionnaire was to be sent 2 years later. Although this could have resulted in rather an underscoring than an overscoring of the problems, the total number of symptoms in the head trauma group still exceeded significantly four times the number of symptoms in the group with a fractured

bone. Since the maximum number of symptoms on this scale is 682 (31 areas in 22 children), the head trauma group showed 15% of symptoms, which is significantly higher than the 4% in the group with a fractured bone [10]. Only four areas of no symptoms were scored in the head trauma group, in contrast to 13 areas of no symptoms in the bone fracture group. Significant differences were found for symptoms such as headache, dizziness, fatigue and memory disturbances in the head trauma group compared to those in the group with a fractured bone. These areas all have a relation to head trauma.

Ruijs et al. [16] reported on sequelae still existing in children 2 years after mild to severe head injury, including somatic problems such as headache, dizziness and sleeping disorders, personality changes such as mental slowing, and school problems including memory impairment, concentration disturbances and fatigue. On the other hand of the children having suffered only mild head injuries, 27% had somatic symptoms after 2 years and 51% had personality changes while only 3% had school problems. The present study supports this low percentage of school problems.

In the head trauma group, fatigue was reported often, but this was not specifically related to the school situation. Memory disturbances were reported more often in the head trauma group. This may reflect a tendency for the occurrence of more school problems a long time after head injury. Somatic symptoms like headache and dizziness were also reported in this study supporting the findings of Ruijs et al. [16]. The number of children with headache in the present study is in contradiction with the study of Bruyn and Lanser [5, 8], which showed no higher incidence of headache 1 year after mild head injury compared with children without CHI. The socio-economic background of the children in both the head injury group and the control group was comparable meaning that there was an equal representation of lower, middle and higher socio-economic classes. There was no evidence of an overrepresentation of accident-prone children in either the head-injured children or the children with a fractured bone. The control group in this study was trauma-matched to rule out the possibility that the accident itself could have caused any symptoms. In one earlier study, orthopaedic patients were chosen as a control, however, these were more heavily injured children and the children with mild head injury in that study rather fulfilled the criteria for moderate or severe head injury considering the time of post-traumatic amnesia of 1 h to less than 7 days [6, 12].

This study shows that a significant proportion of children have symptoms related to mild head injury even 2 years after the accident. The question arises if these symptoms can be prevented by special programmes immediately beginning after the accident. This management has to be compared with the existing management of reassurance that no serious effects were caused by the accident and that the child should take up the usual daily activities as soon as possible.

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