

## ACUTE HEAD INJURIES IN CHILDREN - A REVIEW OF 100 CONSECUTIVE PATIENTS

Z. KOTWICA, K. TYBOR, J. BRZEZIŃSKI

Department of Neurosurgery Medical Academy of Łódź

Received 15 Oct 1990

Head injuries of children between 4-16 years in the first hour after the trauma have been studied. The neurological examination was completed by CT-scan. Glasgow Coma Score (GCS) as well as Glasgow Outcome Scale (GOS) were also applied and proved to be very helpful. Our findings show a significantly frequent occurrence of epidural haematomas. Their treatment in patients with GCS above 8 was in 90% successful.

### INTRODUCTION

Patient's age is one of the most important factors in the prediction of outcome after head injury /1, 2, 3, 9, 10/. It is generally accepted, that children suffer a lower risk of mortality from head injury than adults /1, 2, 3, 10/ and also have a lower rate of occurrence of intracranial haematomas /10, 11, 12/. Some authors reported a better outcome in children younger than 10 years /3/ compared to adolescents.

In this study we analysed 100 consecutive children admitted to our Department directly after head trauma. All patients with concomitant extracranial injury were excluded from the study due to the important influence of this injury on outcome, especially in cases with chest trauma /8/ or lower extremities fractures /7/. It must be pointed out, that as a rule we do not admit patients younger than 4 years.

## MATERIAL AND METHOD

The files of 100 consecutive patients younger than 16 years admitted to Department of Neurosurgery of Medical Academy of Łódź within the first hour after head trauma were respectively analysed. On admission the patients were examined neurologically and CT-scans performed. The level of consciousness was evaluated using Glasgow Coma Scale /13/.

59 children were younger than 10 years, but only 2 were below 4 years. Eighty-four percent of head injuries were traffic accident-related. Table I shows the mechanism of injury related to patient's age. Twenty-one children were admitted with GCS 3-5 points, 23 with 6-8 points and 56 had 9-12 points. There were no patients with GCS above 12.

TABLE I

The mechanism of head injury related to the age of the patients

Age (y)	Mechanism of injury			
	Traffic accidents	Falls	Assault	Total
0 - 3	1	1	0	2
4 - 7	16	2	0	18
8 - 10	33	3	3	39
11 - 15	34	4	3	41
Total	84	10	6	100

Clinical examination and CT-scans led to the diagnosis of concussion in 34 cases and to brain contusion in 37. In 6 cases from the last group CT findings showed diffuse axonal injury - in 9 of the remaining 31 cases CT findings showed diffuse brain swelling. 13 children had mass lesions - 8 epidural, 2 subdural and 3 intracerebral haematomas. In 15 cases CT showed skull fractures without brain damage, but in 10 of them there were opened fractures. All children with epidural haematomas had posttraumatic fractures. Table II shows the comparison between GCS on admission and clinical diagnosis.

13 patients with expanding mass lesion and opened skull fractures were treated surgically. All children with GCS below 6 points were managed with artificial ventilation to maintain the arterial  $pCO_2$  between 25 and 30 mmHg. In all cases with symptoms on intracranial hypertension mannitol and diuretics were used. Steroids were never used.

TABLE II

Glasgow Coma Score on admission related to CT and clinical diagnosis

Diagnosis	GCS			
	3 - 5	6 - 8	9 - 12	Total
Concussion	0	6	28	34
Brain contusion	7 (6)	9 (4)	15	31 (10)
Diffuse axonal injury	6	0	0	6
Skull fracture:				
- closed	0	0	5	5
- opened	0	2	8	10
Haematoma:				
- epidural	3	5	0	8
- subdural	2	0	0	2
- intracerebral	3	0	0	3
SAH	0	1	0	1
Total	21	23	56	100

( ) = diffuse brain swelling

Outcome status was evaluated 3 months after injury according to Glasgow Outcome Scale (GOS) /6/. The overall mortality was 14% ; all the children who died were admitted with a GCS of 3-5 points. All the patients (6 cases) with diffuse axonal injury or subdural haematoma (2 cases) died. Of the 31 patients with brain contusion, 5 who showed diffuse brain swelling on CT - died. Only 1 of the 8 children with epidural haematoma died. In 73 cases the result of treatment was good.

Table III shows the relationship between GOS and GCS on admission, and Table IV shows the results of treatment related to clinical diagnosis.

TABLE III

Glasgow Coma Score on admission related to outcome (Glasgow Outcome Scale)

GOS	GCS			Total
	3 - 5	6 - 8	9 - 12	
I	1	9	39	49
II	4	7	13	24
III	2	7	4	13
IV	0	0	0	0
V	14	0	0	14
Total	21	23	56	100

### DISCUSSION

Luerksen /10/ found that mortality declined with increasing age in the pediatric age group. In our analysis there was no difference among different age groups, but it can be due to the fact, that we had almost no patients younger than 4 years. Surgical mass lesions occurred in 13% of the patients. It confirms the findings of Alberico /1/ that in pediatric population there is a trend toward a lower incidence of surgical lesions than in adults. We found statistically significant ( $p < 0.001$ ) difference between the frequency of epidural and subdural hematomas, epidural being 4 times more frequent than subdural ones, which is opposite to the findings of the other authors /10/. However, subdural hematomas have a bad prognosis, both children died, while in patients with epidural lesions the result of treatment was good in 7 of the 8 patients. We must also point out that all children with mass lesions were operated within two hours after the trauma. In 10% of patients there was an opened skull fracture. Such high frequency of this lesion can suggest that the skull of the child is much less resistant to high velocity trauma than in adults.



TABLE IV

Outcome (GOS) related to CT and clinical diagnosis

Diagnosis	GOS					Total
	I	II	III	IV	V	
Concussion	32	2	0	0	0	34
Brain contusion	4	13	9	0	5	31
Diffuse axonal injury	0	0	0	0	6	6
Skull fracture:						
- closed	3	2	0	0	0	5
- opened	5	3	2	0	0	10
Haematoma:						
- epidural	5	2	0	0	1	8
- subdural	0	0	0	0	2	2
- intracerebral	0	1	2	0	0	3
SAH	0	1	0	0	0	1
Total	49	24	13	0	14	100

GCS on admission proved to be the most important prognostic factor. Deaths only occurred in children admitted with GCS below 6 points, and in 90% of patients with GCS above 8 we achieved a good result of treatment.

Diffuse brain swelling found in CT scans /14/ led to 50% mortality, thus we do not agree with the opinions of the others, that it usually takes a benign clinical course /4/. When the patient presented symptoms of diffuse axonal injury, the prognosis was always bad, and all children died.

#### REFERENCES

1. Alberico AM, Ward JD, Choi SC, et al: Outcome after severe head injury. J Neurosurg 67: 648, 1987
2. Bruce DA, Schut L, Bruno LA, et al: Outcome following severe head injuries in children. J Neurosurg 48: 679, 1978

3. Comninou SC: Early prognosis of severe head injuries in children. *Acta Neurochir suppl* 28: 144, 1979
4. Cordobes F, Lobato RD, Rives JJ, et al: Post-traumatic diffuse brain swelling: isolated or associated with cerebral axonal injury. *Child's Nerv Syst* 3: 235, 1987
5. Fell DA, Fitzgerald S, Moiel RH, et al: Acute subdural hematomas. *J Neurosurg* 42: 37, 1975
6. Jennett B, Bond M: Assessment of outcome after severe brain damage: a practical scale. *Lancet* 1: 480, 1975
7. Kotwica Z, Balcewicz L, Jagodziński Z: Head injuries coexistent with fractures of pelvic or lower extremities bones - early or delayed osteosynthesis. *Acta Neurochir (Wien)* 102: 19, 1990
8. Kotwica Z, Brzeziński J: Head injuries complicated by chest trauma - a review of 50 consecutive patients. *Acta Neurochir (Wien)* 103: 109, 1990
9. Lobato RD, Rivas JJ, Cordobes F, et al: Acute epidural hematoma: an analysis of factors influencing the outcome of patients undergoing surgery in coma. *J Neurosurg* 68: 48, 1988
10. Luerksen TG, Klauber MR, Maushall LF: Outcome from head injury related to patient's age. *J Neurosurg* 68: 409, 1988
11. Miller JD, Butterworth JF, Gudeman SK: Further experience in the management of severe head injury. *J Neurosurg* 54: 289, 1981
12. Snoek JW, Minderhoud JM, Wilmink JT: Delayed deterioration following mild head injury in children. *Brain* 107: 15, 1984
13. Teasdale G, Jennett B: Assessment of coma and impaired consciousness. A practical scale. *Lancet* 2: 81, 1974
14. Zimmermans RA, Bilaniuk LT, Bruce D, et al: Computed tomography of pediatric head trauma: acute general cerebral swelling. *Radiology* 126: 403, 1978

**Z. KOTWICA, MD**

Medical Academy of Łódź, 90-153 Łódź  
Kopcińskiego 22  
Poland