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Serum S100B Level in the Management of Pediatric Minor Head Trauma

A Randomized Clinical Trial

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Introduction

- Head trauma (HT) constitutes a leading public health problem in children

- The primary objective of our study was to evaluate the reduction in cranial computed tomographic (CCT) scans recommendation after measurement of serum S100B levels in the management of pediatric minor HT

- The secondary objectives were to evaluate the benefits of S100B-guided management in terms of length of stay in the emergency department, hospitalizations, radiation exposure, the detection of complications, the absence of late adverse effects, and lower management

Methods

- Participants :

Inclusion criteria: *Children and adolescents 16 years or younger

* management within 3 hours after HT

* GCS score of 15 classically requiring hospitalization and/or a CCT scan : loss of consciousness at the time of the accident, vomiting, trauma due to severe accident and severe headache

For children younger than 2 years, the criteria were

*parietal or occipital scalp hematoma

*loss of consciousness for more than 5 seconds

*trauma due to a severe accident

*abnormal behavior according to the parents.

Exclusion criteria : *enrollment in another therapeutic trial with drug administration

* Down syndrome
* melanoma
* trauma occurring more than 3 hours prior to admission
*GCS score of 13 or 14
* signs of skull fracture or skull base lesions (CCT scan recommended)
*HT not requiring hospitalization and/or a CCT scan as per SFP recommendations, and
*refusal by the child, parents, or legal guardian

Enrollment period: November 1, 2016, to October 31, 2021
Follow-up period: 1 month for each patient

control group : received conventional treatment in accordance with the French Paediatric Society recommendations

In the S100B biomonitoring group : A single micromethod venous blood sample (1 mL) was collected in patients for S100B determination within 3 hours of trauma, and their subsequent management depended on the results of S100B assay

- **S100B Assay:** The analytical method used was based on an electrochemiluminescence assay. Results were available within 1 hour.
- The S100B serum assay finding was considered positive (for intracranial lesion) according to age as follows:

→ 0 to 9 months, greater than 0.35 µg/L

→ 10 to 24 months, greater than 0.23 µg/L

→ older than 24 months, greater than 0.18 µg/L

- Children with a **positive test result** received conventional treatment in accordance with the SFP recommendations.

- In the case of a **negative test result**, the children were discharged from the emergency department after 6 hours of observation

- For discharged patients, the presence or persistence of clinical signs **at 48 hours and 3 weeks after injury** was evaluated through a standardized telephone interview conducted by a clinical research associate.

- The following items were collected and analyzed separately for all participating children:

→frequency of vomiting since returning home
→problems or difficulties observed by parents related to arm or leg movements
→ Convulsions
→ ocular discomfort
→ signs of facial paralysis

Table 1. Characteristics of the Conventional Treatment Group and S100B Biomonitoring Group

Characteristic	Patient group[a]		P value
	Conventional treatment (n = 926)	S100B biomonitoring (n = 1152)	
Age, median (IQR), y	2.7 (0.9-7.7)	3.4 (1.1-9.2)	.02
Age group distribution, mo			
0-9	184/926 (19.9)	174/1152 (15.1)	.02
10-24	214/926 (23.1)	276/1152 (24.0)	
>24	528/926 (57.0)	702/1152 (60.9)	
Sex			
Boys	533/926 (57.6)	702/1152 (60.9)	.14
Girls	393/926 (42.4)	450/1152 (39.1)	
Weight, median (IQR), kg	14.0 (9.2-25.9)	15.0 (10.0-30.0)	.007
Height, median (IQR), cm	93 (74-128)	97 (74-137)	.04
Distance between home and hospital, median (IQR), km	13 (6-25)	12 (5-25)	.57
Direct mechanism of injury	910/926 (98.3)	1144/1152 (99.3)	.01
Causes of minor HT			
Domestic accident	648/926 (70.0)	753/1152 (65.4)	<.001
School accident	154/926 (16.6)	139/1152 (12.1)	
Sports related	74/926 (8.0)	163/1152 (14.1)	
Road accident	44/926 (4.8)	94/1152 (8.2)	
Intoxication	6/926 (0.6)	3/1152 (0.3)	
Inclusion criteria for children aged <2 y			
Parietal or occipital scalp hematoma	79/390 (20.3)	63/435 (14.5)	.10
Loss of consciousness >5s	42/391 (10.7)	46/435 (10.6)	.77
Trauma due to serious accident	278/391 (71.1)	333/435 (76.6)	.59
Abnormal behavior in parents' opinion	74/390 (19.0)	66/435 (15.2)	.26
Inclusion criteria for children aged ≥2 y			
Loss of consciousness	196/534 (36.7)	260/710 (36.6)	.94
Vomiting	203/534 (38.0)	240/709 (33.9)	.15
Trauma due to serious accident	238/534 (44.6)	317/710 (44.7)	.42
Severe headache	136/534 (25.5)	156/710 (22.0)	.78

Results

A total of 2078 children were included over a period of 60 months

A significant marginal difference was observed in the age comparison between the control group and the S100B biomonitoring group, which logically implied that children in the control group were smaller in height and weight, had more domestic accidents

Primary End Point

Table 2. Proportion of CCT Scans Recommended Within 48 Hours Following Minor HT Compared Between the Conventional Treatment Group and S100B Biomonitoring Group

Analysis type	No. of centers	Patient group, No. with CCT/total No. (%)		RR (95% CI)	*P* value	ARR (95% CI)[a]	*P* value	ICC
		Conventional treatment	S100B biomonitoring					
Modified intention-to-treat analysis	11	299/926 (32.3)	112/1152 (9.7)	0.95 (0.65-1.39)	.79	0.87 (0.61-1.24)	.44	0.32
Post hoc analysis	4	20/261 (7.7)	31/757 (4.1)	0.52 (0.28-0.96)	.04	0.49 (0.30-0.77)	.002	0.02

Abbreviations: ARR, adjusted relative risk (RR); CCT, cranial computed tomography; HT, head trauma; ICC, intraclass correlation coefficient.

[a] Adjusted for age group distribution and minor HT causes.

A CCT scan was performed for 299 children (32.3%) in the control group (n = 926), and 112 (9.7%) in the S100B biomonitoring group (n = 1152).
This difference of 23% (95% CI, 19%-26%) was not statistically significant with an ICC of 0.32

An exploratory post hoc analysis was conducted at 4 observant centers over the entire inclusion period and in compliance with the decision algorithm. This analysis showed that 7.7% of children in the control group had a CCT scan within 48 hours of minor HT compared with 4.1% in the S100B biomonitoring group. This reduction between the 2 groups was statistically significant, with no significant center effect

Table 3. Secondary End Points Compared Between the Conventional Treatment Group and S100B Biomonitoring Group

Secondary end points	Patient group[a] Conventional management control group (n = 926)	S100B biomonitoring group (n = 1152)	RR (95% CI)	*P* value
Hospitalization				
Hospital monitoring	849/926 (91.7)	479/1152 (41.6)	0.46 (0.39 to 0.51)	<.001
Hospitalization >48 h	55/926 (5.9)	50/1152 (4.3)	0.33 (0.15 to 0.75)	.005
Hospitalization in ICU	1/926 (0.1)	4/1152 (0.3)	3.12 (0.41 to 23.60)	.27
Hospitalization in neurosurgery department	10/926 (1.1)	6/1152 (0.5)	0.53 (0.11 to 2.51)	.43
CCT scan				
Effective radiation dose, median (IQR), mSv	400/926 (285-570)	526 (367-768)	121 (50 to 192)[b]	.01
Presence of intracranial injury on first CCT scan	66/299 (22.1)	33/112 (29.5)	1.35 (0.87 to 2.09)	.15
Presence of intracranial injury on every CCT scan	82/324 (25.3)	55/140 (39.3)	1.53 (0.97 to 2.41)	.07
Bone fracture	66/82 (80.5)	43/55 (78.2)	0.97 (0.78 to 1.20)	.79
Epidural hematoma	13/82 (15.9)	15/55 (27.3)	1.42 (0.01 to 184.40)	.89
Hemorrhagic contusion	11/82 (13.4)	2/55 (3.6)	0.27 (0.03 to 2.65)	.26
Subdural hematoma	6/82 (7.3)	7/55 (12.7)	1.74 (0.61 to 4.94)	.30
Pneumocephalus	11/82 (13.4)	11/55 (20.0)	1.49 (0.70 to 3.18)	.30
Subarachnoid hemorrhage	14/82 (17.1)	7/55 (12.7)	0.75 (0.32 to 1.71)	.49
Othematoma	9/82 (11.0)	3/55 (5.5)	0.50 (0.21 to 1.20)	.12
Persistent clinical signs at the telephone follow-up interview 48 h after the minor HT				
Presence of persistent clinical signs	195/795 (24.5)	235/977 (24.1)	0.98 (0.69 to 1.40)	.91
Vomiting, No. (%)	35/195 (17.9)	39/235 (16.6)	0.92 (0.68 to 1.25)	.61
Headache in children aged ≥2 y	100/195 (51.3)	120/235 (51.1)	1.00 (0.86 to 1.16)	.96
Motor deficit	0	0	NE	NE
Convulsion	1/195 (0.5)	0	NE	NE
Facial paralysis	0	1/235 (0.4)	NE	NE
Abnormal pupillary light reflex	46/195 (23.6)	47/235 (20.0)	0.85 (0.50 to 1.44)	.54
Abnormal behavior	85/195 (43.6)	128/235 (54.5)	1.10 (0.52 to 2.31)	.81
Persistent clinical signs at the telephone follow-up interview 3 wk after minor HT				
Presence of persistent clinical signs	90/808 (11.1)	87/945 (9.2)	0.73 (0.59 to 0.91)	.006
Vomiting	10/90 (11.1)	13/87 (14.9)	1.05 (0.22 to 5.02)	.95
Headache in children aged ≥2 y	47/90 (52.2)	36/87 (41.4)	0.79 (0.53 to 1.18)	.25
Motor deficit	0	0	NE	NE
Convulsions	1/90 (1.1)	1/87 (1.1)	1.03 (0.15 to 7.21)	.97
Facial paralysis	2/90 (2.2)	4/87 (4.6)	2.07 (0.63 to 6.76)	.23
Abnormal pupillary light reflex	8/90 (8.9)	11/87 (12.6)	1.42 (0.72 to 2.79)	.31
Abnormal behavior	44/90 (48.9)	54/87 (62.1)	0.78 (0.45 to 1.36)	.37
Hospitalized within 3 wk	3/808 (0.4)	5/945 (0.5)	1.36 (0.31 to 6.04)	.69
Cost of management				
Cost of hospitalization, median, median (IQR), €	498 (498-498)	181 (181-498)	−213 (−344 to −84)[b]	<.001
Parental leave	66/805 (8.2)	49/935 (5.2)	0.50 (0.35 to 0.70)	<.001

Conclusion

- S100B biomonitoring yielded a reduction in the number of CCT scans and in-hospital observation when measured in accordance with the conditions defined by a clinical decision algorithm

- Limitations : The limitations of our study are related to the difficulty of some centers to enroll in the 2 groups also the impact of the center effect on the primary end point which leds the independent committee to decide to stop the trial and to perform a post hoc exploratory analysis.


THANKS FOR
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ATTENTION