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Sleep Disorders Following Trauma Brain Injury in School Aged Children-Presentation of a Greek Survey Study

Kyriakos Apostolidis[1], Anastasia Tsolaki[2], Theodoros Aslanidis[3, *], Evangelos Pavlou[4], Georgios Koutsoumis[5], Eleftherios Kontopoulos[6]

[1]Department of Pediatric Surgery, Hippokratio General Hospital, Thessaloniki, Greece
[2]Pediatric Intensive Care Unit, Hippokratio General Hospital, Thessaloniki, Greece
[3]Mobile Intensive Care Units, National Center of Emergency Care, Thessaloniki Department, Thessaloniki, Greece
[4]2nd Department of Pediatrics, "A. H. E. P. A." University Hospital, Aristotle University of Thessaloniki, Thessaloniki, Greece
[5]1st Department of Pediatric Surgery, "Genimmatas" General Hospital, Thessaloniki, Greece
[6]1st Department of Pediatrics, "Hippokratio" General Hospital, Aristotle University of Thessaloniki, Thessaloniki, Greece

Email address

thaslan@hotmail.com (T. Aslanidis)

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Abstract

Introduction: Sleep disorders with potentially important developmental consequences have been neglected in the care of children with TBI. Reports in the literature are few with controversial findings. *Objective:* The present study aims to study the prevalence and the nature of sleep disorders in children aged between 6-14 years old following a trauma brain incident. *Methods:* A survey study was conducted in a tertiary hospital from October 2009 to May 2011. 129 patients aged 6-14years old were evaluated for sleep disorders 90-95 days after trauma brain injury. Data from 38 children were excluded from the study due to presence of post-concussion syndrome. *Results:* Among the participants 14.5% of the males and 13.3% of the females were found suffer sleep disorders. Sleep disorders were strongly related with the severity of brain injuries. All cases of sleep disorders were insomnias. *Conclusion:* A strong relation between sleep disorders and severity of TBI children aged 6-14yrs old was found. Yet, further studies upon the subject are necessary.

Keywords

Brain Injury, Sleep Disorder, Post Concussion Syndrome

1. Introduction

Traumatic brain injury (TBI) is an insult to the brain, not of a degenerative or congenital nature, but caused by external physical force that may produce a diminished or altered state of consciousness, which results in an impairment of cognitive abilities or physical functioning. Profound disturbances of cognitive, emotional, and behavior functioning after TBI may produce permanent impairments that result in partial or total functional disability and psychosocial maladjustment[1].

Only in the United States, TBI is the single leading cause of injury-related death and acquired disability among children and young adults, affecting both sexes and all economic, racial, and social backgrounds[2]. Most TBIs are mild [Glasgow Coma Scale (GCS) score 13-15]; however, up to a quarter are moderate (GCS 9–12) or severe (GCS 3–8) and responsible for a disproportionately high degree of morbidity and mortality[3].With high rates of TBI-related morbidity and mortality contributing to many lost years of productive life, both the financial (over 1$ billion per year only in USA) and human cost of pediatric TBI make it a significant public health problem[4,5].

In Greece data around mortality and morbidity due to TBI in children are scarce. Even less is known about the occurrence of sleep disorders among them. The present study aims to study the prevalence and the nature of sleep disorders in children aged between 6-14 yr old following a TBI incident.

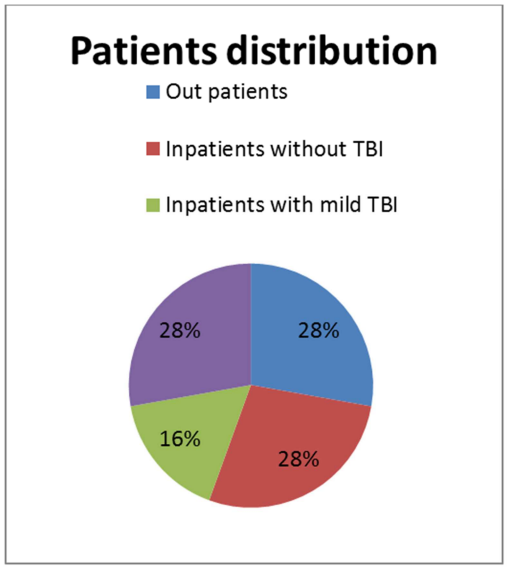
2. Materials and Methods

During a 27month period (Jan 2009 to May 2011) a survey study was conducted in "Hippokratio" G.H. Local University Research Ethics Committee approval has been obtained before the start of the study. The interview was taking place either in pediatric outpatient clinic, or in the department of pediatric surgery.

There were interviewed 129 children between 6-14 years old. Exclusion criteria included: age<6years old, history of past neurological disease, hospitalization, brain injury (older than 3 months) or sleep disorders; any history or suspicion for abuse-related TBI, hospitalization in rehabilitation center after discharge; children on chronically drug regiment and evidence of not peaceful family environment (=recent divorce, death of a relative or stress due to school or extracurricular activities). The presence of post concussion syndrome, neurosurgical operation during the hospitalization and any communications issues (different language, inadequate information given by parents) were considered as exclusion criteria. Finally, children suffered from TBI but contacted in outpatient clinic more than 3 months after their discharge, were also excluded from the study.

Hospitalized children (n^{0}=87) were assessed between the 90th and 95th day after their discharge from hospital. All those meeting criteria (n=49) were sent an invite letter, information sheet, and consent form. Parents who returned signed consent forms were contacted by telephone to arrangeparticipation in the study. A contact telephone number was provided for the researcher if the parents or children had any queries. During every interview, it was also assured the presence of one, at least, parent.

Children interviewed in pediatric outpatient clinic ($n^{0.1}$=40) were served as control group 1.Those children visited outpatient service for reasons not related to TBI. The study also included a second control group, hospitalized children without TBI ($n^{0.2}$=40), in order to minimize the bias of hospitalization.



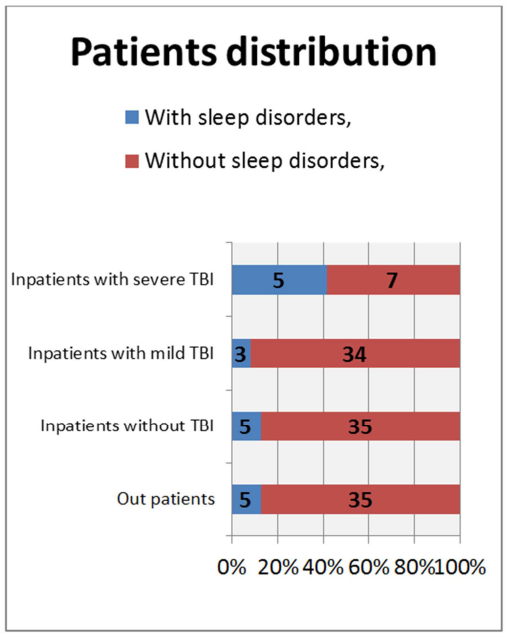


Figure 1. *Occurrence of sleep disorders among different types of patients.*

The questionnaire used, included 44 items divided in three sections: A) confirmation of brain injury (8 questions), B) enquiry for the presence of post concussion syndrome (7 questions) and C) evaluation of sleep disorders (29 questions). Although the interest group was children with confirmed diagnosis of TBI Section A was considered necessary: firstly, because history details were necessary to re-evaluated and confirmed; and secondly, because this section served as a TBI screening tool for the control groups. Thus, its construction was based on Ohio State Univ. TBI identification method and The Brief Traumatic Brain Injury Screen (BTBIS)[6-8].Section B was a modification of River mead Post Concussion Syndrome Questionnaire[9-10].For section C, Robert Wood Johnson Medical School Pediatric Sleep questionnaire was used[11]. Hence, even though the questionnaire was designed especially for the present study, no further validation was needed, as it was using already validated tools.

Study design was retrospective analysis of a prospective observational data. For the entire TBI pediatric population in Greece for one year, a sample size of 126 was estimated (Calculated from Raosoft Sample Size Calculator, Raosoft Inc., USA using the following conditions :confidence interval 95%, margin error 8%,population size 1000, response distribution 40%[12]).

Further statistical analysis (SPSS v.18 - IBM SPSS Inc., USA) included, initially, descriptive analysis and Shapiro-Wilk W test for normality of the data. Pearson's Chi-square test was used to estimate the presence of various binomial factors such as sex and hospitalization on the occurrence of sleep disorders. Student t-test was used for detecting differences in age between children with or without sleep disturbances. Finally, a regression analysis was performed in order to examine the effect of certain parameters (age, TBI, hospitalization, severity of TBI) on the possibility of sleep disorders occurrence.

3. Results

Descriptive characteristics of the different group are displayed in table 1. Sleep disorders were found in 12.5% of outpatients and in 14.6% of inpatients children (χ^2=0.102, p=0.749).

Occurrence of sleep disorders in the total number of hospitalized patients without TBI and those of them hospitalized because of TBI were 12.5% and 16.3%, respectively (Table 2) (χ^2=0.259, p=0.611).Yet, the severe TBI group (PICU) seems to suffer considerably more than the mild TBI group (41.5% versus 8.1%, p<0.01). Both sexes suffered the same from sleep disorders (14.5% in males versus 13.3% in females, p~0.7). Logistic regression model analysis revealed that only TBI severity was independently related with the appearance of sleep disorders (Table 3).The most frequent symptoms mentioned were late going for sleep, feeling sleepiness during the day and frequent awaking during the night (Table 4). Children with severe TBI had also appearance of more symptoms than other groups (Figure 2). An interesting fact was also that all cases of sleep disorders were insomnias (in fact ICD-10-CM code G47.01) and none parasomnias or other sleep disorders.

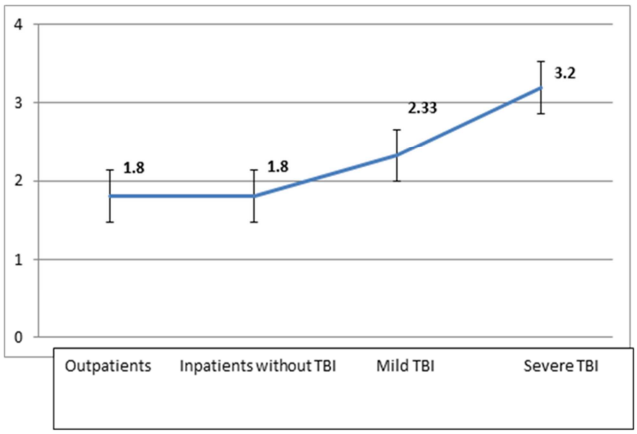


Figure 2. *Number of symptoms (Y axis) mentioned in children with sleep disorders in different groups (X axis).*

Table 1. *Characteristics of the sample.*

Group	Outpatients	Inpatients without TBI (Pediatric Department)	Inpatients with mild TBI	Inpatients with severe TBI (PICU)	Total
N	40	40	37	12	129
Ratio Male: Female	17:23	24:16	21:16	7:5	69:60
Age (mean±sd)	9,15 ± 2,29	8,62 ± 2,16	9,14±2,42	9,92±2,51	9,05±2,32

Table 2. *Occurrence of sleep disorders in inpatients children.*

	Inpatients without TBI	Inpatients with TBI
Patients with sleep disorders, n (%)	5 (12.5%)	8 (16.3%)
Total, n (%)	40 (100.0%)	49 (100.0%)

Table 3. *The role of confounders in appearance of sleep disorders (Logistic regression analysis).* - significant, B- coefficient for the constant ('Intercept)' in the null model.SE- the standard error around the coefficient for the constant, Exp (B) - This is the exponentiation of the B coefficient, which is an odds ratio.*

	B	SE	Waldχ^2test	p for Wald χ^2 test	Exp(B)
(constant)	-2,578	2,888	0,797	0,372	0,076
Age	0,088	0,123	0,516	0,473	1,092
Sex	0,169	0,549	0,095	0,758	1,184
Hospitalization	0,047	0,690	0,005	0,946	1,048
TBI presence	-0,463	0,773	0,359	0,549	0,629
TBI severity	2,173	0,853	6,493	0,011*	8,787

Table 4. *Distribution of symptoms mentioned in children suffered from sleep disorders.*

Group	Outpatient	Inpatients without TBI	Mild TBI	Severe TBI
Late going for sleep, n (%)	5 (12,5%)	3 (7,5%)	2 (5,4%)	3 (25,0%)
Late falling asleep, n (%)	2 (5,0%)	4 (10,0%)	3 (8,1%)	4 (33,3%)
Awaking during the night, n (%)		1 (2,5%)		4 (33,3%)
Sleepiness during the day, n (%)		1 (2,5%)		4 (33,3%)
Talking during sleep, n (%)		1 (2,5%)	2 (5,4%)	1 (8,3%)
Bruxism, n (%)	2 (5,0%)			
Night diuresis, n (%)				
Night tremor, n (%)				
Walking during sleep, n (%)				

4. Discussion

In Greece, this is the first (2014) study targeting children between 6-14years old. Results suggest a good correlation between sleep disorders and severity of TBI.

Sleep disorders in adults with TBI are either acute: central apnea (36%) or disorders of initiating and maintaining sleep (57%); or chronic: disorders of excessive somnolence (38-46%),obstructive sleep apnea (23%), narcolepsy (6%) and Periodic limb movements of sleep *(*PLMS*)* (7%)[6,7,13-16].

In children, studies of TBI and sleep disturbance are few, and their findings controversial. Beebe et al. reported that children aged 6-12 years with sever TBI are at increased risk for sleep problems compared with those suffered from moderate TBI and with those suffered only form orthopedic injury[17].Children aged 7-12 years ols with mild TBI were found to have greater sleep problems than those with orthopedic injuries[18].

Sleep disorders symptoms have been detected in polysomnography and actometry exams up to 3 years after the incident in adolescents suffered from minor head injury; in fact up to 25% of them had subjective disturbances up to 6 years after[19-20].A more recent prospective study over 2 years of children aged up to 17 years of age who had experienced TBI confirmed higher rate of sleep disturbance (with more prolonged duration) than comparison children who had experienced an orthopaedic injury[21]. Risk factors included pain, psychosocial factors, and mild TBI, which has been reported to be possibly more closely correlated with an increased likelihood of sleep disturbance than severe forms of TBI. In fact, the latter is just one of the many current imponderables in this area of enquiry[22].

Finally, several limitation of the present study should be mentioned. This is a single-center study with a relative small sample size. The survey is focused on children not operated for TBI and statistical analysis has not included the kind of injury-analysis to the final assessment of sleep disorders. Using retrospective parental reports for pre-injury sleep and repeated prospective post-injury assessments up to 2 years is the more popular way of assessing the problem. The authors of the present study chose the 90^{th} to 95^{th} day post TBI as the most appropriate time to evaluate sleep habits.

Reports in the literature mention in details, the difficulties encountered when assessing such kind of disorders. Sleep disturbance can be caused in several ways; a fact that has serious implications for the extent of assessment required initially and subsequently in patients with TBI. Along with the neuropathology of the TBI itself, factors like physical, cognitive, behavioral and psychiatric co-morbidities can also play essential role[23-35]. In addition to that, screening for sleep symptoms does not necessary constitutes a diagnosis. Both physical and behavioural examination may well be appropriate, and possibly further assessment in the form of sleep diary records and objective sleep recordings such as actigraphy or polysomnography (including the Multiple Sleep Latency Test for assessing EDS, or combined with audio-visual recording in the case of possible parasomnias). Yet, questionnaires remain the easier and most popular mean of assessment. In the current study polysomnography, actigraphy or Multiple sleep latency test were not an option due to many technical issues (lack of sleep laboratory in the aforementioned hospital and difficulties of the, only one, available laboratory in the city to study the patients).

5. Conclusion

In the current study, a good relation between sleep disorders and severity of TBI in children aged 6-14yrs old was found. Yet, as this is a single-centre study and as on the current literature many issues (including methodological) remain unresolved further well-designed systematic research is required on the epidemiology of TBI in children.

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