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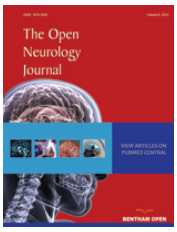

RESEARCH ARTICLE

Spectrum and Outcome of Moderate Pediatric Head Injury Patients Admitted to Main Tertiary Hospital in Northern Jordan Border Hosting City During Strain Period of Syrian Crises

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Abstract:

Aims and Background:

To evaluate and compare Health-Related Quality of Life (HRQoL) and disability outcome in pediatric moderate Traumatic Brain Injury (TBI) according to age, brain CT findings and treatment. The outcome could be different for none-war children in the border hosting community when health system under strain from Syrian crises.

Methods:

The HRQoL scores of 43 children with moderate TBI and abnormal brain CT, aged 8-12(n=24) and 13-18 (n=19) years at the time of injury were assessed using the Pediatric QOL Inventory, child self-report version (PedsQL). Group I (n=18) is surgically treated compared to group II (n=25) being medically treated. Disability, injury mechanism was compared.

Results:

Mean (SD) age was 12.2 (3.1) year. Based on treatment, the two groups differed only in the number of admission days (p = 0.009) with no significant difference in mean disability outcome and mean QoL in all domains. Based on age, older children (13-18 year) had better psychosocial health than younger children (8-12 year). Falling down, sport and recreational activity predominate as a mechanism of injury followed by a pedestrian. The acute epidural hematoma was the most common CT scan finding in the operative group (n=17) whereas, contusions were the most common in non-operative.

Conclusion:

This initial work could enhance research outcome from border hosting community that may suffer strain on the health sector and personal in periods of refugee influx and sudden population increase though they are not directly affected by the conflict crises. Single-incident moderate TBI where the diffuse axonal injury is absent or limited based on injury mechanism and severity has a good long-term outcome in children.

Keywords: TBI, Pediatric, Quality of life, Outcome, Head injury, Brain.

1. INTRODUCTION

The impact on domestic injury spectrum and outcome in border hosting communities from sudden population

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increase with refugee influx is rarely investigated. Northern Jordan population suddenly doubled during Syrian crises which inflict strain on the health system and infrastructure. This initial work is addressing the outcome of non-war injury in one of the most prone group; children; with the aim of enhancing research and outcome in crises border hosting communities though they are not directly affected by armed conflicts.

Traumatic Brain Injuries (TBI) are among the leading causes of pediatric morbidity and mortality [1, 2] with rising incidence [3]. TBI can lead to neurocognitive, psychological and behavioral health issues [4]. Despite that, pediatric TBI may have debilitating long-term consequences; the estimation of severity in early childhood can be challenging [5] (Jennett, 1998). Poor prognosis is noticeable in age group <4 years with better outcomes in older children [6].

TBI is classified based on the depth and duration of loss of consciousness, presence and duration of Posttraumatic Amnesia (PTA) and brain CT findings [7 - 10]. Utilizing level of consciousness based on Glasgow Coma Scale (GCS) as the sole diagnostic criterion may not reflect the actual brain damage [11], whereas, brain CT based classification [12, 13] without clinical correlation may misguide surgical management.

A challenging group of patients is moderate TBI where GCS is 13-15 in the presence of non-operative brain CT findings compared to those with operative CT findings. Moderate TBI received less attention than the more common mild TBI and more serious severe TBI [14, 15].

Health-Related Quality of Life (HRQoL) which represents the patient's subjective physical and mental perception is an important addition to the functional and disability outcomes [16]. The Pediatric Quality of Life Inventory (PedsQL 4.0) Generic Core Scales have demonstrated reliability and validity with formats for different pediatric age groups [17, 18]. The PedsQL 4.0 measures 4 domains: physical, emotional, social and school functioning [19].

Currently, there is paucity in literature studying the impact of TBI on developmental, cognitive and quality of life in children and adolescent [20].

The aim of the present study was to evaluate and compare the HRQoL in a subset of the pediatric population following TBI according to age, brain CT findings and treatment and to report the outcome of none-war injury victims during a period of stress and northern Jordan health sector strain in the presence of Syrian crises.

2. METHODS

A cross-sectional study was conducted among all admitted children (age 8-18 years) with moderate Traumatic Brain Injury (TBI) between Jan 2014 and Dec 2015 at King Abdullah University Hospital (KAUH). Patients were included if they met the inclusion criteria: age at the time of injury 8-18 year, moderate TBI (LOC of 30 min to 24 h, an initial GCS of 9–12, PTA 24 h to 7 days, abnormal brain CT scan findings), timing from injury 1-2 years. To limit the bias and heterogeneity with retrospective recruitment, exclusion criteria were: Children with pre-injury epilepsy or cognitive disability (both can interfere with the outcome assessment). For eligible patients, children completed PedsQL 4.0 appropriate form (8-12, 13-18). Disability outcomes (GOSE) were measured for all patients. The survey also collected demographic data including gender, age at the time of injury, GCS at admission and discharge, mechanism of injury (Motor vehicle, pedestrian, sports/recreational activity, fall from a height, blunt force trauma, and firearm), CT scan findings, and treatment (conservative or surgical).

Pediatric Quality of Life Inventory (PedsQL 4.0) Generic Core Scale was used to assess the QoL among patients after 1 to 2 years of injury. The scale consists of 23-item that can be grouped into 4 domains of HRQoL: Physical Functioning (8 items), Emotional Functioning (5 items), Social Functioning (5 items) and School Functioning (5 items).

Statistical analyses were carried out with *SPSS*, IBM version 20. Data were normally distributed. Items are reverse-scored and linearly transformed to a 0 to 100 scale (0 = 100, 1 = 75, 2 = 50, 3 = 25, 4 = 0), so that higher scores indicate better HRQoL. Scale scores are computed as the sum of the items divided by the number of items answered [21].

The Arabic validated self-report forms for children 8-12 years and 13-18 years (at time of injury) were obtained from eprovide.mapi-trust after permission (https://eprovide.mapi-trust.org). The Arabic version has been validated before [22]

Disability was assessed using Glasgow Outcome Scale-Extended (GOSE) which is a global scale of functional outcome that has been designed for TBI [23, 24]. GOSE consists of 8 categories [25].

The study was approved by the Ethical Review board of Jordan University of Science and Technology.

3. RESULTS

A total of 43 patients (7 girls and 36 boys) aged between 8 and 18 years with a mean (SD) age of 12.2 (3.1) year were included in this study. A total of 24 patients aged 8-12year and 19 patients aged 13-18 years (at the time of injury). Of all patients, 25 patients were treated conservatively and 18 were treated surgically. The mean age was 12.2 (2.9) year for patients in the conservative group and 12.1 (3.5) year for patients in the surgical group (p-value = 0.928). The patients' characteristics according to the treatment group are shown in Table **1**. There was no significant difference in gender and age between patients who were managed conservatively and those who were managed surgically.

Table 1. Patients' characteristics according to the treatment group.

-	Treatment group				Total	*p*-value
	Conservative		Surgical			
-	n	%	n	%		
Gender	-	-	-	-	-	0.370
Female	3	12.0%	4	22.2%	7	-
Male	22	88.0%	14	77.8%	36	-
Age (year)	-	-	-	-	-	0.977
8-12	14	56.0%	10	55.6%	24	-
13-18	11	44.0%	8	44.4%	19	-

Table **2** shows the health-related quality of life, disability outcome scale GOSE, and days of admission for patients in the conservative and surgical groups. The two groups differed significantly in the number of admission days (p = 0.009). The mean number of days was 9.2 (5.9) for patients who were treated surgically and 5.2 (3.5) days for patients who were treated conservatively. There was no significant difference between the two groups in the mean disability outcome scale GOSE and mean QoL between the two treatment groups in all domains including emotional functioning, social functioning, school functioning, and physical functioning.

Table 2. Health-related quality of life and days of admission for patients in the conservative and surgical groups.

-	Group				-		-
Variable	Conservative (n = 25)		Surgical (n = 18)		Total (N = 43)		*p*-value
-	Mean	SD	Mean	SD	Mean	SD	
Number of admission days	5.2	3.5	9.2	5.9	6.9	5.0	0.009
GOSE	7.9	0.4	7.9	0.5	7.9	0.4	0.950
Emotional functioning	87.4	22.8	88.9	19.1	88.0	21.1	0.823
Social functioning	92.8	16.9	96.4	7.4	94.3	13.7	0.405
School functioning	88.8	22.1	90.0	24.1	89.3	22.7	0.866
Physical functioning (Physical health summary score)	95.3	14.5	94.4	7.8	94.9	12.1	0.832
Psychosocial Health summary score	89.7	19.7	91.8	10.6	90.5	16.3	0.684

When patients were compared according to age (Table **3**), older patients (13-18 year) had better psychosocial health than younger patients (8-12 year) (Table **3**). The mean scores for all individual domains of QoL and disability outcome scale GOSE were not different between the two age groups.

Table 3. Health-related quality of life for patients according to age group.

-	Age (year)				-		-
-	8-12 year (n = 24)		13-18 year (n = 19)		Total (N = 43)		*p*-value
-	Mean	SD	Mean	SD	Mean	SD	
Number of admission days	7.2	6.2	6.5	3.2	6.9	5.0	0.660

(Table 3) contd.....

-	Age (year)				-		-
-	8-12 year (n = 24)		13-18 year (n = 19)		Total (N = 43)		*p*-value
-	Mean	SD	Mean	SD	Mean	SD	
GOSE	7.9	0.4	7.9	0.5	7.9	0.4	0.888
Physical functioning	93.1	15.6	97.2	4.2	94.9	12.1	0.273
Emotional functioning	83.3	26.8	93.9	7.6	88.0	21.1	0.102
Social functioning	91.5	17.1	97.9	6.5	94.3	13.7	0.129
School functioning	83.3	28.7	96.8	6.1	89.3	22.7	0.051
Psychosocial Health summary score	86.0	20.6	96.2	4.5	90.5	16.3	0.041
Physical health summary score	93.1	15.6	97.2	4.2	94.9	12.1	0.273

4. DISCUSSION

The sudden huge population increase in hosting border cities due to refugee influx, has its impact on health centers and infrastructure which could change the spectrum and outcome of treatment. Research concentrate on injury and outcome in crises zone rarely address the indirect effect on the domestic population (both local and refugee) in hosting border community. Though published data from hosting border community on non-war related injury is not available to compare, we present an initial work in one of the prone subgroup (children) hoping this shall enhance reporting from hosting community in other parts of the third world regions.

Despite that, the adult literature correlates TBI with cognitive decline, dementia and Alzheimer's disease [26, 27], these results may not be generalized to pediatric patients. The plasticity of the developing brain has been considered to be protective in pediatric TBI, however, this has been challenged, and an early brain damage may disrupt normal maturation and development [28 - 30].

The present study focuses on moderate TBI in pediatric population assessed by disability outcome scale GOSE and health-related quality of life using PedsQL 4.0. The exclusion of mild, severe and younger children TBI is to limit bias and heterogeneity. Clinicians are challenged daily with moderate TBI where brain CT findings operative decision is equivocal in contrary to the clearer conservative or operative patients in mild and severe TBI. It is probable that determining the long-term disability and patient perceived physical, social and emotional daily activity can assess in the clinical decision.

The physical domain in patient-reported PedsQL scores showed no significant difference between the two groups. This is in line with other studies as both medical (conservative) and surgical treatment aim to improve patient physical health which is seen by surgeons as the best parameter for surgery success. TBI is an acute condition where the physical domain on admission and the early post-traumatic period is expected to be lower than the baseline of the healthy children or pre-injury status [31]. This is in contrast to chronic illnesses where lower scores are expected at follow-up due to lower baseline HRQoL [32, 19]. Moreover, the injury severity has been shown to be strongly predictive of both 1-year post-TBI [33] and longer-term outcomes [34, 35], consequently, severe TBI is expected to have more impact on disability and HRQoL.

The psychosocial domain is less visible especially in the pediatric population where caregivers tend to intervene in HRQoL. In the present study, there was no significant difference between the two groups in the psychosocial domain with both groups scoring high. Although this may appear contrary to previous studies where delayed cognitive and neuropsychiatric impairment have been shown [36, 37], an important factor is to differentiate between TBI after repetitive head injury and single-incident TBI, the first like in boxers with dementia pugilistica and football players or wrestlers with chronic traumatic encephalopathy, whereas, the latter is the present study population. A possible explanation for the difference between the two is the mechanisms at the cellular level that is amyloid β peptide (Aβ) accumulation in single incident TBI which is absent in the repetitive mild head injury [27, 37].

The present findings are in contrast to severe head injury and injury sustained in early childhood where both may have significant and potentially persistent negative impact on personality, emotional, social and intellectual performance that may even decline with age [38 - 42]. A possible explanation is the presence of diffuse injury components in the more severe forms; however, further studies are needed to elaborate on TBI effect on early childhood brain especially at the cellular level. In general, children aged 13-18 years tend to score better in psychosocial and school performance compared to children 8-12 years possibly due to the support from the beers compared to younger

children who are more dependent on caregivers.

Acute Epidural Hematoma (EDH) was the most common CT scan finding in the operative group (n=17) whereas, contusions were the most common in non-operative. In contrast to subdural hematoma, EDH commonly occurs from focal impact and rarely associated diffuse parenchymal damage due to the absence of rotation-deceleration [43].

Falling is the leading cause of TBI in infants and young children whereas, motor vehicle-related predominates in older children [44]. Girls may have better-predicted outcome than boys [45]. In the present study, falling down, sport and recreational activity predominate followed by pedestrian injury. Falling and sports activity may not be separable in the present age group.

We hope that this initial work could enhance research outcome from hosting community that may suffer strain on the health sector and personal though they are not directly affected by the conflict crises.

Despite the limitation in the number of patients, the present data may allow clinicians to gain a better understanding of the impact of moderate TBI treatment on child physical and psychosocial daily life in Syrian crises border hosting community during periods of the sudden huge increased population. This study suggests that single-incident TBI has a different and better outcome than the more reported repetitive head injury models. Moreover, the mechanism and severity of injury in children were diffuse injury components may be absent or limited, tend to have good long-term outcome both in medically conservative and surgically indicated patients.

FUNDING

No funding was received for this research.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the Ethical Review board of Jordan University of Science and Technology.

HUMAN AND ANIMAL RIGHTS

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

CONSENT FOR PUBLICATION

For this type of study formal consent is not required.

CONFLICT OF INTEREST

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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