Available online at www.sciencedirect.com
ScienceDirect
Surgical Neurology 66 (2006) S2:14–S2:19
SURGICAL NEUROLOGY
www.surgicalneurology-online.com

Trauma

Head injuries in adolescents in Taiwan: a comparison between urban and rural groups

Ming-Fu Chiang, MD, PhD[a,1], Wen-Ta Chiu, MD, PhD[b,c,1], H. Jasmine Chao, PhD[d], Wan-Lin Chen, MD[c,e], Shu-Fen Chu, RN[c], Shiu-Jau Chen, MD[a], Ching-Chang Hung, MD[b], Shin-Han Tsai, MD, PhD[c,e,f,]*

[a]*Department of Neurosurgery, Mackay Memorial Hospital, Mackay Medicine, Management and Nursing College, Taipei, Taiwan*
[b]*Division of Neurosurgery, and* [c]*Institute of Injury Prevention and Control, Taipei Medical University-Wan Fang Medical Center, Taipei, Taiwan*
[d]*Graduate Institute of Public Health, Taipei Medical University, Taipei, Taiwan*
[e]*Division of Neurosurgery, Taipei City Hospital Renai Branch, Taipei, Taiwan*
[f]*Department of Critical Care and Emergency Medicine, Taipei Medical University-Wan Fang Medical Center, Taipei, Taiwan*

Received 20 April 2006; accepted 21 August 2006

Abstract

Background: Data pertaining to head injuries in adolescents in Taiwan are scarce. The purpose of this study was to investigate the trend and pattern of head injuries in adolescents in both urban and rural areas in Taiwan.

Methods: We collected data from major hospitals in the urban (20) and in the rural (4) areas of Taiwan for a period of 3 years. Data were obtained from the Head Injury Registry, a 10-year electronic database of head injury in Taiwan. The inpatient medical records of adolescents with head injury were thoroughly reviewed. Severity of head injury was classified by the GCS score, and patient outcome at discharge from hospital was measured by the Glasgow Outcome Scale. Differences and correlation between study groups (13-15 and 16-18 years old) in the urban and rural areas were examined using 2-tailed t and χ^2 tests.

Results: A total of 469 head injury cases in the urban area and 131 in the rural area were identified. Traffic accidents were the major cause of head injury, and motorcycles were the most predominant vehicles causing traffic accidents in both urban and rural areas. Intracranial hemorrhages were the most prevalent injury pattern in the study population. In both urban and rural areas, the severities of injury were not significantly different (P = .184), but the outcomes at discharge were significantly better in urban areas (P = .032). The correlation between the initial GCS and outcomes in both areas was significant (P < .001). Craniotomy was performed more frequently in the rural area than in the urban area (15.3% vs 7.2%). The mean hospital stay was shorter in the latter than in the former (P < .001). Education on helmet use, input of neurosurgical staff, and facility and emergency medical transportation service of head-injured patients following guidelines proposed by the WFNS are crucial for head injury and better control in rural areas.

Conclusions: The causes, patterns, and outcomes of head injury were statistically different between the 2 age groups of adolescents in urban and rural areas. Further studies on adolescent head injury are necessary.

Keywords: Adolescent; Glasgow Coma Scale; Glasgow Outcome Scale; Head injury; Helmet use law; Intracranial hemorrhage; Motorcycle

Abbreviations: EDH, epidural hematoma; GCS, Glasgow Coma Scale; GOS, Glasgow Outcome Scale; ICHs, intracranial hemorrhages; JHS, junior high school; SAH, subarachnoid hemorrhage; SDH, subdural hematoma; SHS, senior high school; TBI, traumatic brain injury; WFNS, World Federation of Neurosurgical Societies.

* Corresponding author. Institute of Injury Prevention and Control, Taipei Medical University, Taipei, 110 Taiwan. Tel.: +886 2 27390217; fax: +886 2 27390387.
E-mail address: shtsai@tmu.edu.tw (S.-H. Tsai).

[1] M.-F. Chiang and W.-T. Chiu contributed equally to this work.

0090-3019/$ – see front matter © 2006 Elsevier Inc. All rights reserved.
doi:10.1016/j.surneu.2006.08.029

1. Introduction

Since 1989, patients with head injury have had a 10-fold higher mortality than those bluntly traumatized without head injury [15]. Head injury is the leading cause of death in accidents, and motorcycle-related traffic accidents compose the majority (71%) of accidents in Taiwan [3,5,9,12,13,20]. In the analysis of age groups with accident mortality, the 10- to 19-year age group had the highest mortality rate, especially in the 15- to 19-year age group [3,14,18,21,22]. As most victims of motorcycle-related head injuries were young, the resulting cognitive, psychological, and neurologic sequelae were overwhelmingly damaging to society [3]. How to prevent and control the mortality and morbidity of head injury in adolescents is therefore a challenging problem in Taiwan.

A long-term trend (1989-2000) showed that fatal head injuries in the age group from 15 to 20 years were decreasing [18]. On June 1, 1997, the helmet use law was implemented in Taiwan. Thereafter, the number of motorcycle-related head injuries and the severity of injury decreased, and better outcomes were obtained [3]. However, data regarding current status of head injuries in adolescents, especially the differences between urban and rural areas are lacking in Taiwan. Therefore, we conducted this study to investigate the distributions and patterns of head injuries in adolescents in both the urban and rural areas in Taiwan.

2. Materials and methods

2.1. Data collection

The data of patients with TBI in Taipei and Hualien were extracted from the Head Injury Registry. In the setting of the study, Taipei is defined as the urban area and Hualien County is defined as the rural area. These 2 areas differ in population density, the density and distribution of neurosurgical centers, manpower personnel, and facilities.

Taipei City is the capital of Taiwan. It covers an area of 271.8 km^2 and has a population of 2 630 000, with a population density of 9737/km^2. There are 20 major neurosurgical centers equally distributed throughout the whole city district. A board-certified neurosurgeon serves about 17 533 people. It takes an average of 15 minutes to transport a patient with TBI by ambulance to a neurosurgical center.

Hualien County, located at the eastern part of Taiwan, is a mountainous area. The area of the county is 4638.6 km^2 (the largest county in Taiwan) and population is 400 000; the population density is 133/km^2. There are only 4 neurosurgical centers in Hualien, all located downtown. A board-certified neurosurgeon serves about 26 667 people in Hualien. However, the geographic limitations in Hualien make transportation of patients with TBI time-consuming. It takes, on average, more than 1 hour to transport patients with TBI from the periphery or hills to each center.

In this collaborative case-series study, data on adolescents (aged between 13 and 18 years) with head injuries were collected from July 1, 2001, to June 30, 2004. We divided the adolescents into 2 age groups, the 13- to 15-year group (JHS) and the 16- to 18-year group (SHS). Data were collected from 20 major hospitals in an urban area and 4 major hospitals in a rural area.

Data were also obtained from the Head Injury Registry, a 10-year electronic database with more than 100 000 cases of head injury in Taiwan. The inpatient medical records of adolescents with head injury were thoroughly reviewed. Information pertaining to head injury including sex, age, GCS, cause and pattern of injury, presence of multiple systemic injuries, length of hospital stay, and GOS at discharge was analyzed. Diagnosis was made by brain computed tomography scans and skull x-rays to show various patterns of head injury: skull fracture, brain swelling/edema, and ICHs (epidural hematoma, subdural hematoma, ICH, subarachnoid hemorrhage).

2.2. Severity and outcomes

The severity of head injury was classified by the GCS score [11,19] as follows: (1) severe, score of 8 or below; (2)

Table 1
Demography of study adolescents in urban and rural areas

	Urban	Rural	*P*
No. of cases	469	131	
M:F	306:163 = 1.9	78:53 = 1.5	
JHS	127 (27.1)	46 (35.1)	
SHS	342 (72.9)	85 (64.9)	
Causes			<.001
Traffic	264 (56.3)	100 (76.3)	
Fall	81 (17.3)	8 (6.1)	
Assault	72 (15.4)	9 (6.9)	
Sports	26 (5.5)	3 (2.3)	
Traffic			.002
Motorcycle	163 (34.8)	78 (59.5)	
Bicycle	19 (4.1)	10 (7.6)	
Walking	32 (6.8)	32 (6.8)	
Rider	129 (27.5)	55 (42)	.025
Patterns			.011
Skull fracture	75 (16)	18 (13.7)	
Swelling	67 (14.3)	7 (5.3)	
ICHs	118 (25.2)	29 (22.1)	
Craniotomy	34 (7.2)	20 (15.3)	.011
GCS (JHS/SHS)			.184
3-8	30 (6.4) (8/22)	13 (9.9 (3/10)	
9-12	25 (5.3) (6/19)	12 (9.2) (6/6)	
13-15	414 (88.3) (113/301)	106 (80.9) (37/69)	
Outcomes and GCS score (severe/moderate/mild)			<.001
Dead	13 (2.8) (11/2/0)	7 (5.3) (6/1/0)	
Vegetative	3 (0.6) (2/1/0)	3 (2.3) (2/1/0)	
Dependent	7 (1.5) (4/2/1)	7 (5.3) (2/2/3)	
Independent	25 (5.3) (4/3/18)	8 (6.1) (1/3/4)	
Good	421 (89.8) (9/17/395)	106 (80.9) (2/5/99)	

Values are presented as n (%).