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Research article

Risk factors for myocardial dysfunction after traumatic brain injury: A one-year follow-up study

Kang Lu[a,b], Cheng-Loong Liang[a,b], Ping-Chia Li[b], Po-Chou Liliang[a,b], Chih-Yuan Huang[c], Yi-Che Lee[d], Kuo-Wei Wang[a,b], San-Nan Yang[b], Yuan-Ting Sun[e], Hao-kuang Wang[a,b,*]

[a] Department of Neurosurgery, E-Da Hospital, I-Shou University, Kaohsiung, Taiwan
[b] School of Medicine for International Students, I-Shou University, Kaohsiung, Taiwan
[c] Neurosurgical Service, Department of Surgery, National Cheng Kung University Hospital, Tainan, Taiwan
[d] Department of Nephrology, E-Da Hospital, I-Shou University, Kaohsiung, Taiwan
[e] Department of Neurology, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan

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ABSTRACT

Introduction: Traumatic brain injury has been associated with an increased risk of myocardial dysfunction. Common abnormalities accompanying this pathology include electrocardiographic abnormalities, elevated creatine kinase levels, arrhythmias, and pathologic changes of the myocardium. The aim of this study was to determine if TBI patients have a higher risk of myocardial dysfunction than the general population and to identify the risk factors of myocardial dysfunction in TBI patients.
Patients and methods: The study sample was drawn from Taiwan's National Health Insurance Research Database of reimbursement claims, and comprised 26,860 patients who visited ambulatory care centers or were hospitalized with a diagnosis of TBI. The comparison group consisted of 134,300 randomly selected individuals. The stratified Fine and Gray regression was performed to evaluate independent risk factors for myocardial dysfunction in all patients and to identify risk factors in TBI patients.
Results: During a 1-year follow-up period, 664 patients with TBI and 1494 controls developed myocardial dysfunction. TBI was independently associated with increased risk of myocardial dysfunction. Diabetes, hypertension, peptic ulcer disease, chronic liver disease and chronic renal disease were risk factors of myocardial dysfunction in TBI patients.
Conclusions: Individuals with TBI are at greater risk of developing myocardial dysfunction after adjustments for possible confounding factors. Early monitor should be initiated to decrease disability and dependence in patients with TBI.

Introduction

In individuals younger than 45 years, injury is the primary cause of death across the world [1]. Traumatic brain injury (TBI) is the major cause of disability, morbidity, and mortality among this group and is responsible for a significant proportion of all traumatic deaths [2,3]. Due to increasing motor-vehicle use especially in Taiwan and other developing countries, the incidence of TBI is rising sharply. TBI can cause a variety of later problems including physical, cognitive, emotional, and behavioral complications [2,3]. Because most of the patients with TBI are teenagers and young adults, disabilities caused by TBI are a major health and socioeconomic problem [4].

TBI are often associated with myocardial dysfunction [5–13]. Common abnormalities accompanying this pathology include electrocardiographic (ECG) abnormalities, elevated creatine kinase levels, arrhythmias, and pathologic changes of the myocardium [5–13]. The release of large amounts of catecholamines both systemically and at the myocardial neuronal level, caused by increased intracranial pressure, leading to myocardial dysfunction [5,8]. Several studies have examined the potential benefits of adrenergic blockade in the acutely injured patient [8,10]. It is not known whether the extent of myocardial dysfunction is related to the etiology or magnitude of brain injury, associated arrhythmias, ischemic heart disease, or heart failure. In addition, factors that predispose patients to the development of myocardial dysfunction have not been identified.

* Corresponding author at: Department of Neurosurgery, E-Da Hospital/I-Shou University, No.1, Yida Road, Jiaosu Village, Yanchao District, Kaohsiung City 82445, Taiwan.
E-mail addresses: ed101393@gmail.com, ed101393@edah.org.tw (H.-k. Wang).

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In our previous study, patients with TBI were more likely to have stroke, diabetes, and hypertension [2]. As stroke, diabetes, and hypertension are the known risk factors for cardiac dysfunction. To date, few population-based studies have evaluated whether TBI really increases myocardial dysfunction compared to the general population. Risk factors in TBI patients are also not identified. This nationwide population-based study aimed to investigate the association between TBI and myocardial dysfunction after adjusting for potential confounding factors, and to identity independent risk factors for myocardial dysfunction in TBI patients.

Methods

Database

Taiwan officially commenced the National Health Insurance (NHI) program in 1995 to cover the health care of all residents. The National Health Research Institute (NHRI) of Taiwan manages the medical benefit claims of all 22.9 million individuals of Taiwan, representing 99% of the Taiwanese population, have been enrolled in this program [2]. The NHRI established several claims data files for public use. We replied the National Health Insurance Research Database (NHIRD) from the institute, which covers claims data from 1997 to 2012. The completeness and accuracy of the NHIRD were guaranteed by the Department of Health and the NHI Bureau of Taiwan. This retrospective population-based cohort study used data from the Longitudinal Health Insurance Database 2000 (LHID 2000), which is the subset of the NHIRD. The LHID2000, which is made up of 1,000,000 randomly sampled people who were alive in the year 2000, is representative of the original NHIRD and consists of de-identified secondary data, including all the original medical-claims data and registration files. The details of database generation, monitoring, and maintenance are published online (http://nhird.nhri.org.tw/). Until the end of 2012, all sampled individuals were followed up for outcome identification using the International Classification of Disease, 9th Revision, Clinical Modification (ICD-9-CM). The study was exempted from a full review by the local ethics review committee.

Study sample

This study was designed as a retrospective cohort study. Based on the LHID 2000, we included patients who were diagnosed with fracture of skull (ICD-9-CM 800.X-804.X) or intracranial injury (ICD-9-CM 850.X-854.X) for the first time between January 1, 2002 and December 31, 2011, and labeled these patients as the "TBI cohort" [2]. TBI patients were defined by one of the following criteria: (1) two or more outpatient visits, each with a diagnosis of TBI; and (2) inpatients with TBI. The first day of diagnosis was defined as the index day. Non-TBI subjects were selected from the same data set. They were individually matched at a ratio of 5:1 with TBI cohort according to age, gender, and index day. Enrolled subjects with a history injury of thorax, abdomen, pelvis, myocardial dysfunction, and myocardial dysfunction before the index day, and less than 15 years of age were excluded. All subjects were observed till being diagnosed with myocardial dysfunction or one year after the index day. The comorbidities for subjects in both cohorts were collected before or at the time index day and included diabetes, dyslipidemia, hypertension and its complications, peripheral vascular disease, cerebrovascular disease, peptic ulcer disease, chronic liver disease, and chronic kidney disease.

Sub-cohort of TBI

The study separated the TBI into three groups by severity (skull fracture, ICD-9-CM 800-804; brain concussion, ICD-9-CM 850;

Table 1
Comparison of Demographic Characteristics and Comorbidities between Patients with and without TBI.

Characteristic	Patients With TBI (N = 26,860)		Matched cohort (N = 134,300)		P
	N	%	N	%	
Age, mean ± SD	40.41 ± 18.62		40.41 ± 18.62		0.9996
Age					>0.9999
15–39	14290	53.20	71450	53.20	
40–59	8009	29.82	40045	29.82	
60–74	3209	11.95	16045	11.95	
≥75	1352	5.03	6760	5.03	
Sex					>0.9999
Male	14971	55.74	74855	55.74	
Female	11889	44.26	59445	44.26	
City Rank					>0.9999
1st	10506	39.11	61934	46.12	
2nd	8583	31.95	38760	28.86	
3rd	2617	9.74	12164	9.06	
4th	2580	9.61	10650	7.93	
5th	313	1.17	1306	0.97	
6th	691	2.57	2731	2.03	
7th	1570	5.85	6755	5.03	
Comorbidities					
diabetes	2320	8.64	8904	6.63	<0.0001
dyslipidemia	26	0.10	63	0.05	<0.0001
hypertension	4238	15.78	18612	13.86	<0.0001
peripheral vascular disease	544	2.03	2310	1.72	<0.0001
cerebrovascular disease	1944	7.24	4315	3.21	<0.0001
respiratory disease	3269	12.17	13668	10.18	<0.0001
peptic ulcer disease	5797	21.58	21944	16.34	<0.0001
chronic liver disease	4409	16.41	17736	13.21	<0.0001
chronic renal disease	1041	3.88	4088	3.04	<0.0001
rheumatologic disease	756	2.81	2980	2.22	<0.0001
cancer	776	2.89	3922	2.92	<0.0001

SD, standard deviation.

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