Association between electrocardiographic findings and cardiac dysfunction in adult isolated traumatic brain injury

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Abstract

Background: Abnormal electrocardiographic (ECG) findings can be seen in traumatic brain injury (TBI) patients. ECG may be an inexpensive tool to identify patients at high risk for developing cardiac dysfunction after TBI. The aim of this study was to examine abnormal ECG findings after isolated TBI and their association with true cardiac dysfunction, based on echocardiogram.

Patients and methods: Data from adult patients with isolated TBI between 2015 and 2017 was retrospectively examined. Inclusion criteria included the presence of a 12-lead ECG within 24 h of admission and a formal echocardiographic examination within 72 h of admission after TBI. Patients with preexisting cardiac disease were excluded. Baseline clinical characteristics, 12-lead ECG, and echocardiogram report were abstracted. Logistic regression was used to identify the relationship of specific ECG abnormalities with cardiac dysfunction.

Results ECG values showed abnormalities in 11 patients (22.4 %) at the first day of admission in the form of ; two patients (18.1 %) had ventricular ectopics, three patients (27.2%) developed supraventricular tachycardia and nine patients (81.8 %) had significant ST segment elevation.

Conclusion: Repolarization abnormalities (prolonged QTc and MERA), but not ischemic-like ECG changes, are associated with cardiac dysfunction after isolated TBI. 12-lead ECG may be an inexpensive screening tool to evaluate isolated TBI patients for cardiac dysfunction prior to more expensive or invasive studies

Introduction:

Traumatic brain injury (TBI) is a major public health concern and a leading cause of traumatic death worldwide.[1] Complications after TBI known as second insults can worsen neurologic and patient outcomes[2,3] Clinically, post-TBI hypotension (systolic blood pressure <90 mmHg) has been directly linked to mortality and poor disposition[4,5] While the majority of patients experience a hypotensive episode during TBI surgery[6] the cause is often unknown, and treatment may be empiric. Cardiac dysfunction has been documented in TBI, and implicated as a cause for hypotension in other brain injury paradigms, where experimental evidence postulates that brain-heart-lung interactions may cause myocardial dysfunction in TBI[7,8] This suggests that the cardiac dysfunction may be one reason for post-TBI hypotension.

Abnormal electrocardiographic (ECG) findings can also be associated with neurologic hemorrhage, where both ischemic-like changes and a variety of repolarization abnormalities have been described[9,10] Autonomic instability has been described in small series in adults and children with TBI, with noted changes in heart rate variability thought to be secondary to sympathetic over-activity and autonomic imbalance[11,12] In addition to repolarization abnormalities and ischemic-like ECG changes, heart rate variability may be blunted in brain-injured patients, reflecting dysfunction in the autonomic nervous system[11,12] Early ECG may serve as an inexpensive test to screen for cardiac dysfunction prior to ordering more expensive and potentially more

invasive testing. The aim of this study was to examine abnormal ECG findings early after isolated TBI and their association with cardiac dysfunction.

Aim of the study:-

Association between electrocardiographic findings and cardiac dysfunction in adult isolated traumatic brain injury

Patients and methods:

After Institutional Review Board approval, data were abstracted from our institution's trauma registry, which includes complete admission and hospitalization records for all patients with traumatic injury that were triaged to our Level 1 trauma center. We identified all adult (age >18 years) patients with isolated TBI who received care between 2015 and 2017. Inclusion criteria included the presence of a 12-lead ECG within 24 h of admission and a formal echocardiogram within 72 h of admission after TBI.

Results:-

Eighty patients were admitted to our ICU with TBI within a period of 48 months from March 2015 to March 2017, Ninety-four patients had fullfiled our criteria and were enrolled in the study.

15 patients were excluded being above 30 years old , three patients were excluded due to cardiac arrest shortly after ICU admission, seven patients were excluded due to associated chest trauma and six patients were excluded due to previous history of smoking.

Demographic data for our patients were shown in table :

	Range	Mean	Std. Deviation
Age (y)	**(8–30)y**	**23.0408**	**6.2648**
Weight (kg)	**(25-95)kg**	**69.8367**	**14.6988**
Height (cm)	**(110-190)cm**	**169.7551**	**15.3100**

Table (1) Patient's characteristics

All elligable patients were included in the final analysis (49 patients); 47 (95.9%) of them being males and 2 (4.1%) females with a mean age of (23.04), mean weight of (69.83) and with a mean height (169.75).

ECG values showed abnormalities in 11 patients (22.4 %) at the first day of admission in the form of ; two patients (18.1 %) had ventricular ectopics, three patients (27.2%) developed supraventricular tachycardia and nine patients (81.8 %) had significant ST segment elevation.

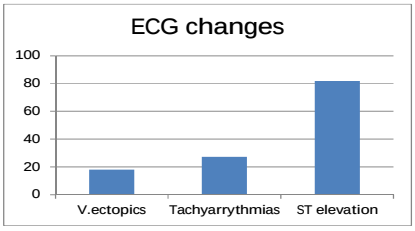

Fig (1) Abnormalities of ECG frequencies

Discussion:

Brain injury-related ECG abnormalities have been recognized for more than five decades and are particularly common after SAH where they are reported in 49–100% of cases. The most common findings are ST

segment changes, flat or inverted T waves, prominent U waves, and prolongation of the QT interval (QT interval corrected for heart rate). Clinical studies showed no correlation between circulating catecholamine levels and ECG abnormalities, suggesting that they are also due to myocardial injury secondary to local sympathetic activation.[18]

Similar phenomenon was thought to occur following TBI. Several studies were able to quantify an increase in sympathetic activity after TBI by measuring plasma and urinary catecholamine levels. [13,14]Furthermore, beta-blocker therapy has shown to confer a survival advantage to TBI patients with elevated cardiac enzymes. [16,17] Despite growing evidence that suggested a potential link between cardiac dysfunction and TBI, only few studies have investigated the clinical outcomes of patients with cardiac dysfunction and TBI.

In our study we aim to identify the relation between head trauma and the occurring of stress cardiomyopathy and using of cardiac troponin I as indicator of cardiac dysfunction.

In our study the mean age was (23 ± 6 years) with exclusion of other risk factors of ischaemic heart diseases, however in other studies the mean age of patients under their study was higher, in Prathep's study was (58 ± 20 years) [21], the age of patients studied in Hasanin et al. [20] was (31 ± 12 years) with age limit 50 years old.

In the current study eleven patients with TBI (22.4%) developed cardiac injury as documented by abnormal ECG , in the form of ; two patients (4.08 %) had ventricular ectopics, three patients (6.1 %) developed supraventricular tachycardia and nine patients (18.3 %) had significant ST segment elevation, unlike ECG findings recorded by Chadi etal and his colleague Of the 105 patients identified with head trauma , 35 patients (33%) had ST-segment elevation on the ECG at admission and 1 patient (0.9%) had new onset of LBBB, 32 patients (30%) had T-wave inversions and 34 patients (32%) had nonspecific ST segment elevation,[19] that difference may be attributed to many factors, first there was no age limit in his study with mean age 69 years old, they did not exclude patients with IHD or chest trauma.

Vijay ,etal and his colleagues studied 59 patients with head trauma they found ECG abnormalities in 12 pt. (20.3 %) In the form of Prolonged PR interval occurred in (6.8%) of patients, while a prolonged QTc interval was diagnosed in (42.4%) of patients. Ischemic-like ST-elevation (23.5 %) and 13 (22%) patients had supra ventricular tachycardia,[20] these results in line with our study as regard they exclude patients with IHD and patients with chest trauma.

Hasanin et al. [21] in his study reported that cardiac assessment of patients revealed that among the 50 patients, the ECG for 31 (62 %) patients showed abnormalities, six (12 %) patients had abnormal QT interval and 29 (50 %) of patients developed tachyarrhythmia, the higher incidence of ECG changes in his study may be attributed to higher mean age of their patients, and they didn't exclude patients with heart and chest trauma, and patients with risk factors for IHD.

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