The Value of Serum BNP for the Diagnosis of Intracranial Injury in Head Trauma

Kafa Travmalı Hastalarda Kafa İçi Yaralanmanın Tanısında Serum BNP'nin Yeri

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SUMMARY

Objectives

Head injuries are the leading cause of death in persons less than 45 years old. In order to diagnose these patients, cranial computed tomography (CT) is used. Brain natriuretic peptide (BNP) was isolated first from the cerebral ventricles. The aim of this study was to research whether bedside BNP measurement has a place in determining intracranial injury in patients admitted to the emergency department (ED) with head trauma.

Methods

The study was done prospectively in the ED of the Trakya University Hospital. Patients admitted to the ED because of head injury (100 patients), and a control group (20 healthy volunteers) were enrolled in the study. Mann-Whitney U test was used to compare the binary groups, and Kruskal-Wallis test was used to make multi-group comparison. A p-value of <0.05 was considered to be significant.

Results

Demographic features of the subjets showed that eighty-one patients (81%) were male, and 19 (19%) were female. The median serum BNP level was 5.00 pg/ml in a total 86 patients in the cranial CT (–) group. The mean serum BNP level in 14 patients of the cranial CT (+) group was 6.15 pg/ml. There was no statistically significant difference between these two groups from the point of serum BNP levels (p>0.05).

Conclusions

The study showed that serum BNP examination to reveal any intracranial injury in patients with head trauma was poor.

Key words: Emergency; head trauma; brain natriuretic peptide.

ÖZET

Amaç

Travmalar 1-44 yaş arası insanlarda ölümün en sık nedenidir. Beyin bilgisayarlı tomografisi bu hastalarda tanı için kullanılır. Beyin natriüretik peptid (BNP) serebral ventriküllerden izole edilmiştir. Bu çalışmada acil servise kafa travması ile başvuran hastalarda kafa içi yaralanmayı belirlemede yatak başı serum BNP seviyelerinin yeri olup/olmadığının araştırılması amaçlandı.

Gereç ve Yöntem

Çalışma Trakya Üniversitesi Tıp Fakültesi Acil Servisi'nde prospektif olarak yapıldı. Kafa travması nedeniyle acile gelen 100 hasta çalışmaya alındı (ve 20 sağlıklı gönüllü). İkili grupları karşılaştırmada Mann-Whitney U-testi, çoklu grupları karşılaştırmada Kruskal-Wallis testi kullanıldı. p<0.05 değeri istatistiksel olarak anlamlı kabul edildi.

Bulgular

Seksen bir hasta (%81) erkek, 19 hasta (%19) kadındı. Beyin BT'si negatif olan 86 hastanın ortanca serum BNP düzeyi 5.00 pg/ml idi. Beyin BT'si pozitif olan 14 hastanın ortanca serum BNP düzeyi ise 6.15 pg/ml idi. Yapılan istatistiksel analiz sonucu bu iki grup arasında serum BNP düzeyleri açısından anlamlı bir fark bulunmadı (p>0.05).

Sonuç

Kafa travmalı hastalarda serum BNP düzeylerinin bilgisayarlı beyin tomografisi ile saptanan intrakraniyal hasarı belirlemede etkili olmadığı saptanmıştır.

Anahtar sözcükler: *Acil; kafa travması; beyin natriüretik peptid.*

Submitted *(Geliş Tarihi):* 20.02.2012 **Accepted** *(Kabul Tarihi):* 08.08.2012

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Introduction

Traumas are the most frequent cause of death among people between the ages of 1-44.[1] Head traumas and traumatic cerebral injuries are the most important causes of death and long term disabilities particularly in adolescents, young adults and elderly. The most common mechanisms are motor vehicles accidents, falls from height, violent assaults and gunshot injuries. Most head traumas are minor, accounting for 80% of all head traumas, while 10% are moderate and 10% are major injuries in the some location of the world.[1,2] Cranial computed tomography (Cranial CT) is frequently used for patients with head trauma during emergency management; however, CT is an expensive examination that is not available everywhere.

It has been shown that the levels of some biochemical markers such as neuron specific enolase (NSE), S100b, Tau protein, and malonyl dialdehyde (MDA), etc., are increased in patients with head trauma.[3-6] Brain natriuretic peptide (BNP) is a 32-amino acid natriuretic peptide that was first isolated from the cerebral ventricles and is released secondary to increased wall tension. It is secreted primarily by the cardiac ventricles. BNP plays an important role in the diagnosis of cardiovascular diseases including congestive heart failure and ischemic heart disease. It is commonly used for the estimation of the degree of heart failure and is used as a determining factor of left ventricular systolic and diastolic functions. Other uses of BNP include for the determination of prognosis following an acute myocardial infarction. BNP is also a predictor of mortality and cardiovascular events in older adults.[7,8] It was suggested in some previously performed studies that it could be used for diagnosis in patients with head trauma.[7-11]

The aim of this study was to search whether bedside BNP measurement has a place in determining intracranial injury in patients admitted to the emergency department with head trauma. If we could show that BNP was increased following traumatic brain injury in this study, unnecessary CTs could be prevented, a waste of the country's resources could be avoided, and the patients could be protected from excess radiation.

Materials and Methods

The study was done prospectively in the Emergency Department (ED) of the Trakya University Hospital. Ethics committee approval was taken from Trakya University Ethics Committee (2008/155). The patients that participated in the study included 100 subjects who were admitted to the emergency department with head trauma and that fit the inclusion criteria. The criteria for inclusion of patients to the study and exclusion of patients are summarized in Table 1.

Demographic features of the patients, mechanisms of the trauma, the presence of accompanying injuries, time passed following the trauma, GCS scores, physical examination findings, and cranial CT results were also gathered. GCS scores was used to determine the severity of trauma.

The patients were divided into 2 groups: Group 1 (Cranial CT negative group) consisted of patients with normal cranial CT findings and linear fractures, whereas Group 2 (Cranial CT positive group) had intracranial lesions such as brain edema, epidural hematoma, subdural hematoma, subarachnoid bleeding, cerebral contusion, intraparenchymal bleeding, and depressed fracture on the cranial CT. Cranial CT reports were received from the hospital automation system.

Patients were administered a Cranial CT if indicated and BNP was measured at the bedside by drawing into an EDTA tube on admission. Plasma BNP levels were measured on admission using a quantitative fluorescence immunoassay (Triage-BNP Meter, Biosite Diagnostics, Ins. San Diego, California). The sensitivity of the quantitative fluorescence immunoassay assessment was less than 5 pg/mL.

Clinical and demographical data of the patients were entered into the computer database. BNP levels of the groups were compared.

SPSS 15.0 software was used for statistical analysis. Demographic and clinical features of the patients were examined according to mean ±SD, median, interquartile range, and percentage. BNP levels were given as median and interquartile range. χ^2 test was used for the categorical variables. The normal distributions were tested with the One Sample Kolmogorov Smirnov test and non parametric tests were used

Table 1. The criteria for inclusion or exclusion of patients to the study

Criteria for inclusion to the study	Criteria for exclusion from the study
To be admitted to the emergency department because of a head trauma	To be younger than 18 years old
To be older than 18 years old	To refuse to participate the study
To give his/her consent to participate in study	Having a known neurological disease
	Having a known cardiac insufficiency

Table 2. Clinical and demographic characteristics of the patients

	Group 1	Group 2	p
Age (average, years)	39.41±17.8	49.38±19.3	p>0.05*
Time to admit (min)	399.60±1374.3	163.46±113.2	p>0.05*
Gender (n)			
Male	71/86	10/14	p>0.05*
Female	15/86	4/14	
Trauma mechanism (n)			
Motor vehicle accident	37	3	p>0.05**
Pedestrian	25	6	
Falling	13	3	
Violent assaults	11	2	
Accompanying trauma	36	6	p>0.05*
Systolic blood pressure (mmHg)	118.05±17.1	130.70±43.1	p>0.05*
Diastolic blood pressure (mmHg)	74.02±12.1	82.31±20.8	p>0.05*
Heart rate (pulse/min)	87.14±9.6	87.20±10.8	p>0.05*
Bnp levels (median, IQR) (pg/ml)	5.00, (5.13)	6.15, (26.03)	p>0.05*

*Mann-Witney U-test; **Kruskal-Wallis test.

in the analysis. Mann-Whitney U-test was used to compare the two continuous groups, and Kruskal-Wallis test to compare multiple continuous groups. p<0.05 was considered to be significant.

Results

The study was conducted in the Emergency Department of Trakya University Hospital during the summer of 2010. Of the subjects, 100 patients met the inclusion criteria and were enrolled in the study. There were 86 patients in Group 1 and 14 patients in Group 2.

Demographic and Clinical Findings

Eighty-one patients (81%) were male, and 19 (19%) were female. Fifty eight patients (58%) had isolated head trauma, while 42 patients (42%) had other accompanying injuries. Twenty six patients had extremity fractures, ten had haemopneumothorax, ten had spleen rupture and one had a liver laceration. The demographic and clinical findings are summarized in Table 2.

The most frequently seen symptoms were headache (45%), vomiting (35%), amnesia (19%), sensory loss (14%), somnolence (12%) and seizure (5%). The frequently seen physical findings were scalp laceration (64%), tumefaction in the scalp (46%), raccoon eyes (5%) and otorrhea (3%). Cranial CT findings of the patients are outlined in Table 3.

Table 3. Brain CT findings of the patients

Finding	n	%
Normal	86	86
Linear fracture	15	15
Cerebral edema	10	10
Subarachnoid hemorrhage	8	8
Compression fracture	1	1
Parenchymal haemorrhage	1	1

BNP

In Group 1, the median serum BNP level was 5.00 pg/ml The. median serum BNP level in Group 2 was 6.15 pg/ml. When comparing these two groups, no statistically signifcant result was detected (p>0.05). The median serum BNP level was 5.00 pg/ml in males and 10.20 pg/ml in females. The difference in serum BNP levels between male and female patients groups was found to be statistically significant (p<0.05).

BNP levels of the patients according to trauma mechanisms are shown in Table 4. There was not any statistically significant difference between serum BNP levels and trauma mechanism (p>0.05).

Serum BNP levels according to trauma severity are shown in Table 4. There was no statistically significant difference between the serum mean BNP levels of the patients from the point of trauma severity (p>0.05).

Table 4. BNP levels according to trauma mechanism and trauma severity

	n	BNP (pg/ml) Median (IQR)	p
Trauma mechanism			
Motor vehicle accident	40	5.00 (7.53)	
Pedestrian	31	5.00 (3.00)	χ^2=2.980,
Falling	16	5.15 (12.27)	*p=0.395
Violent assaults	13	5.10 (15.25)	
Head trauma severity			
Mild	91	5.00 (5.20)	χ^2=0.949,
Moderate	4	5.00 (17.55)	p=0.622
Severe	5	7.00 (46.95)	

*Kruskal-Wallis test.

Discussion

There were few studies found in the literature that reported an increase in serum BNP levels in patients with head trauma.[7-10] Costa et al.[12] observed that serum BNP levels did not increase in patients with head injury and this was not correlated with cerebral salt-wasting syndrome. Çevik et al.[7] reported that serum BNP levels were higher than 10 pg/ml in patients with head injury and were considerable in determining an intracranial pathology. Sviri et al.[8] reported that serum BNP levels were elevated shortly after head injury. Lu et al.[9] also reported that BNP levels in the cerebrospinal fluid increased in patients after head trauma. Çevik et al.[7] showed that there was a statistically significant difference between the serum BNP levels of the head trauma group and the non-head trauma group. According to our results, there were no statistically significant difference between these two groups. We suggested that the difference between the studies resulted from the fact that patient number in Group 2 in our study was low. We suggested that a larger number of patients can provide better information about the relationship between serum BNP and head trauma.

Çevik et al.[7] reported a significant relevance between delay in admission and BNP levels. They showed that a positive correlation exists between admission time and BNP levels. We found that there was no significant correlation between the serum BNP levels and admission time.

Çevik et al. showed that no significant relationship between trauma mechanism and BNP levels was found. We found that there was no significant correlation between the serum BNP levels and trauma mechanism.

GCS is frequently used as a clinical situation to assess head trauma patients. Although there is a general consensus about the predictive value of GCS in patients with mild and major head trauma, there are different approaches about radiological assessment of patients with minor head trauma. For this reason, there were many studies conducted in order to determine either indications for cranial CT scanning by using biochemical markers and clinical features or indications for hospital admission.[3-5] Çevik et al.[7] reported that there was no statistically significant correlations between the severity of the head trauma and serum BNP levels. Stewart et al.[10] reported that there was no correlation between the serum BNP levels and the severity of the head trauma and time to admit. Wu et al.[11] demonsrated BNP levels increased with severity of head trauma. We also found that there was no significant correlation between the serum BNP levels and the severity of the head injury. Further studies are needed on this subject.

Çevik et al.[7] reported that BNP levels of patients with intracranial lesions on the cranial CT scan were significantly higher in comparison to BNP levels of patients who had no intracranial lesion. Çevik et al. suggested that serum BNP levels can be used as a marker in patients with head trauma. While Stewart et al.[10] reported that they do not have any value. Our results seem to support Stewart et al. Our results showed that BNP levels were incresed in both Group 1 and 2.

Conclusion

In our study, we found that serum BNP examination to elucidate any intracranial injury in patients with head trauma was not useful. Since there were different results in previous studies, we suggest that further studies with larger numbers of patients could provide better information about the relationship between serum BNP and head trauma.

Limitation of the study

The statistical power of the study was poor because of the relatively small number of patients. Secondly, a small number of patients in Group 2 (14 patients, 14%) were also included in the study. Although all of these patients had intracranial pathologies demonstrated in cranial CT, the results showed that there was no significant difference between the serum BNP levels of patients in Group 1 and 2. Another limitation was that radiological evaluation was performed by different radiologists.

Conflict of Interest

The authors declares no conflict of interest related to this work.

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