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RESEARCH ARTICLE
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Evaluation of Optic Nerve Diameter Measurement: According to Bleeding Subtypes in Patients with Non-Traumatic Intracranial Hemorrhage in the Emergency Department

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Abstract

Objective: Nontraumatic intracranial hemorrhage is an important cause of adult death and disability. The optic nerve sheath is surrounded by cerebrospinal fluid. Therefore, the increase in intracranial pressure; causes a diameter change in the optic nerve sheath. In this direction, to determine the changes in optic nerve diameter measurements according to the bleeding subtypes of patients diagnosed with non-traumatic intracranial hemorrhage in the emergency department. Thus, it is aimed to assist in early diagnosis and treatment.

Methods: The study is retrospective and includes 136 patients diagnosed with non-traumatic intracranial hemorrhage, who applied to the 3rd level university hospital emergency department between January 01/ 2015 and June 01/ 2017. The parameters of each patient at the time of first admission and at eight hours were checked. These were subtypes of bleeding in brain tomography, amount of bleeding, optic nerve diameter measurements, Glasgow coma scales and demographic characteristics.

Results: 136 patients were included in the study. The mean age of the patients was 64.5 ± 17.8 years, 47.1% were female (n=64), 52.9% were male (n=72). Intracranial hemorrhage was 64.7% (n=88), subdural hemorrhage was 29.4% (n=40), and epidural hemorrhage was 5.9% (n=8) (p<0.001). In addition, the patients showed a significant increase in both the right and left optic nerve diameter at the 8th hour (p<0.001). Bleeding diameter increased in parallel with the increase in right and left optic nerve diameter. Similarly, a significant decrease was observed in Glasgow Coma Scales at the 8th hour (13.0 (2)) compared to the first admission (14.0 (1)) (p<0.001).

Conclusion: When evaluating brain tomography of patients with nontraumatic intracranial hemorrhage; In addition to the existing parameters, it is recommended to look at the optic nerve diameter change.

Keywords: Non-traumatic, intracerebral hemorrhage, optic nerve diameter, glaskow coma scale

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INTRODUCTION

Intracranial hemorrhage is a clinical picture that can be treated, its progression can be prevented. Otherwise, it can cause serious morbidity and mortality (1). Dramatic increase in intracranial pressure (IP) of patients with intracerebral hemorrhage; associated with deaths (2).

IP measurement is important in terms of patient follow-up and prognosis. IP is measured by interventional methods such as lumbar puncture or ventriculostomy. At the same time, changes in IP affect the optic nerve sheath diameter (ONSD) via cerebrospinal fluid (CSF). Especially since this pressure increase can cause enlargement in the retrobulbar segment, this region is used in measurements. (3). ONSD; it is an anatomical structure that continues from the intracranial area and is surrounded by CSF. Thus, the increase in ONSD is used to detect IP.

The gold standard method for measuring IP is ventricular catheterization. However, the invasiveness of these methods, the need of a neurosurgeon to perform the intervention, technical difficulties, infection, hemorrhage, contraindications of the procedure such as coagulopathy and thrombocytopenia are limiting factors in the application of the method (4). It is thought that IP in patients diagnosed with intracranial hemorrhage can be evaluated with ONSD without using an invasive method. In this study, the aim of this study is to evaluate the changes in ONSD according to the subtypes of intracranial hemorrhage in patients diagnosed with nontraumatic intracranial hemorrhage, early and without any interventional procedure.

METHODS

Before starting the study, ethical approval was obtained from Ankara Yıldırım Beyazıt University Faculty of Medicine Clinical Research Ethics Committee (Decision No. 46, dated February 17, 2016). Since the presented study was retrospective and observational, informed consent was not obtained from the participants. However, all authors paid attention to its compliance with the Declaration of the World Medical Association of Helsinki.

Study Population

Inclusion criteria: Statistical analysis

All cases with nontraumatic intracranial hemorrhage, aged 18 years and over, who applied to Ankara Yıldırım Beyazıt University Hospital Emergency Medicine Clinic between the specified dates, and whose data could be accessed, were included.

Exclusion criteria

Patients with a history of trauma, eye or orbital diseases such as glaucoma, optic neuritis, ischemic optic neuropathy, lens opacity, history of malignancy, pregnancy and trauma were not included in the study.

Data Collection

Demographic data of the patients included in the study, both Glasgow coma scale (GCS) and brain tomography (CCT) images at the time of first admission and eight hours later were analyzed retrospectively. In cases where the patient does not have sudden changing clinical findings, the control CCT scan time is applied as the 8th hour in our center. According to CCT images, it was analyzed by dividing into 3 classes as intracerebral hemorrhage (ISH), subdural hemorrhage (SH) and epidural hemorrhage (EH). subarachnoid hemorrhage (SAH) patients in our hospital were excluded from the study because it was determined that it developed secondary to trauma. The amount of bleeding in the patients CCT was measured after determining the widest part of the bleeding area. In addition, the ONSD of each patient's first admission and eighth hour CCT scans were measured separately in both the right and left eyes. Measurements were made in the axial and sagittal planes of both eyes, 2-3 mm behind the optic disc, at 5 times magnification. All CCT evaluations were made by the radiologist and recorded in the data collection forms.

Statistical Analysis

The analysis of the study was performed using SPSS 21.0 package program. Descriptive statistics of the variables (Frequency, Percentages, Mean ± Standard Deviation, Median (IQR) were given with tables. Shapiro-Wilk tests were used to determine whether the variables met the parametric test assumptions, and it was determined that they did not fit the normal distribution (p< 0.05) The difference between dependent groups was determined by Wilcoxon signed rank test. A p value of <0.05 was considered statistically significant.

RESULTS

136 patients were included in the study. The mean age of the patients was 64.5 ± 17.8 years, with 47.1% female (n=64) and 52.9% male (n=72). ICH 64.7% (n = 88), SH was 29.4% (n = 40) and additional 5.9% (n = 8) (Table 1) first admission median (IQR) values of bleeding diameters in CCTs at 8 hours were 23.3 (24.4) and 27.9 (31.2), respectively. And this increase at 8 hours was statistically significant (p<0.001). At the 8th hour, the right ONSD (5.2 (0.6)) showed a significant increase in the moment (4.5 (0.6)) (p <0.001). Similarly, the left ONSD was significantly higher than the 8th time (5.2 (0.7)) of first admission (p <0.001). Parallel to the increase in hemorrhage diameter, right and left ONSD, a significant decrease was observed in GCS at 8 hours (13.0 (2)) compared to the time of admission (14.0 (1)) (p<0.001) (Table 2).

Table 1. Demographic and clinical characteristics of the patients

Parameter		
Age (years)		
	Mean±SD	64.5 ± 17.8
	Median (IQR)	65.0 (25.8)
Gender		
	female; % (n)	%47.1 (64)
	male; % (n)	%52.9 (72)
Diagnosis		
	ISH; % (n)	%64.7 (88)
	SH; % (n)	%29.4 (40)
	EH; % (n)	%5.9 (8)

ISH; Intracerebral Hemorrhage, SH; Subdural Bleeding, EH; Epidural Bleeding.

Table 2. Comparison of changes in repeated measured parameters in all patients.

Variable	**first admission Median (IQR)**	**8 hours Median (IQR)**	***p***
Bleeding Diameter	23.3 (24.4)	27.9 (31.2)	**<0.001**
Right ONSD	4.5 (0.6)	5.2 (0.6)	**<0.001**
Left ONSD	4.5 (0.6)	5.2 (0.7)	**<0.001**
GCS	14.0 (1)	13.0 (2)	**<0.001**

Wilcoxon signed rank test
ONSD; optic nerve sheath diameter, GCS; Glasgow coma scale.

The median (IQR) values of the bleeding diameters in the 8th hour CCT of the patients with ISH, SH, and EH were found to be 35.8 (25), 13 (7.7) and 17.7 (19.2), respectively. Moreover, these values were found at the time of admission (30.8 (19.9), 9.1 (7.7) and 12.7 (6.5)), there is a statistically significant increase (p<0.001; p<0.001; p=0.011, respectively) (table 3).

Right ONSD median (IQR) values in the 8th hour CCT of the patients with ICH, SH, and EH were 5.2

(0.5), 5 (0.8), and 5.25 (1), respectively. There is a statistically significant increase compared to (4.5 (0.5), 4.3 (0.6) and 4.5 (0.9)) at the time of arrival ($p<0.001$; $p<0.001$; $p=0.012$, respectively).

Left ONSD median (IQR) values in the 8th hour CCT of the cases with ICH, SH, and EH were 5.2 (0.5), 4.95 (0.8), .3 (1.1), respectively, at the time of arrival (4.5 (0.5), 4.3 (0.5), 4.6 (0.9)), there is a statistically significant height ($p<0.001$; $p<0.001$; $p=0.012$, respectively).

The median GCS (IQR) values of patients with ICH and SH at the eighth hour CCT were 14.0 (1.8), 12.0 (3.0), respectively, and there was a statistically significant decrease compared to the GCS values at the time of admission (14.0 (1.0), 14.0 (2.0). ($p<0.001$; $p<0.001$ respectively) In the EH group, there was no significant difference in GCS care between arrival and 8th hour ($p=0.066$). 0.047)

Table 3. The relationship between bleeding subtypes and GCS, optic nerve diameter and bleeding diameter.

Variable		**first admission Median (IQR)**	**8 hours Median (IQR)**	**p**
Bleeding diameter	**ISH**	30,8 (19.9)	35.8 (25)	**<0.001**
	SH	9.1 (7.7)	13 (7.7)	**<0.001**
	EH	12.7 (6,5)	17.7 (19.2)	**0.011**
Right ONSD	**ISH**	4.5 (0.5)	5.2 (0.5)	**<0.001**
	SH	4.3 (0.6)	5 (0.8)	**<0.001**
	EH	4.5 (0.9)	5.25 (1)	**0.012**
Left ONSD	**ISH**	4.5 (0.5)	5.2 (0.5)	**<0.001**
	SH	4.3 (0.5)	4.95 (0.8)	**<0.001**
	EH	4.6 (0.9)	5.3 (1.1)	**0.012**
GKS	**SH**	14.0 (1.0)	14.0 (1.8)	**<0.001**
	SH	14.0 (2.0)	12.0 (3.0)	**<0.001**
	EH	14.5 (1.8)	12.0 (5.0)	0.066

1: Wilcoxon signed rank test
ONSD; optic nerve sheath diameter, GCS; Glasgow coma scale, ICH; Intracerebral hemorrhage, SH; Subdural bleeding, EH; epidural bleeding

DISCUSSION

In this study, the effect of ONSD on patients diagnosed with nontraumatic intracranial hemorrhage in the emergency department was investigated between the time of first admission to the hospital and the eight-hour follow-up period. In the eight-hour follow-up of the patients, a significant increase was found in the bleeding diameter and ONSD value in all three bleeding subtypes compared to the value at the time of admission. In the evaluation, it was determined that both the right eye and the left eye had a significant increase in ONSD. The level of consciousness is the first and important finding that informs the change in the neurological status of the patient. GCS is a scoring method that shows the level of consciousness and brain damage (5,6). Accordingly, in parallel with the increase in bleeding diameter, right and left ONSD, a significant decrease was observed in GCS at 8 hours (13.0 (2)) compared to the time of admission (14.0 (1)) ($p<0.001$) This situation can be explained by the fact that when the increase in ONSD is observed, it is thought that GCS may decrease, and the patient can be followed in this direction.

According to the available source information, it has been shown that there is dilatation of ONSD in cases with increased intracranial pressure. In addition, investigators reported that in cases where intracranial pressure increases, ONSD increases significantly (7,8). Similarly, in the presented study, it was found that ONSD increased in the following hours due to the increase in IP. This can be explained as the increase in the diameter of bleeding may lead to an increase in intracranial pressure.

In studies, ONSD has been suggested as an indirect and alternative parameter for the detection of increased intracranial pressure. However, in the source information reached, no research was found regarding the examination of ONSD according to the bleeding subtypes. Accordingly, ONSD was evaluated according to bleeding subtypes in patients with non-traumatic intracranial hemorrhage, considering that ONSD may vary according to its subtypes and may guide the diagnosis and treatment in this situation. In the study, the relationship between nontraumatic intracranial hemorrhage (ICH) subtypes (ICH, SH, and EH) and SAH was investigated, but SAH was excluded because it was traumatic. It was determined that the ONSD of all cases with ICH, SH and EH increased statistically significantly. A significant decrease was observed in the median GCS (IQR) at the eighth hour in patients diagnosed with ICH and SH. In the EH group, there was no significant difference in GCS care between arrival and 8th hour. This situation can be explained as the low number of patients in the EH group.

In the literature, frequent follow-up of patients with non-traumatic intracranial hemorrhage is recommended (9,10,11). In the presented study, a significant decrease in GCS values was found in patients with ICH and SH at the eighth hour. It can be explained as the need for rapid intervention, as it can cause serious complications in patients with a diagnosis of ICH and SH if it is waited for eight hours. In different studies, Geeraerts et al. reported that there is a significant relationship between GCS and IP (12). Similarly, Karakitsos et al. reported that there is a significant relationship between IP and GCS. In addition, while the ONSD was 5.8 ± 1.1 mm in patients with moderate and severe coma with GCS <13, it was found to be 4.9 ± 0.8 mm in patients with mild coma. Researchers have reported that there is a statistically significant relationship between GCS and ONSD(13). Besides, IP can be evaluated by measuring the noninvasive and easy method (ONSD). 14,15). Patients with IP had increased ONSD and its measurement using CCT has been reported to be important(16,17). In the presented study, it is thought that the bleeding diameters of the cases increased at the 8th hour, and accordingly, IP and GCS decreased. The significant relationship between the increase in ONSD and decrease in GCS is; It was thought that the increase in IP and the increase in ONSD may occur.

Study Limitation

Since the study is retrospective, the data obtained are limited to file information.

CONCLUSION

In cases with non-traumatic ICH, the change in the ONSD level and the change in GCS score should be checked in the first admission to the hospital and in the eighth hour control brain tomography. It was concluded that this situation could be effective in reducing mortality and morbidity by detecting IP change. Accordingly, when evaluating the brain tomography of patients with non-traumatic ICH;in addition to the existing parameters, it was suggested that optic nerve diameter change should also be considered.

Ethics Committee Approval: Ethical approval was obtained from Ankara Yıldırım Beyazıt University Faculty of Medicine Clinical Research Ethics Committee (Decision No. 46, dated February 17, 2016).

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REFERENCES

1. Gonzalez-Duarte A, Cantu C, Ruiz-Sandoval JL, Barinagarrementeria F. Recurrent Primary Cerebral Hemorrhage Frequency, Meohanisms, and Prognosis. Stroke. 1998;29:1802-1805.
2. Hacke W, Schwab S, Horn M, Spranger M, De Georgia M, von Kummer R. 'Malignant' middle cerebral artery territory infarction: clinical course and prognostic signs. Arch Neurol. 1996;53:309-315.
3. Hansen HC, Helmke K. The subarachnoid space surrounding the optic nerves. An ultrasound study of theoptic nerve sheath. Surg Radiol Anat. 1996;18 (4) :323-8.
4. Rickert K, Sinson G. Intracranial pressure monitoring. Oper Tech Gen Surg. 2003;5:170-175.
5. Vavilala MS, Lujan SB, Qiu Q, Petroni GJ, Ballarini NM, Guadagnoli N, et al. Benchmarking Prehospital and Emergency Department Care for Argentine Children with Traumatic Brain Injury: For the South American Guideline Adherence Group PLoS One. 2016;11 (12) :e0166478.
6. Bombacı E, Boztepe A, Cizen A, Cevik Z, Çolakoglu S, Yollu Atakan T. The relationship between bispectral index monitoring and modified Glasgow coma and Ramsay sedation scale scores in unconscious intensive care patients. Bakirköy Medical Journal. 2005;1 (3):90-4.
7. Hayreh SS. Pathogenesis of edema of the optic disc. Doc Ophthalmol. 1968;24:289-411
8. Amini A, Kariman H, Dolatabadi AA, Hatamabadi HR, Derakhshanfar H, Mansouri B, et al. Use of the sonographic diameter of optic nerve sheath to estimate intracranial pressure. Am J Emerg Med. 2013;31 (1) :236-9.
9. Sekhon MS, McBeth P, Zou J, Qiao L, Kolmodin L, Henderson WR, et al. Association between optic nerve sheath diameter and mortality in patients with severe traumatic brain injury. Neurocritical care. 2014;21 (2) :245-52.
10. Karasu A, Sabancı PA, Cansever T, Hepgül KT, Imer M, Dolaş I, et al. Epidemiological study in head injury patients. National Journal of Trauma Emergency Surgery. 2009;15 (2) :159-163.
11. Cokuk A, Kozaci N, Ay MO, Acikalin A, Seviner M, Satar S. Evaluation of Head Trauma Cases in the Emergency Department. Cukurova Medical Journal. 2013;38;63-71.
12. Thomas Geeraerts, Sybille Merceron, Dan Benhamou, Bernard Vigue, Jacques Duranteau. Non-invasive assessment of intracranial pressure using ocular sonography in neurocritical care patients. Intensive Care Med. 2008;34:2062-67.
13. Karakitsos D, Soldatos T, Gouliamos A, Armaganidis A, Poularas J, Kalogeromitros A, et al. Transorbital sonographic monitoring of optic nerve diameter in patients with severe brain injury. Transplant Proc. 2006;38:3700-6.:963-7.
14. Guzelda S, Yılmaz G, Tuna M, Altuntas M, Ozdemir M. Measuring the Optic Nerve Sheath Diameter with Ultrasound in Acute Middle

Cerebral Artery Stroke Patients. Journal of Stroke and Cerebrovascular Diseases,2021,30.2: 105523.

15. Celik K, Demiryurek B. E.The association between intracranial pressure and optic nerve sheath diameter on patients with head trauma. Arq Neuropsiquiatr 2021;79(10):879-885

16. Kim D Y, Kim S Y, Hong D Y, sung B Y, Lee S, Paik J H et all. Comparison of ultrasonography and computed tomography for measuring optic nerve sheath diameter for the detection of elevated intracranial pressure. Clinical Neurology and Neurosurgery 204 (2021) 106609

17. Altayar A S, Abouelela A Z, Abdelshafey E E, Mohammed K S, Hassan A A, Khattab M A et all. Optic nerve sheath diameter by ultrasound is a good screening tool for high intracranial pressure in traumatic brain injury. Ir J Med Sci (2021) 190:387–393