Journal of Kerman University of Medical Sciences

JKMU

Journal of Kerman University of Medical Sciences, 2020; 27 (5): 468-473

The Prevalence and Properties of Intracranial Vascular Abnormalities in CT Angiography of Patients with Non-traumatic Intracranial Hemorrhage

Mohammad Saba, M.D. [1], Ahmad Naghibzadeh-tahami, Ph.D. [2], Salman Daneshi, M.Sc. [3], Batool Labibi, M.D.[4], Fatemeh Labibi, M.D. [5]

1. Assistant professor, Department of Radiology, Neurology Rersearch Center Kerman University of Medical Sciences, Kerman, Iran
2. Physiology research Center, Kerman University of Medical Sciences, Kerman, Iran
3. Lecturer, Department of Public Health, School of Public Health, Jiroft University of Medical Sciences, Kerman, Iran
4. Medical student, Afzalipour School of Medicine, Kerman University of Medical Sciences, Kerman, Iran
5. Resident, Department of Radiology, Shafa Hospital, Afzalipour School of Medicine, Kerman University of Medical Sciences, Kerman, Iran

(Corresponding author: Email: Fatemehlabibi64@gmail.com)

Received: 14 October, 2018 Accepted: 23 October, 2019

ARTICLE INFO

Article type:
Short Communication

Keywords:
Epidemiology
Intracranial hemorrhage
Subarachnoid hemorrhage
Arteriovenous malformations
Intracerebral aneurysms

Abstract

Introduction: Intracranial hemorrhage (ICH) is divided into two traumatic and non-traumatic categories. The present study sought to investigate the anatomical properties of non-traumatic intracranial hemorrhage in Kerman, Iran.

Method: A total of 305 non-traumatic ICH cases were chosen in Shafa medical center. Data from patients' files and CT scan images, including demographic factors and type of malformation, aneurysm size and shape, as well as the invovled location and artery were gathered and statistically analyzed.

Results: Most cases were 40-60 years old. SAH, ICH and SAH+IVH were 69.5%, 14.4 and 8.5% respectively. From all, 65.2% had arteriovenous malformation and following furthure assessment, aneurysm with 148 cases (74.4%) was the most frequent and 57.4% of aneurysm cases were located in the right hemisphere. In 14.9% of cases, multiple aneurysms were observed.

Conclusions: According to the results of this study, non-traumatic intracranial hemorrhages caused by arteriovenous malformation were in the shape of an aneurysm; an increase in age may result in higher probability of aneurysm occurence.

Copyright: 2020 The Author(s); Published by Kerman University of Medical Sciences. This is an open-access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Saba M, Naghibzadeh-tahami A, Daneshi S, Labibi B, Labibi F. The Prevalence and Properties of Intracranial Vascular Abnormalities in CT Angiography of Patients with Non-traumatic Intracranial Hemorrhage. *Journal of Kerman University of Medical Sciences*, 2020; 27 (5): 468-473.

Introduction

Intracranial hemorrhages (ICH) are divided into traumatic and non-traumatic categories. Hemorrhage caused by trauma to head are more common, while 10-15% of strokes result in non-traumatic or automatic hemorrhages. More often than not, these hemorrhages are parenchymal; however, in some cases, subarachnoid space, subdural space, intraventricular space and, in rare cases, Epidural space is also involved (1). The prevalence of spontaneous brain hemorrhage was 15.5/100000 in general population of Kerman city (2).

Among the most probable causes of non-traumatic intracranial hemorrhage, we could point to high blood pressure,

cerebral amyloid angiopathy (CAA), hemorrhagic changes of cerebral ischeic traumas, aneurysmal bleeding of subarachnoid, arteriovenous malformations and defects, intravenous thrombosis, neoplasia and cancers, and vasculopathies and vasospasms (1, 3).

In most cases, clinical manifestations of parenchymal hemorrhage are usually focal neurologic deficit with headache, changes in consciousness level, seizure, nausea and sometimes vomitting (4). Clinical manifestations in ischemic strokes can be very similar to intracerebral hemorrhage, therefore early diagnosis and treatment of paients require accurate imaging. For more accurate results, most clinics use supplementary studies including angiography, MRI and etc (5). Arteriovenous malformations cause up to 20% of automatic ICHs and are the main cause of ICH occurance in young adults. These malformations may include arterial aneurysms, arterial-venous malformations, dural arteriovenous fistula (DAVF), cavernous malformations and telangiectasia and etc (6,7).

The most prevalent cause of subarachnoid hemorrhage is trauma. However, among non-traumatic cases, torn aneurysms, with 85% occurrence, were the most common cause. While aneurysmal subarachnoid hemorrhage can only casue 5% of the strokes, in 12-66% of cases it results in death (9). The most common risk factors of aneurysmal subarachnoid hemorrhage are hypertension and smoking and its incidence is higher in female patients than male patients (10). Angiographic CT is used as a diagnostic modality in most medical centers. In the scan image, aneurysm is seen as a bag full of contrast agent which is protruding from vessel. This diagnositic modality is quick and easy to use, even with critical patients. In addition, angiographic CT is very accurate and in case of access to multi-slice scaners, we can reach 100% accuracy and sensitivity which can even identify small aneurysms and is only contraindicated in patients with contrast agent allergies and kidney failure (11, 12).

In a cohort study, Song *et al.* (2006-2008) examined 2562 patients with non-traumatic subarachnoid hemorrhage. Based on the results of their study, 81.4% of non-traumatic subarachnoid hemorrhage had been caused by aneurysm among which 15.4% were multiple aneurysms. Moreover, they reported ACOM artery with 30.1%, PCA with 28.7% and MCA with 15.9% as the most prominent sources of aneurysms (13).

After the clear diagnosis of malformation through recognition of hemorrhage source and aneurysm size and location, patient treatment protocol can be determined. Therefore, considering the lack of any valid and novel epidemiologic research in our region, the present study sought to investigate the prevalence rate of this defect in patients with non-traumatic hemorrhage in Kerman/Iran, examine their anatomical properties and evaluate the relevant occurrence factors to reach a better epidemiologic view of the disease in this region.

Material and Methods

A total of 305 patients admitted in neurology, neurosurgery and other departments of Shafa Medical Center, Kerman, Iran with possible diagnosis of intracranial vascular anomalies were enrolled in this study. All these patients suffered from intracranial hemorrhage in the time period of September 2012 to May 2017 and had been referred to the CT scan department to undergo a cerebrovascular angiographic CT scan. If the angiographic scan showed any sign of trauma, the patient was excluded from the study. Angiographic images and restored

images of all patients were verified. In addition, patients' files were completely reviewed and CT angiographic information, such as kind of malformation, aneurysm size and shape, the involved artery and its location, and also personal characteristics such as age, sex, diabetes, blood pressure, time of hemorrhage, were extracted from medical records. Finally, all data were entered into SPSS 20 software and the relations between different variables were analyzed.

Results

In this cross-sectional study, a total of 305 medical files of cases with intracranial hemorrhage with the possibility of intracranial vascular abnormalities and available cerebral angiography CT were examined. The number of male and female patients were almost similar [155 female (50.8%) and 150 male (49.2%)]. Mean age of study participants was 50.52±15.61 years ranged from 12 to 91 years old. The age group of 40- 60 years, with 159 patients (52.1%), had the most frequency. During the period of study, the highest and lowest rates of patient admission belonged to spring with 92 patients (30.2%) and summer with 70 patients (23%) respectively. Ten patients suffered from diabetes and all of them were female patients. In addition, 42 patients (13.1%), including 14 males and 28 females, had high blood pressure and only seven patients, all of them female, had both diabetes and high blood pressure. There was a significant difference between male and female patients in terms of having diabetes (p=0.001) and high blood pressure (p=0.007).

In terms of the causes of admission, SAH with 212 cases (69.5%) was the most frequent cause followed by ICH with 44 cases (14.4%) and SAH+IVH with 26 cases (8.5%). In whole, 199 cases (65.2%) had vascular malformation, among which aneurysm with 148 cases (74.4%), AVM with 29 cases (14.6%) and venous angiomas (DVAs) with 18 cases (9%) were seen more frequently (Table 1). Two cases of moyamoya disease and also two cases of cavernos hemangioma were observed. Among 148 patients with aneurysms, 69 individuals (46.6%) were male and 79 individuals (53.4%) were female with no significant difference.

Table 1. The frequency of vascular malformation variations

Vascular malformation variations	Number (%)
Aneurysm	148 (74.4%)
AVM	29 (14.6%)
Venous angiomas (DVAs)	18 (9%)
Cavernous hemangioma	2 (1%)
Moyamoya disease	2 (1%)
Sum	199 (100%)

In terms of aneurysm location, 7.79% of aneurysms were at posterior region and 92.21% were located at the anterior region. Among 14 aneurysm cases, most frequent ones were ACOM with 60 cases (40.5%) and MCA BIF with 31 cases (20.9%).

From all, 85 aneurysms (57.4%) were located on the right hemisphere, while the rest of them were located on the left hemisphere. There was no significant difference between male and female patients considering the place of aneurysm (p=0.48). Among diabetic patients, aneurysms were mostly located on the left which was statistically significant (P=0.04); however, no significant difference was observed among patients with high blood pressure in regard to aneurysms location (P=0.32).

Among cases with aneurysm, 126 cases (85.15%) had one aneurysm, 18 cases (12.25%) had two aneurysms and four

cases (2.7%) had three aneurysms. There was no significant relationship between diabetes and occurrence of aneurysm (P=0.62). Also, there was no relationship between high blood pressure and aneurysm in patients (P=0.48).

Discussion

Based on the results of this study, aging has a direct relationship with aneurysms occurrence, in a way that with aging the risk of carrying aneurysms increases by 2% (P=0.009, OR=0.01). In addition, female sex can increase the risk if carrying aneurysms by 35%, although this situation was statistically insignificant (P=0.1, OR=0.35). In other words, females were more potent to have aneurysms, but this difference was not statistically significant. The results of this study are parallel to the results of Rinkel (2007) who investigated the epidemiology of intracerebral aneurysms. Based on their study, the prevalence of aneurysms in adults without a risk factor was 2.3%. Moreover, the possibility of aneurysm in female patients was higher and also aging could increase this possibility further (14).

Some researchers have shown a positive correlation between diabetes and increase of aneurysms chance by 60%. However, this situation was statistically insignificant. High blood pressure could also increase the risk of aneurysms by 2.3%. There was a significant relationship between high blood pressure and the possibility of getting aneurysms (P=0.02, OR= 2.3) (Table 2).

Table 2. The frequency of vascular malformation-induced aneurysms among patients with high-blood pressure and diabetes

			malformation		SUM
			YES	NO	
High blood pressure	Positive	Diabetes	6 (85.7%)	1 (14.3%)	7 (100%)
		Non-diabetes	22 (66.7%)	11 (33.3%)	33 (100%)
	Negative	Diabetes	1 (33.3%)	2 (66.7%)	3 (100%)
		Non-diabetes	170 (64.9%)	92 (35.1%)	262 (100%)

In the present study, up to 15% of cases had more than one aneurysm. Similar studies have also reported multiple aneurysms. In Meisel *et al*. (2000) study, the occurrence of multiple aneurysms was 18.2% (15), while this possibility was 20.2 in Kaminogo *et al*. study (16).

Based on the results of the present study, diabetes and high blood pressure showed no significant relationship with multiple intracerebral aneurysms. Juvela has also reported the same results and although in this study high blood pressure as been considered as an affective factor in aneurysm occurrence, there has been no evidence for the relationship between high blood pressure and multiple aneurysms (17).

In the present study, most torn aneurysms were related to ACOM (40.5%) and 30.2% were observed in spring, 23% in summer, 23.3% in fall and 23.6% in winter. No significant relationship was observed between season and torn aneurysm (P=0.24) (Table 3).

Table 3. Frequency of reasons for visiting in each season

		Visiting Season			
		Spring	**Summer**	**Autumn**	**Winter**
Reasons for visiting	SAH	67 (72.8%)	43 (61.4%)	49 (69%)	53 (73.6%)
	SAH+IVH	11 (12%)	10 (14.3%)	2 (2.8%)	3 (4.2%)
	SAH+ICH	1 (1.1%)	3 (4.3%)	2 (2.8%)	3 (4.2%)
	ICH	10 (22.7%)	11 (15.7%)	15 (21.1%)	8 (11.1%)
	SAH+IVH+ICH	0 (0%)	2 (2.9%)	0 (0%)	1 (1.4%)
	IVH	3 (3.3%)	1 (1.4%)	3 (4.2%)	3 (4.2%)
	SUM	92 (100%)	70 (100%)	71 (100%)	72 (100%)

Conclusion

Aneurysmal hemorrhage accounts for a big part of intracranial hemorrhage which mostly affects anterior blood flow and the possibility increases as the patient gets older. Blood pressure is a known risk factor in aneurysm occurrence, while sex and diabetes have no significant relationship with aneurysm occurrence.

References

1. Fischbein NJ, Wijman CA. Nontraumatic intracranial hemorrhage. Neuroimaging Clinics 2010; 20(4):469-92.
2. Ebrahimi HA, Shafa MA, Saba M. Non-truamatic brain hemorrhage in Kerman Iran. Archive of Iranian Medicine 2000; 2(3):1-3.
3. Caceres JA, Goldstein JN. Intracranial hemorrhage. Emerg Med Clin North Am 2012; 30(3):771-94.
4. Magistris F, Bazak S, Martin J. Intracerebral hemorrhage: pathophysiology, diagnosis and management. MUMJ 2013; 10(1):15-22.
5. Domingues R, Rossi C, Cordonnier C. Diagnostic evaluation for nontraumatic intracerebral hemorrhage. Neurol Clin 2015; 33(2):315-28.
6. Smith SD, Eskey CJ. Hemorrhagic stroke. Radiol Clin North Am 2011; 49(1):27-45.
7. Qureshi AI, Tuhrim S, Broderick JP, Batjer HH, Hondo H, Hanley DF. Spontaneous intracerebral hemorrhage. N Engl J Med 2001; 344(19):1450-60.
8. Aguilar MI, Brott TG. Update in intracerebral hemorrhage. Neurohospitalist 2011; 1(3):148-59.
9. Suarez JI, Tarr RW, Selman WR. Aneurysmal subarachnoid hemorrhage. N Engl J Med 2006; 354(4):387-96.
10. Wong GK, Ng RY, Poon WS. Aneurysmal subarachnoid haemorrhage. Surgical Practice 2008; 12(2):51-5.
11. Kidwell CS, Wintermark M. Imaging of intracranial haemorrhage. Lancet Neurol 2008; 7(3):256-67.
12. Heit JJ, Iv M, Wintermark M. Imaging of intracranial hemorrhage. J Stroke 2017; 19(1):11-27.

13. Song JP, Ni W, Gu YX, Zhu W, Chen L, Xu B, et al. Epidemiological features of nontraumatic spontaneous subarachnoid hemorrhage in China: a nationwide hospital-based multicenter study. Chin Med J (Engl) 2017; 130(7):776-81.

14. Rinkel GJ. Natural history, epidemiology and screening of unruptured intracranial aneurysms. J Neuroradiol 2008; 35(2):99-103.

15. Meisel HJ, Mansmann U, Alvarez H, Rodesch G, Brock M, Lasjaunias P. Cerebral arteriovenous malformations and associated aneurysms: analysis of 305 cases from a series of 662 patients. Neurosurgery 2000; 46(4):793-800.

16. Kaminogo M, Yonekura M, Shibata S. Incidence and outcome of multiple intracranial aneurysms in a defined population. Stroke 2003; 34(1):16-21.

17. Juvela S. Risk factors for multiple intracranial aneurysms. Stroke 2000; 31(2):392-7.