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Original Article

Retrospective evaluation of the patients who were admitted to the emergency department of our hospital due to a brain aneurysm and operated by brain surgery clinic

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Abstract

Aim: In this study, we aimed to evaluate the clinical features of brain aneurysms in patients who were admitted to the emergency department in our hospital.

Material and Methods: The records of 91 patients who were admitted to the emergency department for any reason between 01.01.2013 and 01.01.2018 and diagnosed with a brain aneurysm after brain- CT-angiography together with aneurysm-related symptoms and were operated were retrospectively screened after the approval of the local ethics committee. The patients' age, weight, sex, bleeding time, Glasgow coma scale (GCS), Fisher, Yasargil scores, complications, postoperative status, and the presence of diabetes mellitus were recorded. Brain-CT-angiography was used to record the localization of the aneurysm, its size,Fisher grading scale, projection, anatomical variation, whether it was multiple or incidental, he presence of intraventricular hemorrhage and SAH.

Results: There was a statistically significant and strong negative correlation between GCS and Fisher and Yasargil classifications. There was a statistically significant and strong positive correlation between the post-op status of the patient and Fisher, Yasargil classifications and the complications.

Conclusion: Whether the patients are admitted to the emergency department with clinical symptoms of an aneurysm or not, when the patients are diagnosed with an aneurysm, we believe that one of GCS, Fisher, or Yasargil classifications will reflect the patient's clinical status, vasospasm status if SAH is present, post-op status, and complications. We think that the location, size, and projection of the aneurysms are related to the emerging complications and post-op status.

Keywords: Brain aneurysm; surgical treatment; fisher classification; Yasargil classification.

INTRODUCTION

Subarachnoid hemorrhage (SAH) is the condition where blood passes through the cerebrospinal fluid (CSF). It often occurs after aneurysm rupture (85%) (1). Intracranial aneurysms are the most common intracranial pathology leading to SAH other than trauma and their frequency has been reported to be 6-8/100,000 (2). It has been reported that 15-20% of these untreated patients had a recurrent hemorrhage in the first 2 weeks, resulting in a mortality rate of 45% in the first 30 days (3). 30% of patients with SAH suffer from moderate and severe disabilities, and 66% cannot return to the pre-hemorrhage quality of life despite successful surgery and treatment (4). There are several classification systems for evaluating the radiological and clinical findings of SAH. These include Hunt and Hess for clinical evaluation, and Fisher classification system for radiological evaluation (5). Yasargil classification is also one of the systems used for clinical staging (6). It has been reported that advanced-stage cases have a poor prognosis.

The etiology of aneurysms includes acquired factors such as hypertension, atherosclerosis, and hemodynamic stress. There are opinions suggesting that both congenital and acquired factors play a role in the formation of aneurysms. It has been reported that vascular variations may also contribute to aneurysm formation due to changes caused by blood flow (7).

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Patients with clinical symptoms of an aneurysm going to the emergency department should be checked for the status of aneurysms, clinical staging, the presence of diabetes mellitus, and the frequency of complications after the operation. These are of foremost importance in terms of early intervention and timely prediction of future events.

In this study, we aimed to retrospectively evaluate the radiological and clinical staging, the localization of the aneurysms, their projection, size, and anatomical variation, whether there were multiple aneurysms, whether they were incidental, the presence of intraventricular hemorrhage, complications, the presence of SAH and diabetes mellitus among the patients who were admitted to the emergency department with the clinical symptoms of aneurysm and were operated.

MATERIAL and METHODS

The records of 91 patients who were admitted to the emergency department for any reason between 01.01.2013 and 01.01.2018 and diagnosed with a brain aneurysm after brain-CT-angiography together with aneurysm-related symptoms and were operated were retrospectively screened after the approval of the local ethics committee.

The patients' age, weight, sex, bleeding time, Glasgow coma scale (GCS), Fisher, Yasargil scores, complications, postoperative status, and the presence of diabetes mellitus were recorded from patient files.

Brain-CT-angiography images were used to record the localization of the aneurysm, its size, Fisher grading scale, projection, anatomical variation, whether it was multiple or incidental, the presence of intraventricular hemorrhage and SAH.

Patient position: the patient was placed on the operating table with the head neutral and 20-25 degrees of extension in the supine position. The table was positioned so that the head was above the heart level. The head is fixed at three points with a studded hood. After cutting the patient's skin and subcutaneous fronto temporal craniotomy was performed. When the dura mater is opened then classic way distal from Sylvian cerebral artery and internal carotid artery bifurcation accessible reached. This aneurysm is dissected, separated from surrounding tissues, and an aneurysm clip is placed around the neck of the aneurysm. After the release of papaverine, the dura mater was sutured and closed.

Fisher grading scale:

1. Subarachnoid blood not detected
2. Diffuse or vertical layers>1mm
3. Local clot or vertical layers>1mm
4. Intracerebral or intraventricular clot with or without diffuse subarachnoid hemorrhage

Yasargil staging:

1. Stage-0a: Non-ruptured aneurysm, no neurological deficits
2. Stage-0b: Neurological deficits with ruptured aneurysm - losses such as 3rd cranial nerve palsy or progressive hemisyndrome
3. Stage-1a: There is SAH but no neurological deficit
4. Stage-1b: Patient is awake, engaged with its surroundings, there are no signs of meningeal irritation, but there is a significant neurological deficit, however, does not include findings such as 3rd-4th cranial nerve palsy
5. Stage-2a: Patient is awake; however, there are findings of headache and meningeal irritation following SAH
6. Stage-2b: There is a neurological deficit in addition to Stage-2a
7. Stage-3a: Patient is drowsy, blurred consciousness, not engaged with its surroundings, restless.
8. Stage-3b. In addition to 3a, there is focal neurological deficit
9. Stage-4: In a semi-coma, there is a response to painful stimuli, but there is no response to audible stimuli, extensor posture can be seen.
10. Stage-5: In a coma, pupils do not respond to light, there is no extensor response or any response to painful stimuli, vital signs are insufficient.

Statistical Analysis: All data were evaluated on SPSS for Windows 11.5 package program. Descriptive statistics were presented as mean±SD or n%. Correlation between variables was evaluated through bivariate correlation tests.

Pearson correlation coefficient (r):

<0.2 very weak or no correlation

Between 0.2-0.4 weak correlation

Between 0.4-0.6 moderate correlation

Between 0.6-0.8 strong correlation and r>0.8 very strong correlation.

P<0.05 was considered statistically significant in all analyses.

RESULTS

Age and gender of the patients are shown in the Table 1. Aneurysm status and the clinical findings of the patients are presented in Table 2. Table 3 shows whether there is any correlation between GCS, aneurysm localization, aneurysm size, projection, anatomic variation, Fisher's classification, Yasargil classification, complications, the presence of SAH and diabetes mellitus.

Table 1. Demeographic data of patients (Mean±SD, n%)

	Mean±SD
Age (years)	48.2±15.33
Weight (kg)	69.49±9.11
Gender M/F (n%)	33 36.3%-58 66.7%
Glaskow coma scale	12.03±3.36

Table 2. Data on the aneurysm and the patient's clinic (n%)		
	No	12-13.2%
Bleeding time	1. day	76-83.5%
	2. day	3-3.3%
Localization:	1R	6-6.6%
Internal carotid artery:1	1L	6-6.6%
A-COM-A:2	2R	41-45.1%
MCA:3	3R	12-13.2%
ACA:4	3L	14-15.4%
PCA:5	4R	3-3.3%
Right:R	4L	6-6.6%
Left:L	5R	3-3.3%
	<1	64-70.3%
Size (cm)	1-3	24-26.4%
	>3	3-3.3%
Projection:	S-A	36-39.6%
S:Superior	S-P	29-31.9%
A:Anterior	A-I	14-15.4%
P.Posterior	Fusiform	3-3.3%
A:Inferior L:Lateral	S-L	9-9.9%
Anatomical Variation	-	79-86.8%
	+	12-13.2%
Multiple	-	82-90.1%
	+	9-9.9%
Incidentally	-	79-86.8%
	+	12-13.2%
	1	9-9.9%
	2	43-47.3%
Fisher	3	9-9.9%
	4	30-33%
	1a	9-9.9%
	1b	30-33%
	1c	10-11%
	3a	20-22%
	4	22-24.2%
	-	67-73.6%
	+	24-26.4%
	-	70-76.9%
	+	21-23.1%
	Ex	55-60.4%
Post-op status	Healthy	35-38.5%
	Palliative care patient	1-1.1%
	-	12-13.2%
	+	79-86.8%
Diabetes mellitus	-	79-86.9%
	+	12-13.2%

There was a significant and strong negative correlation between GCS and Fisher, a significant and very strong negative correlation between GCS and Yasargil classification, a significant and weak negative correlation between GCS and the presence of SAH and between aneurysm localization and complications, aneurysm size and projection, between anatomic variation of aneurysm and Yasargil classification, between the occurrence of complications and occurrence of SAH, between anatomic variation and complications, between diabetes mellitus and GCS, between the post-op status of the patient and GCS, between the post-op status of the patient and the presence of SAH, between GCS and anatomic variation.

There was a significant and weak positive correlation between aneurysm size and presence of diabetes mellitus.

There was a significant and moderate positive correlation between Fisher classification and SAH, between Yasargil classification and the presence of SAH.

There was a significant and strong positive correlation between Fisher classification and Yasargil classification, between the post-op status of the patient and Fisher classification, between the post-op status of the patient and Yasargil classification, between the post-op status of the patient and complications.

DISCUSSION

Despite the development of alternative treatment methods for the treatment of intracranial aneurysms, surgical clipping remains the golden standard. In 1990, Gugliemi developed a treatment method where an aneurysm was filled with a coil via endovascular intervention. This method began to be widely used after FDA approval in 1995. After the International Subarachnoid Aneurysm Trial (ISAT) study published in 2002, it was proposed that endovascular coil embolization (ECE) results of intracranial aneurysms were similar to or better than microsurgery (8). However, the randomization of a small proportion of the total cases, randomization in favor of ECE in the selection of microsurgery or ECE, the lack of a guideline showing which patients should be treated with ECE, the centers participating in this study being located in Europe, Canada and Australia, the lack of information about the experiences of surgeons and endovascular operators, 80% of the cases being in good clinical status (H&H stage 1 or 2), 93% of aneurysms being ≤10 mm and 97% having anterior circulation were controversial issues for this study. With the development of endovascular techniques and materials (onyx, stents, flow modifiers, balloon-assisted coils, etc.) over time, the treatment of especially elderly patients (over 75 years), advanced stage, ruptured aneurysms with difficult access, aneurysm configuration (dom/neck ratio <0.5, neck thickness <5 mm), posterior circulation aneurysms, hemorrhagic aneurysms with Plavix-like antiaggregant use also brought ECE treatment of aneurysms to the forefront (9). Although it has become widespread in Turkey in recent years, the number centers with ECE experience are still few.

Table 2. Correlation of parameters related to aneurysm and patient clinic

	GKS	Localization	Size	Projection	A V	Fisher	Yasargil	Complication	SAC	DM
GKS										
r					0.239	-0.789	-0.885		-0.346	-0.346
p					*0.023	*<0.001	*<0.001		*<0.001	*0.001
Localization										
r								-0.257		
p								*0.014		
Size										
r				-0.251					0.348	
p				*0.016					*0.001	
Projection										
r			-0.251							
p			*0.016							
AV										
r							-0.246	-0.213		
p							*0.019	*0.042		
Fisher										
r	-0.789						0.774		0.528	
p	*<0.001						*<0.001		*<0.001	
Yasargil										
r	-0.885					0.774			0.509	
p	*<0.001					*<0.001			*<0.001	
Complicationn										
r		-0.257			-0.213				-0.249	
p		*0.014			*0.042				*0.017	
SAC										
r	-0.346					0.528	0.509	-0.249		
p	*<0.001					*<0.001	*<0.001	*0.017		
DM										
r	-0.346		0.348							
p	*0.001		*0.001							
Postop status of r	-0.346					0.626	0.644	0.537	0.234	
the patient p	*0.001					*<0.001	*<0.001	*<0.001	*0.025	

r: Pearson correlation coefficient. Statistically significant GKS: Glaskow coma scale,AV: Anatomical variation,SAC: Subarachnoid hemorrhage, DM: Diabetes mellitus

Although an aneurysm can be treated by both surgical and endovascular route, a brain injury caused by sudden intracranial pressure increase and a decrease in cerebral perfusion pressure at the time of SAH occurrence results in significant disabilities and mortality in the early period (10). Due to early brain damage caused by SAH, our patients were admitted to our center with GCS 12.03±3.36; Fisher 1: 9.9%, Fisher 2: 47.3%, Fisher 3: 9.9%, Fisher 4:33%; and Yasargil 1a: 9.9%, 1b: 33%, 1c: 11%, 3a: 22%, 4: 24.2%.

The relationship between the amount of bleeding in tomography and the outcome is known to be a crucial factor in terms of vasospasm development (11). At the same time, the degree of consciousness and the amount of bleeding at the time of admission were reported to be powerful factors affecting the outcome (12). However, in these patients, the goal is to eliminate the risk of the recurrent bleeding of the aneurysm and to prevent secondary damage. The timing of the treatment of bleeding aneurysms for this purpose is also a separate matter of discussion (13). Early surgery is advocated for causes such as 4% of recurrent bleeding happening in the first 24 hours, the hypertension, hemodilution, hypervolemia (HHH) treatment applied after the third day to fight against vasospasm not presenting any risk for recurrent aneurysm bleeding, the removal of potential vasospasmogenic agents in the subarachnoid distance during surgery, overall mortality's being lower despite a higher surgery-related mortality rate (14). In our study, we elucidated the relationship between Fisher classification, Yasargil classification, GCS, patient consciousness, and the amount of bleeding and found a significant and strong positive correlation between Fisher and Yasargil classification, and a significant and strong negative correlation between GCS and Fisher and Yasargil classifications. We think that one of these three classifications can be used to evaluate aneurysms.

In the subarachnoid distance, vasospasm after SAH resulting from mixed mechanisms triggered by vasospasmogenic blood products is seen in 30-45% of the cases (15). Vasospasm, usually seen 3-14 days after bleeding, may result in focal or progressive neurological deficits, even death, despite successful aneurysm surgery (16). A relationship between the vasospasm and Fisher and Yasargil staging and the amount of blood in the subarachnoid distance has been reported (17). Despite the use of calcium channel and endothelin receptor blockers, HHH treatment, intra-arterial papaverine, mechanical arterial dilatation and angioplasty methods in the treatment of clinical vasospasm, a 100% successful treatment protocol is unfortunately still not available (18). Interventional methods such as percutaneous transluminal angioplasty and intra-arterial vasodilator injection are also used in the fight against vasospasm. However, these methods have failed to become a standardized treatment for vasospasm, which is a dynamic process and seen in the microcapillary level near large vessels, and uncertainty about the long-term results and significant complication risks have also been reported (19).

Post-op status of our cases was positively correlated with the frequency of complications, negatively correlated with GCS, and positively correlated with Fisher and Yasargil classifications. This suggested that these scoring systems gave a sound idea of the post-op status of patients. We also found that the post-op status of our cases was correlated with the frequency of complications.

The size of an aneurysm is statistically significant in terms of SAH risk. Incidental aneurysms less than 10 mm have a lower risk of hemorrhage compared to aneurysms between 10 and 25 mm (20). Wiebers et al. (21) found that, left to their natural course, aneurysms above 10 mm were more likely to have hemorrhage compared to aneurysms below 10 mm. However, when the size of hemorrhaged aneurysms was investigated, the higher number of hemorrhaged aneurysms below 10 mm was attributed to the decrease in aneurysm size after bleeding (21). The bleeding rate of non-hemorrhaged aneurysms of patients with multiple aneurysms diagnosed with SAH was found to be 11 times higher than patients without a history of SAH (22). In accordance with the literature, we found the incidence of aneurysms <1cm as 70.3% in our study. The incidence of aneurysms 1-3cm was 26.4% and >3cm was 3.3%. However, we did not find a significant correlation between size and SAH formation. We only found a significant weak correlation between aneurysm size and diabetes mellitus in patients and attributed this to vasculopathies in diabetic patients.

Basilar peak, vertebrobasilar system aneurysms, posterior cerebral artery (PCA) aneurysms, and posterior communicating artery (PCoA) aneurysms carry a substantial risk of hemorrhage (23). However, we could not find a correlation between localization and the presence of SAH.

Limitations

Due to the lack of regular health insurance records and death data because of the lack of general studies in the field of epidemiology, information on disability, mortality, risk factor distribution, and their relationship to the clinical status is insufficient. Determining the common risk factors by making extensive epidemiological studies, and especially identifying the risk factors that can be changed, decreased or are yet unknown, is extremely important in terms of preventive health measures to be taken in a community. We conducted a retrospective, single-center study with a small sample size related to the epidemiology of aneurysms. We recommend that multi-center studies with larger sample sizes be performed in the future.

CONCLUSION

Whether the patients are admitted to the emergency department with clinical symptoms of an aneurysm or not, when the patients are diagnosed with aneurysm, we believe that one of GCS, Fisher, or Yasargil classifications will reflect the patient's clinical status, vasospasm status if SAH is present, post-op status, and complications.

We think that the localization, size, and projection of the aneurysms are related to the emerging complications and post-op status.

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