Original Article

Epidemiologic and Demographic Features, Therapeutic Intervention and Prognosis of the Patients with Cerebral Aneurysm

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Abstract

Background: Cerebral aneurysms are a kind of cardiovascular diseases which are accompanied with high morbidity and mortality due to rupturing and causing subarachnoid hemorrhages. The current study aimed to determine epidemiologic and demographic features and prognosis of patients with cerebral aneurysms. **Materials and Methods:** In this cross-sectional study, 465 patients with cerebral aneurysms hospitalized in Al-Zahra Hospital were studied. The required information including demographic, epidemiologic, and clinical features of the disease were extracted from their records. The obtained data were analyzed using SPSS software and the factors associated with the prognosis of the disease were determined. **Results:** Four hundred and sixty-five cases with cerebral aneurysm undergoing surgery were investigated. The mean age of the patients was 48 ± 14 years whereas 216 cases (46.5%) were male and 249 (53.5%) were female. Two hundred and thirty-seven patients (51%) remitted completely while the disease caused moderate disability in 84 cases (18.1%), severe disability in 24 ones (5.2%) and vegetative state in 9 cases (1.9%) and mortality in 57 ones while it was unknown in 54 cases (11.6%). In terms of the age of patient, WFNS index, anatomical position of aneurysm, type of aneurysm lesion, the incidence season of the disease, type of postoperative complications, family history and operative approach, the disease outcome had a significant difference while gender, ethnicity, and risk factors had no significant effect on the disease outcome. **Conclusions:** According to the type of aneurysm, the incidence position of the aneurysm and other epidemiologic, demographic, and clinical features, providing the prevention and treatment strategies is necessary.

Keywords: *Aneurysm, disease outcome, subarachnoid hemorrhage*

Introduction

Cerebral aneurysms are one of the major cerebrovascular diseases which cause detrimental effects on individuals' health and performance due to rupturing and creating subarachnoid hemorrhage (SAH). Furthermore, the treatment methods of the disease are also associated with numerous side complications.[1] Regardless of the traumatic brain injuries which are considered as the most common types of intracranial hemorrhage, SAH includes one-third to one-half of spontaneous intracranial hemorrhage. The most common cause of spontaneous SAH is arterial aneurysms that include about 70–80% of the cases. With regard to the previous studies conducted on patients with cerebrovascular aneurysm, the number of aneurysms has been estimated as 2–44.9%.[1]

Various studies have so far been conducted on the epidemiology of cerebral aneurysms and that several risk factors have been reported in its incidence of the disease. According to the above mentioned studies, after trauma, rupture in aneurysm and vascular malformations such as arteriovenous fistula, respectively, are the most common causes.[1]

SAH caused by rupture in aneurysm has a far worse prognosis and 12% of patients die before reaching the medical centers and in 10–15% of the patients, despite all investigations, no cause of SAH can be found; however, these patients have relatively better prognosis.[2-4] According to the study by Atkinson, the overall incidence of intracranial aneurysms is between 2% and 8% of the population.[5] Obviously, most aneurysms are small and in more than 90% of the cases, it remains asymptomatic throughout their life.[6]

If the annual risk of rupture and hemorrhage of an aneurysm has a size of <10 mm as

How to cite this article: Sabouri M, Mahabadi A, Tabesh H, Rezvani M, Kouchekzadeh M, Namazi A. Epidemiologic and Demographic Features, Therapeutic Intervention and Prognosis of the Patients with Cerebral Aneurysm. Adv Biomed Res 2018;7:6.

Received: April, 2015. **Accepted:** September, 2015.

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Access this article online

Website: www.advbiores.net

DOI: 10.4103/abr.abr_77_15

Quick Response Code:

well as no history of SAH aneurysm, it will increase about ½% per year and if the annual risk of rupture and hemorrhage of an aneurysm has a size of more than 25 mm, its risk of hemorrhage will increase 6% per year.[7]

Morphologically, aneurysms are divided into saccular, fusiform, and dissecting among which saccular is the most common type of cerebral aneurysms[8,9] and this type of aneurysms increases in the field of diseases such as polycystic kidney, congenital vascular anomalies, diseases of connective tissue vasculitis, and metastasis.[10]

A bulk of research has also been conducted on the treatment method and surgery type and the tendency to do screening methods and detect asymptomatic patients have now been increased. In these patients, the possibility of elective treatment and fewer complications are provided,[11] while in patients with ruptured aneurysms, the risk of remedial measures and its complications are more.[12]

Given that neurosurgery ward of Al-Zahra University Hospital is the main referral center for patients with symptomatic aneurysms not only for patients from Isfahan but also for those from nearby provinces and no studies have so far been conducted on epidemiology, intervention and prognosis of cranial aneurysms. On the other hand, SAH due to rupture of intracerebral aneurysm accounts for approximately 4% of all strokes, but its impact is relatively greater because it tends to affect younger adults in good health, often with devastating consequences.[13] A better understanding of the incidence and important causal risk factors for SAH could lead to improvements in prevention and treatment of the condition. Hence, this study aimed to determine epidemiology and prognosis of patients with cerebral aneurysms hospitalized in Al-Zahra University Hospital in Isfahan during 2003–2012.

Materials and Methods

This is a cross-sectional study conducted in Al-Zahra University Hospital in Isfahan in 2013. The study population included patients with cerebral aneurysms admitted in this center from 2003 to 2012. Inclusion criteria were individuals with cerebral aneurysm undergoing surgery in Al-Zahra University Hospital in Isfahan and the availability of patient's information. Patients who were candidates for treatments other than surgery or endovascular were excluded. The sampling method was census sampling within which all patients eligible to enter into the study from 2003 to 2013 that were 155 cases were investigated.

The method was in a way that after the approval of proposal, names of patients with cerebral aneurysms and treated by surgery at the mentioned center were extracted from the list of operating room and then, their records were collected from the archive of the hospital. Then, the required information for each patient was obtained from the records and filled in the particular questionnaire for the plan. When there was any deficiency in each file, we telephoned the patient's family and the existing defects were eliminated and in case of any failure to complete the information, the patient was excluded.

The obtained data were checked for validity and quantitative data were tested for normality by Kolmogorov–Smirnov test. All data finally entered into a computer and analyzed using SPSS version 22 (SPSS Inc., Chicago, IL, USA), IBM Inc, Chi-square and *t*-test.

Results

In this study, 465 cases with cerebral aneurysm undergoing surgery in Al-Zahra University Hospital in Isfahan from 2003 to 2013 were investigated. The mean age of the patients was 48 ± 14 with the age range of 13–82 years. Two hundred and sixteen cases were male (46.5%) and 249 ones (53.5%) were female. The mean age of men and women was 48.3 ± 14.2 and 47.7 ± 44 years, respectively and according to the *t*-test, no significant difference was observed between men and women ($P = 0.79$).

In all studied patients, the mean aneurysm assessment index (WFNs) was 2.12 ± 1.09 with the range of 1–5. The mean for men and women was 2.11 ± 1.12 and 2.12 ± 1.08, respectively and according to *t*-test, no significant difference was observed between the two genders ($P = 0.96$).

The type of aneurysm lesion was saccular in 306 cases, fusiform in 60 cases, dysmorphic in 66 cases, infectious in 6 cases and unknown in 27 cases. The frequency of each type was also saccular in 6 (1.3%) individuals, fusiform in 12 (2.6%) individuals, dysmorphic in 15 (3.2%) individuals, infectious in 6 (8.4%) individuals and unknown in 78 individuals who had more than one lesion [Figure 1]. It should be noted that the most common lesion in men and women was saccular with the frequency of 162 and 144 (75% vs. 57.8%), respectively and according to the Chi-square test, the type of lesion was not different in the two genders ($P = 0.08$).

The most common anatomic position of aneurysm were in Middle cerebral artery (MCA) with the frequency of

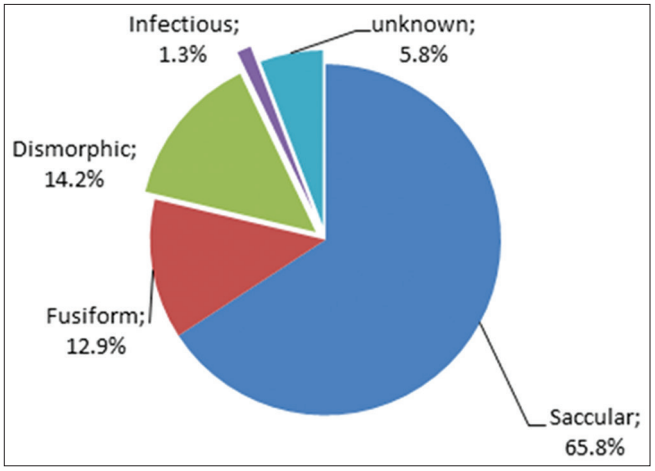

Figure 1: Frequency percentage of type of aneurysm in the studied patients

174 and the least common anatomic position of aneurysm was in postcirculation with 15 cases (3.2%), [Figure 2]. The maximum and minimum number of aneurysm lesions in the studied patients was 1 case in 345 (74.4%) patients and 4 ones in 3 (0.6%) patient while the number of lesion had no significant difference in terms of gender ($P = 0.8$).

Finally, 237 patients (51%) remitted completely while the disease caused moderate disability in 84 cases (18.1%), severe disability in 24 ones (5.2%) and vegetative state in 9 cases (1.9%) and mortality in 57 ones while it was unknown in 54 cases (11.6%) [Figure 3].

The season of disease incidence was spring for 147 ones (31.6%), summer for 78 (16.8%), fall for 141 (30.3%), and winter for 99 patients (21.3%).

According to the obtained results, the incidence of the disease was associated with no complication in 246 patients (52.8%) and with complication in 219 patients (47.1%). The most common complication in patients was convulsion with the frequency of 54 cases (11.6%). The incidence of hydrocephalus and vasospasm in these patients was 42 and 45 cases (9% and 9.7%), respectively [Figure 4].

In terms of the prevalence of risk factors affecting the incidence of aneurysm, 294 cases (63.2%) had risk factor. The most common known risk factor in the studied patients was hypertension with the frequency of 129 individuals (27.7%) [Figure 5].

Investigating the family history of the patients showed that 375 patients (80.6%) had no family history while 90 individuals had the family history such as aneurysm (7.7%), stroke (4.5%), TIA (3.2%), AVM (2.6%), and cavernous malformation (1.3%).

Of 465 studied patients, 126 patients had postoperative complications that the most common one was myocardial infarction with the frequency of 57 cases (12.3%) [Figure 6].

The operative approach was open surgery in 390 patients (83.9%), endovascular surgery in 30 (6.5%), ventriculostomy in 12 (2.6%), and prophylactic in 3 case (0.6%).

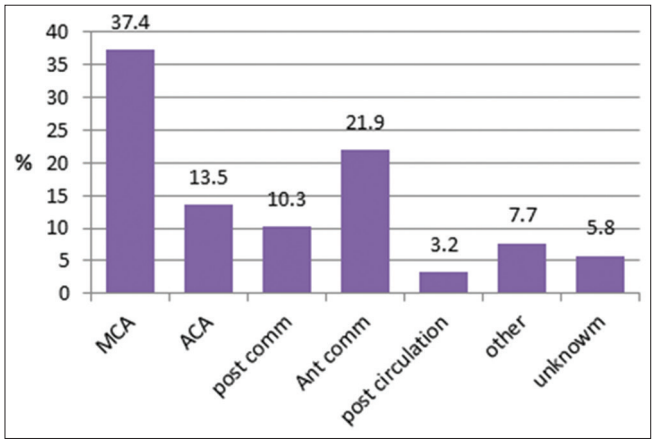

Figure 2: Frequency percentage of anatomical position of aneurysm incidence

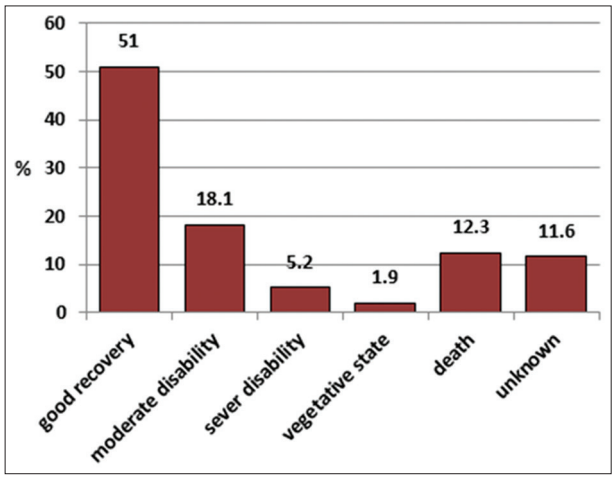

Figure 3: Frequency percentage of disease outcome

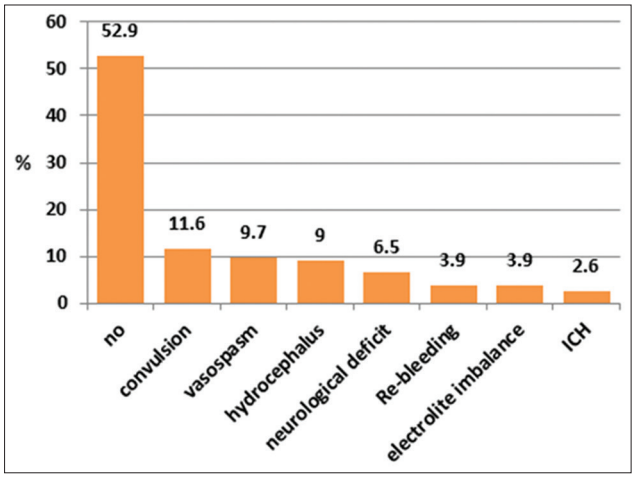

Figure 4: Frequency percentage of incidence of complications

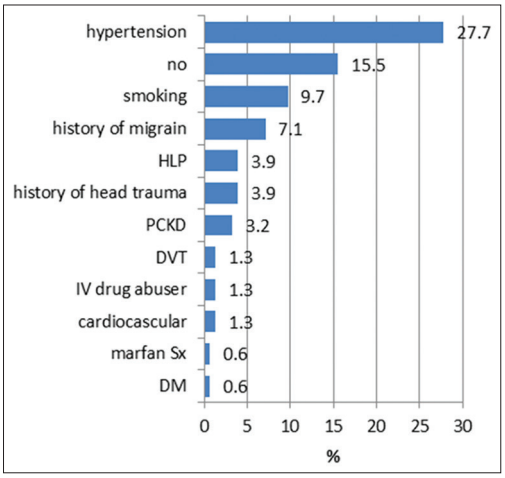

Figure 5: Frequency percentage of incidence of risk factor

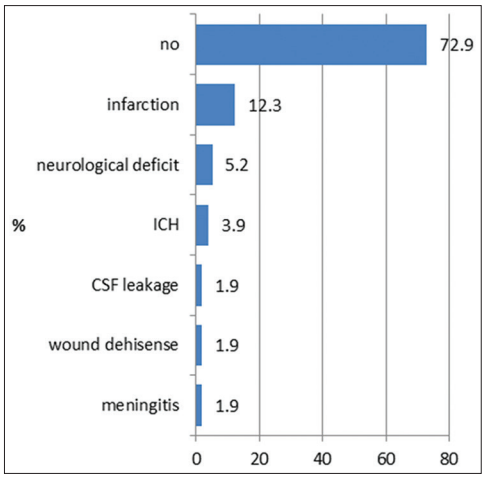

Figure 6: Frequency percentage of postoperative complications

In Table 1, the frequency distribution of epidemiologic demographic and clinical findings of the studied patients has been shown according to the disease outcome. According to the above table, in terms of the age of patient, WFNS index, anatomical position of aneurysm, type of aneurysm lesion, the incidence season of the disease, type of postoperative complications, family history and operative approach, the disease outcome had a significant difference while gender, ethnicity, and risk factors had no significant effect on the disease outcome.

Discussion

The overall objective of the current study was to investigate epidemiologic and demographic features and prognosis of patients with cerebral aneurysms admitted to Al-Zahra University Hospital in Isfahan during 2003–2012.

In this study, 155 cases with cerebral aneurysm undergoing surgery in Al-Zahra University Hospital in Isfahan during 2003–2012 were evaluated. In a study conducted in Australia in 2005, the annual prevalence of cerebral aneurysms was 9.4/100,000 individuals and rate of its prevalence became more by increasing age in the way that at the age of over 80 years, the rate was 38.8/100,000 individuals.[2]

The mean age of the patients was 48 ± 14 years. In the study by Cowan *et al*. in 2003, the mean age of patients with aneurysm was 53.2 years[3] which is almost similar to that of patients in our study while in the study by Johnston *et al*., the mean age of patients was 59 years.[4] According to the results obtained from our study and other studies, the age is a factor affecting the incidence of aneurysm and the prognosis of patients in a way that the improved patients have a lower mean age compared to the patients who died and had complications.

In terms of gender distribution, 46.5% and 53.5% of patients in our study were male and female, respectively. Most conducted studies have also considered higher incidence of aneurysm in women than in men[6,8] while according to the results of our study, the sex was not a factor influencing the disease prognosis.

In terms of the anatomic position of the lesion, the most common anatomic position of the aneurysm was at MCA with the frequency of 37.4% and the least common position was in postcirculation with the frequency of 3.2% and the anatomic position of the lesion was effective on the disease prognosis while in the study by Gambhir *et al*., postcirculation has been the most common position of aneurysm.[8]

In our study, the most common type of aneurysm was saccular with the frequency of 65.8% and the type of dysmorphic and fusiform also had relatively high prevalence (14.2% and 12.9%, respectively) while other types of aneurysms including infectious type had a low prevalence. According to other studies, the saccular is the most common type of cerebral aneurysm[8,9] and this type of aneurysm is increased in diseases such as polycystic kidney, congenital vascular anomalies, connective tissue, vasculitis, and metastasis.[10]

According to the results of our study, approximately 50% of patients had a full recovery after surgery and other patients (12.3%) either died or suffered from moderate to severe disabilities while in the study by Wood and Nowitzke, the mortality rate following surgery was 6.1%.[2] From various epidemiologic studies, several factors play role in the prognosis and outcome of disease including the age of patient, WFNS index, anatomical position of aneurysm, type of aneurysm lesion, the incidence season of the disease, type of postoperative complications, family history, operative approach etc. In the study by John, factors associated with mortality included chronic obstructive pulmonary disease, chronic renal failure, older age and emergency surgery.[3] In the study conducted in Chicago in 2005, the incidence rate in African-American race was more than other races while the type of race had no effect on the prognosis of disease[5] and the same result was obtained from our study and the disease outcome had no relationship with the ethnicity of patients. In a similar study conducted on the epidemiology of patients with aneurysm by Eden in Michigan, the incidence rate was higher in Mexican race and in female.[6]

With regard to the results of our study, the prevalence of risk factors for aneurysm had no significant effect on the disease prognosis while other studies considered the disease prognosis associated with the prevalence of risk factors. For example, in the study by Gambhir, 45% of patients with aneurysm had also left ventricular hypertrophy (secondary HTN)[8] and in the study of Craig, a strong relationship was proven between smoking and aneurysmal SAH, especially in females. Furthermore in this study, it was found that by stopping smoking, the risk of aneurysm rupture decreases.[9] In the study performed in Washington State

Table 1: Distribution of epidemiological, demographic and clinical variables of patients in terms of the disease outcome

Outcome variables	Good recovery	Moderate disability	Sever disability	Vegetative state	Death	Unknown	*P*
Mean of age	46.4±13.7	44±13.6	62.1±9.2	49±14.4	52.3±13.9	50.3±14.3	0.016
Sex							
Male	123 (51.9)	33 (39.3)	15 (62.5)	0 (0)	33 (57.9)	12 (22.2)	0.07
Female	114 (48.1)	51 (60.7)	9 (37.5)	9 (100)	24 (42.1)	42 (77.8)	
Ethnicity							
Persian	192 (81)	63 (75)	15 (62.5)	6 (66.7)	51 (89.5)	36 (66.7)	0.51
Armanian	21 (8.9)	9 (10.7)	3 (12.5)	0 (0)	0 (0)	9 (16.7)	
Lor	24 (10.1)	12 (14.3)	6 (25)	3 (33.3)	6 (1.5)	9 (16.7)	
Mean of WFNS	1.78±0.92	2.18±0.91	2.75±1.04	2±1	2.74±1.49	2.56±1.2	0.001
Anatomy							
MCA	93 (39.2)	45 (53.6)	9 (37.5)	9 (100)	9 (15.8)	9 (16.7)	0.001
ACA	42 (17.7)	6 (7.1)	3 (12.5)	0 (0)	9 (15.8)	3 (5.6)	
Postoperative complications	9 (12.7)	3 (3.6)	3 (12.5)	0 (0)	6 (10.5)	6 (11.1)	
Ant comm	54 (22.8)	54 (28.6)	6 (25)	0 (0)	12 (21.1)	6 (11.1)	
Postcirculation	3 (1.3)	0 (0)	3 (12.5)	0	3 (5.3)	6 (11.1)	
Unknown	0 (0)	0 (0)	0 (0)	0 (0)	9 (15.8)	18 (33.3)	
Type							
Saccular	192 (81)	45 (53.6)	15 (62.5)	9 (100)	30 (52.6)	15 (27.8)	<0.001)
Fusiform	30 (12.7)	15 (17.9)	6 (25)	0 (0)	9 (15.8)	0 (0)	
Dismorphic	15 (6.3)	24 (28.6)	3 (12.5)	0 (0)	9 (15.8)	0 (0)	
Infectionus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6 (11.1)	
Unknown	0 (0)	0 (0)	0 (0)	0 (0)	3 (15.8)	18 (33.3)	
Seasons							
Spring	69 (29.1)	24 (28.6)	15 (62.5)	3 (33.3)	6 (10.5)	30 (55.6)	0.048
Summer	30 (12.7)	27 (32.1)	0 (0)	3 (33.3)	6 (10.5)	12 (22.2)	
Autumn	84 (35.4)	18 (21.4)	6 (25)	3 (33.3)	27 (47.4)	3 (5.6)	
Winter	54 (22.8)	15 (17.9)	3 (12.5)	0 (0)	18 (31.6)	9 (16.7)	
Complications							
No	174 (73.4)	33 (39.3	3 (12.5)	0 (0)	18 (31.6)	18 (33.3)	0.001
Hydrocephalus	12 (5.1)	3 (3.6)	9 (37.5)	0 (0)	9 (15.8)	9 (16.7)	
Vasospasm	9 (3.8)	12 (14.3)	3 (12.5)	3 (33.3)	6 (10.5)	12 (22.2)	
ICH	9 (3.8)	0 (0)	0 (0)	0 (0)	3 (5.3)	0 (0)	
Re-bleeding	0 (0)	6 (7.1)	0 (0)	0 (0)	9 (15.8)	3 (5.6)	
Convulsion	12 (5.1)	15 (17.9)	3 (12.5)	3 (33.3)	3 (15.8)	12 (22.2)	
Electrolyte imbalance	12 (5.1)	3 (3.6)	3 (12.5)	0 (0)	0 (0)	0 (0)	
Neurological deficit	9 (3.8)	12 (14.3)	3 (12.5)	3 (33.3)	3 (5.3)	0 (0)	
Risk factors							
No	72 (30.4)	45 (53.6)	6 (25)	0 (0)	30 (52.6)	18 (33.3)	0.1
Yes	115 (69.6)	39 (46.4)	15 (75)	9 (100)	27 (47.4)	36 (66.7)	
Family history							
No	198 (83.5)	75 (89.3)	24 (100)	9 (100)	33 (57.9)	36 (66.7)	<0.001
Yes	39 (16.5)	9 (10.7)	0 (0)	0 (0)	24 (42.1)	18 (33.3)	
Approach							
Endovascular	0 (0)	0 (0)	0 (0)	0 (0)	6 (10.5)	24 (44.4)	<0.001
Open surgery	234 (98.7)	84 (100)	24 (100)	9 (100)	36 (63.2)	3 (5.6)	
Ventriculostomy	0 (0)	0 (0)	0 (0)	0 (0)	15 (26.3)	15 (27.8)	
Other	3 (1.3)	0 (0)	0 (0)	0 (0)	0 (0)	12 (22.2)	

MCA: Middle cerebral artery, ACA: Anterior cerebral artery, ICH: Intracerebral hemorrhage, WFNS: World Federation of Neurological Surgen

in 2006, a strong relationship was demonstrated between cigarette smoking, alcohol and aneurysm rupture[10] while in a study conducted in New Zealand, among from three factors of heavy physical activity, cigarette and alcohol, only heavy physical activity was strongly associated with aneurysm rupture.[14]

In the present study, there was a significant relationship between the family history of the disease and prognosis of the disease. In the study conducted by Woo in New Zealand in 2009, positive family history and cigarette smoking were determined as risk factors.[15] In a study conducted in Japan in 2011, it was revealed that cigarette smoking, arterial hypertension, and family history were the most important causes of symptomatic SAH in patients.[16] In another study conducted in Australia in 2005, it was found that factors such as arterial hypertension, low age and its presence in the posterior circulation were considered as risk factors for aneurysm rupture.[17] In 2006, Mocco *et al*. examined the risk factors in clinically low-grade patients based on Hess and hunt scale and found that older age, smaller size of the aneurysm, and hyperglycemia on admission were associated with worse prognosis. However, clinically low-grade causes worsening prognosis in these patients.[17]

According to the results obtained in the present study, the incidence of postoperative complications had a significant relationship with the disease prognosis. After the incidence of SAH, one of the treatment problems of patients is the secondary complications such as vasospasm, re-bleeding, and hydrocephalus which can lead to disastrous results.[18,19] In the study conducted by Nahed *et al.* in 2008, it was found that re-bleeding had a prevalence of about 7.7% that often occurred in males, anterior communicating artery A.com aneurysm and onset hours after the incidence of SAH and resulted in worsening the prognosis in patients.[20] In our study, the disease prognosis was associated with the operative approach so that the risk of death in open surgery was significantly higher than other techniques. Thus, according to the results of this study and comparing them with other studies, the general conclusion is that the prognosis of aneurysm and subsequently, SAH depend on many factors including the age of patient, WFNS index, anatomical position of aneurysm, type of aneurysm lesion, the incidence season of the disease, type of postoperative complications, family history and operative approach. According to the type of aneurysm, the incidence position of aneurysm and other epidemiologic, demographic and clinical features, providing the prevention and treatment strategies is necessary. Given the high prevalence of risk factors associated with the disease (however, in this study, risk factors were not associated with the disease outcome) including lifestyle, nutrition, high prevalence of diabetes and high blood pressure and other peripheral factors such as demographic and genic features of patients, the prevention programs from the disease should be provided and a step should be taken to enhance awareness in the community. In the study conducted by Ghosh *et al*., of 2347 cases, 1088 (46.36%) had at least a single aneurysmal rupture. Among the morphologic factors, size > 10 mm, right sidedness, aspect ratio >1.6, deviated neck type, and multiplicity were found to be associated with higher incidences of rupture. Aneurysms on posterior communicating and MCAs were found to be more prone to rupture. The demographic factors that were more linked with the ruptured aneurysms were positive family history, smoking, and hypertension.[13] Finally, most studies, on the risk of rupture, have methodological weaknesses; the overall risk of rupture found in follow-up studies is around 1% per year. Size is the most important risk factor for rupture, with smaller risks for smaller aneurysms. Other risk factors are the site of the aneurysm (higher risk for posterior-circulation aneurysms), age, female gender, population (higher risks in Finland and Japan) and probably also smoking. For aneurysms smaller than 10 mm, treatment carries a risk of around 5% of complications leading to death or dependence on help for activities of daily living.[21]

Lack of cases of cerebral aneurysms, unavailable cases and uncompleted hospital records were the limitations of our study.

Conclusion

According to results of the study, incidence rate of cerebral aneurysms is relatively high and some of risk factors such as age. Family history, smoking, race, and hypertension had been a positive effect on suffering to cerebral aneurysms. Hence, several preventive activities and try to improvement of population awareness mast be done for decrease of cerebral aneurysms.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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