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Evaluation of the Results of Therapeutic Management of Patients Treated Endovascularly for Cerebral Aneurysm

Ocena wyników postępowania terapeutycznego chorych leczonych endowaskularnie z powodu tętniaka mózgu

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Abstract

Introduction. Intracranial aneurysm is the most common type of brain vascular defects. Their treatment is based on excluding vascular malformation from circulation. Endovascular methods are being performed more and more often.
Aim. Evaluation of the results of therapeutic management of patients treated endovascularly for cerebral aneurysm.
Material and Methods. The study involved 49 patients with a diagnosed brain aneurysm qualified for endovascular treatment (embolization, stent). Standardized research tools were used: GCS, H&H, GOS, SWF. The examination was carried out twice on one patient: on the day of admission and discharge from the ward. The collected material was statistically processed.
Results. Most of the respondents were women — 74%. Almost 61% of patients had non-cracked aneurysm. In 41% embolization was performed, and in 39% embolization with a stent. The aneurysm site was associated with the GCS score at discharge $\chi^2(8)=15.64$; $p<0.05$; $V=0.40$. Marital status was associated with SWF in the assessment 2: $\chi^2(9)=19.18$; $p<0.05$; $V=0.36$. The state of consciousness of the patients had no significant impact on the scope of their functioning: GCS $Z=0.42$; $p=0.675$ and SWF $Z=0.40$; $p=0.689$.
Conclusions. The clinical condition of patients with cerebral aneurysm varies depending on the stage of treatment, admission mode and type of aneurysm. Only the professional situation and marital status of the examined persons influenced the functional state and the final assessment of patients' treatment. **(JNNN 2020;9(1):3–11)**
Key Words: brain aneurysm, assessment, endovascular methods

Streszczenie

Wstęp. Tętniak tętnic wewnątrzczaszkowych to najczęstszy rodzaj wad naczyniowych mózgu. Leczenie ich opiera się na wyłączeniu malformacji naczyniowej z krążenia. Coraz częściej wykonywane są metody endowaskularne.
Cel. Ocena wyników postępowania terapeutycznego chorych leczonych endowaskularnie z powodu tętniaka mózgu.
Materiał i metody. W badaniach uczestniczyło 49 pacjentów z rozpoznanym tętniakiem mózgu, zakwalifikowanych do leczenia endowaskularnego (embolizacja, stent). Zastosowano standaryzowane narzędzia badawcze: GCS, H&H, GOS, SWF. Badanie zostało przeprowadzone dwukrotnie u jednego pacjenta: w dniu przyjęcia i wypisu z oddziału. Zebrany materiał opracowano statystycznie.
Wyniki. Większość badanych stanowiły kobiety — 74%. Tętniak niepęknięty miało 61% pacjentów. U 41% wykonano embolizację, a u 39% embolizację ze stentem. Miejsce tętniaka było powiązane z oceną GCS przy wypisie $\chi^2(8)=15,64$; $p<0,05$; $V=0,40$. Stan cywilny był powiązany ze SWF w ocenie 2: $\chi^2(9)=19,18$; $p<0,05$; $V=0,36$. Stan przytomności chorych nie miał istotnego wpływu na zakres ich funkcjonowania: GCS $Z=0,42$; $p=0,675$ i SWF $Z=0,40$; $p=0,689$.
Wnioski. Stan kliniczny chorych z tętniakiem mózgu zmienia się w zależności od etapu leczenia, trybu przyjęcia i rodzaju tętniaka. Tylko sytuacja zawodowa i stan cywilny badanych osób wpływały na stan funkcjonalny i końcową ocenę leczenia pacjentów. **(PNN 2020;9(1):3–11)**
Słowa kluczowe: tętniak mózgu, ocena, metody endowaskularne

Introduction

Brain vascular diseases are a major cause of mortality worldwide [1]. WHO postulates that the overall incidence even of strokes will increase in the next 5 years [2]. One type of strike is subarachnoid haemorrhage from a ruptured brain aneurysm. It is estimated that the main reasons for the appearance of subarachnoid haemorrhage is the extravasation of blood from the aneurysm located on one of the cerebral arteries belonging to the Willis arterial circle [3].

The structure of the human brain is equipped with blood vessels supplying and removing blood from it. Each of them performs its specific functions in the human body, which is why it is so dangerous for his life when damage or malformation occurs in the area of the vessel [4].

Intracranial aneurysm is the most common type of brain vascular defect. It occurs as a result of local prominence of an abnormal blood vessel wall under the influence of various factors. The larger the aneurysm, the greater the risk of subarachnoid haemorrhage [5].

The incidence of aneurysms in the human population varies between 1 and 10%, and most often this problem affects people between 40 and 60 years of age, especially women [6]. Genetic conditions are also considered causes of aneurysm — family history, polycystic kidney disease, Elhers Danlos syndrome, black race, age over 50, hypertension, smoking, alcohol abuse, sympathomimetic medicines or drugs [5,7].

The main clinical sign of aneurysmal subarachnoid haemorrhage (SAH) is a very severe sudden onset headache (often referred to as the worst headache in a patient's life) [8]. Acute SAH is also often associated with symptoms of meninges irritation (meningeal symptoms, photophobia), symptoms of intracranial hypertension (nausea and vomiting, disturbance of consciousness), epileptic seizures and focal neurological deficits [9].

About 80–90% of all brain aneurysms are located in the anterior cerebral circulation (internal carotid, anterior and middle cerebral arteries and their branches), and only 10–20% in the posterior circulation (vertebral, basal, and posterior cerebral arteries and their branches) [10]. Unbroken aneurysms are usually asymptomatic, but in 5% of cases they can cause epileptic seizures or, if they are large, a thromboembolic incident or a neurological deficit due to a mass effect (e.g. oculomotor nerve burn) [10].

The gold standard in detecting brain aneurysms as a source of bleeding in primary acute SAH is digital subtraction angiography (DSA) [10]; the result of this study serves primarily as a basis for planning the final treatment to protect the aneurysm [8,10].

Treatment of brain aneurysms is based on excluding this vascular malformation from circulation. Clipping procedures are performed, which involve placing the clip on the neck of the aneurysm — a very invasive method, which gradually goes away in favour of embolization, which is considered more effective [11]. Currently, 50–85% of all intracranial aneurysms can be treated by the intravascular route; only in 2002–2008 the frequency of endovascular treatment of aneurysms increased from 17% to 58% [10,12].

Studies show that about a third of patients after SAH ultimately remain permanently dependent on nursing care, and only 30% are able to return to independent life [9]. Rapid diagnosis and appropriate diagnostics, proper neurological and neurosurgical management are of key importance for the patient's prognosis and quality of life.

The aim of the study was to evaluate the results of therapeutic management of patients treated endovascularly for brain aneurysms.

Material and Methods

The study involved 49 patients hospitalized in the Department of Neurosurgery and Neurology, the Department of Neurosurgery and Neurotraumatology with the Subdivision of Medical Improvement University Hospital no. 2 of Dr. Jan Biziel in Bydgoszcz.

The following criteria for inclusion of patients in the research were adopted in the research process:

— adults of both sexes,
— patients qualified for the treatment of endovascular brain aneurysm,
— patients with preserved verbal contact.

In contrast the study excluded patients who:

— were unable to give informed consent to participate in the study,
— incapacitated persons, soldiers of the basic service and persons deprived of liberty,
— patients previously treated for the same reason during the period of conducting this study,
— patients diagnosed with a disease other than the presence of a brain aneurysm.

On this basis, 49 patients were qualified for the study, of which the majority — 36 people were women. The patients were between 20 and 71 years old and the average age was 53. City residents constituted the majority of the research sample, as much as about 61% of respondents. In terms of the location of the aneurysm, people with anterior cerebral artery aneurysm predominated — 13 people, followed by the middle cerebral artery. In the posterior part of the brain and in several places at the same time, 9 people in each group had aneurysms. The least number of aneurysms was located in the internal carotid artery — 8 patients. 30 people had an unbroken aneurysm, which is about 61% of the subjects, and 19

people had aneurysm rupture. Most of the subjects — 22 people had an aneurysm up to 10 mm, and then between 11–15 mm and 20–24 mm. The smallest number of subjects were patients with an aneurysm >25 mm, because about 10% of the research group. In 20 people, accounting for about 41% of respondents, embolization was used, and in 29 people — about 59% embolization with a stent. The largest group were non-smokers — 19 respondents. Hypertension was the most common comorbid disease — as many as 65% of the patients suffered from it. Atherosclerosis, diabetes and thyroid disease — they were the second most frequently repeated group of comorbidities. This data is presented in Table 1.

Table 1. Characteristics of the study group (N=49)

Variable	N	%
1	2	3
Gender		
Woman	36	73.5
Man	13	26.5
Age		
Up to 35 years	3	6.12
36–40 years	3	6.12
41–45 years	3	6.12
46–50 years	8	16.3
51–55 years	7	14.3
56–60 years	12	24.5
61–65 years	11	22.4
65 years and more	2	4.08
Place of residence		
Village	19	38.8
City	30	61.2
Education		
Primary	3	6.12
Vocational	19	38.8
Secondary	15	30.6
Higher	12	24.5
Marital status		
Single	3	6.12
Married	31	63.2
Divorced	9	18.4
Widow/widower	6	12.2
Type of aneurysm		
Ruptured	19	38.8
Unruptured	30	61.2
Location of aneurysm		
Anterior cerebral artery	13	26.5
Internal carotid artery	8	16.3
Anterior cerebral artery	13	26.5
Internal carotid artery	8	16.3
Middle cerebral artery	10	20.4
Posterior cerebral artery	9	18.4
Anterior cerebral artery, internal carotid artery	5	10.2
Anterior cerebral artery, middle cerebral artery	1	2.04
Anterior cerebral artery, internal carotid artery, middle cerebral artery	1	2.04
Anterior cerebral artery, posterior cerebral artery	2	4.08
Size of aneurysm		
Up to 10 mm	22	44.9
11–15 mm	12	24.5
20–24 mm	10	20.4
>25 mm	5	10.2
Treatment used		
Embolization	20	40.8
Embolization, stent	29	59.2
Smoking		
Yes	30	61.2
No	19	38.8
Co-morbidities		
Diabetes	12	24.5
Hypertension	32	65.3
Atherosclerosis	15	30.6
Depression	2	4.08
Thyroid disease	8	16.3
Allergy	1	2.04
None	7	14.3
Other	9	18.4
BMI		
Underweight	2	4.08
Normal weight	21	42.9
Overweight	19	38.8
Obesity	7	14.3

The following research tools were used in the study:
— Interview questionnaire — for collecting sociodemographic and clinical data; these data were obtained on the basis of patient history and patients records (individual nursing history and patient history),
— H&H — Boterell scale modified by Hunt & Hess [13],

— GCS — Glasgow Coma Scale [14],
— GOS — Glasgow Outcome Scale [15],
— SWF — Functional Performance Scale [16].

A prospective study plan was used with a double evaluation in time. Before surgery — assessment 1 — the following scales were used: H&H, GCS and SWF scales, and interviews regarding sociodemographic and clinical data were carried out, whereas after surgery — assessment 2 — the scales were measured using the following scales: GCS, GOS and SWF.

The research was approved by the Bioethics Committee of the Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Toruń — KB 143/2018.

The collected data has been statistically reviewed in the SPSS Statistics 23.0. program. The following tests were used: Wilcoxon, u Mann-Whitney, chi-square. A statistical significance level of $p<0.05$ was assumed.

Results

Individual SWF determinants indicating the scope of activities of the need for care before surgery and at discharge were compared using a series of Wilcoxon tests (Table 2). These analyses showed that the differences were in the following range: dressing and drainage $Z=-3.55$; $p<0.001$. At discharge, more people obtained 1 point and 2 points, which means that the largest care deficit among patients was the change of dressings and drainage after surgery than before surgery (Table 2).

Table 2. Wilcoxon test results for comparison of SWF care determinants

Care determinants according to SWF	Z	p
Moving	−0.87	0.384
Nutrition	−0.47	0.635
Hygiene	−0.25	0.806
Physiological needs	−0.45	0.653
Measurement of vital signs GCS	−0.25	0.806
Breathing	−1.56	0.119
Diagnostics	−0.30	0.762
Preparation for surgery and care after	−1.26	0.206
Dressings, drainage	−3.55	0.000
Severity of pain	−0.68	0.498
Pharmacotherapy	−0.72	0.474
Mental state	−0.50	0.617

Z — Wilcoxon statistics, p — level of statistical significance

Additional confirmatory comparisons of raw results were made for GCS and SWF. For this purpose, Mann–Whitney U test analysis was used (Table 3). It turned out that there were no statistically significant differences in these two assessments, in GCS $Z=0.42$; $p=0.675$ and SWF $Z=0.40$; $p=0.689$, which means that the state of consciousness of the patients did not have a significant impact on the scope of their functioning.

Table 3. Descriptive statistics for GCS and SWF and the result of comparative analysis using the Mann–Whitney U test

Assessment / Descriptive statistics	GCS	SWF
Min	9	21
Max	15	47
Average	13.49	37.24
SD	1.91	9.43
Me	15	42
Min	6	12
Max	15	47
Average	13.49	36.61
SD	2.42	9.66
Me	15	39
Z	0.42	0.40
p	0.675	0.689

Min — minimum, Max — maximum, SD — standard deviation, Me — median, Z — Mann–Whitney U test, p — level of statistical significance

Them, it was verified whether there were sociodemographic and clinical variables that affected the results of the subjects. First, rhoSpearman correlation analysis was used for variables measured on the least ordinal scales. The results are shown in Table 4.

Correlation analyses showed that the subjects' results were not related to age, education, size of the aneurysm, number of diseases and smoking. It was only shown that the BMI level was statistically significantly associated with the assessment of the state of consciousness on the day of discharge $\rho=0.30$; $p<0.05$. This relationship was positive, which means that as the BMI level increased, the subjects scored more points in the GSC on the day of discharge; this relationship was moderately strong.

A series of rhoSpearman correlation analyses also showed that all patient assessment scales were associated with the length of hospital stay. These relations were negative, which means that people who had been in hospital for longer had a worse clinical condition, had disturbances of consciousness and problems in functioning; these relations were very strong (Table 4).

Further analyses of sociodemographic and clinical factors are presented in Table 5.

Table 4. Results of rho-Spearmana correlation analyses for the relationship between therapeutic results and sociodemographic variables and clinical data

Analysed variables / Scale/assessment		Age	Level of education	Aneurysm size	Number of diseases	Smoking	BMI	Days of stay
H&H		0.08	0.23	0.01	–0.07	–0.12	–0.01	–0.80***
GCS	Assessment 1	0.05	0.03	0.08	0.06	–0.08	0.12	–0.83***
	Assessment 2	0.06	0.05	0.12	0.15	0.02	0.30*	–0.49***
GOS		0.07	0.06	0.02	–0.06	–0.06	0.17	–0.70***
SWF	Assessment 1	0.11	0.09	0.11	0.11	–0.06	0.07	–0.78***
	Assessment 2	0.03	0.05	0.02	0.01	0.00	0.06	–0.71***

*p<0.05, **p<0.01, ***p<0.001

Table 5. Results of chi-square test analyses for the relationship between therapeutic results and sociodemographic variables and clinical data

Analysed variables / Scale/assessment		Chi-square independence statistics (χ^2)	Number pf freedom degrees (df)	Statistical significance level (p)	Variation coefficient (V)
1		2	3	4	5
Gender					
H&H		2.27	3	0.517	0.22
GCS	Assessment 1	0	1	1	0
	Assessment 2	1.27	2	0.531	0.16
GOS		3.83	3	0.281	0.28
SWF	Assessment 1	3.23	2	0.199	0.25
	Assessment 2	2.67	3	0.445	0.23
Professional situation					
H&H		6.35	6	0.386	0.25
GCS	Assessment 1	0	1	1	0
	Assessment 2	10.02	4	0.04	0.32
GOS		12.75	6	0.047	0.36
SWF	Assessment 1	4.79	4	0.309	0.22
	Assessment 2	16.16	6	0.013	0.41
Marital status					
H&H		5.4	9	0.798	0.19
GCS	Assessment 1	0	3	1	0
	Assessment 2	8.11	6	0.23	0.29
GOS		8.52	9	0.482	0.24
SWF	Assessment 1	6.13	6	0.409	0.25
	Assessment 2	19.18	9	0.024	0.36
Place of residence					
H&H		1.15	3	0.766	0.15
GCS	Assessment 1	0	1	1	0
	Assessment 2	3.67	2	0.16	0.27
GOS		2.38	3	0.497	0.22
SWF	Assessment 1	2.21	2	0.332	0.21
	Assessment 2	2.24	3	0.524	0.21

Table 5. Continued

1		2	3	4	5
Type of aneurysm					
H&H		37.87	3	0	0.88
GCS	Assessment 1	0	1	1	0
	Assessment 2	9.32	2	0.009	0.44
GOS		21.54	3	0	0.66
SWF	Assessment 1	46.19	2	0	0.97
	Assessment 2	24.65	3	0	0.71
Location of aneurysm					
H&H		8.58	12	0.739	0.24
GCS	Assessment 1	0	4	1	0
	Assessment 2	15.64	8	0.048	0.4
GOS		15.38	12	0.221	0.32
SWF	Assessment 1	3.24	8	0.918	0.18
	Assessment 2	18.74	12	0.095	0.36
Type of treatment					
H&H		3.63	3	0.304	0.27
GCS	Assessment 1	0	1	1	0
	Assessment 2	2.84	2	0.241	0.24
GOS		3.98	3	0.264	0.29
SWF	Assessment 1	0.93	2	0.628	0.14
	Assessment 2	1.02	3	0.795	0.14

And so, the sex of the respondents did not affect the assessment of the clinical condition before the surgery, the assessment of consciousness and functional capacity before and after the surgery, and the final state of the patients at discharge.

The Chi-square independence test analysis showed that the occupational situation was associated with the assessment of consciousness at discharge $\chi^2(4)=10.02$; $p<0.05$; $V=0.32$, with the final state assessment $\chi^2(6)=12.75$; $p<0.05$; $V=0.36$ and the functional performance scale with the $\chi^2(6)=16.16$; $p<0.05$; $V=0.41$. People working more often had better results on the GCS and SWF scale at discharge, and more often their final state according to GOS was assessed as very good.

Then, the analysis with the Chi-square independence test also indicated that marital status was associated with the functional capacity scale in the 2 assessment: $\chi^2(9)=19.18$; $p<0.05$; $V=0.36$. SWF results were better for divorcees and widowers. There was no relationship between marital status and other scales assessing the patient's condition.

The place of residence of the examined persons did not affect the assessment of the clinical state at admission, the assessment of consciousness and functional capacity before surgery and at discharge, and the assessment of the final state of patients at discharge. The results of all analyses turned out to be statistically insignificant $p>0.05$.

The type pf aneurysm had an impact on the assessment of the clinical condition and functional capacity of patients prior to surgery, as well as on the state of consciousness, the final assessment of treatment and the functional capacity of patients at discharge. It turns out that better results before and after surgery were found in patients with an unruptured aneurysm compared to patients with a ruptured aneurysm.

The Chi-square test independence analysis showed that the aneurysm location was only associated with the assessment of consciousness at discharge $\chi^2(8)=15.64$; $p<0.05$; $V=0.40$. The best results of consciousness at discharge were people with anterior brain aneurysm, and the worst people with aneurysms located in more than one place. Other results do not indicate a relationship between the patient's condition and the location of the brain aneurysm.

The type of treatment used (embolization; embolization and stent) of the subjects did not affect the assessment of the clinical status at admission, the assessment of consciousness and functional capacity before surgery and at discharge, and did not affect the assessment of the final state of patients at discharge. The results of all analyses turned out to be statistically insignificant $p>0.05$.

Discussion

Along with the development of imaging diagnostics allowing faster detection and accurate location of brain aneurysms, as well as thanks to obtaining wide access to endovascular treatment, at the turn of several years the treatment results of patients after subarachnoid haemorrhage significantly improved [17]. Although brain aneurysms are still a major challenge for neurosurgeons, SAH mortality has decreased by 17% over the past thirty years [17,18]; a similar decrease in mortality of 18–19% is reported by other authors [19,20]. Unfortunately, many people who survive SAH have long-term cognitive deficits and a reduced quality of life [21].

The literature says that several risk factors are associated with the development of intracranial aneurysms, including age, female sex, genetic factors, smoking and hypertension [22]. In the study group, the vast majority — 73% — were women. Compared to other studies, this is a consistent result, which indicates that women have an increased risk of developing an aneurysm of the brain, including the unruptured one, although the reasons for this are unknown [23,24]. The average age of the examined people was 53, which is consistent with other studies that show the average age of 50 years for the global population with diagnosed intracranial aneurysm [25].

The most common location of aneurysms in the examined group was the anterior cerebral artery — 27%, which is also shown by other studies emphasizing that anterior circulatory aneurysms are much more common than vertebrobasilar aneurisms [26].

This study has shown that the majority of aneurysms found were up to 10 mm in size and were mainly unruptured aneurysms. The authors emphasize the higher incidence of rupture between aneurysms larger than 5 mm [26]; in one Japanese study, the risk of aneurysm rupture under 5 mm was 0.36% [27]. The decision to treat unruptured aneurysms is difficult and is always a clinical dilemma; you need to assess the risk of treatment on the one hand, and on the other — the possibility of stroke, permanent neurological deficit or even death.

The most important factor determining the clinical assessment of patients after SAH is their clinical condition before treatment [28]. This assessment was made on the day of admission and discharge based on clinimetric tests. In the studies of several authors [29–32], using individual scales to assess the condition of patients after an incident of subarachnoid haemorrhage, a high correlation was found between the H&H, GCS, GOS scales with the SWF scale before and after treatment. And so, taking into account the moment of admission to the ward of patients in the study group — most of them (41%) were qualified to the I group in the H&H scale assessing the clinical condition of patients on admission. Similarly, at the time of admission, the state of consciousness of all patients oscillated between 13 and 15 points, according to the GCS scale, which qualified them to the group with mild consciousness disorders. This is mainly due to the fact that the admitted patients were predominantly patients with a non-bleeding aneurysm. As for the clinical condition of patients at discharge, the GCS and GOS scales were used. It was shown that already at discharge, the state of consciousness of the patients deteriorated in some cases. And so, from 100% of patients in the group with mild consciousness disorders on admission, at the time of discharge, about 80% were in this group, and 3 patients, which is about 6% of respondents, did not show any consciousness at all. However, these data had no statistically significant impact. Taking into account the final assessment of the treatment of patients using the GOS scale at discharge, it was shown that 15 patients were in the desired group V, which indicates a very good final state, and 21 patients were already in group IV, which showed minor neurological defects among patients.

Chiang et al. [33] showed that the WFNS scale has the greatest correlation between the assessment of clinical status before treatment and the result of treatment after 6 months.

In own research, functional assessment was performed using SWF; this assessment concerned the perioperative period. And so, on admission it turned out that there were 59% of independent patients in terms of the need for care, which is over half of the respondents, and 35% of the patients showed the need for high care. This condition could have been influenced by the clinical condition of the patients on admission, which was associated with their worse functioning in terms of everyday activities. What is surprising is the fact that the functional status of patients at discharge was much better than at admission, as 49% of people were independent and 29% were moderately dependent on care.

According to Ślusarz et al. [29], the assessment carried out using SWF was comparable to the assessment carried out using standard tools, such as BI (Index Barthel), mRS (modified Rankin Scale) or GOS; the clinical condition assessed by GCS ($p<0.001$) and H&H ($p<0.001$) differentiated the functional state assessed by SWF. Statistically significant correlations between SWF and BI ($r=-0.78$), GOS ($r=-0.69$) and mRS ($r=0.68$) were found in these studies [29].

Some researchers report that patients after SAH, discharged in a severe disability (4 and 5 in mRS) survived over 5 years in half of the cases, and 1/3 returned to independent functioning [34].

Conclusions

1. The clinical status of patients with cerebral aneurysm varies depending on the state of treatment, admission mode and type of aneurysm. People with ruptured aneurysms and urgent admissions had worse treatment outcomes.
2. The functional capacity of the respondents is determined by the period before and after surgery. The better the patient's clinical condition on admission according to H&H and GCS, the better his performance in terms of daily activities after surgery.
3. Only the professional situation and marital status of the examined persons turned out to be statistically significant and influenced the functional state and the final assessment of patients' treatment. Professionally active people as well as widowers and divorcees had better outcomes at discharge.
4. Persons hospitalized for a longer time had worse clinical condition at admission, and worse functional capacity and results of treatment at discharge.

Implications for Nursing Practice

Rupture of the intracranial aneurysm is a life-threatening condition [35]. The participation of a nurse at every stage of the therapeutic procedure requires her to be familiar with modern forms of therapy, but also to the existing threats (unruptured aneurysms). An increasing number of endovascular procedures performed in this group of patients obliges to conduct numerous research works, also by nurses. A good initial clinical status of a patient, especially among unruptured aneurysms, does not mean that there are no nursing problems.

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