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A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection

SHORT- AND LONG-TERM OUTCOME OF SURGICALLY TREATED RUPTURED INTERNAL CAROTID ARTERY ANEURYSMS

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SUMMARY

Background: Most patients who survive a subarachnoid haemorrhage (SAH) leave hospital with a permanent neurological deficit. Factors influencing the short-term outcome and quality of life many years after surgery were not finally investigated.

Material/ Methods: During the non-endovascular period there were 242 patients operated on for a ruptured internal carotid artery (ICA) aneurysm. The mean follow-up was 6.5 years. The Glasgow Outcome Scale (GOS), modified Rankin Scale (mRS) and SF-36 quality of life scale were used in the study. Demographic data, GCS, WFNS, Hunt-Hess and Fisher grade, the preoperative neurologic deficit, recognition of delayed cerebral ischemia (DCI) and the operative method were included in the analysis. The methods of outcome prediction consisted of logistic regression, receiver operating characteristic curves (ROC) and population attributable risk comparisons (PAR).

Results: At discharge, 68.4% of patients experienced moderate disability or good recovery, although 5.8% had no symptoms at all. Morbidity amounts to 41.7%. Unfavourable outcomes were attributed to older age, while morbidity by the presence of postoperative neurological deficit in multivariate analyses. Clinical signs of vasospasm (DCI), the Fisher and Hunt-Hess grade influenced both unfavourable outcome and morbidity. The Hunt-Hess scale was not a dominant component of the multivariate model of short-term outcome or morbidity. In the long-term follow-up, a high quality of life was established in 42.5% of patients. SF-36 differences were associated with age and gender.

Conclusions: The factors influencing an unfavourable outcome differ from those determining morbidity. The Hunt-Hess scale is a dominant component of any short-term outcome prediction.

Key words: Quality of Life, Intracranial Aneurysm, Subarachnoid Haemorrhage, Outcome Assessment,

INTRODUCTION

The outcome of the neurosurgical treatment patients with a ruptured aneurysm is not auspicious. Studies revealed that morbidity (defined as the unfavourable outcome of treatment or death) may refer to up to 30%. Even a half of these patients who have survived a subarachnoid haemorrhage (SAH) leave hospital with persistent neurological deficits. The Glasgow Outcome Scale (GOS) is a basic tool applied in neurosurgery for measuring treatment results. However, the authors of the GOS scale did not intend to measure all the significant aspects of neurological patients. Kim presented the application of the SF-36 quality of life scale in patients operated on for an intracranial aneurysm. Predicting the treatment outcome after experiencing a SAH on both the basis of pre and postoperative data, is essential for the patient and their family. Due to the differences between objective (physician's) and subjective (patient's opinion) treatment assessment, both methods should be applied. Reviews of publications from the last ten years describing the outcome of ruptured aneurysm treatment indicate that the majority of researchers concentrate on estimating the state of patients upon discharge, while fewer studies include a long-term assessment. The aim of this study is to explore factors of outcome as well as to define whether the state of a given patient on the day of discharge is related to the health condition within the long-term observation of affairs. It is known that the general state of patients significantly improves in the first year after treatment, therefore, it is worth determining the point following a neurosurgical procedure when the long-term outcome begins to differ from the postoperative result.

MATERIALS AND METHODS

Among 1035 aneurysm procedures, preformed between 1997 and 2006 at the division of neurosurgery, 281 cases were related to ruptured internal carotid artery (ICA) aneurysms. The group of 34 multiple and 4 blood blister-like aneurysms were excluded (Figure 1).

The short-term outcomes of 206 cases were analysed retrospectively. GOS and mRS were divided into favourable (4.5 GOS grade) and unfavourable short-term outcomes (GOS 2.3). The evaluation of morbidity (poor outcome) included death cases and patients who survive but the treatment result was unfavourable (GOS 1,2,3). The long-term results of treatment were assessed by means of the SF-36 scale (Ware and Kosinski, 2001). The assessment of long-term outcomes was collected from 70.9% (n=146) of patients. The mean value of PCS (Physical Component Summary) and MCS (Mental Component Summary) influence the "total SF-36 score". Results below or equal to 50 were estimated as a "lower quality of life". The shortest observation period lasted 16 months, while the longest 11 years, the mean and median were 78.4 (SD±34.2) and 80 months (>6.5 years) respectively. Patients with ruptured ICA aneurysm were only offered open surgery (frontotemporal craniotomy), as endovascular treatment had not been performed on the site prior to 2007. During surgery, if clipping was not a feasible option, wrapping, trapping or an extra-to-intracranial by-pass was applied. The factorial analysis of the short and long-term outcome contained data such as: general demographics, localization of the ICA, GCS, WFNS, Hunt-Hess (with Kosnik modification) and the Fisher scale, neurological signs before operation, details connected with surgical procedure, postoperative complications and delayed cerebral ischemia (DCI). (Table 1)

The DCI diagnosis was based on neurological deterioration confirmed by cerebral angiography and which occurred in 16 cases (7.8%). The neurosurgeon's experience was also measured, and noted as the number of performed operations. Every studied parameter was investigated according its fulfilment of normal distribution conditions. Then, adequate parametric or non-parametric tests were applied. Multivariate analyses were based on the stepwise logistic regression model with a quasi-Newton estimation, supported by population attributable risk (PAR) – to estimate the percentage of morbidity or unfavourable outcomes reduction if a given factor had not existed. A receiver operating characteristic (ROC) was created and the area under the curve (AUC) was calculated in order to verify the whole model. Confidence intervals (CI) for odds ratios and statistical power (1-β) were established at 95% and 80% respectively; a p-value of less than 0.05 was considered significant. The study was accepted by the Local Ethical Committee (NKEBN/209/2008).

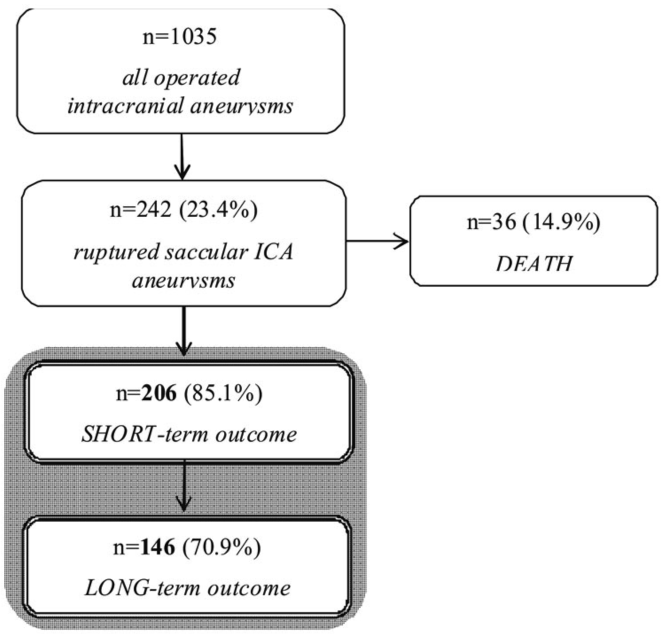


Figure 1. Quantitative structure of analyzed patients. The percentages in particular textboxes mean the percentages of the values from the previous textbox
Abbreviations: ICA – internal carotid artery

Tab. 1. Demographical data, clinical condition and radiological assessment on admission; all patients who survived and were discharged (n=206) and those for whom a long-term outcome was obtained (n=146)
Abbreviations: SD – standard deviation, F – female, M – male

Demographical data	*On discharge*	*In long term evaluation*
Age (mean±SD)	51.6±12.5	50.7±12.2
Gender (F / M)	159 / 47	110 / 36
Higher and secondary education (n; %)	109; 52.9%	79; 54.1%
Residency (rural / urban)	49 / 116	30 / 157

Baseline neurological symptoms	*On discharge*	*In long term evaluation*	***Fisher Scale***	*On discharge*	*In long term evaluation*
Hemiparesis	15; 7.3%	12; 8.2%			
Aphasia	5; 2.4%	4; 9.6%	1	7; 3.4%	5; 3.4%
Oculomotor nerve paresis	13; 6.3%	7; 4.8%	2	122; 59.2%	84; 57.5%
Abducent nerve paresis	1; 0.5%	0; 0.0%	3	63; 30.6%	48; 32.9%
Undefined visual signes	5; 2.4%	5; 3.4%	4	6.8%	9; 6.2%
Lack of neurological symptoms	169; 82.0%	119; 81.5%			
Word Federation of Neurosurgeons Scale (WFNS)	*On discharge*	*In long term evaluation*	***Hunt-Hess Scale***	*On discharge*	*In long term evaluation*
I	137; 66.5%	98; 67.1%	1	48; 23.3%	31; 21.2%
II	10; 4.9%	9; 6.2%	1A	10; 4.9%	9; 6.2%
III	11; 5.3%	8; 5.5%	2	79; 38.3%	62; 42.5%
IV	40; 19.4%	26; 17.8%	3	36; 17.5%	24; 16.4%
V	8; 3.9%	5; 3.4%	4	25; 12.1%	14; 9.6%
			5	8; 3.9%	9; 4.1%

RESULTS

Short-term outcome

The analysis of the short-term outcome showed that 68.4% of patients (n=141) were discharged in a good condition. (Table 2)

Classifying patients into the category of favourable or unfavourable treatment outcome on the basis of the GOS revealed the same number of cases as in the mRS scale (Figure 2).

A high correlation between the GOS and mRS was observed among the studied group (r=-0.98, p<0.001) Only age significantly correlated with the patients' condition on discharge (p<0.01). The GCS, WFNS, Hunt-Hess and Fisher scales significantly correlated with the GOS (p<0.01). Over half of the patients (52.9%; 9/17) who had experienced any complication following the operation were discharged in a poor condition (p=0.05). The separate study of surgical and general

Tab.2. Patient's clinical condition on discharge (n=206)

Glasgow Outcome Scale (GOS)	*n*	*% of group*	*Cumulative count*	*Cumulative percentage*
5 – good outcome	85	41.3%	141	68.4%
4 – moderately disabled	56	27.2%		
3 – severily disabled	51	24.7%	65	31.6%
2 – persisten vegetative state	14	6.8%		
Modified Rankin Scale (mRS)				
0 – no symptoms	12	5.8%	141	68.4%
1 – no significant disability	73	35.4%		
2 – slight disability	56	27.2%		
3 – moderate disability	31	15.0%	65	31.6%
4 – moderately severe disability	19	9.2%		
5 – severe disability	15	7.3%		

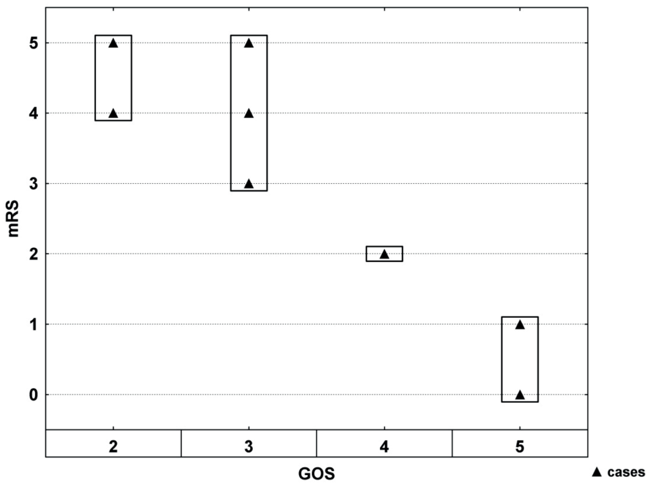


Figure 2. Patients classification on the basis of the GOS (Glasgow Outcome Scale) and the mRS (modified Rankin Scale). The plotted dashed line frame illustrates the favourable short term outcome cases.

complications did not reveal any significant impact on the treatment results ($p>0.05$). Three patients with hydrocephalus following SAH were discharged in a poor clinical condition ($p=0.01$). Among patients who survived the in-hospital postoperative period, DCI was diagnosed in 16 of them (7.8%) and influenced the GOS ($p<0.01$). The multivariate analysis (logistic regression) revealed four independent and significant factors: age, the Hunt-Hess scale, Fisher scale and the presence of DCI. (Table 3, Figure 3)

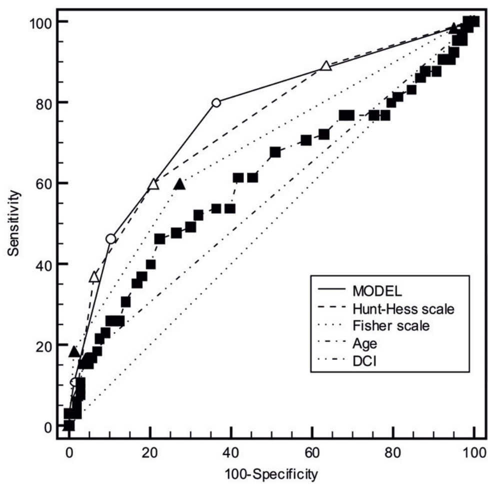
Morbidity

Among the whole group of 242 ruptured ICA aneurysms, death (GOS 1) or unfavourable outcome on discharge (GOS 2,3) was stated in 101 cases, resulting in a total morbidity of 41.7% (poor outcome; GOS 1,2,3) (Table 4).

Tab. 3. Significant unfavourable short term outcome factors in univariate analysis and all variables in multivariate analyses. P-value (p) was provided at the moment of removing it from the regression model

Abbreviations: SAH – subarachnoid haemorrhage, WFNS – World Federation of Neurosurgeons Scale, GCS – Glasgow Coma Scale, DCI – delayed cerebral ischemia

Prognostic factor	*Univariate analysis*	*Multivariate analysis*	*Odds ratio (OR) {95% CI}*	*Sequence of factors removal from multivariate model*
Hydrocephalus after SAH	p=0.01	p=0.99	-	1
WFNS	p<0.01	p=0.96	1.0 {0.5-1.9}	2
GCS	p<0.01	p=0.67	1.0 {0.9-1.3}	3
Operative complications	p=0.05	p=0.22	2.1 {0.6-7.0}	4
Age	p<0.01	**p=0.02**	1.1 {1.0-1.1}	
Fisher Scale	p<0.01	**p=0.02**	2.0 {1.1-3.6}	
Hunt-Hess Scale	p<0.01	**p<0.01**	2.0 {1.4-2.9}	
DCI	p<0.01	**p<0.01**	4.9 {1.4-17.0}	



	AUC	95% CI
MODEL	**0.76**	0.70-0.82
Hunt-Hess scale	**0.74**	0.68-0.80
Fisher scale	0.69	0.62-0.75
Age	0.61	0.54-0.67
DCI	0.56	0.49-0.63

Figure 3. ROC (receiver operating characteristic) curves for the logistic regression model and for significant variables of the multivariable model. Values on the x and y axes represent percentages. Besides, the table shows the AUC (area under the curve) values with their CI (Confidence Interval)

The presence of neurological signs following surgical intervention (p<0.01) as well as the diagnosis of DCI (p<0.01) significantly correlated with the morbidity occurrence. Logistic regression revealed four independent factors: postoperative neurological signs, Fisher and Hunt-Hess scale, and DCI (Table 5), if all combined, they explained only 64% of the morbidity risk (PAR=64.3%; 95% CI: 50.3-78.3).

Tab. 4. Characteristic of the morbidity (GOS 1,2,3) and favourable outcome (GOS 4,5). Percentages represent the proportion of the cases
Abbreviations: WFNS – World Federation of Neurosurgeons Scale, GOS – Glasgow Outcome Scale, DCI – delayed cerebral ischemia, SD – standard deviation, GCS – Glasgow Coma Scale

WFNS	*GOS 1,2,3 [n; %]*	*GOS 4,5 [n; %]*	***Fisher Scale***	*GOS 1,2,3 [n; %]*	*GOS 4,5 [n; %]*
I	40; 27.0%	108; 73.0%	1	1; 14.3%	6; 85.7%
II	1; 10.0%	9; 90.0%	2	36; 27.1%	97; 72.9%
III	5; 41.7%	7; 58.3%	3	46; 56.1%	36; 43.9%
IV	42; 75.0%	14; 25.0%	4	18; 90.0%	2; 10.0%
V	13; 81.3%	3; 18.7%			
Measurable factors	*GOS 1,2,3*	*GOS 4,5*	***Hunt-Hess Scale***	*GOS 1,2,3 [n; %]*	*GOS 4,5 [n; %]*
	[mean±SD]				
			1	7; 14.3%	42; 85.7%
Age	53.7 ±13.7	50.2 ±11.3	1A	1; 10.0%	9; 90.0%
Neurosurgeon's experience (numer of performed operations)	79.0 ±52.1	84.8 ±51.9	2	28; 31.8%	60; 68.2%
GCS	11.3 ±3.8	14.1 ±2.0	3	22; 51.2%	21; 48.8%
			4	31; 83.8%	6; 16.2%
			5	12; 80.0%	3; 20.0%
Factors	*GOS 1,2,3 [n; %]*	*GOS 4,5 [n; %]*	***Factors***	*GOS 1,2,3 [n; %]*	*GOS 4,5 [n; %]*
Gender: Males	20; 35.7%	36; 64.3%	All complications	10; 55.6%	8; 44.4%
Females	81; 43.6%	105; 56.5%	General complications	7; 53.9%	6; 46.2%
Higher education	9; 30.0%	21; 70.0%	Surgical complications	3; 60.0%	2; 40.0%
Rural residency	16; 31.4%	35; 68.6%	Operative method: Clipping	91; 40.3%	135; 59.7%
Comorbidities	60; 40.0%	90; 60.0%	Trapping	3; 100.0%	0; 0.0%
Presence of preoperative neurological signs	22; 51.2%	21; 48.8%	Wrapping	3; 60.0%	2; 40.0%
Presence of postoperative neurological signs	36; 62.1%	22; 37.9%	Only revision	2; 40.0%	3; 60.0%
DCI	18; 78.3%	5; 21.7%	By-pass	2; 66.7%	1; 33.3%

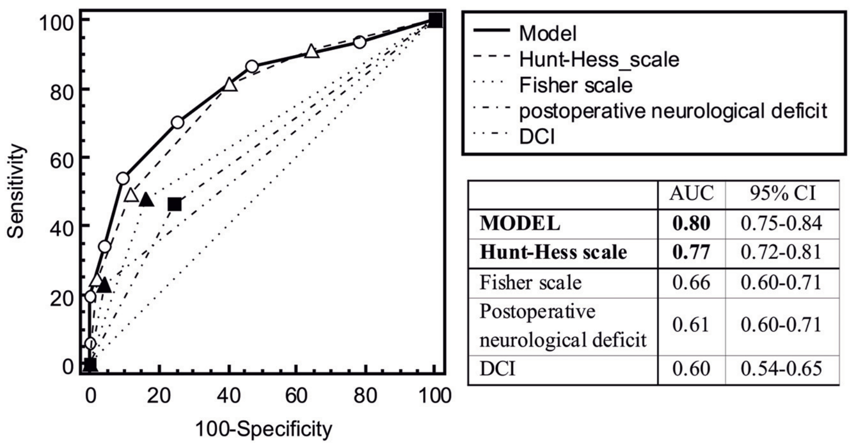
The created model of significant factors defined morbidity better than any variable individually (AUC=0.80; 95% CI: 0.75-0.84). The Hunt-Hess scale was a dominant component of the multivariate model (Figure 4).

Long-term outcome

No recurrent SAH was recorded. A high quality of life was expressed in 91 cases (44.2%). The mean total SF-36 score was 49.1 (SD±18.6), PCS 47.8 (SD±18.8), and MCS 49.3 (SD±17.4). The mean value of all the components of the SF-36 scale ranged from 46.2 to 54.4 points (Figure 5). The total SF-36, PCS and MCS did not depend on the demographic data (Table 6).

Tab. 5. Significant morbidity factors in univariate analysis and all variables of multivariate analyses. P-value (p) was provided at the moment of removing it from the regression model
Abbreviations: GCS – Glasgow Coma Scale, WFNS – World Federation of Neurosurgeons Scale, DCI – delayed cerebral ischemia

Prognostic factor	*Univariate analysis*	*Multivariate analysis*	*Odds ratio (OR) {95% CI}*	*Sequence of factors removal from multivariate model*
Trapping	p=0.04	p=0.99	-	1
GCS	p<0.01	p=0.82	1.0 {0.8-1.4}	2
WFNS	p<0.01	p=0.79	1.1 {0.7-1.5}	3
Age	p=0.03	p=0.05	1.0 {1.0}	4
Presence of postoperative neurological signs	p<0.01	**p=0.04**	1.0 {1.0}	
Fisher Scale	p<0.01	**p=0.02**	1.9 {1.1-3.2}	
Hunt-Hess Scale	p<0.01	**p<0.01**	1.9 {1.3-2.8}	
DCI	p<0.01	**p<0.01**	7.8 {2.6-23.9}	



	AUC	95% CI
MODEL	**0.80**	0.75-0.84
Hunt-Hess scale	**0.77**	0.72-0.81
Fisher scale	0.66	0.60-0.71
Postoperative neurological deficit	0.61	0.60-0.71
DCI	0.60	0.54-0.65

Figure 4. ROC (receiver operating characteristic) curves for logistic regression model and for significant variables of multivariable model. The values on the x and y axes represent percentages. Besides, the table shows the AUC (area under the curve) values with their CI (Confidence Interval)

The exception were the men, as men presented a higher MCS and total SF-36 score. In detail, the group of patients with only primary education, has the lowest values of the mean Role-Emotional (RE) element of SF-36. This was 28.0 ± 32.9 for primary education vs. 51.4 ± 46.5 for other (higher than primary) educational levels (p=0.04). Also a slight correlation between the RE component and the level of education was found (r=0.17, p=0.15). Younger patients (<30 years)

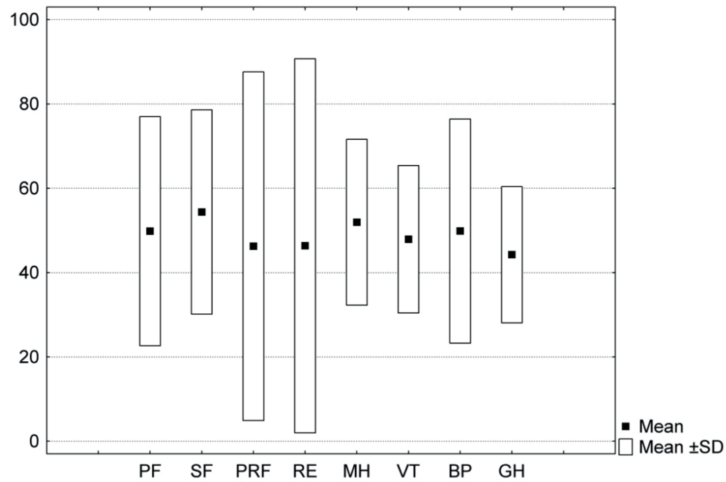


Figure 5. SF-36 (short form 36) scale components mean values. PF – psychical functioning, SF – social functioning, PRF – role physical, RE – role emotional, MH – mental health, VT – vitality, BP – bodily pain, GH – general health

Tab.6. Correlation between demographical and operation related factors with quality of life.
Abbreviations: PCS – physical health, MCS – mental health, SF-36 – short form 36 scale, ICA – internal carotid artery

	PCS	*MCS*	*SF-36*
Age	0.17	0.21	0.14
Gender	0.18	**<0.01**	**0.03**
Education	0.99	0.51	0.52
Rural residency	0.66	0.75	0.58
Comorbidities	0.19	0.75	0.41
Aneurysm side (left / right)	0.73	1.00	0.89
Size of the aneurysm	0.61	0.59	0.55
Segment of ICA	0.32	0.54	0.31
Detailed localisation of ICA aneurysm	0.14	0.36	0.19
Year of operation	0.23	0.31	0.31
Neurosurgeon	0.99	0.85	0.98
Number of performed operation by a neurosurgeon	0.82	0.37	0.55
Operative method	0.38	0.21	0.25

have a significantly higher social functioning (SF) level in comparison to those older (64.6 ± 19.8 vs. 53.7 ± 24.9; p=0.04). Middle-aged persons have higher values of physical functioning (54.4 ± 25.8 vs. 45.0 ± 28.1; p=0.02). Persons over 50 have the lowest scores in physical functioning (43.9 ± 27.9 vs. 53.9 ± 26.6; p=0.01), social functioning (50.6 ± 26.9 vs. 58.6 ± 21.6; p=0.02) and role-emotional (41.2 ± 43.7 vs. 55.6 ± 46.6; p=0.02). The mean values of SF-36 and its components according to gender and age were also estimated (Table 7).

The highest total SF-36 result was in the group of men under 30 (62.8). The lowest mean was in the group of women over 50. These values were significantly

Table 7. Mean SF-36 scale components according to age groups and gender

	Whole population		Below 30 years		30-50 years		Above 50 years	
	Women [n=155]	**Men [n=51]**	**Women [n=9]**	**Men [N=9]**	**Women [N=60]**	**Men [N=19]**	**Women [N=86]**	**Men [n=23]**
Physical Functioning	48,3	50,9	43,3	59,4	54,2	49,7	44,8	48,5
Social Functioning	54,7	54,7	63,9	65,3	58,3	50,7	51,2	53,8
Role-physical	44,3	50,0	38,9	69,4	49,2	40,8	41,6	50,0
Role-Emotional	44,3*	61,4*	63,0	66,7	45,6[c]	70,2[bc]	41,5[b]	52,2
Mental Health	52,2	54,7	49,8	59,1	52,1	48,2	52,6	58,4
Vitality	47,7	51,5	51,1	57,8	49,0	50,3	46,4	50,0
Bodily Pain	50,7	53,2	53,0	72,0[e]	52,0[e]	49,4[e]	49,5[e]	49,1[e]
General Health	42,8	46,6	41,6	51,7	44,4	49,0	41,9	42,7
Physical Component Summary	47,0	50,4	45,6	62,1[f]	49,8	47,8	45,2[f]	48,1
Mental Component Summary	48,7	53,8	53,9	60,1[f]	49,9	53,7	47,3[f]	51,4
Total SF-36	48,4	52,9	50,6	62,8[f]	50,6	51,0	46,6[f]	50,6
% ratio of PCS scores >50 [number of cases]	26,59% [67]	36,84% [28]	33,33% [4]	70,00% [7]	29,73% [33]	29,41% [10]	23,26% [30]	34,38% [11]
% ratio of MCS scores >50 [number of cases]	28,97% [a] [73]	42,11% [a] [32]	41,67% [5]	50,00% [5]	33,33% [37]	47,06% [16]	24,03% [31]	34,38% [11]
% ratio of SF-36 scores >50 [number of cases]	41,94% [65]	50,98% [26]	44,44% [4]	77,78% [7]	47,76% [32]	50,00% [10]	36,71% [29]	40,91% [9]

Legend:
MCS – mental component summary, PSC – physical component summary
* Whole studied population' women and men (p=0,04)
a) Whole studied population' women and men (p=0,03)
b) Women above 50 to men 30-50 (p=0,01)
c) Men to women in 30-50 group (p=0,03)
e) Men below 30 years to both genders in 30-50 and above 50 gropus (p=0,04).
f) Women above 50 to men below 30 (p=0,01)

different (p=0.01). The Fisher scale (p=0.19-0.68), neurological signs before the surgery (p=0.09-0.13), the postoperative presence of DCI (p=0.23-0.32) and the presence of complications (p=0.43-0.85) did not have any influence on the long-term outcomes. The GCS, WFNS and Hunt-Hess scale significantly correlated with the PCS, MCS and the total SF-36 scores (p<0.05). Quality of life relied on the GOS grade on discharge (r=0.29 p<0.001). (Figure 6)

Also mRS on discharge referred similarly SF-36 (r=-0,31 p<0,001). The time point, at which the SF-36 started to differ from the GOS, was determined at 49 months. Logistic regression revealed the weak impact of prognostic factors (p=0.17-0.90) on the long-term treatment assessment (AUC=0.52-0.59). Gender and an unfavourable short-term outcome were responsible for 34% (PAR=33.9%; 95% CI: 3.4-71.3) and 25% (PAR=26.2%; 95%CI: 10.9-41.5) of the low quality of life risk respectively. Replies from patients over 65 (54.8%) were obtained more rarely than from those under this age (73.7%).

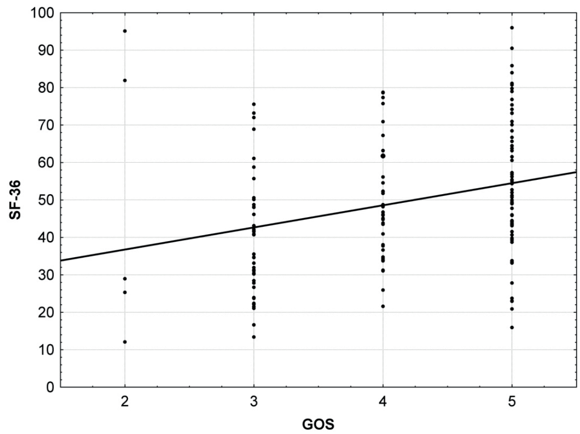


Figure 6. The correlation between short and long-term outcome
Abbreviations: GOS – Glasgow Outcome Scale, SF-36 – short form 36 scale.

DISCUSSION

The GOS is a key tool in assessing patients' state following SAH, whereas mRS offers more categories of disability. Classifying patients by GOS into favourable and unfavourable outcome groups is still debatable with regard to the threshold value. In our research the same cases were categorized as favourable outcomes, by both the GOS and mRS. Another report confirmed the high agreement of these scales. Our study as well as another one proved that the factors determining unfavourable treatment outcome (GOS 2,3) and mortality (GOS 1) are different. However, factors influencing morbidity (GOS 1,2,3) were similar to these influencing early treatment outcomes (GOS 2,3) (Figure 7).

The most important consideration for patients is information regarding their chances of survival. Kasell divided these factors regarding the risk of death from the factors pertaining to favourable treatment outcomes. Fraser emphasized that the reasons for discrepancies in the obtained outcomes stem mainly from demographic inconsistencies and the operation site's experience. In our material, the state of patients on discharge depended on age, the Hunt-Hess, Fisher grade and DCI occurrence. However, the above results explained only 43% of the risk of unfavourable early treatment outcome. Apart from these factors, Kassell and Rosen have mentioned other risk factors for an unfavourable outcome: blood pressure on admission, a pre-existing medical condition and consciousness on admission. We did not assess blood pressure; equally the scale of assessing consciousness applied by Kasell cannot be compared with any currently accepted scales. The significance of the Hunt-Hess scale may exceed the role of GCS in multivariate analyses. The triad of the Hunt-Hess scale, age and DCI predicts the unfavourable treatment outcome. It is worth mentioning that analy-

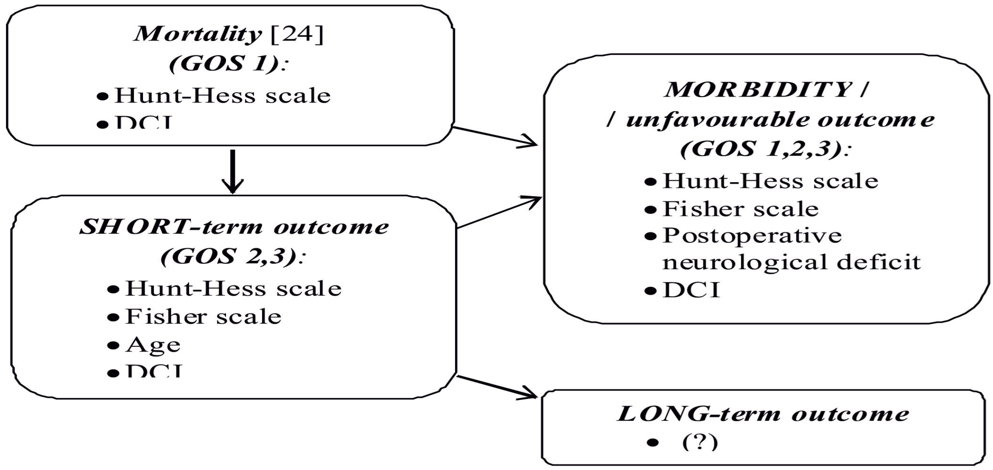


Figure 7. Significant factors of mortality [24] and unfavourable short-term treatment outcome. Lack of significant factors of low quality of life in the long-term observation
Abbreviations: GOS – Glasgow Outcome Scale, DCI – delayed cerebral ischemia

ses supported by large populations of patients are the most reliable source of knowledge. In our group, the risk of an unfavourable outcome in the 4^{th} and 5^{th} grade in the Hunt-Hess was over 8 times higher than in patients admitted to hospital in better condition. An interesting note is that the quality of life in patients with lower scores on the Hunt-Hess scaling may even not differ from patients who were operated on for unruptured intracranial aneurysms. The clinical state on admission, measured with the Hunt-Hess scale, was a dominant factor in the short-term outcome and the morbidity prediction in our series. Following the Hunt-Hess, the Fisher scale, DCI and age were minor factors influencing unfavourable outcomes. However, others did not indicate the dominant factor impacting the outcome, our study complements results with a novel statistical approach. The intensity of SAH in the Fisher scale was the second compelling prognostic factor for early treatment outcomes. Some investigators neglect the role of the intensity of SAH in determining the clinical outcome. DCI occurrence was the last significant variable in the ROC model. Alaraj proved that prognosis in patients with a symptomatic and asymptomatic vasospasm does not differ significantly. Others include DCI and also asymptomatic vasospasm in the risk of unfavourable treatment outcomes. Ionita emphasizes that a vasospasm is the only modifiable factor which became the attainable aim for the improvement.

Certain drawbacks of our study require elaboration. Only principal quality of life components were included into the analysis. Those who survive SAH have multispheric disabilities: neuropsychological, cognitive functions, problems with gaining new knowledge, making decisions in stressful situations and many other disabilities. However, they have not been perceptively investigated yet. Another drawback of the study is that late recurrent bleeding was not noticed, although this refers only to a small group of patients and is related to high mortality (Le Roux, 2004). There are few publications concerning the quality of life after SAH and even fewer reports identify the prognostic factors (Scopus search for keywords “ruptured”, “cerebral aneurysm”, “outcome”, “surgical”, “long term”). In our series the majority of patients (55.8%) represented a low quality of life 6.5 years after surgery. Scharbrodt compared the quality of life after aneurysmal SAH to the healthy population. Each of the SF-36 components was significantly decreased, especially in females. That result is in accordance to a similar study, while another one confirmed that females have better outcome than males. Scharbrodt claimed that this pertains only to some quality of life components. A weak, but significant correlation between the GOS and mRS and SF-36 was observed. The assessment of patients in a poor clinical state on discharge should be complemented with a quality of life scale. The low return rate of questionnaires from those patients discharged in a vegetative state may stem from both the neurological condition and/or query construction. Therefore, the long-term outcome results of those in a good condition are not conclusive. All the components of quality of life are particularly decrease of years following aSAH. Our research proved that a correlation between the GOS on discharge and the SF-36 scale 6.5 years after SAH does not exist. The identification of significant prognostic factors for ruptured aneurysms is timeless, regardless of treatment modality.

CONCLUSIONS

The factors influencing an unfavourable outcome differ from those determining morbidity. The Hunt-Hess scale is a dominant component in short-term outcome prediction.

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