Quality of Life After Treatment of Unruptured Intracranial Aneurysms

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■ OBJECTIVE: **Quality of life is an important factor in the decision making for the treatment of unruptured intracranial aneurysms (UIA). The data dealing with QoL in patients after the treatment are spare. We have evaluated QoL of patients after endovascular or surgical treatment of incidental intracranial aneurysm.**

■ METHODS: **We performed a prospective analysis of retrospectively collected data. All patients received 36-Item Short Form Health Survey (SF-36), Hospital Anxiety and Depression Scale (HADS), German questionnaire for self-perceived deficits in attention (FEDA) and not standardized questionnaire analyzing personal job-related situation, family circumstances and chronic illnesses.**

■ RESULTS: **177 patients were treated during the evaluated period. 79 (44.6%) patients responded. In this cohort, 62.03% of patients underwent coiling. Complications were noted in 13.9% of patients. Stroke was the most common complication (7.6%). All SF-36 related data except for pain showed significant lower mean, if compared to the standard German population ($p < 0.01$). For both genders, anxiety (males, $P = 0.003$ and females, $P = 0.002$) but not depression was more common than in the standard population. According to the FEDA test, treated patients showed significant difference only for fatigue in comparison to healthy population ($P < 0.001$). 54.4% of patients suffered from chronic illnesses, and among them only 1 patient (1.3%) had aneurysm associated chronic disease. No significant differences were found between treatment modalities.**

■ CONCLUSIONS: **The risk for depression and pain is not significantly increased after elective treatment of UIA. According to our results, decreased QoL is common in this cohort of patients but often related to factors not associated with aneurysm treatment.**

INTRODUCTION

Unruptured intracranial aneurysm (UIA) has become more common with the increasing availability of high-resolution imaging methods. The prevalence in the general population is approximately 3.2%.[1] The International Study of Unruptured Intracranial Aneurysms Investigators reported an annual rupture risk of 0.7% for aneurysms with a diameter >2 mm.[2] If preemptive treatment is recommended, the appropriate method of aneurysm occlusion—microsurgical clipping or endovascular treatment—is a matter of intensive discussions within neurovascular teams worldwide.[3,4] With regard to the prophylactic character of the treatment, quality of life (QoL) after an intervention is one of the most relevant factors to be taken into account before the final treatment recommendation is made. Many studies describe patients' outcome using the modified Rankin Scale or the Glasgow Outcome Score. However, it is not possible to summarize fine cognitive, emotional, and social dysfunction resulting from the prophylactic treatment. Detailed characteristics of patients after treatment of intracranial aneurysm are utmost importance to improve further recommendation and treatment strategies. We performed a prospective QoL data collection from a retrospective cohort of patients treated for UIA.

Key words
- Chronic illness
- Coiling
- Quality of life
- Short Form Health Survey
- Surgical clipping
- Unruptured intracranial aneurysm

Abbreviations and Acronyms
FEDA: German questionnaire for self-perceived deficits in attention
HADS: Hospital Anxiety and Depression Scale
ICU: Intensive care unit
QoL: Quality of life
SAH: Subarachnoid hemorrhage
SF-36: 36-Item Short Form Health Survey
UIA: Unruptured intracranial aneurysm

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PATIENTS AND METHODS

Study Design

We conducted a prospective, descriptive observational study, enrolling retrospectively collected patients from 2 hospitals with neurosurgical departments who underwent treatment for UIA between 2008 and 2013. The patients were consecutively enrolled. The study was approved by the local ethics committee (Number 236/13). The study was also performed according to the International Declaration of Helsinki.

Prospective Survey of QoL

The goal was to examine QoL after treatment of UIA. A standardized generic survey for health-related QoL was chosen to ensure reproducibility and comparability in this topic.[5] All patients received the 36-Item Short Form Health Survey (SF-36). To further investigate probable reasons of impaired QoL, we included a questionnaire for anxiety and depression and for neurocognitive aspects of daily life. The Hospital Anxiety and Depression Scale (HADS), the German questionnaire for self-perceived deficits in attention (FEDA), and a not-standardized questionnaire covering the job-related situation, familiar circumstances, negative life events influencing QoL, and chronic illnesses were sent together with the SF-36 to each of the living treated patients.[6] The definition of chronic illnesses was established by the patients. The most common chronic illnesses decreasing the QoL were oncologic disease, degenerative and inflammatory diseases of the musculoskeletal system (e.g., rheumatoid arthritis, disc prolapse), cardiovascular and chronic pulmonary illnesses, and depression. Only 1 patient experienced immobilization as the consequence of stroke after the aneurysm-associated intervention.

Retrospectively Collected Patients' Data

Demographic data including age, gender, aneurysm location, treatment modality (clipping or endovascular), and length of procedure, complications, length of intensive care unit (ICU) treatment, and time between treatment and fulfilling of QoL questionnaires were analyzed retrospectively. During the period considered, 177 patients were treated in 2 hospitals; 79 (44.6%) patients responded and fulfilled the questionnaires. Their mean age was 58.1 years (range, 28–77 years; standard error [SE] 10.6), and 50 (63.3%) were women. The internal carotid artery was the most common aneurysm location (n = 17, 21.5%) followed by the medial cerebral artery (n = 16, 20.3%). Most of the patients presented with a single aneurysm (n = 59, 74.7%). Considering aneurysm size, aneurysms 6 to 10 mm were most frequent (n = 29, 36.7%). The most common treatment modality was endovascular intervention (n = 54, 68.4%). Considering the ICU treatment, most of the patients were treated 1 to 3 days in the ICU. Eleven patients (13.9%) experienced a treatment-related complication. The most common complication was stroke (n = 6, 7.6%), followed by intracerebral hemorrhage (n = 2, 2.5%), subarachnoid hemorrhage (SAH) (n = 2, 2.5%), and infection (n = 1, 1.3%). With respect to the time period between treatment and completion of questionnaires, most patients (n = 23, 29.1%) responded 24 months after treatment (range, 3–120 months).

Selection of Treatment Method

The decision making for most appropriate treatment method was done by the neurovascular team, consisting at least of 1 experienced neurovascular radiologist and at least 1 experienced vascular neurosurgeon. Younger age, size and morphology of aneurysms, and the presence of risk factors such as arterial hypertension, smoking, positive family history for aneurysmatic bleeding or previous SAH were the most important factors leading to the decision for further treatment avoid aneurysm rupture. Considering the treatment modality, aneurysms of the medial cerebral artery in younger patients were preferably treated by microsurgical clipping, and aneurysms in the posterior circulation in older patients with multiple morbidities were commonly treated by endovascular intervention. In case both treatment strategies were equal, the patient's choice was crucial. Patients with small aneurysms (>5 cm) and low-risk profiles (no history of arterial hypertension, previous SAH, or smoking) were not indicated for prophylactic treatment. The initial follow-up period was typically 1 year. Further evaluation is dependent on the dynamic growth of the aneurysms and on morphologic patterns (multilobular aneurysms).

Statistical Analysis

The data were initially analyzed by descriptive methods and clearly outlined. Mean, SE, and ranges are reported in the case of quantitative parameters; continuous variables and absolute and relative frequencies for the qualitative parameters. Explorative tests between interesting subgroups were selected by the underlying parameters (analysis of variance and t test). Nonparametric tests were performed in the presence of non-Gaussian distribution of values (Mann-Whitney test, Kruskal-Wallis test). Univariate and multivariate regression analyses were performed. The significance level was defined as $P < 0.05$. SPSS statistical software (IBM Company, SPSS Inc., Chicago, Illinois, USA) was used to analyze the collected data.

RESULTS

Quality of Life

Evaluating SF-36, all fields except for pain showed significantly lower values if compared with the normal population (Table 1). In assessment of the influence of different variables on SF-36, job situation and chronic illnesses had a significant influence on all aspects of SF-36 (Table 2). The length of intervention and the treatment modality had no significant impact on SF-36. ICU treatment period showed a significant influence on physical functioning (Table 2). Furthermore, the number of aneurysms showed a significant association with social role functioning, mental health, and vitality (Table 2). The occurrence of treatment-related complications showed a significant influence on physical functioning and on emotional and physical role functioning (Table 2). Having compared patients with and without complications related to the treatment, we found significant differences in the summary of physical component ($P = 0.006$), emotional role ($P = 0.008$), physical functioning ($P = 0.005$), and physical role ($P = 0.004$). Interestingly, the direct comparison of patients with and without chronic illness showed significantly lower QoL in all parts of SF-36 ($P < 0.005$).

Table 1. Results of Short-Form 36 Health Survey for Patients with Unruptured Intracranial Aneurysm Compared with Patients After Spontaneous Subarachnoid Hemorrhage

	Mean (SE)	Mean (SE) Normal Population	*P*	Mean (SE), Tjahjadi et al.[8]
Physical functioning (n = 79)	72.64 (26.04)	85.41 (20.65)	<0.001	69.79 (33.26)
Role: physical (n = 74)	56.08 (45.29)	82.36 (32.65)	<0.001	58.37 (41.85)
Bodily pain (n = 79)	63.60 (31.12)	67.38 (25.87)	0.285	70.53 (28.96)
General health (n = 76)	54.46 (22.45)	66.42 (18.16)	<0.001	60.44 (22.78)
Vitality (n = 78)	50.66 (21.81)	60.02 (17.84)	<0.001	49.46 (21.94)
Social functioning (n = 79)	71.84 (25.90)	86.38 (19.92)	<0.001	71.29 (27.81)
Role: emotional (n = 73)	63.47 (44.15)	89.11 (26.69)	<0.001	61.16 (43.84)
Mental health (n = 78)	64.50 (20.67)	72.46 (16.69)	0.001	64.56 (12.68)
Physical component summary (n = 73)	43.73 (12.50)	48.36 (9.42)	0.002	45.09 (12.05)
Mental component summary (n = 73)	45.06 (12.08)	50.87 (8.82)	<0.001	44.40 (11.75)

SE, standard error.

As for HADS, anxiety was significantly different for both genders (Table 3). Among female patients, anxiety was slightly higher than among male patients. However, depression rates were not significantly different in comparison with the normal population (Table 3). Anxiety and depression were significantly associated with job situation and presence of chronic illnesses (Table 4). Only among patients with multiple aneurysms was anxiety significantly more common. Intervention length, method, and complications had no significant influence on depression or anxiety (Table 4). We found no significant difference between patients with and without complications during the treatment ($P < 0.942$). Having compared patients with and without chronic illnesses, HADS showed significantly more common depression and anxiety in patients with chronic disease ($P < 0.001$).

As for the FEDA results, we found no significant differences from the results in the normal population cohort. Only fatigue was

Table 2. Overview of Different Factors That Influence Short-Form 36 Health Survey Parameters

	Working	Intervention Length	ICU Treatment Period	Aneurysm Number	Chronic Illnesses	Negative Events	Clip/ Coil	Complications	Time Intervention Questionnaire
Physical functioning	<0.001	0.451	0.009	0.210	<0.001	0.149	0.180	<0.001	0.434
Role: physical	0.025	0.960	0.149	0.071	<0.001	0.167	0.632	0.002	0.169
Bodily pain	0.003	0.830	0.316	0.109	<0.001	0.003	0.467	0.086	0.031
General health	0.002	0.833	0.749	0.053	<0.001	0.053	0.972	0.249	0.118
Vitality	0.022	0.776	0.795	0.009	<0.001	0.061	0.680	0.105	0.221
Social functioning	0.011	0.853	0.552	0.035	<0.001	0.002	0.787	0.260	0.080
Role: emotional	0.010	0.817	0.238	0.216	0.003	0.117	0.769	0.006	0.299
Mental health	0.001	0.776	0.934	0.010	<0.001	0.007	0.838	0.895	0.360
Physical component summary	0.004	0.947	0.150	0.225	<0.001	0.154	0.480	0.004	0.192
Mental component summary	0.013	0.962	0.851	0.092	0.003	0.021	0.921	0.572	0.269

ICU, intensive care unit.

Table 3. Hospital Anxiety and Depression Scale for Patients with Unruptured Intracranial Aneurysms Compared with Standard Population

	Mean (SE)	Mean (SE), Standard Population	*P*
Anxiety (male, n = 29)	6.67 (4.30)	4.40 (3.30)	0.003
Depression (male, n = 29)	6.00 (4.66)	4.60 (3.80)	0.120
Anxiety (female, n = 50)	6.84 (3.90)	5.00 (3.40)	0.002
Depression (female, n = 50)	5.58 (4.49)	4.70 (3.90)	0.178

SE, standard error.

significantly different in comparison with the healthy population (Table 5). Only chronic illnesses showed a significant association with all fields in the FEDA questionnaire (Table 6). After patients with and without complications were compared, FEDA was significantly lower for distractibility in mental processes ($P = 0.041$) and for fatigue and retardation in activities of daily living in patients with treatment-related complications ($P = 0.027$).

Forty-three patients (54.4%) experienced chronic illnesses that had a relevant influence on QoL. Only 1 patient reported chronic illness related to aneurysm treatment (1.3%). In this case, the patient was living with the sequelae of stroke, which influenced his QoL every day. Twenty-eight (35.4%) patients reported that a negative event, such as their financial situation, influenced their QoL. Only 1 patient (1.3%) had an aneurysm-associated negative event. In this case, it was a newly identified aneurysm, which required further follow-up. Twenty (25.3%) of patients returned to work, and 19 (24.1%) retired. It was significantly more common for patients with chronic illnesses to not be working any more ($P = 0.011$).

DISCUSSION

The QoL is one of the most relevant outcome parameters if prophylactic interventions are suggested.[7] The number of patients with unruptured intracranial aneurysms is rising because of the increased availability and technical progress in radiology.[7] Consequently, more patients need risk assessment and recommendations regarding further actions concerning the aneurysm. We prospectively evaluated a retrospective cohort of patients treated with UIA and assessed their QoL after treatment using a self-reporting questionnaire.

Generally, all patients in our study showed reduced QoL based on SF-36. If we compare these results with QoL in patients after SAH (Table 1) published earlier from our group, except for pain, all parameters of SF-36 are higher in patients with UIA.[8] This aspect logically displays the tremendous impact of acute SAH as a potentially life-threatening event on QoL. The detailed analysis revealed that the most important influencing factor is a chronic illness, which almost in all cases was not related to aneurysm treatment. The detailed definition of chronic illnesses resulting in diminished QoL was done by patients to avoid potential bias that could have influenced the data negatively. The most common were oncologic diseases and chronic degenerative diseases of the musculoskeletal system. According to our results, all questionnaires confirmed significantly decreased QoL of patients with aneurysm-independent chronic illnesses. Our results are similar to the data reported by Solheim et al.[9] In this study, surgical clipping (58%) was the most common procedure. Similarly, no significant difference was found between treatment modalities. Yamashiro et al.[10] evaluated QoL in patients treated only with surgical clipping. They reported that patients' QoL declined postoperatively but returned to preoperative levels 3 years after the surgery. Furthermore, this study showed slightly higher QoL of treated patients in comparison to healthy population. This fact might be the consequence of patients eligible for clipping, who typically are younger and do not have chronic or multiple illnesses. Unfortunately, no preoperative data were available in our study, and follow-up included different periods after the treatment, so that we cannot directly compare QoL before and after the treatment.

Nevertheless, most of the patients experienced other not aneurysm-related illnesses or negative events, so that the treatment for patients with increased risk for SAH seems to be advisable even in terms of postoperative QoL. However, the potential negative effects of prophylactic treatment must be kept in mind, and patients with smaller aneurysms and low-risk profiles for aneurysmatic bleeding should be considered for regular follow-up. Additionally, we compared QoL of patients with and without treatment-associated complications and found the main differences in QoL to be related to physical abilities and to fatigue and distractibility. Interestingly, there was no significant difference in the occurrence of depression. Similarly to our results, Yamashiro et al.[11] showed in another publication that decreased QoL in

Table 4. Overview of Different Factors Influencing Hospital Anxiety and Depression Scale in Patients with Unruptured Intracranial Aneurysms

	Working	Intervention Length	ICU Treatment Period	Aneurysm Number	Chronic Illnesses	Negative Events	Clip/ Coil	Complications	Time Intervention Questionnaire
Depression	0.01	0.68	0.61	0.07	<0.001	0.29	0.76	0.10	0.63
Anxiety	0.01	0.84	0.76	0.02	<0.001	0.05	0.58	0.93	0.09

ICU, intensive care unit.

Table 5. German Questionnaire for Self-Perceived Deficits in Attention in Patients with Unruptured Intracranial Aneurysms

	Mean (SE)	Mean (SE), Standard Healthy Population	Mean (SE), Standard Patient Population	*P*, Standard Healthy Population	*P*, Standard Patient Population
Distractibility in mental processes (n = 78)	49.10 (11.39)	51.66 (7.01)	44.95 (11.93)	0.072	0.011
Fatigue and retardation in activities of daily living (n = 78)	30.42 (7.89)	34.44 (4.28)	29.67 (6.74)	0.000	0.468
Decrease in motivation (n = 78)	22.69 (5.57)	24.03 (3.60)	22.26 (5.21)	0.057	0.556

SE, standard error.

patients with UIA was mostly related to other chronic diseases. Additionally, on the basis of our data, depression and pain were not significantly different in comparison to normal population. Furthermore, the detailed SF-36 analysis showed no significant difference between different treatment modalities. Surgical clipping was related to longer ICU treatment periods which might have had some effect on physical functioning in the subgroup analysis of SF-36. Only 1 patient reported a treatment-associated negative event leading to a relevant decline of QoL. Complications and potential avoidance of stroke is logically one of the most important factors in the treatment of UIA and has a tremendous influence on further QoL. Interestingly, depression seemed not to be a relevant problem after treatment. More than a quarter of patients were able to work again, and almost the same number of patients retired during the time of our study. These numbers are similar to the results published by Solheim et al.,[9] even if in this study more patients returned to work but a lower number of patients retired. This reflects a slightly younger population according to total mean age in comparison with our study (54.8 vs. 58.1 years). Patients with UIA need regular magnetic resonance imaging studies and clinical examination.[12] This fact is reflected in more common anxiety among these patients. These data are congruent with those reported by other authors.[13] Intensive imaging monitoring in patients with small aneurysms (<3 mm) seems to be related to inferior health outcomes.[13] Furthermore, mainly patients with multiple aneurysms are at risk for anxiety because they are aware of a potential source of bleeding that may require further treatment and potential periprocedural risks. Yamashiro et al.[11] confirmed this assumption in their further publication, which reported that patients with untreated intracranial aneurysms are at higher risk for anxiety and depression. Considering demographic data, such as age, distribution of aneurysms, and gender, our study cohort was similar to those in the published literature.[7,9] Our data confirm that patients with multiple aneurysms need special attention and might potentially profit from psychologic support.

Brilstra et al.[14] reported that surgical clipping is related to worse QoL in comparison with endovascular procedures. However, only 51 patients were evaluated in this study, and only 19 patients underwent endovascular aneurysm treatment. Furthermore, the observational period was 1 year after the treatment, which is short, especially with regard to the results published by Yamashiro et al.,[10] which we mentioned before. Considering our results, we found no significant difference between surgical clipping and coiling in regard to QoL. Furthermore, the length of the treatment procedure showed no significant effect on QoL according to our data, so that a potentially longer time needed for surgical treatment does not influence QoL and seems to be relevant mainly for patients with other comorbidities.

The FEDA questionnaire, to our knowledge, was used for the first time for patients with UIA in our study. Only fatigue was significantly different from that in the healthy population;

Table 6. German Questionnaire for Self-Perceived Deficits in Attention and Overview of Different Influencing Factors in Patients with Unruptured Intracranial Aneurysms

	Working	Intervention Length	ICU Treatment Period	Aneurysm Number	Chronic Illnesses	Negative Events	Clip/ Coil	Complications	Time Intervention Questionnaire
Distractibility in mental processes	0.090	0.344	0.275	0.158	<0.001	0.096	0.301	0.055	0.263
Fatigue and retardation in activities of daily living	<0.001	0.668	0.112	0.103	<0.001	0.033	0.351	0.010	0.259
Decrease in motivation	0.054	0.370	0.293	0.087	<0.001	0.120	0.651	0.152	0.182

ICU, intensive care unit.

however, this fact reflects simultaneously the negative role of chronic illnesses. If we look at other factors of QoL, a satisfactory working situation has a significantly positive influence on all fields of SF-36. Backes et al.[15] showed that the duration of reduced functioning and working capacity is approximately 1 to 2 months after endovascular treatment and 3 to 5 months after microsurgical clipping in patients with UIA. The recovery period is related to decreased QoL. Return to work is a great indicator for complete recovery and decrease for potential depression periods. More than one quarter of patients in our study were able to work again, and the same number retired at the time of fulfilling the questionnaires. Furthermore, many patients experienced chronic illnesses not related to the aneurysm, preventing their return to work. Solheim et al.[9] reported in their study that 37% of patients were employed after a mean follow-up period of 2.5 years. Backes et al.[15] reported that 78% of patients returned to work again after elective treatment of UIA. This number is higher than in our patient group. The cohort in this publication was lower and younger than in our study.

Study Limitations

Because of the low number of responders, it is not possible to generalize our results. Furthermore, considering the whole cohort of patients treated with unruptured intracranial aneurysms, many patients were lost to follow-up. This aspect might have influenced our results negatively. The follow-up period encompassed different time spans between the treatment and the questionnaire analysis, which might have influenced the QoL of patients with UIA. QoL analysis before the treatment is missing in our study, so that it is not possible to directly compare QoL before and after the treatment. Prospective and multicenter studies are necessary to justify and personalize our treatment recommendation with the main aim to improve QoL of patients with UIA.

CONCLUSION

Decreased QoL among patients after treatment of unruptured intracranial aneurysms is common in comparison with the healthy population; however, this is mostly related to no aneurysm-associated chronic illnesses or other personal negative events. Depression and pain are not significantly higher in this cohort of patients. Patients with multiple aneurysms are especially at risk for anxiety. We found no significant differences between surgical clipping and endovascular treatment with regard to post-interventional QoL. The connection of return to work, QoL, and sealing of the UIA should be investigated more intensively.

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