Patient-Reported Outcome for Endovascular Treatment versus Microsurgical Clipping in Aneurysmal Subarachnoid Hemorrhage

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■ OBJECTIVE: **Aneurysmal subarachnoid hemorrhage has a high mortality with significant impact on quality of life despite effective management strategies including endovascular treatment and/or microsurgical clipping. Although the modalities have undergone clinical comparison, they have not been evaluated on patient-reported outcomes (PROs). This study compared endovascular versus microsurgical treatment using a PRO measure.**

■ METHODS: **We conducted a cross-sectional telephonic survey of adult patients conducted at Hamad General Hospital, Doha, Qatar between 2017 and 2019. Candidate study participants were identified from procedure logs and hospital electronic health records for endovascular treatment ($N = 32$) versus microsurgical clipping ($N = 32$) of cerebral aneurysm. The primary outcome measure was the short version of the Stroke-Specific Quality of Life (SS-QoL) measure. The secondary outcome measure was the screened clinician-reported modified Rankin Scale (mRS) for all screened patients ($n = 137$). Mean scores were compared for the 2 treatment groups.**

■ RESULTS: **The SS-QoL mean score was 4.23 (standard deviation $\pm$ 0.77) in endovascular treatment and 4.19 $\pm$ 0.19 in surgical clipping ($P = 0.90$). In exploratory analysis, mean physical domain score was 3.17 $\pm$ 0.60 versus 2.98 $\pm$ 0.66 in endovascular treatment and surgical clipping groups, respectively. Mean psychosocial domain scores were 4.43 $\pm$ 0.85 versus 4.18 $\pm$ 0.0.92, respectively. In multivariable analysis, none of the clinical variables were significantly related to SS-QoL except vasospasm irrespective of intervention received. In secondary outcome analysis, modified Rankin Scale score was higher for endovascular treatment ($P = 0.04$).**

■ CONCLUSIONS: **Published evidence has supported clinical benefits of endovascular treatment for cerebral aneurysm treatment, but this study did not find any difference in PROs. Future studies of treatments should include PRO to identify potential differences from the patient's perspective.**

INTRODUCTION

Aneurysmal subarachnoid hemorrhage (SAH) is a devastating neurologic condition with a high immediate mortality rate exceeding 50% if untreated.[1,2] Aneurysmal SAH occurs more frequently in people of working age, so potential loss of quality-adjusted life years and economic impact are disproportionately high.[2,3] Assessing outcome is a fundamental part of good clinical practice. Outcome measures are required to define the quality of care and serve as endpoints in clinical

Key words
- Cerebral aneurysms
- Endovascular coiling
- Microsurgical clipping
- Patient-reported outcome
- Patient-reported outcome measurement
- Subarachnoid hemorrhage

Abbreviations and Acronyms
EHR: Electronic health record
HRQoL: Health-related quality of life
mRS: modified Rankin Scale
PRO: Patient-reported outcome
PROM: Patient-reported outcome measure
SAH: Subarachnoid hemorrhage
SD: Standard deviation
SS-QoL: Stroke-Specific Quality of Life

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trials.[4,5] As medical practice evolves from disease-centered to patient-centered care, patient-reported outcome measures (PROMs) have become common in health care research.[4,5] PROMs can assess a variety of health dimensions, and ample evidence suggests that the data gained can lead to better communication, decision making, outcomes, and patient experience.[5] Defining, measuring, and reporting PROMs in neurosurgical practice has been challenging, especially in aneurysmal SAH due to heterogeneity in clinical outcomes, multiplicity of pathologic processes triggered by SAH, high incidence of posttraumatic stress disorder, and lack of a disease-specific PROM tool.[6-9]

In the neurosurgical literature, it has been suggested that existing generic PROMs may overlook factors unique to patients undergoing neurosurgical procedures.[3,6-8] The Stroke-Specific Quality of Life Scale (SS-QoL) is one of the most used PROMs. Initially developed and validated for use in patients with ischemic stroke patients, it has subsequently been applied for both hemorrhagic and ischemic strokes.[10-12] Recently, a disease-specific PROM for aneurysmal SAH has been developed but has not yet been validated.[13] SS-QoL has undergone a thorough psychometric analysis, has been tested in different linguistic versions with cross-cultural validation, and is judged to be the most suitable PROM currently available for use in research.[12,14-16]

The 2 most common interventions to secure ruptured cerebral aneurysms are microsurgical clipping and endovascular coiling. These treatments have been compared in terms of the durability, complications, and clinician-reported quality of life.[1] However, there are no published data to compare these 2 treatments from the patient's perspective, based on validated PROMs. This observational study aimed to compare the health-related quality of life of patients with aneurysmal SAH who received either surgical clipping or endovascular treatment.

MATERIAL AND METHODS

This study was carried out in the neurosurgical center at Hamad General Hospital, Qatar. The study received ethical approvals from Institutional Review Boards of Hamad Medical Corporation (MRC-01–20–650) and John Hopkins University (IRB-00014691). Written informed consent was obtained from all participants or their next of kin.

The design was a cross-sectional survey. Clinicodemographic data were recorded from the hospital electronic health records (EHRs), and PROM data were collected via telephone interview.

The primary outcome measure was the short version (12-item) of stroke-specific quality of life PROM (SS-QoL-12) (https://strokengine.ca/en/assessments/stroke-specific-quality-of-life-scale-ss-qol/). The SS-QoL-12 is based on the full 49-item generic SS-QoL, using a single item to assess each of the 12 domains. Each item uses a 5-scaled Likert response scale.[17-19] English or Arabic versions, based on the patient's spoken language, were used. The Arabic version was translated and culturally adapted by 2 native Arabic speakers with a medical background in the local clinical setting. The translated versions were submitted to back translation to English to help inform a final Arabic version.

Outcome Measures

The primary cross-sectional outcome analysis compared the mean PROM scores for the 2 treatment groups. The comparators were the type of treatments carried out (in retrospect), and the outcome of interest was the means of the score calculated for the SS-QoL-12. Secondary outcome analysis included comparison of 2 treatment groups using modified Rankin Scale (mRS) as a clinician-reported outcome. This was collected for all the patients who were screened in the study (Figure 1). The mRS score was documented on the basis of the last available follow-up visit in the EHR.

Inclusion and Exclusion Criteria

The study included all patients 18 years and older who were alive at the date of survey and managed for ruptured aneurysmal SAH at Hamad General Hospital in Doha, Qatar from 1 January, 2017 to 31 December, 2019. Patients were treated with either endovascular treatment or microsurgical clipping. The decision to assign patients to endovascular treatment or surgical clipping was based on a multidisciplinary consensus from both neurointervention and neurosurgery teams for each case. They were fully conscious and alert enough to participate and respond to the survey questionnaire. Exclusions included patients younger than 18 years of age, those who died before the study period, those unable to participate in the survey due to impaired consciousness, and patients who received combined treatment with both endovascular treatment and microsurgical clipping at any stage during their course of disease.

Recruitment Procedures

Patient participation was obtained via telephonic interviews rather than in-person visits to minimize risk of personal exposure during the COVID-19 pandemic. After collecting clinicodemographic data and contact information from the hospital EHR, participants were contacted by phone and invited to participate using telephone recruitment script in English/Arabic versions. During the phone call, the patients were briefed about the study and its purpose and then were asked to provide verbal consent. Patients explained about both treatment modalities to address recall bias. After the consent process was completed, the patients were asked to complete the study questionnaire. Family members were allowed to help fill in the responses, but responses had to be obtained exclusively from the patient.

Statistical Analysis

Descriptive statistics were reported as mean ± standard deviation (SD) or median with interquartile range for interval variables and number (percentage) for categorical variables. Mean SS-QoL score and other interval variables in 2 arms were compared by using Independent Student's t-test and Pearson Chi square/Fisher exact tests as appropriate between the 2 treatment arms (endovascular vs. surgical treatment). Multiple linear regression analysis was performed to assess the relationship between the 2 treatment arms and 12-point SS-QoL scale after adjusting for clinical confounding factors (comorbid conditions [diabetes mellitus and hypertension], location/side of aneurysms, location of hematomas, SAH-related and procedure-related complications, cerebral vasospasm [SAH-related

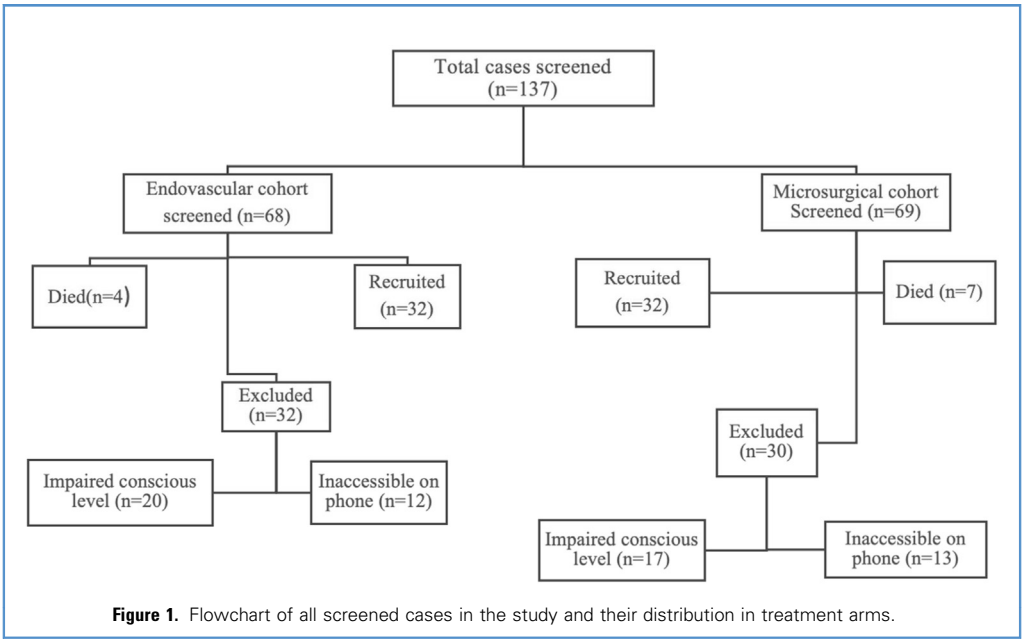

Figure 1. Flowchart of all screened cases in the study and their distribution in treatment arms.

complication], and infarctions [procedure-related complications]). Two-sided P values ($P < 0.05$) were considered statistically significant. All statistical analyses were performed by using SPSS (Statistical Package for social sciences version 25.0). A total sample size of 64 patients (32 in each arm) was calculated to be sufficient to detect a clinically important effect size of 0.8 between the 2 groups to compare the means of SS-QoL score and achieve 88% power with 5% level of statistical significance.[20]

RESULTS

We screened a total of 137 patients and recruited 64 patients (32 in each cohort) who fulfilled the study criteria. In the endovascular treatment cohort, we screened 68 patients, of whom 4 had already died. Of the remaining 64 patients, 32 were excluded due to impaired consciousness ($n = 20$) and inability to be contacted by phone ($n = 12$) for various reasons including being expatriated, no reply, no phone numbers available in an EHR, declining to participate in the study, and being inaccessible by phone. In the surgical clipping cohort, we screened 69 patients, of whom 7 had already died. Of the remaining 62 patients, 32 patients were recruited and 30 patients were excluded due to various reasons similar to those for the endovascular group (Figure 1).

The mean age of patients was 48.03 (SD ± 11.07) years with 29 (45.3%) male and 35 (54.7%) female. Twenty-seven patients used the Arabic version, and 37 patients used the English version of SS-QoL. One quarter of patients were from the Philippines ($n = 17$), 14 (21.9%) were from southeast Asia, 9 (14.1%) were locals from Qatar, and 24 (37.5%) were from other nationalities. Diabetes mellitus was present in 15.6% of patients and hypertension in 57.8%, while 40.6% of patients had no clinical comorbidities associated with aneurysmal SAH. The location of aneurysms was the internal carotid artery in 22 patients, middle cerebral artery in 16, and anterior cerebral artery/anterior communicating artery in 20 patients. Most patients ($n = 43$) did not have any intracerebral hematoma at the time of presentation. One third of patients ($n = 24$) developed vasospasm or delayed ischemic neurologic deficits. Nearly two thirds ($n = 44$) of patients did not develop any procedure-related complication. Mean duration of follow-up was 11.34 months (with median of 9 months). Table 1 shows a bivariate comparison of the 2 interventions.

Most patients ($n = 56$) had good clinical grades of 1 – 3 (based on the World Federation of Neurosurgical Societies scale), and patients were nearly evenly distributed among different Fissure grades with no statistical significance among the 2 treatment groups (Table 2). Comparing the 2 groups based on SS-QoL, the mean was 4.23 (SD ± 0.77) in the endovascular treatment group and 4.19 (SD ± 0.82) in the microsurgical clipping group with a P value of 0.895. For the physical subdomain, mean scores were 3.17 (SD ± 0.60) and 2.98 (SD ± 0.66) in endovascular treatment and surgical clipping groups, respectively (Table 3). For the psychosocial subdomain, mean scores were 4.43 (SD ± 0.85) and 4.18 (SD ± 0.922), respectively. The mean difference between groups for physical 0.183 ($P = 0.251$) and psychosocial was 0.256 ($P = 0.251$), as shown in Figure 2.

In the multivariate regression model, after adjusting for potential confounders, cerebral vasospasm (SAH-related complication) and infarctions (procedure-related complications) were statistically significantly related to SS-QoL (Table 4). Regression analyses conducted separately for each individual variable also showed that cerebral infarctions from procedure/surgery-related complications and vasospasm were related to SS-QoL scale irrespective of treatment modality. In the secondary analysis (Table 5) based on the modified Rankin scale, there were similar numbers of patients in the endovascular ($n = 68$) and surgical clipping groups ($n = 69$). Nearly one third of patients had good mRS

Table 1. Clinicodemographic Data

Parameters	Total (n = 64)	Endovascular Treatment (n = 32)	Surgical Clipping (n = 32)	*P* Value (0.05)
Age in years (mean)	48.03 ± 11.07	49.09 ± (11.63)	46.97 ± 10.56	0.447*
Gender				
Male (%)	29 (45.3)	16 (50)	13 (40.6)	0.451†
Female (%)	35 (54.7)	16 (50)	19 (59.4)	
Nationalities				
Qatari	9 (14.1)	5 (15.6)	4 (12.5)	0.798‡
Filipinos	17 (26.6)	9 (28.1)	8 (25.0)	
South Asian (Indian, Pakistan, Bangladesh, Nepal)	14 (21.9)	8 (25)	6 (18.8)	
Others	24 (37.5)	10 (31.3)	14 (43.8)	
SS-QoL language version				
Arabic	27 (42.2)	13 (40.6)	14 (43.8)	0.800†
English	37 (57.8)	19 (59.4)	18 (56.3)	
Comorbidity				
Diabetes mellitus	10 (15.6)	7 (3.1)	3 (9.7)	0.168†
Hypertension	37 (57.8)	17 (53.1)	20 (62.5)	0.448†
No comorbidities	26 (40.6)	14 (43.8)	12 (37.5)	0.611†
Location of aneurysms ($n = 58$)§				
ICA	22 (37.9)	14 (53.8)	8 (25)	0.006†
MCA	16 (27.6)	2 (7.7)	14 (43.8)	
ACA/ACom	20 (38.5)	10 (31.3)	10 (34.5)	
Side of aneurysm				
Right	16 (25.0)	6 (18.8)	10 (31.3)	0.214†
Left	33 (51.6)	20 (62.5)	13 (40.6)	
Midline	15 (23.4)	6 (18.8)	9 (28.1)	
Location of hematoma				
Intraparenchymal	6 (9.4)	5 (15.6)	1 (3.1)	0.002‡
Intraventricular	15 (23.4)	2 (6.3)	13 (40.6)	
No hematoma	43 (67.2)	25 (78.1)	18 (56.3)	
SAH-related complications				
Vasospasm/DIND	24 (37.5)	11 (34.4)	13 (40.6)	0.856‡
Hydrocephalus	9 (14.1)	5 (15.6)	4 (12.5)	
No complications	31 (48.4)	16 (50.0)	15 (46.9)	
Procedure-related complications				
Bleeding/Hematoma	6 (9.4)	2 (6.3)	4 (12.5)	0.166‡
Infarctions	7 (10.9)	1 (3.1)	6 (18.8)	
Infections	7 (10.9)	4 (12.5)	3 (9.4)	
No complications	44 (68.8)	25 (78.1)	19 (59.4)	
Duration of follow-up in months	11.34 ± 9.36	11.38 ± 7.80	11.31 ± 10.83	0.979*

Results are expressed as mean ± standard deviation, number (percentage).
SS-QoL, Stroke-Specific Quality of Life; ICH, internal carotid artery; MCA, middle cerebral artery; ACA, anterior cerebral artery; ACom, anterior communicating; SAH, subarachoind hemorrhage; DIND, delayed ischemic neurological deficits.
**P* value calculated using independent sample *t*-test.
†*P* value calculated using Pearson Chi-Square test.
‡*P* value calculated using Fisher exact test.
§Vertebrobasilar aneurysm cases excluded as all are treated by endovascular treatment only.

Table 2. Preintervention Assessment (World Federation Neurosurgical Societies [WFNS]) and Fissure Grades()

Grading	Total	Endovascular	Surgical Clipping	*P* Value
WFNS grades				
Good grades (1—3)	56 (87)	27 (84.4)	29 (90.6)	0.708*
Poor grades (4 and 5)	8 (12.5)	5 (15.6)	3 (9.4)	
Fisher grade				
1	18 (28.1)	11 (34.4)	7 (21.9)	0.196†
2	13 (20.3)	6 (18.8)	7 (21.9)	
3	14 (21.9)	9 (28.1)	5 (15.6)	
4	19 (29.7)	6 (18.8)	13 (40.6)	

Results are expressed as mean ± standard deviation, number (percentage).
**P* value has been calculated using Fisher exact test.
†*P* value has been calculated using Pearson chi-square test.

scores (0 and 1), and mean duration of follow-up for this overall cohort was 7.2 months. Patient received endovascular treatment has significantly better outcome (P = 0.036) as shown in Table 5.

DISCUSSION

Quality of Life After Aneurysmal Subarachnoid Hemorrhage

Health-related quality of life (HRQoL) is a multidimensional construct including those aspects of quality of life that directly relate to an individual's health, in which at least physical, psychological, and social dimensions are represented.[21] PROMs can be used to measure HRQoL and are directly reported by patients to reflect their perspective of their own health status.[22,23] PROMs can be important for improving patient-centered health care and managing the follow-up care of patients.[4] Although they can capture outcomes that are not routinely represented by clinical outcome measures (clinician-reported outcome), PROMs have seldom been used in research involving patients with aneurysmal SAH, especially in terms of incorporating patient's preference for the choice of treatment modalities available for managing aneurysmal SAH.[3,6-8]

Patient-Reported Outcome Measure Tools (SS-QoL) in Aneurysmal Subarachnoid Hemorrhage

Medical practice is undergoing a paradigm shift from disease-centered to patient-centered care, and patient-reported outcomes (PROs) have become prominent in health outcome research including in neurosurgery.[3,5] However, there is a paucity of neurosurgery-specific PROM data in the literature.[7] Although there is no current validated disease-specific PROM developed for aneurysmal SAH, the SS-QoL is widely used as a generic tool to evaluate PRO.[12,17,19] In this study, we used the short version (12-items) of SS-QoL since the longer version (of 49-items) with 12 domains is considered time consuming and may be advantageous

Table 3. Patient-Reported Outcome (12-Items Stroke Specific Quality of Life Scale [SS-QoL])

SS-QoL	Endovascular Treatment	Surgical Clipping	Mean Difference and Confidence Interval (95%)	*P* Value*
Physical domain (7 items)				
Total	28.71 ± 5.7	29.4 ± 5.4	−0.688 (−3.46 to 2.08)	0.622
Mean	3.17 ± 0.60	2.98 ± 0.66	0.183 (−0.133 to 0.499)	0.251
Psychosocial domain (5 items)				
Total	22.16 ± 4.23	20.88 ± 4.61	1.28 (−0.93 to 3.94)	0.251
Mean	4.43 ± (0.846)	4.18 ± 0.922	0.256 (0.186 to 0.698)	
Overall (12 items)				
Total	50.88 ± 9.3	50.28 ± 9.8	0.594 (−4.19 to 5.38)	0.805
Mean	4.23 ± 0.77	4.19 ± 0.82	0.495 (−0.34 to 0.45)	

Results are expressed as mean ± standard deviation.
P value has been calculated using independent sample *t*-test.

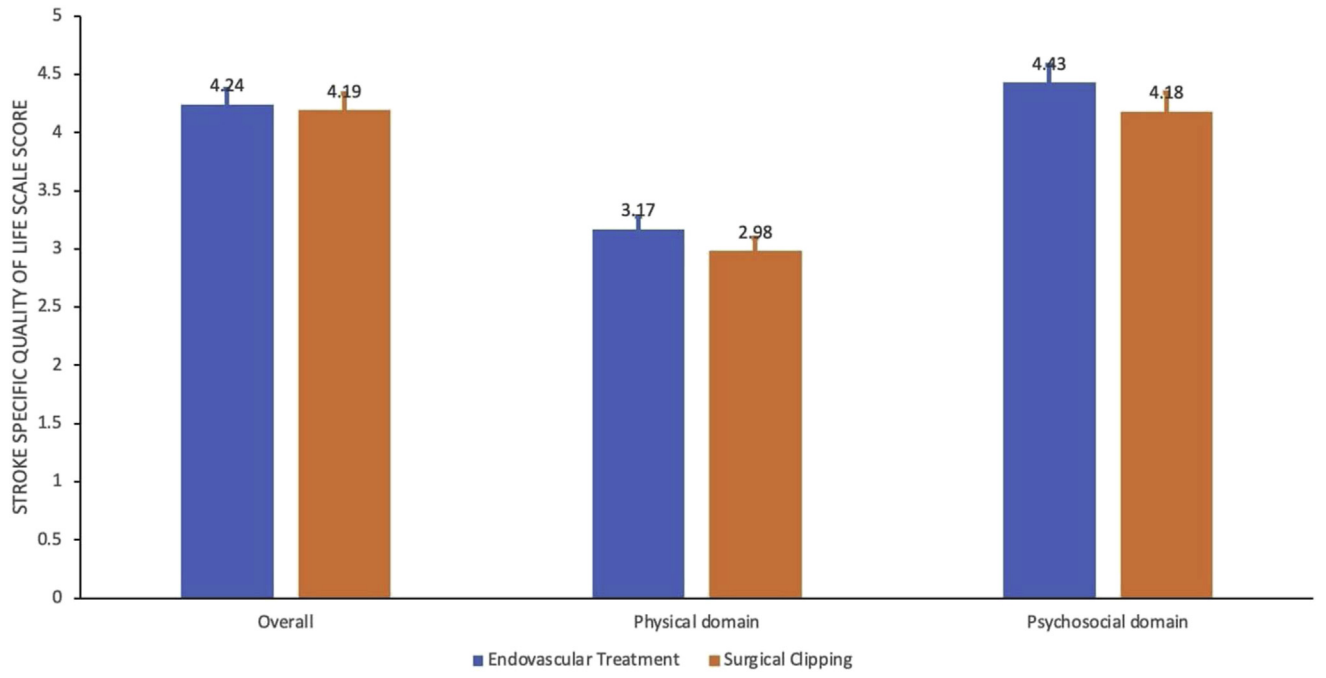

Figure 2. Bar chart showing means with standard error of means of Stroke-Specific Quality of Life scores for overall, physical, and psychosocial domains for 2 treatment modalities.

as patients with strokes often experience attention and concentration problems.[18,19] The short version has also been validated for use in aneurysmal SAH.[12,17-19] To improve the quality of data collected, we used an Arabic culturally adapted and translated version in our study. The Arabic version has helped mitigate the linguistic barriers and enhanced responsiveness to PROM tool. SS-QoL has been previously used in different languages including Danish, French and Chinese but this is the first published use of Arabic translated version.[14-16]

Comparative Clinician-Reported Outcome

The comparative effectiveness of preferred treatment options for aneurysmal SAH (endovascular coiling vs. surgical clipping) in neurosurgical literature remains debatable as published studies have examined different factors related to patients, disease, procedures, and hospital services.[1,22,24-26] A recent Cochrane review comparing the clinical outcome in endovascular versus surgical clipping in aneurysmal SAH concluded that for those patients in good clinical conditions with ruptured aneurysms of either the anterior or posterior circulation, if the aneurysm is considered suitable for both neurosurgical clipping and endovascular coiling, coiling is associated with a better clinical outcome.[27] In neurosurgical practice, microsurgical clipping resulted in lower retreatment rates and is associated with a higher incidence of complete occlusion, while endovascular coiling was associated with shorter length of stay and a lower rate of complications.[26,28] Despite the fact that retreatment rates are higher after coiling, no recurrent hemorrhages are known to have occurred in patients undergoing coiling.[28] The Barrow Ruptured Aneurysm Trial in their 6 years' follow-up results reported only a small difference in outcome between 2 treatments, and the relative benefit of either treatment remains inconclusive.[29] Our study included clinician-reported outcome as a secondary analysis. It shows that almost twice as many patients died in the clipping cohort than the endovascular cohort (7 vs. 4), which is similar to International Subarachnoid Aneurysm Trial results.[1] However, the results based on modified Rankin scale detected a small statistical difference ($P = 0.036$) between 2 treatments, although the study may have been underpowered for this analysis.

Nobel and Schenk presented a meta-analysis of clinical predictors including patient age, sex, neurologic state at the time of hospital admission, bleed severity, physical disability, cognitive impairment, and time between ictus and psychosocial assessment.[30] They concluded that only physical disability had any notable effect on HRQoL. However, the cause of the most HRQoL impairment after SAH remains unknown.[29] In view of the impact of hospital-related factors on clinical outcome after treatment of cerebral aneurysms, hospital procedural volume and the propensity of a hospital to use endovascular therapy were both independently associated with better outcome.[31,32] Fertl et al[23] conducted a critical analysis of functional and emotional status of patients who were categorized as "independent survivors" after aneurysmal SAH with special emphasis on the patient's viewpoint, and they showed that subclinical depression and maladjustment to disabling sequelae of SAH were the key determinants for reduced quality of life. However, these patient-reported ailments can be

Table 4. Relationship Between Intervention and 12-Point Stroke-Specific Quality of Life Scale After Adjusting for Clinical Confounding Factors*

Factors	β	(95% Confidence Interval) of β	*P* Value
Intervention	−.084	(−0.647 to 0.479)	.765
DM	.390	(−0.226 to 1.006)	.209
HTN	−.344	(−0.805 to 0.118)	.140
Location of aneurysms			
ICA	.366	(−0.730 to 1.461)	.505
MCA	.286	(−0.954 to 1.525)	.644
Side			
R_Side	−.876	(−2.152 to 0.399)	.173
L_Side	−.632	(−1.850 to 0.586)	.301
Location of hematoma			
Intraparenchymal	−.077	(−0.930 to 0.776)	.856
Intraventricular	.333	(−0.268 to 0.933)	.270
SAH-related complications			
Vasospasm	−.420	(−0.914 to 0.074)	.093
Hydrocephalus	−.327	(−1.030 to 0.375)	.352
Operative/procedure-related complications			
Bleeding	−.214	(−0.939 to 0.512)	.556
Infarctions	−1.100	(−1.979 to −0.220)	.016
Infections	.053	(−0.790 to 0.897)	.899

DM, diabetes mellitus; HTN, hypertension; ICA, internal carotid artery; MCA, middle cerebral artery; SAH, subarachnoid hemorrhage.
*Multiple linear regression; ß: beta coefficient; CI: confidence interval. R2 = 0.313; *P* = 0.194.

easily missed in routine clinical reviews and physician's practice. Therefore it is important to incorporate the patient's perspective into the holistic management plan for aneurysmal SAH.

Comparative Patient-Reported Outcome

Our study analyzed the comparative effectiveness of 2 treatment modalities based on the PRO tool but included only conscious

Table 5. Clinician-Reported Outcome (Based on Modified Rankin Scale)

Grade	Description	Total (n = 137)	Intervention		*P* Value*
			Endovascular (n = 68)	Clipping (n = 69)	
0	No symptoms	52 (38)	27 (19.7)	25 (18.2)	0.036
1	No significant disability, despite symptoms; able to perform all usual activities	30 (21.9)	15 (10.9)	15 (10.9)	
2	Slight disability unable to perform all previous activities but able to look after affairs without assistance	4 (2.9)	2 (1.5)	2 (1.5)	
3	Moderate disability: requires some help, but able to walk without assistance	8 (5.8)	8 (5.8)	0 (0.0)	
4	Moderately severe disability; unable to walk without assistance	15 (10.9)	4 (2.9)	11 (8)	
5	Severe disability; bedridden, incontinent, and requires constant nursing and attention	17 (12.4)	8 (5.8)	9 (6.6)	
6	Death	11 (8)	4 (2.9)	7 (5.1)	

Results are expressed as number (percentage).
**P* value has been calculated using Fisher exact test.

and alert patients who could self-report their quality of life on PROM-based survey. Being conscious and alert with good World Federation of Neurosurgical Societies clinical grades of 1 and 2 (with mean follow-up interval of nearly 1 year in both treatment arms) ensure that most of the adjustment to potential sequelae (like memory, neurocognitive functions) of aneurysmal SAH has already happened. For patients who achieved a full recovery after either of the treatment received, there was no difference in the quality of life attained. Subdomain analyses for physical and psychosocial domains of SS-QoL also failed to provide any statistically significant difference despite the documented impact of psychosocial factors on clinician-reported outcome of the independent survivors after aneurysmal SAH.

In multivariable analysis after adjusting for different clinicodemographic factors, cerebral vasospasm/delayed ischemic neurologic deficits (SAH-related complications) and cerebral infarctions (procedure-related complication) were associated with SS-QoL. Similar to results of a meta-analysis[33] showing no difference in the incidence of cerebral vasospasm in endovascular versus surgical clipping treatments, we found no difference for cerebral vasospasm in choice of 2 treatment modalities based on the SS-QoL PROM tool. However, it may influence the long-term quality of life as has been detected in PROs despite statistical adjustments.

Strengths and Limitations of Study

To our knowledge, this is the first study to incorporate the patients' perspective in a comparative effectiveness study of endovascular treatment versus surgical clipping in patients treated for aneurysmal SAH. Another strength of this study is that we used an Arabic version of SS-QoL to mitigate the linguistic barrier and cross-cultural adoption of the PROM tool in a setting in which more than half patients were native Arabic speakers. This increases the patient's understanding of questions and validity of their responses. This study also provided concurrent comparative analysis for the choice of treatment of aneurysmal SAH based on PROs and clinician-reported outcomes. Our study may have been underpowered to detect the clinically significant difference between 2 treatment arms. It is a single-center experience that limits its generalizability. Although we have used a validated and reliable PROM (SS-QoL) to capture PRO, it is a generic tool. In terms of postoperative pain and recovery, endovascular approach is undoubtedly preferable, but SS-QoL may not address this. In future studies, it may be beneficial to use an aneurysmal SAH-specific PROM.

CONCLUSIONS

Our study incorporates the patient's perspective into the comparison of treatment options for management of aneurysmal SAH in routine neurosurgical practice. Although there is evidence supporting endovascular treatment based on a clinician-reported outcome, we did not find any difference based on a PRO tool. Our study may increase the impetus to include PROMs in neurosurgical practice, especially in severely debilitating neurologic conditions with long-term sequelae like aneurysmal SAH. Future studies with larger sample size may identify potential differences in preferred treatment options from the patient perspective.

CRediT AUTHORSHIP CONTRIBUTION STATEMENT

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