

Health-related quality of life in patients with abdominal aortic aneurysm undergoing endovascular aneurysm repair: A cross-sectional study

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Abstract

Background: Endovascular aneurysm repair (EVAR) has become a common surgical treatment for abdominal aortic aneurysm (AAA), and postoperative health-related quality of life (HRQoL) is drawing increasing attention. Most studies compare HRQoL in EVAR patients and open aneurysm repair patients, while few studies have investigated HRQoL in EVAR patients versus the general population. This study aimed to investigate whether HRQoL differs between patients with EVAR patients and the general population.

Methods: EVAR patients were recruited from a medical center in northern Taiwan. General population subjects and the EVAR patients were paired based on age and sex, and a simple random sampling method was used for sampling at 2:1. In this study, we used the World Health Organization Quality of Life Scale Abbreviated Version, Taiwan Version to investigate HRQoL. A multivariate regression model was used to analyze intergroup differences related to facets and domains.

Results: A total of 58 patients with EVAR and 116 individuals from the general population were included in this study. The EVAR patients' mean scores for overall QoL and the physical domain, psychological domain, social relations domain, and environment domain were 3.79, 15.53, 15.00, 14.93, and 15.57, respectively, and all of these scores were significantly higher than those in the general population. In addition, the β values ($\beta = 0.21, 0.73, 1.83, 0.81, \text{ and } 2.62$, respectively) of the EVAR patients were also significantly higher in the multivariate analysis. The findings showed that a high education level and nonsmoking status were associated with higher HRQoL, while unemployment was associated with lower HRQoL.

Conclusion: EVAR patients had higher HRQoL than the general population, indicating that patients with AAA have a high likelihood of recovering and enjoying high HRQoL if they receive appropriate medical procedures and nursing education.

Keywords: Abdominal aortic aneurysm; Endovascular aneurysm repair; Health-related quality of life

1. INTRODUCTION

Abdominal aortic aneurysm (AAA) is a common disease that affects approximately 4.8% of the general population. The mechanism is unknown, and surgical treatments include open

aneurysm repair (OAR) and endovascular aneurysm repair (EVAR).^{1,2} EVAR is a common treatment for AAA, and approximately 70% of patients in America undergo this procedure to treat AAA.³ Since the National Health Insurance began to cover endovascular grafts in 2010 in Taiwan, most patients have elected to undergo EVAR to treat AAA,⁴ and even patients with a ruptured AAA are attempting to undergo EVAR.⁵

De Bruin et al.⁶ showed that EVAR is associated with a good short-term survival rate, reduces sequelae, and is even beneficial for elderly patients.⁷ However, given the advancement of healthcare and increasing healthcare costs, the public is expecting good healthcare values as well as a good subjective experience. As a result, many researchers believe that traditional surgical outcome measures (such as prevalence and morbidity) should no longer be used alone to evaluate postoperative outcomes. Patients consider postoperative health-related quality of life (HRQoL) to be as important as surgical outcomes and expect their HRQoL after surgery to be the same or even better than their preoperative HRQoL.⁶⁻⁸

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In recent years, most studies have focused on the HRQoL of EVAR patients versus OAR patients,^{6,7,9,10} while few studies have focused on the HRQoL of EVAR patients versus the general population. Peach et al.¹⁰ showed that although the 36-item Short-Form Health Survey (SF-36) and EuroQoL-5D (EQ-5D) are common tools used to measure HRQoL, they focus only on physical and psychological domains. Some studies have shown that factors such as sex, education level, socioeconomic status, smoking, exercise, and comorbidities affect HRQoL after EVAR.¹¹ The World Health Organization Quality of Life Scale Abbreviated Version (WHOQOL-BREF), which was introduced in Taiwan in 1997, covers physical, mental, social relations, and environment domains,¹² rendering it a more comprehensive tool to measure HRQoL. In this study, we used the WHOQOL-BREF, Taiwan Version to analyze HRQoL after EVAR compared to HRQoL in the general population.

2. METHODS

2.1. Study population

2.1.1. Aortic aneurysm patients

In this study, we used convenience sampling to enroll patients who were followed up at the aortic aneurysm clinic of a medical center in northern Taiwan after EVAR between April and December 2018 and asked them (with consent) to complete the WHOQOL-BREF, Taiwan Version to survey their HRQoL. Inclusion criteria: (1) aged 20 years or above; (2) diagnosed with AAA (International Classification Diseases, 9th Revision Code 441.3 or 441.4); (3) previous EVAR; and (4) conscious, able to communicate and complete the questionnaire, and willing to participate.

Each participant was asked to complete the WHOQOL-BREF, Taiwan Version and its Appendix (general information, including age, sex, height, weight, education level, employment status, marital status, faith, chronic illness, smoking, and drinking). This study was approved by the participating hospital and the institutional review committee of the hospital (No. 2017-01-023ACF) and was supported by the Ministry of Science and Technology (MOST-106-2314-8-010-056).

2.1.2. General population

The general population used in this study was based on the 2001 National Health Interview Survey (NHIS) in Taiwan, which was co-sponsored by National Institutes of Health (Taiwan) and the Ministry of Health and Welfare and was designed to understand health statuses and healthcare resource usage by the general public of Taiwan.¹³ In this study, the Taiwan household registration data as of January 16, 2001, were used as the master data (excluding institutions such as schools, military barracks, prisons, temples, factories, and nursing homes) for multistage stratified systematic sampling from Taiwan (mountain regions and outlying islands were excluded due to overall considerations of healthcare resource usage and populations). During the 2001 NHIS, a total of 6364 households were sampled, 5798 of which (91.1%), or 22 121 of 23 473 residents (94.2%), completed the interview survey.^{14,15} The survey items included general information, personal health status, and personal health behaviors. Moreover, individuals aged 20 or above were encouraged to complete the WHOQOL-BREF, Taiwan Version, and 11 621 individuals completed the survey.¹⁴ Consistency tests showed no significant difference between the sampled population and the master data (national population) with respect to age or sex, suggesting that the sampled population was representative (National Health Interview Survey group, n.d.). The data were approved for use by the Administrative Office of the NHIS of the National Institutes of Health (Taiwan).

To determine the sample size, we used G*Power software to build a multivariate linear regression model, with $\alpha = 0.05$ and

power = 0.8, and determined that at least 135 individuals were needed for this study. According to Setia,¹⁶ statistical power is strongest when the case number and control number are in a 1:1 ratio during matching. However, in the case of a relatively low case number, increasing the control number (up to 1:4) can also improve statistical power. At the end of the 2001 NHIS, consistency tests showed no significant difference between the sampled population and the master data (national population) with respect to age or sex. Therefore, in this study, we used age (5-year increments) and sex as stratification factors and a random sampling method to match our clinic's patients (study population) with the NHIS respondents (general population) at a ratio of 1:2 for statistical analysis.

2.2. HRQoL measurement

We used the WHOQOL-BREF, Taiwan Version to measure HRQoL, which was developed by a designated group that introduced the WHOQOL in 1997. The first two items are related to overall QoL (G1) and general health status (G2), and the next 24 items are divided into four domains with varying numbers of items: physical (DOM1; 7 items), psychological (DOM2; 6 items), social relations (DOM3; 4 items), and environment (DOM4; 9 items). To customize the questionnaire for the Taiwanese population, two Taiwan-specific items were added: "respect for others" (social relations, DOM3TW) and "eating one's favorite food" (environment, DOM4TW), bringing the total number of items to 28. Each item is rated on five-point Likert scale (1-5). The score for each domain is calculated as (the sum of the scores in the domain) \times 4/(the number of items in the domain). The total score ranges from 4 to 20, and a higher score indicates higher HRQoL.¹² During questionnaire development, analysis of the study sample showed internal consistency (Cronbach's $\alpha = 0.91$), a correlation coefficient of 0.53 to 0.78 between each item (facet) and the relevant domain, and a correlation coefficient of 0.51 to 0.63 between domains.¹²

In this study, analysis of the enrolled EVAR patients and the general population subjects yielded Cronbach's α values of 0.92 and 0.93, respectively, indicating good internal consistency. We did not perform a validity test because the WHO holds the copyright to the WHOQOL-BREF, Taiwan Version and does not allow any modification to instructions, items, scales, or the order of the items. The WHOQOL-BREF, Taiwan Version was approved for use in this study by the designated group.

2.3. Statistical analysis

SPSS v21.0 (IBM Corp., Armonk, NY) was used for statistical analysis. The Mann-Whitney U test and Fisher's exact test were performed to analyze the demographic characteristics of the EVAR patients and the general population and each WHOQOL domain. The multivariate linear regression model was used to analyze the relationships between each domain and its facets after controlling for demographic characteristics (age, sex, body mass index [BMI], education level, employment status, faith, marital status, chronic illness, smoking, and drinking). Binary categorical variables were used for the multivariate linear regression model. Education level was stratified as <12 years versus ≥ 12 years because national compulsory education lasts 12 years in Taiwan, and marital status was either single (including divorced and widowed) or married for backward removal analysis. $p < 0.05$ was considered statistically significant.

3. RESULTS

All 58 EVAR patients and the 116 individuals from the general population were matched for age and sex. Overall, 86.2% of the participants were male. The mean ages of the EVAR patients

Table 1
Demographic characteristics of the EVAR patients and the general population

	EVAR patients	General population	<i>p</i>
	N = 58 (M ± SD/%)	N = 116 (M ± SD/%)	
Age	58.31 ± 8.73	57.99 ± 8.59	0.82 ^a
Sex			1.0
Male	50 (86.2%)	100 (86.2%)	
Female	8 (13.7%)	16 (13.7%)	
BMI	25.55 ± 4.38	24.19 ± 2.97	0.02 ^a
Education level			<0.01
<12 years	35 (60.3%)	97 (83.6%)	
>12 years	23 (39.6%)	19 (16.3%)	
Employed			0.26
Yes	27 (46.5%)	65 (56%)	
No	31 (53.4%)	51 (43.9%)	
Faith			0.02
Yes	35 (60.3%)	46 (39.6%)	
No	23 (39.6%)	70 (60.3%)	
Marital status			0.02
Single (never married/divorced)	15 (25.8%)	13 (11.2%)	
Married	43 (74.1%)	103 (88.7%)	
Chronic illness			<0.01
Yes	45 (77.5%)	62 (53.4%)	
No	13 (22.4%)	54 (46.5%)	
Smoking			<0.01
Yes	8 (13.7%)	61 (52.5%)	
No	50 (86.2%)	55 (47.4%)	
Drinking			0.74
Yes	25 (43.1%)	46 (39.6%)	
No	33 (56.8%)	70 (60.3%)	

BMI = body mass index; EVAR = endovascular aneurysm repair.

^aMann-Whitney U test; otherwise, Fisher's exact test.

and the general population subjects were 58.31 ± 8.73 years and 57.99 ± 8.59 years, respectively. Compared with the general population subjects, the patients with EVAR had a significantly higher BMI (25.55 ± 4.38). 23 (39.6%) had an education ≥12 years, 35 (60.3%) held faith, 15 (25.8%) were single, 45 (77.5%) had chronic illnesses, and 50 (86.2%) were nonsmokers (Table 1).

For HRQoL, the EVAR patients' scores were significantly higher for overall QoL (3.79 ± 0.55) and the physical domain (15.35 ± 2.04), psychological domain (15.00 ± 2.24), social relations domain (14.93 ± 2.07), and environment domain (15.57 ± 1.70), with no significant between-group difference in overall health status (Table 2).

Multivariate linear regression analysis showed that EVAR was positively associated with overall QoL ($\beta = 0.21$, $p < 0.05$) after controlling for general health status and all HRQoL domains (namely, physical, psychological, social relations, and environment). In addition, the EVAR patients were positively associated with the physical, psychological, social relations, and environment domains ($\beta = 0.73$, 1.83, 0.81, and 2.62, respectively) after controlling for demographic variables (Tables 3 and 4).

Table 5 summarizes the results of the multivariate linear regression analysis of HRQoL scores in facets of each domain after controlling for demographic variables. In the physical domain, the EVAR patients had significantly higher scores for pain and discomfort, activities of daily living, and working capacity ($\beta = 0.25$, 0.03, and 0.29, respectively). In the psychological domain, the EVAR patients had significantly higher

Table 2
Analysis of each domain of HRQoL for the EVAR patients and the general population

	EVAR patients	General population	<i>p</i>
	N = 58 (M ± SD/%)	N = 116 (M ± SD/%)	
HRQoL			
Overall HRQoL (G1)	3.79 ± 0.55	3.18 ± 0.70	<0.01 ^a
General health status (G2)	3.33 ± 0.87	3.24 ± 0.74	0.42 ^a
Physical domain (DOM1)	15.35 ± 2.04	14.37 ± 2.05	0.01 ^a
Psychological domain (DOM2)	15.00 ± 2.24	12.97 ± 2.30	<0.01 ^a
Social relations domain (DOM3 TW)	14.93 ± 2.07	13.83 ± 2.12	<0.01 ^a
Environment domain (DOM4 TW)	15.57 ± 1.70	12.73 ± 2.20	<0.01 ^a

EVAR = endovascular aneurysm repair; HRQoL = health-related quality of life.

^aMann-Whitney U test.

scores for positive feelings, spirituality/religion/personal beliefs, thinking, learning, memory and concentration, body image and appearance, and self-esteem ($\beta = 0.92$, 0.65, 0.28, 0.39, and 0.27, respectively). In the social relations domain, the EVAR patients had significantly higher scores for personal relationships, social support, and being respected and accepted ($\beta = 0.25$, 0.41, and 0.44, respectively). In the environment domain, the EVAR patients had significantly higher scores for all facets.

We found that a high education level was associated with higher HRQoL in the facets of positive feelings, spirituality/religion/personal beliefs, financial resources, participation in and opportunities for recreation or leisure, health and social care: availability and quality, and eating. Nonsmoking status was also associated with higher HRQoL in the facets of energy and fatigue, dependence on medication or treatments, working capacity, and negative feelings, while unemployment was associated with lower HRQoL β values in the facets of working capacity, sexual activity, and social support.

4. DISCUSSION

In this study, we used the WHOQOL-BREF, Taiwan Version to survey the HRQoL of EVAR patients versus the general population. The results showed that the EVAR patients scored significantly higher for overall HRQoL and the physical, psychological, social relations, and environment domains. These results differ from those of Hinterseher et al.¹⁷ who used the WHOQOL-BREF, German Version to analyze the HRQoL of 47 EVAR patients versus the reference population in Germany and

Table 3
Relationship between overall HRQoL and general health status and each domain score for the EVAR patients and the general population

	Overall HRQoL (G1)
(Constant)	0.52* (0.26)
EVAR (no/yes)	0.21* (0.10)
General health status (G2)	0.15* (0.06)
Physical domain (DOM1)	
Psychological domain (DOM2)	0.10*** (0.03)
Social relations domain (DOM3 TW)	
Environment domain (DOM4 TW)	0.07** (0.03)

Unstandardized β coefficients and standard errors (in parentheses).

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

EVAR = endovascular aneurysm repair; HRQoL = health-related quality of life.

Table 4
Factors for each domain of HRQoL for the EVAR patients and the general population

	Physical domain (DOM1)	Psychological domain (DOM2)	Social relations domain (DOM3TW)	Environment domain (DOM4TW)
(Constant)	13.37** (0.55)	11.75** (0.53)	14.14** (0.66)	11.60** (0.47)
EVAR (no/yes)	0.73* (0.35)	1.83** (0.37)	0.81* (0.35)	2.62** (0.33)
Sex (male/female)				
QAGE				
BMI				
Education level (<12 y/>12 y)		1.01* (0.41)	0.74* (0.38)	0.96* (0.37)
Employed (yes/no)				
Faith (yes/no)			-0.76* (0.33)	
Married (no/yes)				
Chronic illness (yes/no)				
Smoking (yes/no)	0.80* (.36)			
Drinking (yes/no)				

Unstandardized β coefficients and standard errors (in parentheses).

* $p < 0.05$, ** $p < 0.01$.

BMI = body mass index; EVAR = endovascular aneurysm repair; HRQoL = health-related quality of life.

showed no significant between-group difference in any domain except for the environment domain (the EVAR patients scored significantly higher), which may be due to more advanced grafts and technologies and fewer comorbidities among the patients during the research period of this study. Early studies showed that EVAR was associated with complications such as endoleak and graft migration, which required patients to return to the hospital, and the reintervention rate was approximately 11%, resulting in tremendous physical and psychological burdens.^{1,18} On the other hand, Bergonti et al.¹⁹ retrospectively analyzed the data of 64 patients who underwent EVAR with a new generation of graft and found that the reintervention rate was 3.2%, indicating that the new graft technology had been substantially improved, which helped to reduce complications and physical and psychological burdens and contributed to higher scores in the physical and psychological domains for EVAR patients.

Smoking affects the outcomes of EVAR. Koole et al.²⁰ analyzed the data of 8638 patients who underwent EVAR, 4176 of whom were nonsmokers, and found that smoking was associated with a higher rate of graft migration. In this study, 86.2% of the EVAR patients reported that they were nonsmokers, which may have helped reduce comorbidities and contributed to more energy, better mobility, a higher capacity to engage in daily activities, more satisfaction with their ability to work, and therefore a significantly higher score in the physical domain.

Few studies have investigated the role of employment status in EVAR patients' HRQoL. In this study, the multivariate linear regression β values for the EVAR patients' employment statuses were associated with higher HRQoL, which may be related to the EVAR patients' sense of rebirth and new outlook on life after recovering from a life-threatening condition.¹⁷ Such an outlook would be consistent with the interview results of 10 EVAR patients.²¹ Pettersson and Bergbom showed that patients became aware that they had a life-threatening condition before EVAR, but that some patients found accepting this fact to be difficult due to their lack of symptoms. They usually followed up with their doctors for a while to ascertain whether the aneurysm was growing. During this time, the patients often felt that they were living on borrowed time. When informed that they must undergo EVAR because the aneurysm had become too large, the patients felt that they had no choice but to undergo surgery. However, after EVAR, the patients felt privileged to have undergone minimally invasive (not open) surgery without prolonged hospitalization despite some minor physical discomfort. Moreover, they had difficulty believing that they had just

undergone major surgery because the incision in the groin area was so small. Pettersson and Bergbom believed that such experiences caused these patients to feel that they had been given a new life and could work as before; therefore, they valued what was truly important and enjoyed life more than before.

While the possibility of EVAR complications is always present, regular follow-ups provide patients with good healthcare.¹⁷ Taiwan has implemented a universal health insurance scheme (99.7% coverage rate), and 93% of the medical facilities in Taiwan are contracted hospitals,²² thus rendering healthcare accessible and convenient. Moreover, patients can easily obtain information about AAA from health authorities or media. At our hospital, nurses educate patients about clinical signs and symptoms and explain the medical procedures during each visit. Tung et al.²³ believed that a high education level helped improve HRQoL, which translated into a higher score for overall HRQoL and in the environment domain. Pettersson and Bergbom²¹ pointed out that patients felt saved and no longer feared for their lives after EVAR. They felt safe, wanted to engage in leisure activities, could eat what they wanted and develop personal relationships, and felt respected by others, which contributed to a higher score in the social relations domain than that in the general population.

In the past, most studies have focused on the HRQoL of EVAR patients versus OAR patients, and few studies have focused on the HRQoL of EVAR patients versus the general population. Moreover, few studies have controlled for potential interfering factors. In Taiwan, the NHIS has been conducted every 4 years since 2001, and the fifth survey was conducted in 2017. The 2001 NHIS is the only survey to have used the WHOQOL, Taiwan Version to measure HRQoL, and the population surveyed was representative of the national population. Therefore, we used the 2001 data in this study. Several limitations of this study exist. First, determining the cause-effect relationship between investigated factors is difficult in a cross-sectional study. Second, the number of EVAR patients was small due to the nature of the NHIS, the enrollment period, the number of patients enrolled, and controllable potentially interfering factors (such as the lack of available data on comorbidities or other medical conditions). Third, a truly representative sample of the EVAR population is difficult to obtain. Thus, the generalizability of our findings might be limited to North Taiwan. However, this study used the multidomain WHOQOL, Taiwan Version to analyze the HRQoL of EVAR patients and the general population (sampled from a population representative of the national population)

Table 5
Factors for each facet of HRQoL for the EVAR patients and the general population

Domains	Facets	EVAR (no/yes)	Sex (male/female)	Age	BMI	Education (<12 y/>12 y)	Employed (yes/no)	Faith		Married		Chronic Illness		Smoking (yes/no)	Drinking (yes/ no)
								(yes/ no)	(no/ yes)	(yes/ no)	(yes/ no)				
Physical	Pain and discomfort	0.25* (0.11)												0.40* (0.13)	0.24* (0.11)
	Energy and fatigue														
	Sleep and rest														
	Mobility														
Psychological	Activities of daily living	0.03* (0.11)		-0.02* (0.01)	0.03* (0.02)										
	Dependence on medication or treatments	0.29* (0.13)													
	Working capacity	0.92** (0.14)													
	Positive feelings	0.65*** (0.14)				0.34* (0.16)									
	Spirituality/religion/personal beliefs	0.28* (0.14)				0.43*** (0.16)									
	Thinking, learning, memory, and concentration	0.39** (0.14)		-0.39* (0.19)											
	Body image and appearance	0.27* (0.10)													
Social Relations	Self-esteem														
	Negative feelings														
	Personal relationships	0.25* (0.11)													
Environment	Sexual activity														
	Social support	0.21* (0.10)													
	Being respected and accepted	0.44*** (0.12)													
	Physical safety and security	0.42*** (0.14)													
Environment	Physical environment	0.64*** (0.15)													
	Financial resources	1.12*** (0.14)													
	Opportunities for acquiring new information and skills	0.98*** (0.13)													
	Participation in and opportunities for recreation or leisure	0.76*** (0.16)													
	Home environment	0.38*** (0.11)													
	Health and social care: availability and quality	0.73*** (0.10)													
	Transport	0.64*** (0.10)													
Environment	Eating	0.34*** (0.11)													

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
 BMI = body mass index; EVAR = endovascular aneurysm repair; HRQoL = health-related quality of life.

and controlled for potential interfering factors, which ensured its clinical reference value. In the future, large studies with different sampling sources for the control group may be conducted to further investigate the effect of EVAR on HRQoL.

In conclusion, EVAR patients scored higher on HRQoL measures in the physical, psychological, social relations, and environment domains than the general population (representative of the national population), indicating that AAA patients have a high likelihood of recovering and enjoying high HRQoL if they receive appropriate medical procedures and nursing education. Healthcare workers can further promote such patients' HRQoL by modulating the factors for each facet and domain.

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