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ORIGINAL ARTICLE

Long Term Health Related Quality of Life After Acute Type B Aortic Dissection: a Cross Sectional Survey Study

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WHAT THIS PAPER ADDS

This multicentre, cross sectional survey study describes long term health related quality of life (HRQoL) in patients treated for acute type B aortic dissection (ATBD). Compared with the Dutch normative population, HRQoL was significantly lower in both female and male ATBD patients. Mostly the physical domains were impaired, and younger patients seemed more severely affected compared with the general population. No substantial associations were observed in HRQoL between treatment groups and sex. Follow up time was associated with better HRQoL scores. HRQoL should be an integrated part of the clinical follow up, and particularly physical rehabilitation might improve HRQoL in patients with ATBD.

Objective: Acute type B aortic dissection (ATBD) is a rare yet serious cardiovascular event that potentially has an impact on health related quality of life (HRQoL). However, long term follow up data on this topic are scarce. This study aimed to review the long term HRQoL among patients treated for ATBD.

Methods: In this multicentre, cross sectional survey study, consecutive treated patients with ATBD between 2007 and 2017 in four referral centres in the Netherlands were retrospectively included and baseline data were collected. Between 2019 and 2021 the 36 Item Short Form Survey (SF-36) was sent to all surviving patients (n = 263) and was compared with validated SF-36 scores in the Dutch general population stratified by age and sex.

Results: In total, 144 of 263 surviving patients completed the SF-36 (response rate 55%). Median (IQR) age was 68 (61, 76) years at completion of the questionnaire, and 40% (n = 58) were female. Initial treatment was medical in 55% (n = 79), endovascular in 41% (n = 59), and surgical in 4% (n = 6) of ATBD patients. Median follow up time was 6.1 (range 1.7−13.9; IQR 4.0, 9.0) years. Compared with the general population, patients scored significantly worse on six of eight SF-36 subdomains, particularly physical domains. Apart from bodily pain, there were no substantial differences in HRQoL between male and female ATBD patients. Compared with sex matched normative data, females scored significantly worse on five of eight subdomains, whereas males scored significantly lower on six subdomains. Younger patients aged 41−60 years seemed more severely impaired in HRQoL compared with the age matched general population. Treatment strategy did not influence HRQoL outcomes. Follow up time was associated with better Physical and Mental Component Summary scores.

Conclusion: Long term HRQoL was impaired in ATBD patients compared with the Dutch general population, especially regarding physical status. This warrants more attention for HRQoL during clinical follow up. Rehabilitation programmes including exercise and physical support might improve HRQoL and increase patients' health understanding.

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INTRODUCTION

Acute thoracic aortic dissection (TAD) is a rare yet highly lethal disease[1], with an incidence of 4.6—6.0 cases per 100 000 inhabitants annually.[2,3]. Acute Stanford type B aortic dissection (ATBD), which does not involve the ascending aorta,[4] comprises approximately 27% of all TAD cases.[5] In the acute phase, anti-impulse medication is recommended for ATBD, while endovascular or surgical repair is advised in complicated cases.[4]

Regardless of the chosen treatment in the early phase, survivors of ATBD have a poor prognosis, with considerable mortality and morbidity, and require close surveillance.[6,7] In the conservatively treated patient group, aneurysm formation is common in the chronic phase[8], whereas re-interventions are frequently observed in repaired ATBD.[9] These factors, along with the impact of the acute dissection itself, might trigger anxiety and psychological stress as well as a decrease in physical activity, as described in surviving TAD patients.[10] ATBD patients tend to live with uncertainty in their daily activities such as exercise or travelling, as there might be a risk of worsening the dissection. Communication regarding these issues by physicians is not always optimal, also because medical knowledge on these issues is poor. Unfortunately, literature on health related quality of life (HRQoL) after ATBD is scarce and encompasses only small study populations focusing on a specific treatment group.[11,12] Previous studies have investigated HRQoL in TAD in general or acute type A aortic dissection (ATAD).[10,13,14] As ATBD has a different clinical presentation, treatment options, and outcomes than ATAD, investigation of the impact on HRQoL focused on ATBD is warranted.

Furthermore, patient specific information on HRQoL, in particular male—female differences, is needed to optimise treatment and rehabilitation after ATBD. HRQoL is known to differ between males and females in the general population and in patients with thoracic aortic disease.[15,16] Although male—female differences in clinical presentation and outcomes have been identified in TAD[17], no published study to date has examined male—female differences in HRQoL.

Therefore, this study aimed to assess the long term HRQoL in patients after ATBD in a large, multicentre, cross sectional survey study based on a retrospective cohort and to make a comparison with the Dutch normative population. Secondary objectives were to compare HRQoL stratified by sex, treatment strategy, and age category, and to study associations with HRQoL scores and patient characteristics. It was hypothesised that ATBD patients would have an impaired HRQoL compared with the general population.

MATERIALS AND METHODS

Study design and study population

A cross sectional survey study in a large, multicentre, retrospective cohort was conducted following the STROBE guidelines for cross sectional studies.[18] All consecutive patients ($\geq$ 18 years) who were diagnosed with ATBD in four tertiary referral centres in the Netherlands (Erasmus University Medical Centre, Rotterdam; Catharina Medical Centre, Eindhoven; Radboud University Medical Centre, Nijmegen; and St Antonius Hospital, Nieuwegein) between 2007 and 2017 were eligible for inclusion. Patients with non-acute, traumatic, or iatrogenic ATBD were excluded. This multicentre study was designed, conducted, and controlled complying with local and international good clinical practice guidelines and was approved by the local medical ethics committees (MEC-2018-1535). Eligible patients were sought with national diagnostic codes for thoracic aortic disease used by the cardiology, cardiothoracic surgery, and vascular surgery departments and verified with existing local research databases in each centre. The diagnostic codes and search strategy are explained in the Supplementary material (Appendix I).

A sample size calculation was performed based on estimates of two 36 Item Short Form Survey (SF-36) domains comparing thoracic aortic disease patients with the normative Dutch population[16] using a web based calculator[19] (see Supplementary material, Appendix II for more details). With a power of 0.80 and level of significance of .05, the required sample size ranged between 109 and 209 patients.

Data collection

Both the retrospective data of the total cohort and the questionnaire data were documented in an anonymised, standardised case report form using OpenClinica v.3.6 (OpenClinica, LLC, Waltham, MA, USA). Retrospective data collection of patient characteristics, presentation, and treatment was performed using patient files. All included variables with their definitions are shown in the Supplementary material (Appendix III). A mortality check was performed in the municipal data registry before sending the questionnaires. Between July 2019 and February 2021, the SF-36 questionnaire[20—22], including an informed consent form on paper, was sent to the patients still alive in all four participating study centres. To increase the response rate, all patients who had not returned the questionnaire were contacted by telephone. If the patient did not respond after all attempts mentioned, they were deemed a non-responder. Informed consent was waived for retrospective data collection.

Health related quality of life questionnaire

The SF-36 is a widely used HRQoL questionnaire with 36 items highlighting eight domains: physical functioning; role limitations due to physical health problems; bodily pain; general health perceptions; vitality; social functioning; role limitations due to emotional problems; and general mental

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health (psychological distress).[15,22] The first four domains together form the Physical Component Summary (PCS), and the last four domains form the Mental Component Summary (MCS). All SF-36 subdomains have a score range of 0—100, with higher scores reflecting a better quality of life. The SF-36 has been used in previous studies on HRQoL in patients with ATAD and in thoracic endovascular repair (TEVAR) patients.[13,14,23] The SF-36 has been translated, validated, and normed in the Dutch population as well as categorised by sex and age groups, which can be considered as normative data.[15]

Statistical analysis

Data were analysed using statistical and computing program R version 4.1.2 (R Foundation for Statistical Computing, Vienna, Austria). Continuous data were presented as the mean ± standard deviation (SD) when normally distributed and as the median with interquartile range (IQR) when skewed. Normality was checked visually with histograms and was tested using the Shapiro—Wilk test. Group comparisons were done using unpaired Student's *t* test when normally distributed, and a Mann—Whitney *U* test when data were not normally distributed. Categorical data were presented as frequencies with percentages and were compared with χ^2 test or Fisher's exact test, as appropriate.

Additionally, the male and female subdomain scores were compared with the male and female norm values of the national general Dutch population and per age category[15] using the age at completion of the questionnaire of ATBD patients. Comparing the patient with the normative data, means and SDs were reported and a one sample Student's *t* test was used.

Univariable linear regression analyses were performed to study associations with the follow up time, age, sex, initial treatment strategy, comorbidities, and late (re)intervention during follow up with the PCS and MCS scores separately in a complete case analysis. Multicollinearity was assessed with a correlation matrix. Additionally, variables with a *p* value of $< .10$ in the univariable analysis were entered into a backward selection process to obtain the final models. In the backward selection, a threshold of $p < .10$ was used to keep relevant variables in the final model.

To investigate non-responder and survival bias, the patient characteristics of responders were compared with non-responders and non-survivors of the total cohort.

If data in one or more questions in a subdomain were not filled in by the participant, that complete subdomain was considered as missing. All patients with any missing subdomain consequently missed the end score of the PCS and MCS. If the date of completion of the questionnaire was not filled in by the participant, the date was estimated using the median date in that study centre.

A two sided *p* value of $< .050$ was considered statistically significant.

RESULTS

The patient selection flowchart is shown in Figure 1. In total, 263 SF-36 questionnaires were sent to all ATBD patients who were alive, and 144 completed questionnaires were returned, resulting in a response rate of 55%. The median follow up time from admission to completing the questionnaire was 6.1 (range, 1.7—13.9; IQR, 3.96, 8.99) years. Table 1 shows the patient and treatment characteristics stratified by sex. Of the 144 patients, the median age at time of the questionnaire was 68 years (IQR, 61, 76) and 40% ($n = 58$) were female. For one patient, the date of completing the questionnaire was not reported and so was estimated. In this selected patient group, 26% (35/137) of patients had received a (re)intervention during follow up before completing the questionnaire; for 7 patients it was unknown.

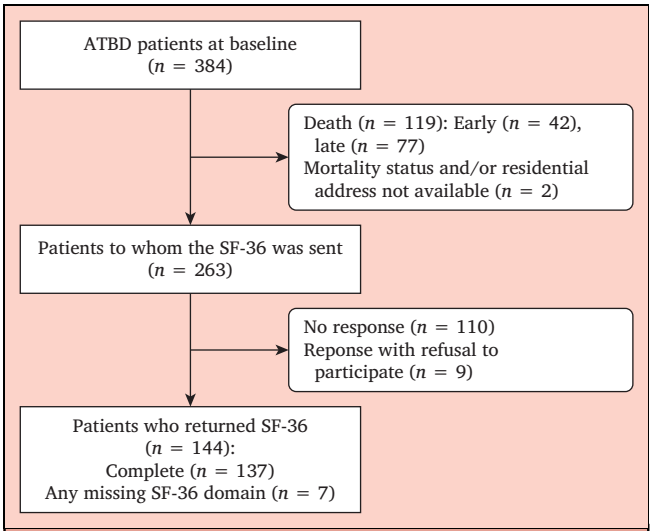

Figure 1. Flowchart of patient selection. ATBD = acute type B aortic dissection; SF-36 = 36 Item Short Form Health Survey.

Table 2 shows the scores on all subdomains of the SF-36 as well as the PCS and MCS score for the whole study population and stratified by sex. Female patients scored significantly lower on bodily pain than males ($p = .028$). In Figure 2, mean SF-36 subdomain scores are compared with the general Dutch population for the whole study population as well as stratified by sex; the crude data are shown in the Supplementary material (Appendix IV). On six of eight SF-36 subdomains, ATBD patients scored lower than the general population. A similar pattern was observed when comparing females and males with the sex matched normative population. In Figure 3, ATBD HRQoL scores are compared with the age matched normative population; the crude data are reported in the Supplementary material (Appendix V). Figure 3 shows impaired HRQoL in the youngest age group (41—60 years) when compared with the general population.

In Table 3, HRQoL scores are shown for patients who initially received medical treatment compared with endovascular or surgical treatment, which showed no significant differences between treatment groups.

Table 4 shows the univariable and multivariable analyses with the PCS and MCS scores for the whole study population. A longer follow up time (> median) was associated

Table 1. Patient and treatment characteristics at presentation of acute type B aortic dissection (ATBD)

Characteristic	All patients (n = 144)	Females (n = 58)	Males (n = 86)	p value	Missing %
Median follow up time (range) [IQR] − years	6.11 (1.66–13.9) [3.96, 8.99]	5.43 (1.68–12.7) [4.03, 8.84]	6.63 (1.66–13.9) [3.93, 9.06]	.49	0.7
Patient demographics					
Age at ATBD − years	61.5 ± 10.6	62.3 ± 10.7	59.3 ± 10.4	.096	0.0
Age at questionnaire − years	68.3 (61.0, 75.6)	69.1 (63.5, 76.2)	67.3 (58.6, 74.3)	.15	0.0
BMI − kg/m^2	25.6 (22.9, 28.1)	24.2 (22.5, 28.1)	26.2 (24.1, 28.1)	.040	18.1
BSA − m^2	1.95 (1.83, 2.09)	1.79 (1.70, 1.88)	2.03 (1.94, 2.15)	<.001	18.1
History of hypertension	71 (49.3)	31 (53.4)	40 (46.5)	.52	0.0
Hyperlipidaemia	25 (17.4)	11 (19.0)	14 (16.3)	.85	0.0
Diabetes mellitus	5 (3.5)	1 (1.7)	4 (4.7)	.65 *	0.0
COPD	10 (6.9)	4 (6.9)	6 (7.0)	1.0 *	0.0
History of CVA	9 (6.3)	5 (8.6)	4 (4.7)	.49 *	0.0
History of MI	2 (1.4)	0 (0.0)	2 (2.3)	.52 *	0.0
CKD †	4 (2.8)	3 (5.2)	1 (1.2)	.30 *	0.0
Prior TAA	6 (4.2)	2 (3.4)	4 (4.7)	1.0 *	0.0
Prior AAA	12 (8.3)	1 (1.7)	11 (12.8)	.028 *	0.0
Prior aortic dissection	3 (2.1)	1 (1.7)	2 (2.3)	1.0 *	0.0
Prior cardiac surgery	5 (3.5)	0 (0.0)	5 (5.8)	.082 *	0.0
Prior aortic surgery	13 (9.0)	3 (5.2)	10 (11.6)	.24 *	0.0
Connective tissue disease ‡	6 (4.7)	5 (10.0)	1 (1.3)	.035 *	11.8
Treatment strategy				.69	0.0
Medical	79 (54.9)	30 (51.7)	49 (57.0)		
Endovascular	59 (41.0)	26 (44.8)	33 (38.4)		
Surgical	6 (4.2)	2 (3.4)	4 (4.7)		
Endovascular or surgical treatment					
Patients - n	65	28	37		
Urgency of treatment				.52 *	3.1
Acute	30 (47.6)	11 (39.3)	19 (54.3)		
Urgent	30 (47.6)	15 (53.6)	15 (42.9)		
Elective	3 (4.8)	2 (7.1)	1 (2.9)		
Indication for invasive treatment				.028 *	1.5
Uncomplicated (study)	1 (1.6)	1 (3.6)	0 (0.0)		
Occlusion of major aortic branch leading to ischaemia	22 (34.4)	7 (25.0)	15 (41.7)		
Persistent severe pain	4 (6.3)	3 (10.7)	1 (2.8)		
Extension of dissection	1 (1.6)	0 (0.0)	1 (2.8)		
Aneurysmal expansion	8 (12.5)	4 (14.3)	4 (11.1)		
Expanding haematoma	4 (6.3)	4 (14.3)	0 (0.0)		
Rupture	9 (14.1)	3 (10.7)	6 (16.7)		
Multiple	8 (12.5)	1 (3.6)	7 (19.4)		
Other	7 (10.9)	5 (17.9)	2 (5.6)		

Data are presented as mean ± standard deviation, median (interquartile range), and n (%). IQR = interquartile range; BMI = body mass index; BSA = body surface area; COPD = chronic obstructive pulmonary disease; CVA = cerebrovascular accident; MI = myocardial infarction; CKD = chronic kidney disease; TAA = thoracic aortic aneurysm; AAA = abdominal aortic aneurysm.

* Fisher's exact test.

† None of the patients with known CKD was requiring dialysis at presentation with ATBD.

‡ Connective tissue disease diagnosed before or after ATBD.

with better scores both for the PCS and MCS on univariable analysis. A history of hypertension, chronic kidney disease, and prior aortic surgery were independently associated with impaired PCS scores, whereas hypertension was independently associated with impaired MCS scores. No significant associations were found with treatment groups or (re) intervention during follow up.

In Table 5, responders (n = 144) were compared with non-responders (n = 119). In Appendix VI of the Supplementary material, responders (n = 144) were compared with non-survivors (n = 119), showing a difference in age (61 ± 11 years in responders *vs.* 69 ± 11 in non-survivors) and a higher proportion of comorbidities in non-survivors.

DISCUSSION

This multicentre, cross sectional survey study examined long term HRQoL in all consecutive patients treated for ATBD, the first published study to date. Compared with the Dutch normative population, HRQoL was significantly lower in both female and male ATBD patients. In the ATBD study population, no male—female differences were found except for bodily pain, which was more common in females than males. No significant differences were observed in HRQoL

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Table 2. Long term health related quality of life scores after acute type B aortic dissection for the SF-36

Domain	All patients (n = 144)	Females (n = 58)	Males (n = 86)	p value	Missing − %
Physical functioning	70.0 (45.0, 85.0)	60.0 (45.0, 80.0)	75.0 (40.0, 85.0)	.15	0.7
Role physical	75.0 (0.0, 100.0)	75.0 (0.0, 100)	62.5 (0.0, 100.0)	.34	2.8
Bodily pain	78.8 (56.9, 100.0)	67.5 (50.0, 100.0)	90.0 (67.5, 100.0)	.028	0.0
General health	50.0 (35.0, 70.0)	50.0 (40.0, 68.8)	52.5 (35.0, 70.0)	.70	0.0
Vitality	60.0 (40.0, 75.0)	50.0 (40.0, 75.0)	60.0 (40.0, 75.0)	.27	0.7
Social functioning	87.5 (62.5, 100.0)	75.0 (50.0, 100.0)	87.5 (62.5, 100.0)	.23	1.4
Role emotional	84.0 (68.0, 92.0)	100.0 (0.0, 100.0)	100.0 (58.3, 100.0)	.18	2.1
Mental health	84.0 (68.0, 92.0)	80.0 (68.0, 88.0)	84.0 (68.0, 92.0)	.30	0.7
PCS score	45.4 (33.5, 51.0)	45.8 (35.7, 48.5)	45.2 (33.3, 52.2)	.47	4.9
MCS score	53.5 (41.4, 57.9)	52.4 (36.9, 57.6)	55.0 (45.5, 58.0)	.22	4.9

Data are presented as median (interquartile range). SF-36 = 36 Item Short Form Health Survey; PCS = Physical Component Summary; MCS = Mental Component Summary.

between treatment groups. The impairments seemed mostly regarding patients' physical status, and the study suggested HRQoL in younger patients was more severely affected compared with the general population. Follow up time was associated with better HRQoL scores.

When comparing the patient population with the general population, both males and females scored lower on almost all SF-36 subdomains. In a selected group of uncomplicated ATBD patients, Winnerkvist *et al* observed no substantial differences with the normative Swedish population in terms of functioning and well being with a follow up of 5.4 years (range, 1.9—12.7 years).[12] A possible reason for this is the relatively small study population (n = 53) and thereby limited statistical power of the study. Similar to our findings, several other studies regarding thoracic aortic aneurysms (TAAs) observed impaired HRQoL.[16,24]. In the study by Winnerkvist *et al* no significant association was found with follow up duration and HRQoL scores[12], while the present study showed that a longer follow up duration was associated with better HRQoL. In a longitudinal study on HRQoL after treatment for abdominal aortic aneurysms (AAAs), a strong decrease in HRQoL was observed immediately after treatment, reaching a plateau phase during follow up.[25] The event of ATBD might also have a large impact on the mental

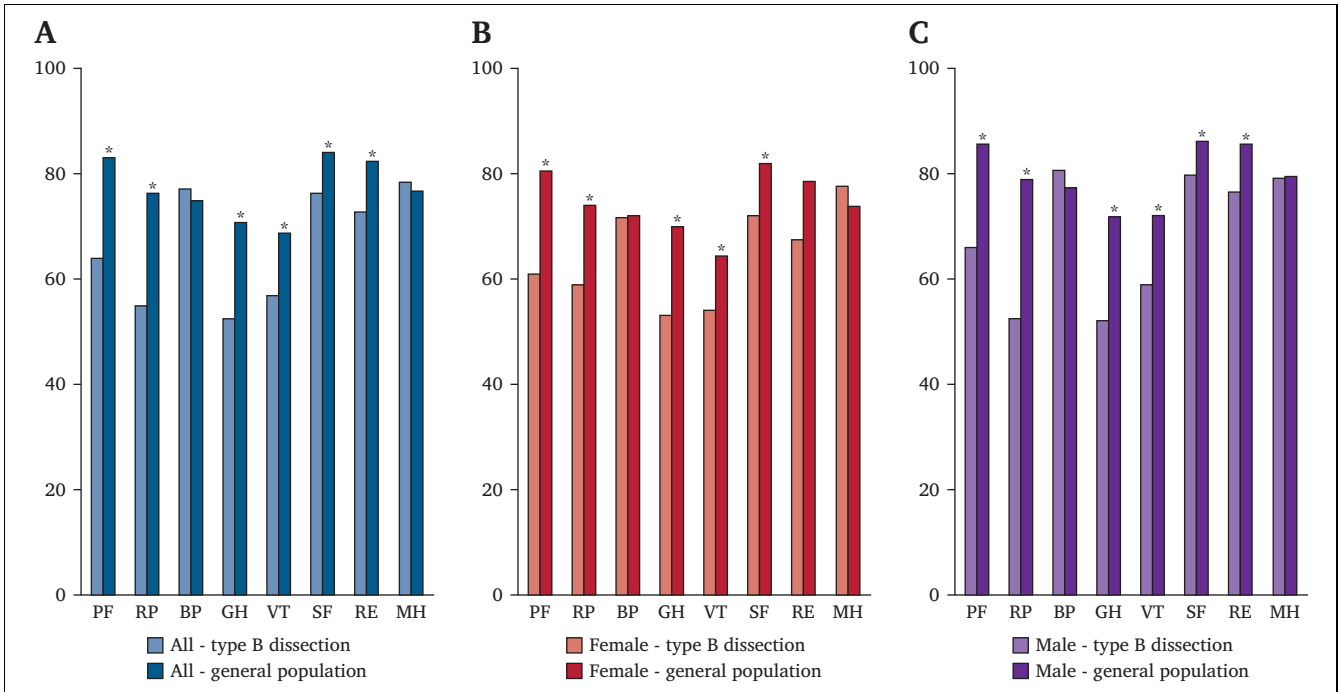

Figure 2. Comparison of mean SF-36 scores for (A) the whole study population and (B,C) stratified by sex for female (B) and male (C) acute type B aortic dissection patients compared with the general population. SF-36 subdomain scores are presented as the mean in order to compare the data with the general population data, which were reported as the mean. * p value < .050 in one sample Student's t test compared with the general population. SF-36 = 36 Item Short Form Health Survey; PF = physical functioning; RP = role physical; BP = bodily pain; GH = general health; VT = vitality; SF = social functioning; RE = role emotional; MH = mental health.

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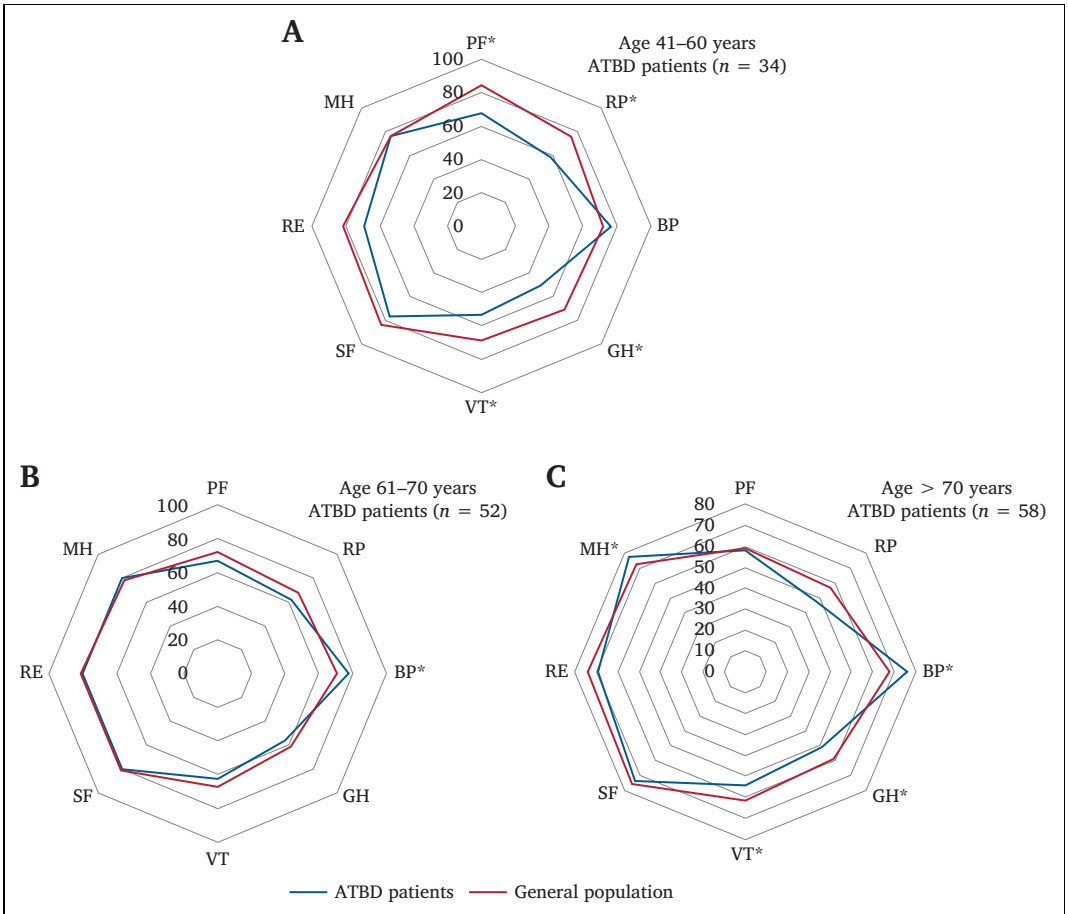

Figure 3. Comparison of the mean SF-36 scores of acute type B aortic dissection (ATBD) patients with the general population according to age category (age at time of questionnaire). SF-36 subdomain scores are presented as the mean in order to compare the data with the general population data, which were reported as the mean. * p value $< .050$ in one sample Student's t test compared with the general population in that age category. SF-36 = 36 Item Short Form Health Survey; PF = physical functioning; RP = role physical; BP = bodily pain; GH = general health; VT = vitality; SF = social functioning; RE = role emotional; MH = mental health.

and physical well being of patients in the short term, while over time it increases to a stable level — although lower than in the general population.

In the present study, the physical domains seemed particularly impaired, namely physical functioning, role physical, general health, and vitality. In the study by Olsson

Table 3. Comparison of long term SF-36 scores between initial endovascular or surgical treatment and medical treatment in acute type B aortic dissection for all patients (n = 144)

	Medical treatment (n = 79)	Endovascular or surgical treatment (n = 65)	p value	Missing − %
Physical functioning	65.0 (42.5, 85.0)	75.0 (45.0, 85.0)	.39	0.7
Role physical	50.0 (0.0, 100.0)	100.0 (0.0, 100.0)	.084	2.8
Bodily pain	77.5 (52.5, 100.0)	87.5 (65.0, 100.0)	.58	0.0
General health	45.0 (35.0, 70.0)	55.0 (40.0, 70.0)	.26	0.0
Vitality	55.0 (35.0, 75.0)	60.0 (40.0, 75.0)	.55	0.7
Social functioning	75.0 (62.5, 100.0)	87.5 (75.0, 100.0)	.071	1.4
Role emotional	100.0 (33.3, 100.0)	100.0 (83.3, 100.0)	.085	2.1
Mental health	80.0 (66.0, 92.0)	84.0 (68.0, 92.0)	.23	0.7
PCS	44.3 (32.9, 50.4)	46.5 (35.4, 51.5)	.31	4.9
MCS	51.8 (37.3, 57.5)	54.5 (47.5, 58.1)	.22	4.9

Data are presented as median (interquartile range). SF-36 = 36 Item Short Form Health Survey; PCS = Physical Component Summary; MCS = Mental Component Summary.

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Table 4. Associations of patient and treatment characteristics of type B aortic dissection (ATBD) patients with Physical Component Summary (PCS) and Mental Component Summary (MCS) in linear regression analysis

Characteristic	PCS				MCS			
	Univariable β estimate (95% CI)	p	Multivariable β estimate (95% CI)	p	Univariable β estimate (95% CI)	p	Multivariable β estimate (95% CI)	p
Follow up time, per year	0.542 (−0.003 − 1.087)	.051	0.450 (−0.067 − 0.968)	.088	0.516 (−0.002 − 1.087)	.076	− *	−
Follow up time > median	0.543 (0.086 − 6.922)	.050	−	−	4.097 (0.531 − 7.662)	.025	−	−
Age at ATBD, per year	−0.195 (−0.360 − −0.030)	.021	−	−	−0.008 (−0.360 − −0.030)	.93	−	−
Female sex	−0.935 (−4.471 − 2.600)	.60	−	−	−2.079 (−4.471 − 2.600)	.27	−	−
History of hypertension	−4.636 (−8.015 − −1.256)	.008	−3.734 (−7.108 − −0.359)	.030	−4.066 (−8.015 − 1.256)	.026	−4.084 (−7.678 − −0.489)	.026
History of hyperlipidaemia	−4.591 (−9.014 − −0.168)	.042	−	−	−5.839 (−9.014 − −0.168)	.013	−	−
Diabetes	−4.531 (−13.750 − 4.688)	.33	−	−	2.704 (−13.750 − 4.688)	.58	−	−
COPD	−5.331 (−11.937 − 1.277)	.11	−	−	−4.640 (−11.938 − 1.277)	.19	−	−
History of CVA	−7.275 (−14.167 − −0.383)	.039	−	−	−6.235 (−14.167 − −0.383)	.092	−	−
History of MI	12.289 (−2.023 − 26.600)	.092	14.153 (0.589−27.718)	.041	6.772 (−2.023 − 26.600)	.38	−	−
Chronic kidney disease	−15.189 (−26.757 − −3.620)	.011	−15.072 (−26.095 − −4.050)	.008	1.664 (−26.757 − −3.620)	.79	−	−
Known TAA	−8.836 (−17.179 − −0.493)	.038	−	−	−0.232 (−17.179 − −0.493)	.96	−	−
Prior AAA	−8.077 (−14.057 − −2.096)	.009	−	−	−7.150 (−14.057 − −2.096)	.027	−	−
Prior AD	−10.831 (−22.541 − 0.878)	.070	−	−	−7.624 (−22.541 − 0.878)	.22	−	−
Prior aortic surgery	−7.844 (− 13.611 − −2.076)	.008	−5.848 (−11.547 − −0.1493)	.044	−5.689 (−13.611 − −2.077)	.068	−	−
Prior cardiac surgery	0.549 (−8.702 − 9.800)	.91	−	−	3.445 (−8.702 − 9.800)	.48	−	−
Connective tissue disease	−4.332 (−12.999 − 4.335)	.32	−	−	−1.109 (−12.999 − 4.335)	.81	−	−
Endovascular/ surgical *vs.* medical treatment	1.831 (−1.646 − 5.308)	.30	−	−	3.154 (−1.646 − 5.308)	.087	−	−
(Re)intervention during follow up	−0.293 (−4.428 − 3.842)	.89	−	−	0.815 (−3.469 − 5.098)	.71	−	−

β coefficient and corresponding 95% CI are shown. Interpretation for β coefficients: if the β coefficient is positive, for every unit increase in the predictor variable, the outcome variable (PCS or MCS score) will increase by the β coefficient value. CI = confidence interval; COPD = chronic obstructive pulmonary disease; CVA = cerebrovascular accident; MI = myocardial infarction; TAA = thoracic aortic aneurysm; AAA = abdominal aortic aneurysm; AD = aortic dissection.

* − indicates that the variable was not included in the final multivariable model after backward selection.

and Franco-Cereceda TAA patients scored lower mostly on the physical domains[24], as also found in a study among patients treated for AAA.[25] Since most of the questions in the physical subdomains cover impairments of daily living activities, patients might benefit from physical rehabilitation programmes such as cardiac rehabilitation or the support of paramedics in physical activities. Although significant differences in mental health with the general population were not observed, these might still exist but are not captured in the SF-36 questionnaire, as depression

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Table 5. Sensitivity analysis comparing acute type B aortic dissection (ATBD) patient characteristics between responders and non-responders

Characteristic	Responders (n = 144)	Non-responders (n = 119)	p value	Missing %
Patient demographics				
Female sex	58 (40.3)	49 (41.2)	.98	0.0
Age at ATBD − years	60.5 ± 10.6	60.1 ± 14.1	.78	0.0
BMI − kg/m^2	25.6 (22.9, 28.1)	25.9 (23.2, 28.8)	.47	23.2
BSA − m^2	1.95 (1.83, 2.09)	1.99 (1.81, 2.14)	.43	23.2
History of hypertension	71 (49.3)	55 (46.2)	.71	0.5
Hyperlipidaemia	25 (17.4)	26 (22.0)	.43	1.0
Diabetes mellitus	5 (3.5)	5 (4.2)	1.0	0.5
COPD	10 (6.9)	6 (5.0)	.70	0.5
History of CVA	9 (6.3)	12 (10.1)	.36	0.5
History of MI	2 (1.4)	9 (7.6)	.026 *	0.8
CKD	4 (2.8)	5 (4.2)	.74 *	0.5
Prior TAA	6 (4.2)	9 (7.6)	.36	0.8
Prior AAA	12 (8.3)	7 (5.9)	.60	0.3
Prior aortic dissection	3 (2.1)	4 (3.4)	.71 *	0.5
Prior cardiac surgery	5 (3.5)	13 (10.9)	.033	0.5
Prior aortic surgery	13 (9.0)	16 (13.4)	.35	0.3
Connective tissue disease †	6 (4.7)	10 (9.7)	.22	15.1
Treatment strategy				
Medical	80 (55.6)	58 (48.7)	.54	0.0
Endovascular	58 (40.3)	55 (46.2)		
Surgical	6 (4.2)	6 (5.0)		

Data are presented as mean ± standard deviation, median (interquartile range), and n (%). BMI = body mass index; BSA = body surface area; COPD = chronic obstructive pulmonary disease; CVA = cerebrovascular accident; MI = myocardial infarction; CKD = chronic kidney disease; TAA = thoracic aortic aneurysm; AAA = abdominal aortic aneurysm.

* Fisher's exact test.

† Connective tissue disease diagnosed before or after ATBD.

and anxiety have been reported to be increased in previous studies on TAD survivors and TAA patients.[10,16] Qualitative research on mental health in ATBD patients could provide more information and meaningful cues for clinicians to account for in daily practice. Furthermore, the SF-36 does not take into account the disease specific impact of ATBD on daily activities. In future studies, a quantitative questionnaire tailored for ATBD patients, including questions on exercise, travelling, and sexual activity, might increase understanding.

Furthermore, no significant differences were observed in HRQoL when stratified per treatment regimen (conservative *vs.* interventional), and (re)intervention during follow up did not seem to be associated with HRQoL scores. In a study on TEVAR in acute and subacute type B dissections, comparable or improved HRQoL was observed when comparing pre- and post-operative HRQoL.[11] In the present study, no statistical difference in HRQoL was observed between treatment groups, however it had a limited sample size as it was not designed for this purpose. Therefore, the authors encourage to prospectively study HRQoL in larger study populations among different ATBD treatment groups, as well as possible associations with (re)interventions during follow up, preferably using multiple HRQoL measurements. In patients with uncomplicated ATBD, the debate regarding the most accurate timing and management is ongoing. Regarding clinical outcomes such as death and re-interventions, no significant differences between TEVAR and conservative medical treatment in the acute phase exist.[26] Patient reported outcomes and cost effectiveness might offer more insight into a favourable timing and management of uncomplicated ATBD.

In this population, a comparable pattern in HRQoL was observed among females and males when compared with the general population. In contrast, in the study by Winnerkvist *et al* female chronic type B dissection patients tended to score worse on physical functioning[12], and in the study by Thijssen *et al* female patients had lower scores on eight of eight subdomains compared with male TAA patients.[16] In the present study population, female patients scored lower solely on bodily pain compared with males. This difference might reflect the existing male—female difference in the general population, as females score significantly lower on seven of eight subdomains, including bodily pain.[15] Another explanation might be a different perception of pain or the way of coping with pain in female ATBD patients. In ATAD, females tend to report a more tearing pain, whereas male patients experienced sharp pain more frequently.[27] During follow up, the impact of ATBD on pain might be different in females and males and is worth discussing during clinical visits.

Nevertheless, age might be of more importance in ATBD: compared with the general population, especially ATBD patients in the younger age range from 41—61 years seemed to have impaired HRQoL on predominantly physical subdomains. Younger patients might have higher

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expectations of their physical functioning and therefore feel more deterioration due to the disease. Interestingly, a study on HRQoL after ATAD showed that especially younger patients had a greater deterioration in the MCS of the SF-36.[14] ATBD might cause more anxiety, and impact on the social environment and job functioning in younger patients compared with older patients. Several other patient specific associations with the PCS were observed: hypertension, history of myocardial infarction, chronic kidney disease, and prior aortic surgery were negatively associated. Patients with a younger age and patients with the aforementioned comorbidities require extra attention during follow up and might benefit from tailored physical rehabilitation programmes.

In clinical practice, the study findings should lead to more awareness of long term HRQoL among healthcare providers and physicians, especially in young patients. Further investigation of cardiac rehabilitation for ATBD patients could be both in clinicians' and patients' best interests. Furthermore, studies investigating the effect on daily activities, such as exercise, travelling, and sexual activity, could give more insight into the impaired HRQoL and are clearly warranted. The authors believe that if patients were better informed about the risks of complications and what activities they are (not) allowed to do, anxiety and stress could be reduced.

Limitations

Several limitations apply to this study. In this cross sectional, observational study, no baseline HRQoL scores at the time of onset of disease were available, and HRQoL was assessed at one time point during follow up. As a result, no time trend analysis could be performed. The response rate was 55%, comparable with other (online) questionnaires.[28] Nonetheless, some non-responder bias was present: the sensitivity analysis showed that although the groups were largely comparable, non-responders more often had a history of myocardial infarction and cardiac surgery. Also, survival bias might be present: a higher age and proportion of comorbidities was observed comparing non-survivors with responders. Thus, patients with worse cardiovascular status might have been excluded from this study, resulting in overestimated HRQoL scores. These scores were compared with age matched individuals in the general population, which accentuates the impact of this disease. Due to the retrospective baseline data collection, it was not possible to collect data on important matters associated with HRQoL, such as psychiatric conditions and cognitive abilities. The results of the subgroup analyses and linear regression analyses should be interpreted with caution owing to limited statistical power. Lastly, as the participating centres were tertiary referral centres, the proportion of uncomplicated ATBD might be lower than in clinical practice, limiting the generalisability of the findings.

Conclusion

In this multicentre, cross sectional survey study, HRQoL was impaired in both male and female ATBD patients compared with the Dutch normative population. In particular, the physical domains were affected and HRQoL seemed especially impaired in younger patients. No substantial associations with sex and HRQoL were found apart from bodily pain, and initial treatment strategy did not seem to be associated with HRQoL. HRQOL should be an integrated part of the clinical follow up care of patients with ATBD.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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APPENDIX A. SUPPLEMENTARY DATA

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejvs.2023.05.037

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