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SHORT REPORT

The Potential Value of Prehabilitation for Preventing Delirium in Elective Surgery for Aneurysms of the Abdominal Aorta

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Objective: Delirium is a common and serious postoperative complication in elderly patients undergoing abdominal aortic aneurysm (AAA) repair and is associated with a variety of adverse outcomes. Multimodal prehabilitation aims to identify and minimize potential risk factors for delirium and improve overall health. The aim of this study is to investigate the effect of multimodal prehabilitation on delirium incidence in elderly patients undergoing elective repair for AAA.

Methods: A single-centre cohort analysis was performed in the Netherlands for patients aged ≥70 years, undergoing elective repair for AAA (open surgery and endovascular aortic repair). Prehabilitation was gradually introduced between 2016 and 2019 and offered as standard care from 2019. The program was constructed to optimize overall health and included delirium risk assessment, home-based tailor-made exercises by a physical therapist, nutritional optimization by a dietician, iron infusion in case of anaemia and a comprehensive geriatric assessment by a geriatrician in case of frailty. The primary outcome was incidence of delirium within 30 days after surgery.

Results: A total of 81 control and 123 prehabilitation patients were included. A reduction in incidence of delirium was found (11.1% in the control group to 4.9% in the prehabilitation group), with too small numbers to reach statistical significance (p=0.09). Also, patients in the prehabilitation group had a small, non-significant decreased length of hospital stay (4 days) compared to the control group (5 days) (p=0.07).

Conclusion: Although no significant differences were found, we carefully conclude that this study provides some support for implementing multimodal prehabilitation for delirium prevention in elderly patients undergoing AAA repair. Further research with larger cohorts is necessary to identify and select patients that would most benefit from prehabilitation.

Plain Language Summary: Delirium is a common complication in elderly patients after undergoing abdominal aortic aneurysm (AAA) repair. Delirium is associated with a prolonged hospital-stay, decreased quality of life and increased mortality. To prevent delirium it is important to identify possible risk factors and assess the patients' overall fitness. This is best done preoperatively, since the patient is not yet recovering from a major surgery. This is called "prehabilitation".

In this study, we investigated the effect of multimodal prehabilitation in patients undergoing surgery for an AAA. The program consists of:

- Individual delirium risk-assessment,
- Personalized home-based tailor-made exercises,
- Nutritional optimization,
- Iron infusion in case of anaemia, and
- A comprehensive geriatric assessment by a geriatrician in case of frailty.

Eighty-one control and 123 prehabilitation patients were included. A reduction in incidence of delirium was found (11.1% control to 4.9% prehabilitation), with too small numbers to reach statistical significance (p=0.09). Also, patients in the prehabilitation group had a small, non-significant decreased length of stay (4 days) compared to the control group (5 days) (p=0.07).

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Prehabilitation may be effective in preventing delirium in elderly patients undergoing AAA repair. Further research is necessary to identify and select patients that would most benefit from prehabilitation.

Keywords: aneurysm of the abdominal aorta, prehabilitation, preoperative rehabilitation, delirium, delirium/prevention and control

Introduction

Delirium is a common and serious postoperative complication in elderly patients undergoing abdominal aortic aneurysm (AAA) repair.[1] This serious neuropsychiatric disorder is associated with a variety of adverse outcomes, such as a prolonged hospital stay, institutionalization after discharge, functional and cognitive decline and functional dependence, decreased quality of life and increased mortality.[2] Performing a structured preoperative assessment of older surgical patients identifies potential risk factors for postoperative complications, including delirium.[3] Prehabilitation is the all-encompassing term that subsequently addresses these risk factors. Multimodal prehabilitation aims to identify and minimize potential risk factors for delirium and improve overall health and has been studied in different types of surgical procedures, however, studies on prehabilitation within vascular surgery are needed.[4] The aim of this study is to investigate the effect of multimodal prehabilitation on delirium incidence in elderly patients undergoing elective repair for AAA.

Methods

A single-centre cohort analysis was performed in the Netherlands for patients aged ≥70 years, undergoing elective repair for AAA in the Amphia Hospital in Breda, the Netherlands.[4,5] Prehabilitation was gradually introduced between 2016 and 2019 and offered as standard care from 2019. This explains the three-year overlap with the prehabilitation group (2016–2022) and the control group (2013–2019). The analysis of AAA patients was stratified for open surgery or endovascular aortic repair (EVAR). Patients were considered ineligible when acute hospitalization or surgery was required, when they had surgery six months prior to diagnosis or when surgery was planned within 2 weeks of the initial outpatient clinic visit. The prehabilitation program was constructed to optimize overall health and included delirium risk assessment, home-based tailor-made exercises by a physical therapist, nutritional optimization by a dietician, iron infusion in case of anaemia and a comprehensive geriatric assessment by a geriatrician in case of frailty. A detailed description of the prehabilitation program and the initial study was described previously.[5]

The primary outcome was incidence of delirium within 30 days after surgery, analysed with chi-square tests and logistic regression. Ward nurses screened for delirium during regular rounds using the delirium observation screening scale (DOSS). When delirium was suspected, a geriatrician was consulted to confirm the diagnosis using the DSM-V criteria.[2] Secondary outcomes were length of hospital stay, postoperative complications, unplanned ICU admission and 30-day mortality. Dichotomous variables were presented as frequencies with percentages and continuous variables as medians with interquartile range. Differences in these characteristics were tested for statistical significance by using Pearson chi-squared test and Mann–Whitney *U*-test respectively. We also performed an ordinal logistic regression analysis for a composite outcome of delirium and mortality, where we scored survivors without delirium as zero (best outcome), survivors with delirium with their duration of delirium in days (longer is worse), and assigned the worst score (30) for patients who deceased within 30 days after surgery. We adjusted for previously identified key prognostic factors including age, American Society of Anaesthesiologists (ASA) score higher than 2, a history of delirium and open versus EVAR.[4]

Statistical analyses were performed using IBM SPSS statistics software (SPSS Inc., Chicago, Illinois, USA). This current research paper is an update of previously published results of the initial study, which is – despite the decision of the Medical research Ethics Committees United (MEC-U) that registration of this trial was not required – registered in the Dutch Trial Registration with trial number NTR5932 as following the guidelines of Good Clinical Practice.[4] The guidelines outlined in the Declaration of Helsinki were followed, and informed consent was obtained from all study participants.

Results

A total of 81 control and 123 prehabilitation patients were included. Baseline characteristics differed with respect to ASA-score, malnutrition and visual impairment (Table 1). The analysis of AAA patients was stratified for open surgery or EVAR (Table 2). Within the open repair group, more prehabilitated patients had an ASA-score higher than 2 (73% vs 48% in control, p=0.03, chi-square test), and more patients were visually impaired (46% vs 19%, p=0.005). Delirium occurred in 6 of 123 patients (4.9%) in the prehabilitation group and 9 of 81 patients (11.1%) in the control group (p=0.09, chi-square test, unadjusted odds ratio = 0.41, 95% confidence interval: 0.14–1.2). After adjustment for prognostic factors, the adjusted odds ratio (aOR) confirmed this association (aOR = 0.33, 95% confidence interval: 0.1–1.09, p=0.07). The difference in delirium incidence was strongest in the open repair group (aOR = 0.28, 95%

Table 1 Baseline Characteristics and Results of the Total Group

		Total group n = 204 (100%)			
		Control n = 81 (39.7%)	Prehabilitation n = 123 (60.3%)	Total n = 204	P-value
Baseline characteristics					
Demographics	Age	75 (72–80)	77 (73–81)	76 (73–81)	0.15
	Gender (male)	70 (86.4)	105 (85.4)	175 (85.8)	0.83
Medical history	Cognitive impairment	3 (3.7)	1 (0.8)	4 (2)	0.15
	History of delirium	2 (2.5)	9 (7.3)	11 (5.4)	0.13
	CCI ≤7	21 (25.9)	41 (33.3)	62 (30.4)	0.26
	ASA ≤3	53 (65.4)	95 (77.2)	148 (72.5)	0.07
Physical impairment	KATZ-ADL ≤1	7 (8.6)	19 (15.4)	26 (12.7)	0.15
	SNAQ-RC ≤ 3	6 (7.4)	5 (4.1)	11 (5.4)	0.024
	Visual impairment	17 (21)	53 (43.1)	70 (34.3)	0.005
	Hearing impairment	25 (30.9)	50 (40.7)	75 (36.8)	0.27
Intoxications	Daily alcohol use	31 (38.3)	51 (41.5)	82 (40.2)	0.43
	Active smoker	25 (32.1)	28 (22.8)	53 (26)	0.15
Type of surgery	Open AAA	31 (38.3)	41 (33.3)	72 (35.3)	0.47
	EVAR	50 (61.7)	82 (66.7)	132 (64.7)	0.47
Results					
Primary outcome	Incidence of delirium	9 (11.1)	6 (4.9)	15 (7.4)	0.09
	Duration of delirium in days	3 (2–8)	4 (3–8)	3.5 (2.3–10.3)	0.67
Complications	Any complications other than delirium	27 (33.3)	46 (37.4)	73 (35.8)	0.55
	Clavien-Dindo-I-II	17 (21)	30 (24.4)	47 (23)	0.57
	Clavien-Dindo-III-V	10 (38.5)	16 (61.5)	26 (12.7)	0.89
	Multiple complications	6 (7.4)	11 (8.9)	17 (8.3)	0.70
ICU stay	Unplanned ICU admission	11 (13.6)	14 (11.4)	25 (12.3)	0.64
	ICU length of stay - days	5 (2–6.5)	4 (2–6)	5 (2–6.5)	0.87
Stay and readmission	Length of stay - days	5 (4–8)	4 (3–7.5)	4 (3–8)	0.02
	30-day readmission[a]	3 (3.9)	11 (9.1)	0.17	0.17
Mortality	Mortality during admission	5 (6.2)	2 (1.6)	7 (3.4)	0.08
	30-day mortality	4 (4.9)	3 (2.4)	7 (3.4)	0.34

Notes: Data are presented as n (%) or median (interquartile range). [a]Calculated over the patients that did not decease during admission.
Abbreviations: CCI, Charlson Comorbidity Index; ASA, American Society of Anesthesiology; KATZ-ADL, Katz index of Independence in Activities of Daily Living; SNAQ-RC, Short Nutritional Assessment Questionnaire for Residential Care; AAA, Aneurysm of the Abdominal Aorta; EVAR, Endovascular Aorta Repair; ICU, Intensive Care Unit.

Table 2 Subgroup Analysis: Stratified for Open AAA Repair and EVAR

		Open Repair, n = 72 (35.3%)			EVAR, n = 132 (64.7%)		
		Control n=31 (43.1%)	Prehabilitation n=41 (56.9%)	P-value	Control n=50 (37.9%)	Prehabilitation n=82 (62.1%)	P-value
Primary outcome	Incidence of delirium	8 (25.8)	5 (12.2)	0.14	1 (2)	1 (1.2)	0.72
	Duration of delirium in days, median (IQR)	4 (2.5–9.5)	3.5 (3–4)	0.74	2 (-)	22 (-)	0.32
Complications	Any complications other than delirium	16 (51.6)	21 (51.2)	0.97	11 (22)	25 (30.5)	0.29
	Clavien-Dindo-I-II	9 (29)	9 (22)	0.49	8 (16)	21 (25.6)	0.20
	Clavien-Dindo-III-V	7 (22.6)	12 (29.3)	0.52	3 (6)	4 (4.9)	0.78
	Multiple complications	6 (19.4)	9 (22)	0.79	0 (0)	2 (2.4)	0.27
ICU stay	Unplanned ICU admission	10 (32.2)	13 (31.7)	0.96	1 (2)	1 (1.2)	0.72
	ICU length of stay, days, median (IQR)	5 (2–7)	4 (3–6)	0.66	1 (?)	2 (?)	0.32
Stay and readmission	Length of stay in days, median (IQR)	9 (7–14)	11 (6–14)	0.68	4 (3–5)	3 (3–4)	<0.001
	30-day readmission[a]	1 (3.7)	3 (7.7)	0.50	2 (4.1)	8 (9.8)	0.24
Mortality	Mortality during admission	4 (12.9)	2 (2.8)	0.22	1 (2)	0 (0)	0.20
	30-day mortality	3 (9.7)	2 (4.9)	0.43	1 (2)	1 (1.2)	0.72

Notes: Data are presented as n (%) or median (interquartile range). [a]Calculated over the patients that did not decease during admission.
Abbreviations: EVAR, Endovascular Aorta Repair; ICU, Intensive Care Unit.

confidence interval: 0.07–1.09, p=0.07) rather than in the EVAR group (aOR = 0.80, 95% confidence interval: 0.05–13.9, p=0.88). Length of hospital stay was significantly shorter after prehabilitation in the total group (5 days in control, 4 days after prehabilitation, p=0.02, Mann–Whitney U-test) and in the EVAR group (4 days in control, 3 days after prehabilitation, p=0.001). With a composite outcome of delirium and mortality, the mean number of delirium days per patient was 2.0 in the control group versus 1.1 in the prehabilitation group (p=0.21, ordinal logistic model). The highest number of mean delirium days was in the open repair control group (4.1 days), compared to the open repair prehabilitation group (1.9 days, p=0.13). Within the EVAR group, there was no significant difference (0.6 days in both groups, p=0.62). Mortality during admission and 30-day mortality were both lower in the prehabilitation group than in the control group (6.2% in the control group to 1.6% in the prehabilitation group, *p=0.08*, and 4.9% in the control group to 2.4% in the prehabilitation group, *p=0.34*, respectively).

Discussion

In respect to our findings, we carefully conclude that this study provides some support for implementing multimodal prehabilitation for delirium prevention in elderly patients undergoing AAA repair. Although no significant differences were found in delirium incidence, the prehabilitation group showed a tendency towards a lower incidence of delirium and a significantly shortened length of hospital stay. Previous studies on prehabilitation for vascular surgical patients report varying outcomes in terms of efficacy.[3,6] Compared to a recently published prehabilitation study with patients undergoing surgery for colorectal carcinoma (CRC), this AAA study shows less significant reduction of severe postoperative complications.[7] This may be attributed to the fact that the preoperative fitness of – often malnourished, obstructed and anaemic – CRC patients is generally worse than AAA patients. In AAA patients, the disease is usually an incidental finding on imaging studies ordered for other indications, and thus mostly asymptomatic. Hence, prehabilitation of healthy AAA patients differs from other types of surgical patients and the health improvement might be harder to validate. Limitations of this study include the small sample size with few events, especially for the EVAR group. Small numbers may explain the statistically non-significant results for all endpoints considered. Moreover, the comparison was not randomized, hence we cannot exclude that relevant differences remained between groups that were not adjusted for in the statistical analysis. Finally, since the study occurred over a long period of time, minor changes in standards of care may have occurred. However, no major differences were made in the standard form of patient care. Further research with larger numbers is necessary to identify and select patients who may benefit from prehabilitation.

Conclusion

Prehabilitation may be effective in preventing delirium in elderly patients undergoing elective repair of an AAA, especially in open surgical aortic repair. Further research is necessary to identify and select patients that would most benefit from prehabilitation.

Data Sharing Statement

- If requested, we are willing to share individual deidentified participant data. However, this is not our primary intention.
- There is no specific data we intend to share.
- No other documents will be made available.
- We will participate in the request of how, when and how long the requested data would be accessible.

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Disclosure

The authors report no conflicts of interest in this work.

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