Evaluating abdominal aortic aneurysm and carotid artery surgery in the Netherlands: variations in indication, treatment and outcomes measures

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CHAPTER 6

Textbook Outcome: A Composite Measure for Quality of Elective Aneurysm Surgery

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ABSTRACT

Background and objective

Single quality indicators in vascular surgery are often not distinctive and insufficiently reflect the quality of care. The aim was to investigate a new composite quality measurement, which comprises a desirable outcome for elective aneurysm surgery, called 'Textbook Outcome' (TO).

Methods

All patients undergoing elective abdominal aortic aneurysm (AAA) repair, registered in the Dutch Surgical Aneurysm Audit (DSAA) between 2014-2015 were included. TO was defined as the percentage of patients who had AAA-repair without intraoperative complications, postoperative surgical complications, re-interventions, prolonged hospital stay (endovascular aneurysm repair (EVAR) ≤4 days, open surgical repair (OSR) ≤10 days), re-admissions and postoperative mortality (≤30 days after surgery / at discharge). Case-mix adjusted TO rates were used to compare hospitals and to compare individual hospital results for different procedures.

Results

5170 patients were included, of which 4039 were treated with EVAR and 1131 with OSR. TO was achieved in 71% of EVAR and 53% of OSR. Important obstacles for achieving TO were a prolonged hospital stay, postoperative complications, and re-admissions. Adjusted TO rates varied from 38%-89% (EVAR) and 0%-97% (OSR) between individual hospitals. Hospitals with a high TO for OSR also had a high TO for EVAR, however a high TO for EVAR did not implicate a high TO for OSR.

Conclusion

TO generates additional information to evaluate the overall quality of the care of elective aneurysm surgery, which subsequently can be used by hospitals to improve the quality of their care.

INTRODUCTION

Since 2013, all patients undergoing aneurysm surgery in the Netherlands are registered in the Dutch Surgical Aneurysm Audit (DSAA) to monitor and improve quality of care.[1,2] By registering parameters on structure, process and outcome, surgeons can be provided with benchmarked information on the quality of their care, which subsequently can be used for quality improvement.[3] However, it remains unclear which indicators best reflect quality of care. Single outcome indicators in aneurysm surgery like mortality after endovascular aneurysm repair (EVAR) often have a low event rate, which results in little variation and does not incite improvements. Moreover, a single indicator generally seems to give a one-sided perspective and does not reflect the multidimensional aspect of the surgical process.[4]

'Textbook Outcome' (TO), a composite measure including all desirable outcomes, has first been described in gastro-intestinal cancer surgery.[4,5] Since TO covers the most important parameters of the surgical process, it gives a better impression of the overall quality of care and most likely reflects the desires of patients more closely. Secondly, TO increases the event rate and hence the variation between hospitals. Therefore TO could also be used for hospital comparison in order to recognize 'best-practice' that could serve as an example for participants in the registry.[6,7]

The objective of this study was to define and test TO for elective aneurysm surgery. Hospital variation in (adjusted) outcomes on this composite measure were investigated, as well as the association with the operative technique.

METHODS

Data source

The dataset was retrieved from the DSAA, a national outcome registry initiated in 2013 including all patients who underwent surgery for an abdominal aortic aneurysm (AAA). During the first years of registration, only patients with a primary infra- or juxta-renal AAA were registered. As of 2016, all patients with an aneurysm in the thoracic aorta or aortic arch and all patients with a revision of their aneurysm repair are registered as well.[1]

Patient selection

All patients undergoing elective AAA repair between January 2014 and December 2015 registered in the DSAA, were included provided that date of birth, date of surgery, type of surgical procedure and patient survival status 30 days after surgery and at time of discharge were registered. Patients with a ruptured or acute symptomatic AAA were excluded.

Definitions

When defining TO for elective AAA repair, a difference in definition should be made for patients treated with EVAR or open surgical repair (OSR), since the choice of treatment will influence both the surgical and postoperative process. Patients were categorized by intention to treat. The scientific committee of the DSAA made a selection of relevant process and outcome parameters for desirable patient outcome: no intraoperative complications (1), no postoperative surgical complications (2), no re-interventions (3), no prolonged length of hospital stay (LOS) (EVAR ≤ 4 days, OSR ≤ 10 days) (4), no re-admissions ≤ 30 days after discharge (5) and no postoperative mortality ≤30 days after surgery / at discharge. (6). When all 6 desired outcomes were realized TO was achieved.

Only surgical complications were included in the parameter 'postoperative complications'. All serious non-surgical complications, which had a disadvantageous effect on patient recovery, would have automatically led to a prolonged LOS. Since a prolonged LOS is included in the definition of TO, patients with severe non-surgical complications are captured as well. A re-intervention was defined as any surgical or radiological intervention related to the primary intervention. To determine the cut-off point for prolonged LOS for each surgical procedure a questionnaire was distributed among 20 vascular surgeons, all from different hospitals. The mean reported number of days was chosen. Postoperative mortality was defined as mortality during the initial hospital stay or within 30 days after surgery.

Analysis

All analyses were performed for EVAR and OSR separately. The overall percentages of TO and percentages of patients for each independent outcome parameter were calculated. Parameters were placed in chronological order. When data were missing for one of the selected parameters, TO could not be achieved.

Patient characteristics were compared between patients with and those without TO using the T-test and Chi-square test. Based on the V(p)-POSSUM score, patient characteristics included in this analysis were: gender, age, aneurysm diameter, systolic blood pressure, heart rate, pulmonary status, cardiac status, prior or current malignancies, preoperative electrocardiogram and preoperative laboratory results.[8]

Possible associations between patient characteristics and TO were analyzed to subsequently adjust hospitals TO rates for the case-mix of their patients. Therefore, all previously mentioned patient characteristics were entered in a multivariable logistic regression model at a p-value of 0.05 using an ENTER model.

Funnel plots with confidence intervals (CIs) of 95% and 99% were used to show hospital variation for adjusted TO rates. In case data were missing for continuous variables, the mean of each variable was imputed. Data were missing most frequently for preoperative heart rate (5.8% EVAR, 6.6% OSR) and sodium (9.6% EVAR, 5.8% OSR). In other continuous variables missing data were not exceeding 5% of the total.

TO rates for EVAR and OSR per hospitals were compared with the national mean and plotted in a four quadrants figure. Additionally, the association between TO, hospital volume and EVAR/OSR ratio was assessed. Hospitals where only one of the procedures was performed were excluded in this analysis.
Since prolonged LOS is quite a 'soft' measure, we performed a sensitivity analysis with different cut-off points for prolonged LOS to investigate the influence of the chosen cut-off point on TO. Statistical analyses were performed in PASW Statistics version 21.0 (SPSS inc, Chicago, IL).

RESULTS

A total of 5172 patients underwent elective AAA repair and were registered in the DSAA, of which 5168 (99.9%) were eligible for analyses. 4039 patients were treated with EVAR (78%) and 1129 with OSR (22%). (Appendix 1., Flowchart) Ten patients (0.02%) that were initially planned for EVAR, were converted to OSR. TO was realized in 71% of EVAR patients and in 53% of OSR patients (Figure 1). In both surgical procedures, a prolonged LOS (EVAR 17%, OSR 37%) resulted in a decrease of TO. In addition, 11% of EVAR patients was re-admitted after discharge and 17% of OSR patients had a postoperative surgical complication. In 5.4% of EVAR and in 5.3% of OSR TO was not realized because data were missing for one of the selected parameters.

Univariable Analysis

Patient characteristics are shown in Table 1. Patients with TO were more often male and on average one year younger of age, compared to patients without TO. Furthermore, the distribution of cardiac state, pulmonary state and preoperative hemoglobin levels was significantly different between patients with and without a TO, for EVAR and OSR.

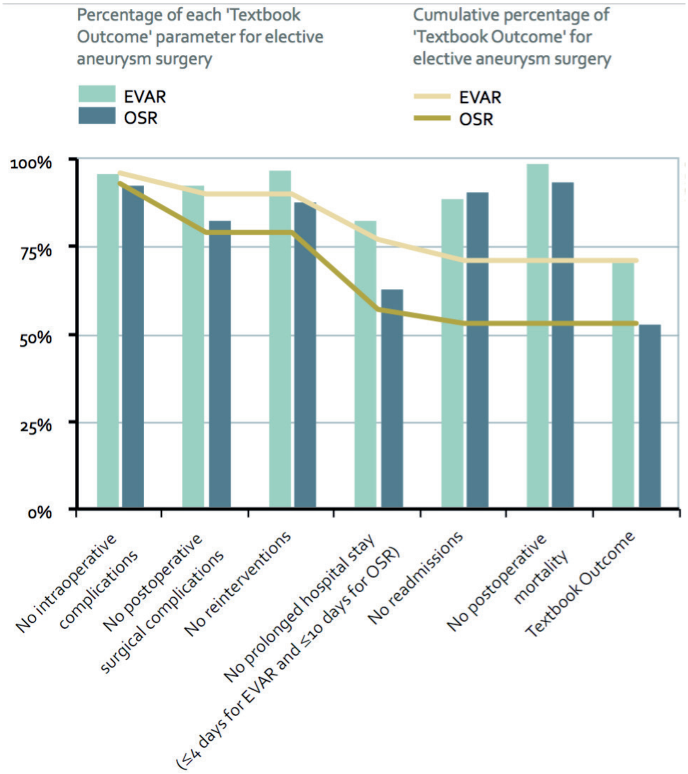
Multivariable Analysis

Younger age (EVAR and OSR (odds ratio[95%CI]), 0.98[0.97-0.99] and 0.97[0.96-0.99]), male gender (OR 1.61[1.32-1.97] and OR 1.73[1.24-2.42]), and higher preoperative hemoglobin (1.17[1.08-1.26] and 1.16[1.01-1.34]) were significantly associated with achieving TO in EVAR and OSR patients. Patients with dyspnea during exercise were less likely to achieve TO. Additionally, this also applies to EVAR patients with peripheral edema and OSR patients with medically treated hypertension. (Appendix 2., which demonstrates the associations between patient characteristics and TO.)

Textbook outcome by hospital

Figure 2a and 2b show the case-mix adjusted percentages of TO for EVAR and OSR by hospital volume for individual hospitals. The adjusted TO varied between hospitals from

Figure 1. Textbook Outcome in EVAR and OSR.



39%-92% and 0%-100%, respectively in EVAR and OSR patients. (Appendix 3., which demonstrates the unadjusted percentage achieved TO-parameters per hospital.) In both surgical procedures, five hospitals had a significantly lower TO rate compared to the mean. No hospitals performed significantly better than the mean in both EVAR and OSR.

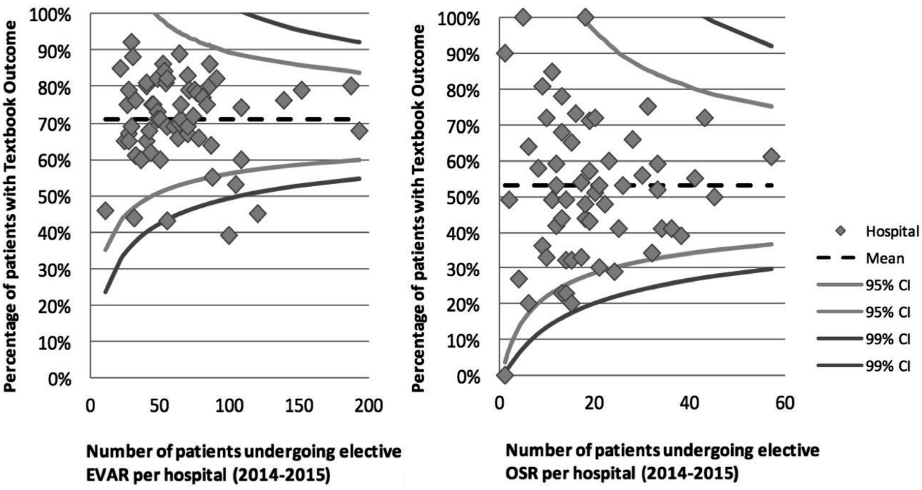
Textbook Outcome EVAR and OSR

Figure 3 shows adjusted TO rates for EVAR and OSR by hospital, compared to the national mean. Hospitals were divided into 4 groups; desirable outcome for both procedures (green), high TO in EVAR and low in OSR (blue), high TO in OSR and low in EVAR (orange) and a low TO in both procedures (red). Most hospitals had a higher TO in EVAR patients than in OSR. Additionally, most hospitals with a high TO for OSR did also had a high TO for EVAR. However, a high TO for EVAR did not automatically result in a high TO for OSR. The variation in hospital volume, TO rates and EVAR/OSR ratio within the different quadrants is shown in table 3.

Table 1. Patient characteristics

	EVAR					OSR				
	No TO		TO		P	No TO		TO		P
	N	%	N	%		N	%	N	%	
Number of patients	1174	29%	2865	71%		536	47%	593	53%	
Age (mean, years)	74.8 ± 7.7		73.5 ± 7.4		.000	71.7 ± 7.3		69.8 ± 7.4		.000
Gender					.000					.000
Male	961	82%	2542	89%		414	77%	508	86%	
Female	213	18%	323	11%		122	23%	85	14%	
Aneurysm diameter (mm)	59.7 ± 10.8		59.0 ± 10.4		.048	62.7 ± 13.3		61.5 ± 13.5		.129
Heart rate (BPM)	73.4 ± 13.3		72.4 ± 12.9		.020	74.4 ± 13.5		74.1 ± 13.5		.698
Systolic blood pressure (mmHg)	139.5 ± 19.7		140.0 ± 20.1		.429	141.2 ± 20.4		140.9 ± 18.9		.744
Cardiac State					.000					.006
No abnormalities	487	42%	1340	47%		208	39%	289	49%	
Peripheral edema	124	11%	238	8.3%		43	8.0%	29	4,90%	
Raised CVP	17	1.4%	28	1,00%		7	1.3%	6	1.0%	
Antihypertensive med	460	39%	1186	41%		251	47%	250	42%	
Unknown	86	7.3%	73	2.5%		27	5.0%	19	3.2%	
Pulmonary State					.002					.001
No dyspnea	824	70%	2189	76%		377	70%	480	81%	
Dyspnea during exercise	278	24%	537	19%		133	25%	91	15%	
Disabling dyspnea	43	3.7%	78	2.7%		8	1.5%	10	1.7%	
Dyspnea at rest	14	1.2%	27	0.9%		6	1.1%	4	0.7%	
Unknown	15	1.3%	34	1.2%		12	2.2%	8	1.3%	
Malignancy					.562					.485
None	941	80%	2272	79%		456	85%	512	86%	
Current	66	5.6%	150	5.2%		18	3.4%	13	2.2%	
History of Malignancy, curative treated	167	14%	443	16%		62	12%	68	12%	
Last preoperative ECG					.272					.212
No abnormalities	620	53%	1574	55%		304	57%	337	57%	
Atrial fibrillation	75	6.4%	197	6.9%		33	6.2%	24	4.0%	
Ischemia	21	1.8%	33	1.2%		9	1.7%	5	0.8%	
Other abnormalities	314	27%	751	26%		150	28%	169	29%	
No ECG performed	144	12%	310	11%		40	7.5%	58	9.8%	
Preoperative laboratory results										
Hemoglobin	8.5 ± 1.0		8.8 ± 1.0		.000	8.5 ± 1.0		8.7 ± 0.9		.000
Sodium					.102					.735
Normal Sodium	1105	94%	2732	95%		506	94%	557	94%	
Hypo/Hypernatremia	69	5.9%	133	4.6%		20	6.1%	36	6.1%	
Potassium					.555					.563
Normal	1102	94%	2703	94%		497	93%	555	94%	
Hypo/ hyperpotassemia	72	6.1%	162	5.7%		39	7.3%	38	6.4%	
Creatinine	100.7 ± 44.5		98.2 ± 43.1		.101	96.7 ± 35.7		93.6 ± 29.5		.116

Figure 2. Influence of volume on the adjusted TO in patients after EVAR and OSR per hospital.



Length of hospital stay and Textbook Outcome

Changing the cut-off point for prolonged LOS to ≥5, ≥6 and ≥7 days in the definition of TO for EVAR resulted in a TO of respectively 75%, 76% and 78%. A cut-off point for prolonged LOS of ≥11, ≥12, ≥13 and ≥14 days in the definition of TO for OSR resulted in a TO of respectively 56%, 59%, 60% and 61%. When comparing hospitals, changing prolonged LOS to ≥7 days for EVAR and ≥14 days for OSR did not lead to a difference in hospital variation of TO. (Appendix 4., which demonstrates TO with LOS ≥7 days for EVAR and ≥14 days for OSR)

DISCUSSION

To our knowledge this is the first article on a composite quality measure for desired patient outcome in elective aneurysm surgery. TO provides information on the overall quality of care, in which the key elements of the surgical process, as defined by the vascular surgical community of the Netherlands, are included. TO was realized in 71% of EVAR patients and 53% of OSR patients. The main reasons why TO was not achieved were a prolonged LOS in both surgical procedures, re-admissions after discharge for EVAR patients and postoperative complications for OSR patients. Variation in hospital outcomes was more pronounced using TO then using single outcome parameters.[2] A wider hospital variation in adjusted TO is seen in OSR, compared to EVAR. The majority of hospitals had a higher TO in EVAR than in OSR. This could be expected, because other audits and trials reported less mortality and postoperative complications in EVAR patients, compared to OSR.[9,10]

Figure 3. Percentage TO for EVAR versus OSR per hospital.

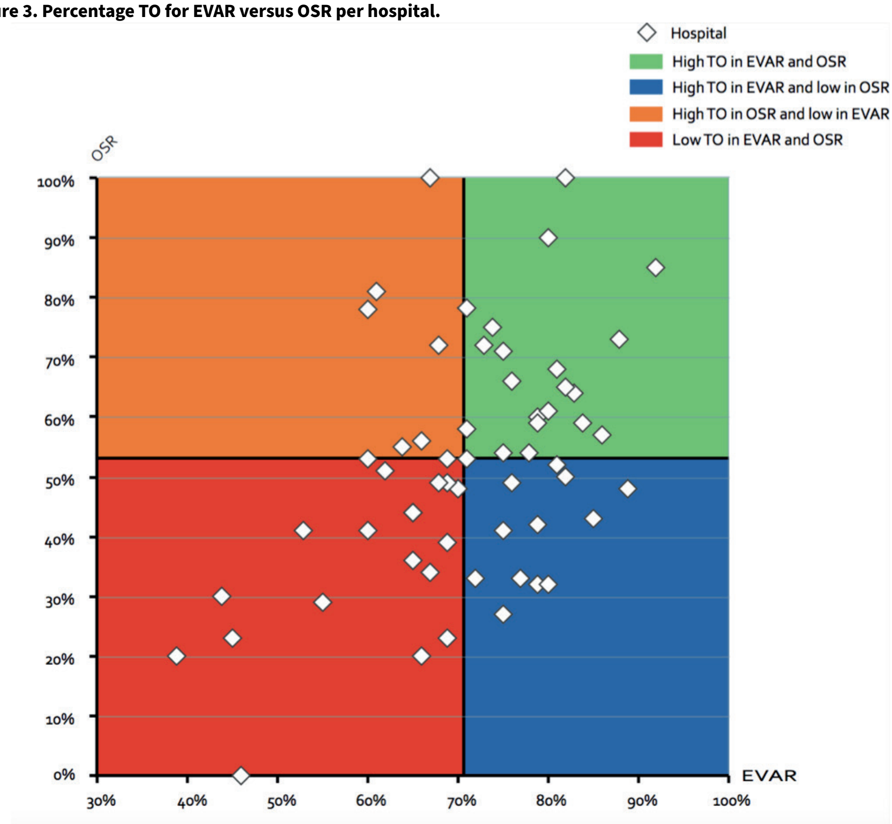


Table 2. TO for EVAR and OSR in relation with volume and the EVAR/OSR ratio

	Mean Volume EVAR (range)	Textbook Outcome EVAR	Mean Volume OSR (range)	Textbook Outcome OSR	EVAR/OSR ratio
Favorable TO for EVAR and OSR both	63 (27-187)	71%–92%	20 (1–57)	53%–100%	76%/ 24%
Favorable TO for EVAR only	75 (22-152)	72%–89%	19 (2-45)	27%–52%	80%/ 20%
Favorable TO for OSR only	53 (28-87)	61%–69%	19 (9-41)	53%–100%	73%/ 27%
Unfavorable TO for EVAR and OSR both	69 (11-193)	39%–70%	18 (1–38)	0%–51%	79%/ 21%

Quality of care has been primarily focused on mortality and morbidity rates. However, mortality and morbidity alone do not reflect the quality of care completely.[11,12] When only single indicators are taken into account, a hospital might perform well in one and worse in the another, as those are often not related.[4,13] Additionally, when the incidence of mortality and morbidity decreases or variation is lacking, it hampers the discriminative ability of single quality indicators.[14] Dimick et al previously described that only 8% of the American hospitals met the minimum caseload for AAA repairs, necessary to detect a doubling of the mortality rate and therefore mortality alone should not be used as a quality indicator.[15]

The Society for Thoracic Surgeons was one of the first to start a clinical audit to monitor their results.[16] In order to measure quality more accurately and to overcome issues with single quality indicators, a task force was formed to develop methods for combining multiple care domains into a comprehensive composite quality measure.[17] On behalf of this task force, O'Brien et al analyzed four methods of composite scoring for cardiac surgery.[18] He describes that the 'all-or-none' method, which we used for TO, increases the variability between hospitals and therefore may be helpful to compare performance between hospitals. Additionally, Nolan et al. stated that an all-or-none scoring system reflects the interests and desires of patients more closely.[19]
Where quality indicators as mortality, morbidity and re-interventions are directly related to desirable outcome, the ideal LOS as quality indicator is more debatable. In the literature, the mean LOS after elective aneurysm surgery is varying from discharge at the same day to 4 days for EVAR, and 5 to 10 days for OSR.[20-28] Our additional sensitivity analysis showed that prolonging the maximal LOS in the definition of TO for both surgical procedures resulted in a gradual increase in TO, but did not lead to a change in hospital variation. Based on this analysis, combined with literature and the questionnaire, the cut-off points we chose in our original definition of TO (EVAR ≥ 4, OSR ≥ 10), seems to provide a reasonable margin.

For both surgical procedures, there is a wide variation in TO with the majority of hospitals performing within the CIs around the mean. When TO rates for EVAR and OSR by hospital are compared with the mean, a different distribution is seen (Figure 3). Most hospitals performing well for OSR also did for EVAR (green), but hospitals with a high TO in EVAR patients did not necessarily do well in OSR (blue). Hypothetically, there is an ideal ratio of EVAR to OSR, so that every patient receives the surgical procedure suiting the anatomy of the aneurysm. Subsequently, the choice of surgical procedure might influence outcomes; surgeons who have a preference to choose to perform EVAR (also on difficult anatomy) will only perform OSR on the most difficult aneurysms. They will perform EVAR on patients where OSR might have been a better choice, resulting in relatively less favorable outcomes than possible in both groups (red). On the other hand, performing OSR in patients who are suitable for EVAR may result in a desirable TO for OSR, however patients are withhold from a potential less invasive operation with less postoperative mortality. So, TO must be considered at least together with postoperative mortality and the ratio EVAR/OSR. In this study EVAR/OSR ratios in the green and red quadrant were comparable and did not seem to explain the difference in TO. Remarkably, the proportion of EVAR is the largest in the blue quadrant and the smallest in the orange quadrant. The question rises if volume of OSR is an important factor. Few hospitals perform well in OSR and less good in EVAR (orange), but this might be confounded by indication. One might expect that hospital volume would influence hospital performance, but procedure volume was varying within the quadrants and did not seem to have effect on TO (table 3). Hospitals with low TO for both procedures (red) should probably look for the more structural problems in their care process to improve outcomes for both procedures.

There are several limitations to this study. The dataset is retrieved from a national clinical audit and has some missing data. When data were missing on the selected parameters for TO, it was consequently not possible to achieve TO, therefore the percentage TO is possibly higher than described, overall and per hospital.
Secondly, because the audit is not designed for scientific purposes purely, the choice of desired parameters for TO was limited.
Thirdly, TO does not consider the unequal influence of different parameters on patient outcome and patient experience. Therefore, TO is not designed to replace single quality indicators, but is meant as an addition.

Since there is a wide variation in TO between hospitals within the CIs, it is difficult to recognize 'best practices'. But more important, individual hospitals can see where they can improve to achieve desired outcomes. Therefore, TO is initially particularly suitable as an instrument for internal quality improvement and not for hospital comparison. In the future, TO can be implemented in the DSAA feedback system for hospitals, to help identify areas for improvement.

CONCLUSION

This first study about TO in elective AAA surgery shows that a composite measure provides additional information on the overall quality of surgical care, which subsequently can be used for internal quality improvement. Overall, a TO was realized in 71% of EVAR patients and 53% of OSR patients, with a wide variation between hospitals.

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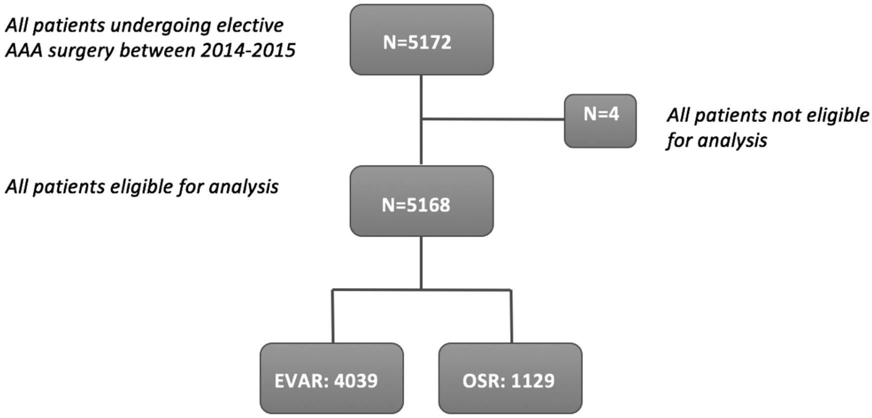
Appendix 1. Flowchart patient selection



Appendix 2. Patient characteristics associated with 'Textbook Outcome'

	EVAR		OSR	
	Odds	95% CI	Odds	95% CI
Number of patients				
Age (years)	0.983	0.974-0.993	0.976	0.959-0.993
Gender				
Female	Ref		Ref	
Male	1.611	1.317-1.971	1.732	1.238-2.422
Aneurysm diameter (mm)	0.996	0.990-1.003	0.996	0.987-1.006
Heart rate (BPM)	0.994	0.989-1.000	0.999	0.990-1.008
Systolic blood pressure (mmHg)	1.002	0.998-1.005	0.997	0.991-1.004
Cardiac State				
No abnormalities	Ref		Ref	
Peripheral edema	0.730	0.562-0.947	0.579	0.332-1.008
Raised CVP	0.696	0.370-1.312	0.836	0.268-2.603
Antihypertensive med	0.966	0.827-1.129	0.731	0.563-0.948
Unknown	0.301	0.214-0.423	0.553	0.290-1.053
Pulmonary State				
No dyspnea	Ref		Ref	
Dyspnea during exercise	0.775	0.653-0.921	0.570	0.418-0.776
Disabling dyspnea	0.755	0.510-1.118	1.173	0.443-3.102
Dyspnea at rest	0.898	0.460-1.754	0.476	0.129-1.755
Unknown	1.067	0.560-2.032	0.595	0.230-1.543
Malignancy				
None	Ref		Ref	
Current	1.060	0.776-1.446	0.716	0.366-1.527
History of Malignancy, curative treated	1.183	0.970-1.444	1.010	0.685-1.487
Last preoperative ECG				
No abnormalities	Ref		Ref	
Atrial fibrillation	1.348	0.993-1.830	0.904	0.494-1.656
Ischemia	0.694	0.391-1.232	0.588	0.187-1.855
Other abnormalities	1.018	0.858-1.208	1.124	0.845-1.495
No ECG performed	0.953	0.759-1.197	1.330	0.849-2.085
Preoperative laboratory results				
Hemoglobin	1.166	1.082-1.256	1.164	1.013-1.338
Sodium				
Normal Sodium	ref		ref	
Hypo- or hypernatremia	0.958	0.703-1.306	1.299	0.769-2.192
Potassium				
Normal potassium	ref		ref	
Hypo- or hyperpotassemia	0.986	0.734-1.324	1.049	0.647-1.701
Creatinine	1	0.998-1.001	0.998	0.994-1.002

Appendix 3. the unadjusted percentage achieved TO-parameters per hospital

	EVAR								OSR							
Hospital	Hospital volume (n=4039)	TO	No Peroperative complications	No surgical complications	No reinterventions	No prolonged LOS	No readmission	No mortality	Hospital volume (n=1129)	TO	No Peroperative complications	No surgical complications	No reinterventions	No prolonged LOS	No readmission	No mortality
1	30	90%	100%	100%	100%	93%	97%	100%	11	91%	100%	100%	100%	91%	100%	100%
2	91	80%	99%	95%	99%	89%	92%	100%	5	100%	100%	100%	100%	100%	100%	100%
3	40	80%	98%	100%	100%	85%	98%	100%	1	100%	100%	100%	100%	100%	100%	100%
4	31	90%	97%	97%	100%	94%	97%	100%	16	75%	100%	81%	81%	81%	94%	94%
5	40	83%	100%	100%	100%	88%	95%	98%	13	77%	100%	92%	92%	85%	92%	85%
6	44	77%	91%	91%	93%	84%	91%	98%	19	79%	95%	84%	89%	84%	100%	100%
7	53	85%	100%	94%	98%	98%	91%	100%	12	67%	92%	75%	75%	75%	92%	92%
8	42	71%	90%	90%	93%	88%	88%	98%	10	80%	80%	90%	90%	80%	100%	90%
9	70	81%	99%	97%	97%	87%	96%	100%	6	67%	100%	100%	100%	67%	100%	100%
10	65	74%	97%	95%	97%	77%	100%	98%	43	74%	100%	91%	91%	79%	91%	98%
11	28	64%	100%	100%	100%	64%	100%	100%	18	83%	100%	89%	89%	83%	100%	100%
12	109	76%	98%	94%	95%	86%	91%	100%	31	71%	94%	90%	94%	74%	100%	97%
13	86	88%	100%	94%	98%	93%	95%	99%	19	58%	95%	68%	79%	63%	100%	79%
14	50	60%	96%	84%	98%	66%	94%	100%	13	85%	100%	100%	100%	85%	100%	100%
15	187	79%	94%	94%	98%	91%	93%	99%	57	65%	93%	84%	88%	72%	96%	93%
16	33	79%	97%	97%	100%	85%	97%	100%	28	64%	86%	100%	100%	71%	93%	96%
17	48	73%	98%	94%	96%	81%	94%	100%	20	70%	100%	95%	95%	70%	100%	95%
18	75	80%	100%	97%	97%	83%	96%	100%	33	61%	100%	85%	88%	70%	94%	100%
19	71	79%	99%	96%	97%	87%	90%	100%	23	57%	100%	87%	87%	70%	87%	87%
20	54	83%	94%	93%	98%	94%	94%	100%	33	52%	97%	85%	85%	55%	100%	94%
21	50	72%	98%	92%	92%	82%	88%	100%	8	63%	63%	75%	75%	88%	100%	88%
22	78	71%	92%	95%	97%	83%	86%	99%	30	63%	90%	90%	93%	83%	83%	93%
23	55	84%	100%	96%	98%	87%	95%	98%	45	49%	87%	73%	80%	58%	96%	93%
24	27	78%	96%	96%	96%	85%	96%	100%	17	53%	100%	82%	94%	59%	100%	94%
25	77	78%	96%	92%	94%	87%	96%	99%	17	53%	100%	100%	100%	53%	94%	94%
26	48	69%	100%	88%	96%	79%	94%	100%	15	60%	87%	80%	93%	60%	100%	100%
27	22	86%	100%	91%	91%	100%	86%	100%	19	42%	95%	68%	74%	68%	84%	95%

Appendix 3 continued

28	139	76%	94%	91%	93%	83%	94%	100%	2	50%	100%	100%	100%	100%	50%	100%
29	48	73%	94%	85%	98%	88%	92%	100%	26	50%	85%	85%	96%	81%	92%	96%
30	64	77%	98%	98%	98%	81%	98%	100%	22	45%	95%	77%	77%	55%	95%	95%
31	70	69%	100%	96%	99%	74%	93%	100%	21	52%	86%	71%	95%	52%	95%	95%
32	87	63%	94%	94%	95%	84%	78%	100%	41	54%	93%	85%	85%	63%	83%	90%
33	84	75%	93%	94%	96%	87%	89%	100%	36	42%	92%	78%	92%	56%	81%	97%
34	86	81%	98%	99%	99%	85%	99%	100%	15	33%	100%	87%	93%	40%	93%	93%
35	40	68%	93%	85%	98%	85%	90%	100%	13	46%	85%	85%	100%	69%	85%	92%
36	64	70%	97%	86%	94%	86%	89%	98%	18	44%	94%	89%	89%	61%	89%	100%
37	43	63%	93%	91%	93%	63%	98%	98%	20	50%	95%	75%	85%	60%	95%	85%
38	81	78%	96%	94%	98%	86%	94%	100%	17	35%	88%	88%	88%	53%	94%	94%
39	74	73%	97%	97%	100%	85%	88%	100%	10	40%	100%	70%	80%	50%	100%	80%
40	28	71%	89%	89%	100%	79%	96%	100%	12	42%	100%	75%	75%	42%	100%	92%
41	30	67%	97%	97%	100%	67%	97%	100%	11	45%	91%	73%	82%	64%	91%	82%
42	193	69%	96%	93%	95%	76%	93%	100%	14	43%	100%	64%	86%	43%	100%	79%
43	36	61%	100%	97%	100%	64%	97%	97%	12	50%	100%	83%	100%	58%	83%	100%
44	152	80%	97%	92%	95%	84%	95%	97%	14	29%	93%	79%	93%	36%	71%	93%
45	28	64%	93%	82%	96%	79%	96%	100%	18	44%	89%	94%	4%	50%	94%	100%
46	55	69%	91%	87%	93%	84%	91%	98%	38	37%	95%	68%	71%	42%	89%	92%
47	70	69%	3%	90%	97%	84%	89%	99%	32	34%	84%	78%	81%	63%	75%	94%
48	65	77%	100%	100%	100%	77%	100%	100%	4	25%	100%	100%	100%	25%	100%	100%
49	109	60%	88%	83%	96%	79%	90%	98%	34	41%	94%	79%	94%	50%	91%	94%
50	25	64%	100%	92%	96%	68%	92%	100%	9	33%	100%	78%	78%	33%	100%	89%
51	60	70%	97%	90%	95%	82%	83%	98%	14	21%	86%	57%	57%	29%	79%	86%
52	52	88%	100%	98%	100%	88%	100%	100%	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
53	88	57%	95%	93%	94%	83%	68%	98%	24	29%	92%	88%	92%	42%	79%	100%
54	63	68%	86%	94%	98%	84%	95%	100%	6	17%	83%	67%	100%	50%	100%	100%
55	45	76%	96%	93%	96%	82%	96%	100%	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
56	32	44%	94%	100%	100%	47%	94%	97%	21	29%	100%	81%	90%	33%	90%	86%
57	33	61%	91%	79%	85%	79%	88%	100%	9	9%	100%	89%	89%	89%	100%	100%
58	120	38%	93%	93%	97%	83%	48%	99%	13	23%	85%	92%	100%	54%	77%	92%
59	100	39%	89%	91%	99%	89%	50%	99%	15	20%	87%	87%	93%	60%	40%	100%
60	105	52%	98%	93%	94%	81%	66%	100%	25	0%	84%	88%	88%	84%	72%	92%
61	11	45%	100%	100%	100%	45%	91%	100%	1	0%	0%	0%	0%	0%	100%	100%
62	55	44%	100%	96%	100%	84%	58%	98%	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total	4039	71%	96%	93%	97%	83%	89%	99%	1129	53%	93%	83%	88%	63%	91%	94%

Appendix 4. Percentage of adjusted Textbook Outcome (EVAR Length of stay ≤ 7 days, OSR length of stay ≤ 14 days) in patients after EVAR and OSR per hospital, identified by volume.