◆ CLINICAL INVESTIGATION ◆

Similar Cost for Elective Open and Endovascular AAA Repair in a Population-Based Setting

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Purpose: To compare cost differences between elective open repair (OR) and endovascular repair (EVAR) of abdominal aortic aneurysm in a population-based setting.
Methods: Clinical data and hospital-related costs (pre-, peri-, and postoperative) were analyzed for 109 consecutive AAA procedures (98 men; mean age 73 years, range 48–95; mean aneurysm diameter 61 mm, range 42–120) performed from 2001 to 2005 (58 OR, 51 EVAR) in our primary catchment area. Data were obtained through case records and hospital accounting systems. Nonparametric bootstrap was used for cost comparison.
Results: EVAR patients were older (76 versus 70 years, $p<0.001$) and had more comorbidities (ASA class 2.6 versus 2.3, $p=0.025$). OR patients more often had anatomically complex aneurysms (52% versus 14%, $p<0.001$). Comparison of data with diagnosis-based reimbursement levels nationally and internationally indicated adequate cost level in the study. No difference was observed in total cost between OR and EVAR (€29,786 versus €26,382; $p=0.336$). Preoperative cost was lower for OR compared to EVAR (€661 versus €1494, $p=0.002$). OR patients had higher cost of intensive care [36% (€8921) of perioperative cost versus 7% (€1460), $p=0.001$], while EVAR had higher implant cost [36% (€7468) versus 2% (€448), $p<0.001$]. Mean follow-up was 2.5 years (range 0.5–5.4). Mean postoperative cost was similar (OR €4613 versus EVAR €4403, $p=0.209$; 16% and 17% of total cost, respectively). Postoperative cost after OR was high early on, with lower cost thereafter. Postoperative cost after EVAR was more homogenously distributed, leveling off at €500 to €1000 annually over 5 years.
Conclusion: In a population-based setting, total cost was similar for OR and EVAR. There were, however, important differences in patient characteristics and cost structure.
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Key words: abdominal aortic aneurysm, surgery, endovascular aneurysm repair, hospital costs, cost-benefit analysis

Abdominal aortic aneurysm (AAA) is a common disease that is life-threatening when rupture occurs. The available therapy to prevent AAA rupture is elective repair in appropriately selected individuals, either with open (OR) or endovascular aneurysm repair (EVAR). The total numbers of elective AAA repairs, as well as the proportion of EVAR, are increasing. Data from the Swedish Vascular Registry (Swedvasc) indicate a 38%

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increase in the total number of elective repairs and 142% in the number of EVARs over the years 2003 to 2005.[1] These numbers may increase even more if screening for AAA is implemented.[2] An understanding of costs related to treatment, cost structure, and cost differences between treatment modalities is important for adequate allocation of resources.

While costs of EVAR and OR previously have been studied in one randomized clinical trial[3] and several retrospective studies,[4–13] no population-based cost analysis of AAA treatment has been published to our knowledge. Previous studies often focus on comparison of treatment cost for OR and EVAR in selected patient groups with similar clinical characteristics; the clinical situation where patients are selected for endovascular or open treatment based on age, aneurysm anatomy, and comorbidity is not reflected.

The aim of this study was to analyze the hospital-related cost of elective AAA treatment, including pre-, peri- and postoperative costs, in a population-based setting and to study differences in patient characteristics and cost structure between those selected for open or endovascular repair.

METHODS

Study Design and Patient Sample

Between January 2001 and December 2005, 269 AAA operations were performed at the region's tertiary care hospital, which serves our primary catchment area of 304,367 inhabitants (as of 31 December 2005).[14] Thirty-one thoracoabdominal and suprarenal operations, 84 emergency operations, 40 operations performed on patients referred from other districts, and 5 operations not performed for a primary AAA (e.g., iliac aneurysm or pseudoaneurysm) were excluded. The remaining 109 primary elective infrarenal AAA repairs form the basis of this study. Clinical data on these cases were obtained from the Swedvasc registry and patient records. Of the 109 patients (98 men; mean age 73 years, range 48–95) in the study (Table 1), 58 (53%) were treated with OR. The mean aneurysm diameter was 61 mm (range 42–120). Patient characteristics (age, comorbidities, aneurysm size, and anatomy), preoperative investigations, surgical method, early and late complications, as well as postoperative follow-up investigations, were evaluated.

TABLE 1
Demographics and Patient Characteristics

	Overall (n=109)	OR (n=58)	EVAR (n=51)	p
Age, y	72.8	69.7	76.3	<0.001
Aneurysm size, mm	61.1	61.6	60.6	0.651
Medical comorbidity				
ASA class	2.40	2.25	2.55	0.025
Cardiac disease	63 (58%)	28 (48%)	35 (69%)	0.035
Current smoker	32 (29%)	24 (41%)	8 (16%)	0.026
Previous smoker	55 (50%)	24 (41%)	31 (61%)	0.026
Diabetes	11 (10%)	3 (5%)	8 (16%)	0.109
Hypertension	75 (69%)	37 (64%)	38 (75%)	0.301
Pulmonary disease	35 (32%)	18 (31%)	17 (33%)	0.839
Cerebrovascular disease	25 (23%)	14 (24%)	11 (22%)	0.822
Renal disease	22 (20%)	13 (22%)	9 (18%)	0.635
Serum creatinine, μmol/L	109	109	109	0.971
Surgical comorbidity				
Complex anatomy	37 (34%)	30 (52%)	7 (14%)	<0.001
Previous abdominal surgery	34 (31%)	14 (24%)	20 (39%)	0.101
Previous vascular surgery/intervention	15 (14%)	8 (14%)	7 (14%)	1.000

OR: open repair, EVAR: endovascular aneurysm repair, ASA: American Society of Anesthesiologists.
Continuous data are presented as means; categorical data are given as counts (percentages).

TABLE 2
Specific Medical Costs

Stent-graft (Trifab) cost for EVAR*	€7487
Radiology cost for EVAR†	€1564
Duplex scan	€214
CT scan	€283
Cardiology/pulmonary consultation	€117
Echocardiography	€243
Spirometry	€124
Anesthesia, /min Level 2–5‡	€3.7–8.2
Operation, /min Level 4–5‡	€25.6–29.4
ICU, /h	€126
Intermediate care, /h	€85
Ward care, /d 2006‡	
Level 1 (admission day)	€762
Level 2	€462
Level 3	€528
Hospitalized rehabilitation, /d	€456

EVAR: endovascular aneurysm repair, CT: computed tomography, ICU: intensive care unit.
* Custom-made devices have a higher cost that is charged separately and included in the cost analysis.
† Radiology cost for EVAR includes cost of radiology personnel, equipment, and disposables other than the stent-graft used during the EVAR intervention.
‡ The levels correspond to resource intensity of patient care based on set criteria, e.g., personnel need, rate of diagnostic investigations, and medical therapy. Anesthesia during EVAR was mainly priced as levels 2–3, while OR was levels 4–5. Ward care was level 1 at admission day for all patients (higher cost due to investigations performed at admission).

Cost Data and Definitions

All pre-, peri- and postoperative hospital-related costs linked to AAA treatment were included in the cost analysis. Preoperative cost was defined as cost of all investigations and hospitalizations performed preoperatively after the decision was taken to operate. Thus, cost of previous surveillance of small aneurysms, as well as cost of opportunistic detection of large aneurysms, was not included, whereas cost of imaging, consultations, and interventions to prepare the patient for operation were included. Standard preoperative imaging included computed tomography (CT) for all patients and angiography for EVAR patients in 2001 to 2002. Perioperative cost was defined as cost incurred during the main hospitalization for AAA repair until discharge from the vascular surgical unit, including cost of preoperative evaluation or investigation during this episode. Postoperative cost was defined as all cost after discharge, including routine follow-up costs, as well as cost of hospitalized rehabilitation, clinical investigations, and rehospitalizations.

Cost of preoperative investigations, perioperative care, and postoperative follow-up was based on the hospital's cost for each investigation according to the 2006 pricelist excluding margins (Table 2). Cost of hospitalizations preoperatively and during AAA repair was obtained from the hospital accounting systems, which include detailed data on operations, anesthesia, and intensive care; the system is verified against actual costs on a regular basis to ensure validity of costing data. Inpatient costs were based on number of minutes/hours/days spent for each intervention/care and level of complexity of the care. Each complexity level (e.g., 5 levels for daytime operations) has a standardized cost according to the hospital's accounting system. Cost of implants was recorded separately. Cost of hospital stay at a surgical ward was based on the number of days and the complexity level of care (levels 1–3), which includes standardized cost of medications, as well as basic laboratory and radiology investigations. Expensive investigations, such as magnetic resonance scans or angiograms during the hospital stay, were charged separately. The number and cost of postoperative outpatient visits, duplex and CT examinations, as well as information on postoperative hospitalizations were obtained as during the preoperative period.

The standard follow-up program for OR patients consisted of clinical examination at 1 month and 1 year postoperatively. For EVAR patients, the standard follow-up program consisted of clinical examination at 1 month and 1 year, as well as imaging studies performed at 1, 6, and 12 months and annually thereafter. Early in the study period, all imaging was performed as CT scans. Later on, duplex scans were performed instead at 1 month, 1 year, and every second year thereafter.

Cost of rehabilitation in a hospital rehabilitation unit was included in postoperative cost and was calculated based on duration (days) and per-day cost for a stay in a rehabilitation ward according to the 2006 cost level for the hospital (Table 2). Cost of rehabilitation after hospital discharge and cost of home-based care (e.g., outpatient rehabilitation and housekeeping aid) was not included in this study. All patient costs are covered by government tax funding.

All major expected costs were cross-checked toward resources used according to the patients' files. Data were completed when hospital accounting data were incomplete or did not match patient records. Cost data for stent-grafts were obtained from the stent-graft supplier (Cook Inc., Bloomington, IN, USA) and matched to the number of stent-grafts used according to the patients' files. Cost for postoperative care after EVAR was based on the postoperative care period identified through the case records or the hospital's price for postoperative care per hour when data were missing. In certain cases, costs of operation, anesthesia, or reintervention were based on data obtained from the patients' files and calculated based on price per minute.

Statistical Analysis

The analysis was based on the intention-to-treat principle for the initial treatment; case records were reviewed retrospectively. Data are presented as the mean ± standard deviation. The independent samples *t* test was used for comparison of normally distributed continuous data and Fisher exact test for comparison of proportions. The nonparametric bootstrap method was used for comparison of cost. This method uses a re-sampling approach that successively recreates the data sample (repeated re-samples) by random selection (with replacement) from the original sample, from which values of interest, such as average difference, are computed.[15,16] The 95% confidence intervals were calculated using the 2.5 and 97.5 percentiles of the computed bootstrap average difference in 5001 re-samples. The corresponding p-value is found using the tail percentile at zero multiplied by 2.

Statistical evaluation was carried out with Stata 9 software (StataCorp LP, College Station, TX, USA) for the bootstrap analysis and SPSS (version 14.0; SPSS, Chicago, IL, USA) for all other statistical analyses. All costs are presented in Euro (€) 2006 values, updated using the Swedish Consumer Price Index[17] and an average exchange rate between Swedish Krona and Euro for the period January 1, 2006 to June 30, 2006.[18]

RESULTS

Although the groups were similar in terms of aneurysm size (Table 1), OR patients more often had complex aneurysm anatomy that made EVAR less appropriate. EVAR patients, on the other hand, were older and had higher rates of comorbidities; they more often had quit smoking.

Clinical Outcome

There was no 30-day mortality. One patient in the OR group died after 37 days. Two patients in the EVAR group were converted to open repair due to complications (1 perioperative stent-graft thrombosis and 1 stent-graft dislocation). These patients were included in the EVAR group on an intention-to-treat basis. Table 3 displays the rates of postoperative complications.

Cost and Resources Used

Overall, the mean total cost for an elective aneurysm repair, including an average 2.5 years of follow-up, was €28,193 (Table 4). All cost data had skewed distributions (Fig. 1), with most cases at low cost and few cases with high cost. Total cost of treatment for 1 patient in the OR group exceeded 3 standard deviations above the mean total cost for patients treated with OR (mean €29,786, range €11,163–€158,637). Total cost for EVAR cases was more homogenous (mean €26,382, range €13,067–€78,562).

Preoperative investigations and hospitalizations constituted 4% of the total cost, while the main hospitalization and operation was 80%; the remaining 16% was cost related to postoperative investigations and hospitalizations. Preoperative cost was lower in the OR group compared to EVAR (€661 versus €1494, p=0.002; equal to 2% and 6% of total

TABLE 3
Frequency of Postoperative Complications and Reinterventions

	OR (n=58)	EVAR (n=51)	p
Main hospitalization	11 (19.0%)	7 (13.7%)	0.607
Any open reoperation for	11 (19.0%)	4 (7.8%)	0.104
Bleeding	6 (10.3%)	1 (2.0%)	0.118
Bowel ischemia	3 (5.2%)	1 (2.0%)	0.621
Embolism/thrombosis	3 (5.2%)	0 (0.0%)	0.246
Local infection	2 (3.4%)	0 (0.0%)	0.497
Any endovascular reintervention	0 (0.0%)	3 (5.9%)	0.099
Stent or stent-graft for type I leak	0 (0.0%)	2 (3.9%)	0.217
PTA for renal failure	0 (0.0%)	1 (2.0%)	0.468
Other complication			
Cardiac	6 (10.3%)	2 (3.9%)	0.279
Hematoma, not operated on	0 (0.0%)	8 (15.7%)	0.002
Sepsis	5 (8.6%)	1 (2.0%)	0.212
Follow-up	7 (12.1%)	7 (13.7%)	1.000
Open reoperations	6 (10.3%)	3 (5.9%)	0.498
Hernia repair	3 (5.2%)	1 (2.0%)	0.621
GI reoperations (ileus, stoma, hernia infection, etc.)	3 (5.2%)	0 (0.0%)	0.246
Vascular reoperations (rupture, arterial stenosis)	1 (1.7%)	1 (2.0%)	1.000
Endovascular reinterventions	1 (1.7%)	5 (9.8%)	0.096
For leak (stent, coil, or diagnostic angiogram)	0 (0.0%)	3 (5.9%)	0.099
PTA for renal artery stenosis	0 (0.0%)	2 (3.9%)	0.217
PTA or thrombolysis for occlusion/stenosis in graft/artery	1 (1.7%)	2 (3.9%)	0.598
Other complication			
Hernia, not operated on	4 (6.9%)	0 (0.0%)	0.121
Leak, no intervention required	0 (0.0%)	4 (7.8%)	0.045
Local infection	1 (1.7%)	3 (5.9%)	0.338

OR: open repair, EVAR: endovascular aneurysm repair, PTA: percutaneous transluminal angioplasty, GI: gastrointestinal. Includes patients converted from EVAR to OR as reoperated patients.

treatment cost for each group, p=0.001). This difference persisted also when excluding early subjects who underwent routine angiography before EVAR, a practice abandoned in 2002 (preoperative cost 2003 to 2005: €432 in OR versus €1332 in EVAR, p=0.003). The higher preoperative cost among EVAR patients was explained by a higher frequency of CT scans, angiograms, and hospital care preoperatively (e.g., 4 EVAR patients underwent preoperative internal iliac artery embolization).

There was no significant difference in perioperative cost between OR and EVAR (€24,512 versus €20,484, p=0.135; equal to 82% and 78% of total treatment cost for each group, p=0.657). OR patients had significantly longer perioperative hospitalizations, as well as longer operations and intensive care unit (ICU) stay. The higher cost of ICU care in OR patients (36% of perioperative cost in OR versus 7% in EVAR, p=0.001) was offset by an increase in cost of the implant in EVAR (2% of perioperative cost in OR versus 36% in EVAR, p<0.001). The proportion of total operation cost (operation, personnel, implants, and disposables) out of the total perioperative cost (Fig. 2) was 22% for OR compared to 61% for EVAR (p<0.001). Mean perioperative cost for uncomplicated cases without reoperation or reintervention was €19,224 for OR and €19,283 for EVAR, with no significant difference between the groups.

Average postoperative cost was similar in both groups (mean €4613 in OR versus €4403 in EVAR, p=0.209; equal to 16% and 17% of total treatment cost for each group, p=0.840). OR patients had a high postoperative cost the first year after operation, which dropped off

TABLE 4
Cost of Treatment in Euros

	Overall (n=109)	OR (n=58)	EVAR (n=51)	p
Total				
Mean ± SD, €	28,193±19,501	29,786±24,463	26,382±11,527	0.336
Range, €	11,163–158,637	11,163–158,637	13,067–78,562	
Preoperative				
Mean ± SD, €	1051±1540	661±1134	1494±1811	0.002
Range,* €	0–9960	0–8120	0–9960	
Percent of total†	3.7 (2.8–4.9)	2.2 (1.2–3.2)	5.7 (3.7–7.6)	
Perioperative				
Mean ± SD, €	22,628±16,048	24,512±20,807	20,484±7344	0.135
Range, €	10,441–158,520	10,441–158,520	12,436–48,070	
Percent of total†	80.3 (69.8–90.4)	82.3 (63.9–100)	77.6 (69.8–85.5)	
Postoperative				
Mean ± SD, €	4515±8915	4613±10,597	4403±6605	0.209
Range, €	0–47,178	0–47,178	268–40,533	
Percent of total†	16.0 (10.2–21.9)	15.5 (6.1–24.8)	16.7 (9.7–23.7)	

OR: open repair, EVAR: endovascular aneurysm repair, SD: standard deviation.
* No preoperative cost incurred in certain cases when preoperative evaluation and/or investigations occurred during the main hospitalization.
† 95% confidence interval in parentheses.

thereafter, while EVAR patients had a more homogenous postoperative cost distribution over a 5-year period (Fig. 3).

In order to evaluate the importance of age, comorbidity, and anatomy as cost drivers, an analysis of overall treatment cost based on these factors was performed. No difference in cost could be identified based on age or cardiac or pulmonary comorbidities (Table 5). However, patients with complex anatomy had a tendency toward higher treatment cost

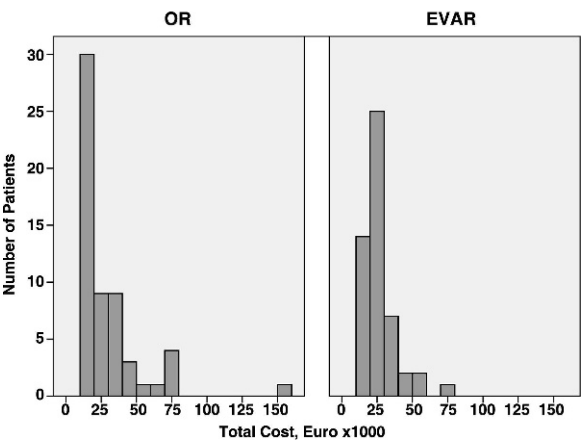


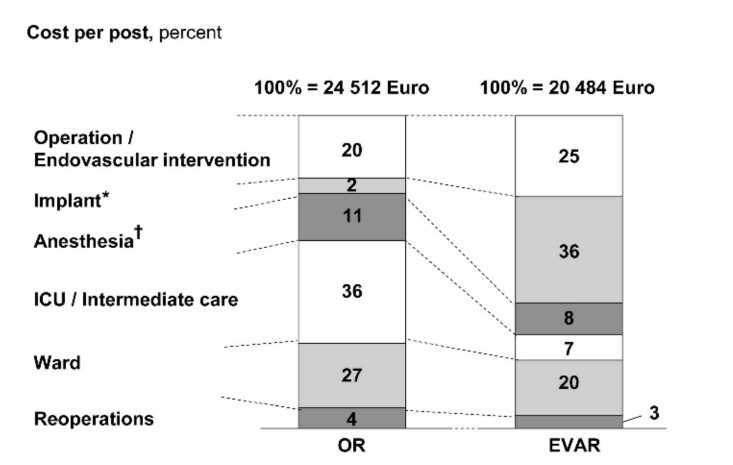
Figure 1. ◆ Histogram showing distribution of total cost values.

compared to others (€33,429 versus €25,503, p=0.057). This difference was due to higher perioperative cost for complex aneurysms (€27,790 versus €19,975, p=0.009).

DISCUSSION

In this population-based study of cost of elective AAA repair, the observed clinical differences between patients selected for OR and EVAR make comparison hazardous. Our primary aim, however, was to analyze differences in cost and cost structure between OR and EVAR in a population-based setting where treatment modality is selected based on clinical factors (age, anatomy, and comorbidities). Despite major clinical differences, there was no significant cost difference between EVAR and OR in this setting.

Due to the skewed distribution, differences in cost between the two groups were tested with the nonparametric bootstrap method.[19] Extreme cases were not excluded since they can be expected to continue to occur with a certain frequency, and cost data were presented as mean values since this is most relevant for healthcare decision-makers[19] who need to be able to calculate overall cost



Resources used	Overall n=109	OR n=58	EVAR n=51	P
In-hospital care after operation, d				
Mean	9	11	7	<0.001
Median	7	9	6	
Range	2–36	4–36	2–21	
Operation, min	189	223	149	<0.001
Anesthesia, min†	359	409	301	<0.001
ICU care, h	41	71	6	<0.001
Intermediary care, h	6	0.5	12	<0.001
Re-operation, min	21	30	12	0.217

Figure 2. ◆ Perioperative cost and resources, breakdown per post. *Implant cost includes cost of the textile graft and stent-graft, respectively. Cost of other operation disposables, such as sutures in the OR and catheters and guidewires in EVAR, as well as personnel-related operation and radiology costs, are included in the Operation/Endovascular Intervention category. †Refers to surveillance by anesthesiology personnel (i.e., includes EVAR patients in whom treatment is performed under local anesthetics but with surveillance, in most cases, by a nurse). ICU: intensive care unit.

of treatment based on mean cost and quantity of cases. Median cost would always be lower than mean cost, as it disregards cases with complications and high cost, which would underestimate total cost of treatment.

The basis for cost calculations were primarily hospital accounting records. These data also form the basis for the hospital charges for patient treatment and are regularly verified internally to ensure that they reflect actual cost. The study center is a non-profit hospital, and all patient costs are covered by government tax funding. To ensure the relevance of these cost calculations, the observed hospital-related cost of AAA treatment were validated against current national reimbursement levels for elective AAA repair. The perioperative cost found in this study (mean €22,628) was similar to the reimbursement level for elective AAA repair based on DRG 110 and 111 at the hospital in 2006 (mean €23,190). A comparison with 2 other university hospitals in Sweden also confirmed that the detailed perioperative cost calculation in the study was within 3% of the diagnosis-based reimbursement levels for AAA repair at these hospitals,[20,21] validating the adequacy of the cost data source.

An international comparison with a British university hospital showed a 19% higher cost for elective AAA repair in the study population compared to the current UK Department of Health reimbursement level[22] (UK reimbursement €10,785 excluding stent-grafts, ICU care, and >21 bed-nights compared to €12,868 in this study based on the same

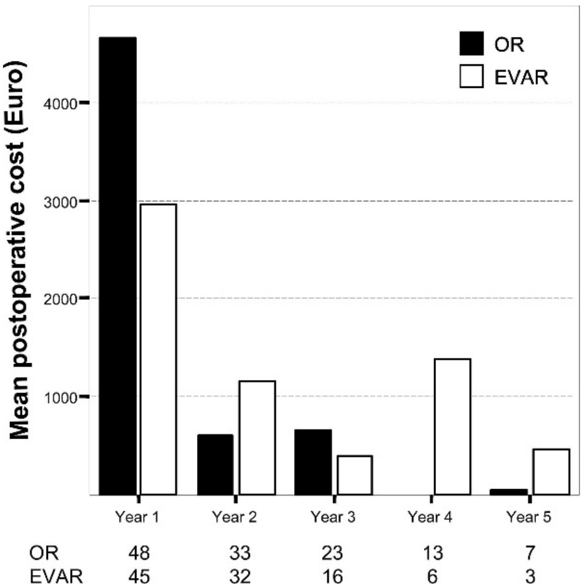


Figure 3. ◆ Postoperative cost and number of patients at follow-up.

criteria). Cost of ICU care is accounted for separately in the UK, and cost of ICU care per diem was 10% lower at the British university hospital. These differences may be explained by a higher financial efficiency in the British healthcare system, indicated by a 10% lower percentage of the gross domestic product (GDP) spent on healthcare and by a 10% higher general cost level in Sweden according to OECD (Organization for Economic Cooperation and Development) comparative cost levels.[23]

Direct comparison of the observed cost with previous reports is cumbersome because differences in included costs are regular and differences in healthcare systems can affect cost.[24,25] No other population-based study exists to our knowledge, and all other studies report cost of treatment in comparable patient groups in OR and EVAR. Most US-based studies do not include physicians' fees, as this cost is billed separately. The EVAR-1 trial, a major randomized study comparing cost of OR and EVAR, showed that cost of EVAR was higher than OR in similar patient groups.[3] Compared to the EVAR-1 trial, the cost of EVAR was 19% higher in this study and thus on par with the cost difference in the previous comparison to the UK (€20,484 in this study versus €17,166 according to the EVAR-1 results converted to Euro at the 2006 price level). However, the cost of OR was 68% higher compared to EVAR 1 (€24,512 versus €14,603). EVAR 1 included patients having both favorable anatomy, making EVAR possible, and no serious comorbidities, making OR possible. Only about half our patients matched these criteria, and those not eligible were naturally more expensive to treat.

TABLE 5
Total Hospital-Related Cost in Euros of AAA Treatment for Subgroups

Subgroup 1	Subgroup 2	p
Age <75 years €28,289	Age ≥75 years €28,076	0.981
Cardiac disease €28,753	No cardiac disease €27,426	0.731
Pulmonary disease €25,486	No pulmonary disease €29,473	0.235
Complex anatomy €33,429	No complex anatomy €25,503	0.057

The criteria for selection of treatment strategy could affect mean cost of OR and EVAR. At our institution, patients over 70 years of age were preferably treated with EVAR if anatomically suitable; younger patients were offered OR if they did not have significant comorbidities. This strategy resulted in a high rate of complex aneurysms in the OR group, as well as older age and more comorbidities in the EVAR group. The high rate of complex aneurysms and the subsequent high rate of complications and reoperations may explain the observed relatively high cost of OR. Cost of EVAR was, on the other hand, relatively low considering the high rate of older patients with comorbidities. Patient selection may explain the relatively long postoperative stay after EVAR in this study (7 days) compared to previous reports (3 to 4 days).[5,6] This trend could also be explained by the high rate of reinterventions and the fact that many patients experience fever and have a high C-reactive protein level after EVAR, which made patient discharge early after intervention difficult. Interestingly, overall treatment cost did not seem to depend on patient age or comorbidities. Complex anatomy was, however, a significant cost driver due to higher operation-related costs and higher rates of complications.

The findings of this study suggest that the common perception, based on earlier studies, that EVAR is more expensive than OR[3–11] is only true for a subset of patients eligible for both treatment modalities. Although the midterm results from the EVAR-2 trial[26] may not support selection of patients with serious comorbidities for EVAR, other studies[27] and data from the Swedvasc registry[1] indicate that the selection criteria (age, anatomy, and comorbidities) used in the studied population are still being used in many centers.

Despite similarities in total cost, there were important differences in cost structure between OR and EVAR:

(1) Cost of preoperative investigations was higher for EVAR patients. This cost difference is a result of the higher frequency of radiological investigations and hospitalizations for EVAR patients (for preoperative coil embolization). In recent years, embolotherapy is more frequently being combined with the main EVAR procedure, which decreases preoperative cost while increasing operation cost. However, the total cost of treatment is probably lower with perioperative coil embolization due to shorter total hospital stay.

(2) The operation cost was highly dependent on the cost of the stent-graft in the EVAR group and the length of ICU care in the OR group, explaining more than 30% of the main hospitalization cost for each group. The cost of the stent-graft in the current study is on the same level as previously reported from Australia,[4] but €1000 to €3000 lower than the cost in the US.[5,6] Differences in stent-graft prices may thus affect total cost of EVAR significantly. A reduction in stent-graft prices is anticipated with increasing use of the EVAR technique and increasing market competition. The suppliers' price per stent-graft is often highly dependent of purchased volumes, with reduced prices as volumes increase. However, prices for stent-grafts in fact increased at a higher rate than the average consumer price over the 5 years studied. With the competition between different suppliers of stent-grafts that currently exists, there should be a possibility to negotiate prices.

Overnight ICU care after elective OR is routine at our hospital, as in most hospitals in Sweden. This practice increases the cost of patients selected for OR. However, it may also be one factor partly explaining the low postoperative mortality observed at our hospital, as well as in the country overall, where the 30-day mortality after elective AAA repair has been consistently below 3% during the last few years.[1] At our hospital, we have had 1 case of 30-day mortality after infrarenal elective AAA repair (OR) over a period of >9 years.

Cost of anesthesia accounted for 11% of OR and 8% of EVAR cost, respectively. EVAR was more frequently performed under local anesthesia later on in the study period, and consistent use of this technique will reduce cost for EVAR in the future.

(3) Mean postoperative costs were similar in the 2 groups. An analysis of median costs, however, showed a large difference between the groups (OR €308 versus EVAR €2588), indicating a high mean cost due to extreme cases in OR. More importantly, there was a difference in the timing of the cost between the groups. OR patients had a higher rate of early rehospitalizations and open reoperations, primarily due to hernia repair, resulting in high cost the first postoperative year and low cost thereafter. Lack of data on cost of home-based care could affect postoperative cost calculations, especially in the short term, potentially underestimating total postoperative cost in the OR patients, who are most prone to needing postoperative rehabilitation. Over time, EVAR patients had a more homogenous cost distribution due to regular checkups and occasional reinterventions. Our study indicates that postoperative cost for EVAR patients levels off at €500 to €1000 annually after 5 years of follow-up, which is similar to the cost reported by Prinssen et al.[28] In the long term, this would result in an increased lifetime cost of €4000 to €8000 for EVAR over a 10-year period (at

3% discount rate). However, changes in follow-up routines would affect this cost.

Conclusion

In a population-based setting, patients operated on electively for AAA and selected for OR more often had anatomically complex aneurysms, with ICU care as the major cost driver. Patients selected for EVAR were older and had more serious comorbidities, with stent-grafts as the major cost driver. Despite these differences in patient characteristics and cost structure, the total cost of elective AAA repair was similar for OR and EVAR.

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