Selection, Thirty Day Outcome and Costs for Short Stay Endovascular Aortic Aneurysm Repair (SEVAR)

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Abstract

Background: Endovascular Aortic aneurysm Repair (EVAR) offers the potential for a reduced hospital stay. The aim of this study was to identify patients suitable for short stay EVAR (SEVAR) with a single night in hospital and document their outcome.

Method: Patients for EVAR were assessed prospectively for SEVAR over a 21-month period using UK Day Surgery Guidelines. Joint anaesthetic and surgical approval were necessary for these patients to be included in this vascular pathway. Patients were admitted on the day of surgery with a designated care protocol for discharge the day after.

Results: 101 patients were assessed for SEVAR. 33 (33%) patients met the criteria for SEVAR and 27 of these (81%) were successfully discharged one day post-operatively. Total SEVAR median LOS was one day (IQR = 0) versus four days (IQR = 2) for the standard EVAR group (P < 0.0001) reducing costs from £13,360 (CI = £6,107) to £9,844 (CI = £6,282). Increased utilisation of SEVAR during the study period led to reduced overall average EVAR costs, £12,102 (CI = £6,795) to £10,330 (CI = £7,573).

Conclusion: SEVAR protocol reduces hospital stay for selected patients. The outcomes from a larger cohort of such patients require further study. This would identify whether SEVAR could be expanded to more patients.

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Background

Endovascular aortic aneurysm repair (EVAR) is a well-established modality for treating elective abdominal aortic aneurysms (AAA). Although AAA patients usually have significant comorbidities, EVAR still offers the potential for a reduced hospital length of stay (LOS) and reduced morbidity compared to open surgery.1–4 In recent series a mean length of stay for EVAR has been documented at between 2.5 and 2.8 days.5,6 Protocols for day of surgery admission are widespread in the UK now.7 To reduce hospital stay to a minimum, patients required assessment to identify those that could safely be admitted on the day of surgery and discharged the next day Fig. 1.

The Royal College of Anaesthetists has published criteria for successful day surgery. Their guidelines cover not only pre-assessment medical selection but extend to intra-operative care, post-operative discharge instructions, follow up and unit management.8 There is emphasis on leadership from a nominated clinical lead, trained pre-assessment teams, anaesthetists with a specific interest in day surgery and audit and governance.

Many of these factors can be applied to EVAR procedures to help reduce LOS. Breast, Endocrine and Hepato-Biliary surgery have all successfully implemented day case practice for selected procedures. Thyroidectomy, breast cancer surgery and laparoscopic cholecystectomy have all been performed on a day case or short stay basis with low complication rates and no increase in re-admission rates.9–11 Careful patient selection is stressed as the key to achieve successful outcomes.

The hypothesis underlying this study was that for selected patients the LOS could be reduced further with a single overnight stay. The aim of this study was to identify patients suitable for short stay EVAR (SEVAR) using recognised day surgery selection criteria, and document their outcome.

Method

This was a prospective study of all patients undergoing elective infrarenal AAA EVAR from 01/09/2009 to 01/06/2011. A total of 101 patients were entered into the study. The overall unit activity during
the study was 142 cases which includes a further 25 open aortic aneurysm repairs, 3 Fenestrated EVARs, 5 Aorto Uni-iliac grafts and 8 emergency EVARs. Fenestrated and branched procedures were excluded from the analysis since they were not considered for SEVAR due to the longer and more complex procedure.

At the pre-assessment visit prior to EVAR, the vascular specialist nurse (VSN) screened patients for SEVAR suitability according to the criteria summarized in (Table 1). A Vascular anaesthetist was informed of the selected patients for approval. All SEVAR patients were given an information leaflet explaining the recovery process and planned discharge the day after surgery. After patient's agreement and anaesthetic approval, patients were admitted on the day of EVAR surgery using a specific SEVAR integrated care pathway (ICP). Post-operatively patients were nursed and monitored on a vascular ward. Patients were assessed on the morning of the first post-operative day for discharge. Early follow up was by telephone from the VSN. Clinic follow up was at six weeks.

Details of the EVAR procedures were entered prospectively onto an EVAR database. The hospital costing and administration database (Cambridge Hospital Evaluation and Quality System) was used to calculate direct procedural costs incurred from the cost of theatre time, ward, staff and investigations requested post-operatively.

All EVAR procedures were performed in a vascular operating theatre with a mobile C-arm image intensifier and radiolucent table. Bilateral open common femoral artery cutdown was used in all cases. All patients had a general anaesthetic. Urinary tract catheterisation was avoided. Oral paracetamol and opiates were used for post-operative analgesia.

Statistics

Continuous, normally distributed variables are reported as means with SD and 95% confidence intervals (CI). Medians and Interquartile ranges (IQR) are used for skewed distributions. Categorical variables are given as absolute number (%), unless stated otherwise. The Mann–Whitney U test was used for comparisons of continuous variables. All p-values are two-sided.

Results

101 consecutive patients attended pre-assessment for an elective EVAR during the 21 months. There were 94 (93%) males and the mean age was 76 (SD ± 7.1) years. The mean aneurysm diameter was 6.0 cm (SD ± 1.0). Sixty eight (67%) patients were not selected for SEVAR as they did not meet one or more criteria (Table 2). Twenty eight (41%) were due to significant medical co-morbidities including unstable ischaemic heart disease (9), chronic obstructive pulmonary disease (9) and chronic kidney disease (CKD) requiring pre-operative intravenous hydration (10). Ten (15%) procedures had technical factors that were felt to require a longer hospital stay, (cross-over graft, femoral endarterectomy, iliac occlusive disease). Thirteen (19%) required embolization of the internal iliac artery. Our unit policy is to perform these 1–2 days post-operatively during the same admission as for the EVAR. Eight (12%) were missed and not assessed by the VSN in the pre-assessment clinic. Nine (13%) had transport difficulties to hospital.

Thirty three patients (33%) were selected for SEVAR as they met all criteria and 27 (81%) were successfully discharged after one night in hospital. Six (19%) had an unplanned extended stay in hospital. One patient had unforeseen transport issues and stayed for 2 days, 2 patients with social care problems stayed 2 days, 2 patients had unexpected difficulty in graft implantation and stayed for 2 days and 1 patient had urinary retention and haematuria post-operatively and stayed for 7 days. Over the duration of the study the proportion of patients selected for SEVAR increased. In the first half of the study period 30% were selected for SEVAR and in the second half of the study this has increased to 45%. Median LOS in the SEVAR group was one (IQR = 0) day compared to 4 (IQR = 2) days in the standard EVAR group. (P < 0.001).

None of the SEVAR patients had a re-admission to hospital within 30 days after successful discharge from hospital. None of the patients in the standard EVAR group with an American Society of Anaesthesiologists (ASA) grade of >3 were discharged within 3 days of surgery. No patients in the standard EVAR group were discharged after one night in hospital.

We analysed the costs for both groups of patients. The average cost of stay for the standard EVAR group was £13,360 (SD = 4520, CI = ±1074) compared to £9844 (SD = 1840, CI = ±628) for the

![Categorized LOS](image)

**Figure 1.** Comparison between the length of stay for both SEVAR and standard EVAR groups. Vertical axis number of patients. LOS is categorized into 1, 2–3, 4–5, 6–10 and >10 days. No patients were discharged within the first post-operative day from the standard EVAR group.

**Table 1**

<table>
<thead>
<tr>
<th>Patient selection criteria for SEVAR.</th>
<th>SEVAR</th>
<th>Non-SEVAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Favourable anatomy (Excluding Fenestrated, Uni-iliac and internal iliac artery embolization)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>ASA Grade 3 or below</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>BMI &lt; 35</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Dyspnoea grade 2 or less</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>No Myocardial infarction in the last 6 months</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Angina classification 2 or below</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>No CVA/TIA within last year</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Non-Diabetic (excluding diet controlled)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>No significant renal impairment (eGFR &gt; 60 ml/min)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>No advanced liver disease</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>No significant cognitive impairment</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Carer support available post-operatively</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Transport available peri-operatively</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 2 Baseline and procedural characteristics for both SEVAR and Non-SEVAR groups.
SEVAR group (P < 0.0001). Furthermore, we analysed the cost of stay for all patients in the first half and the second half of the study to assess the benefit of increased adoption of SEVAR (45% vs. 30%). The average total EVAR cost in the first half was £12,102 (SD = 4017, CI = ±795) compared to £10,330 (SD = 2892, CI = ±757) (P < 0.0001) in the second half of the study period. This increase in SEVAR patients recruited was due an increase in the utilization of SEVAR protocol in the unit.

Discussion

EVAR is associated with reduced morbidity and length of stay in hospital. This study has shown that selecting patients for SEVAR can further reduce hospital stay, with associated cost savings. This short stay protocol depends on ensuring a seamless discharge back into the community and identifying any pre-operative variables that may hinder a short stay.

Other surgical specialties have introduced similar short stay protocols for selected procedures with good outcomes, low re-admission and complication rates.3–11 Our experience with SEVAR mirrors these conclusions from other specialties. Careful selection is vital and should involve not only medical factors but also social care and transport issues. Another common theme in these short stay protocols is good patient information regarding discharge and post-operative contacts. When patients are prepared for early discharge in advance it becomes their expectation.

One unpredictable area we found was urinary retention. One of our SEVAR patients had a long stay of 7 days due to this complication. Elkhodair et al. have shown that using an International Prostate Symptoms Score (IPSS) for patients undergoing arterioplasty they were able to identify those at risk for post-operative urinary retention.12 High risk patients can have an altered management plan to facilitate early discharge such as intentional catheterisation with planned community removal.

Pre-existing chronic kidney disease and pre-procedural hydration prevented SEVAR in 10 of our patients with an eGFR < 60 ml/minute. Our policy was to hydrate these patients overnight with intravenous fluids and hence they were excluded from SEVAR. Published guidance from Goldfarb et al.13 offers the potential to hydrate patients with an eGFR between 30 and 60 ml/min for just 1 h pre-operatively and 3 h post-operatively. Using this protocol these patients could be included in a SEVAR programme increasing the proportion selected. Overnight hydration would still be recommended for patients with an eGFR < 30 ml/min.15

Two other measures to consider for SEVAR would be local or regional anaesthesia and percutaneous femoral access. Neither of these techniques were employed in this study but require consideration to increase the proportion of patients eligible for a SEVAR programme. EVAR under local anaesthesia (LA), including ASA > 3 patients, has been successfully reported.14–17 This was claimed to reduce LOS, although no randomised comparisons exist to confirm this. LA EVAR can still be quite demanding requiring experienced anaesthetic support to control patient anxiety and pain while performing the procedure. Edwards et al. reported less post-operative LOS and pulmonary complications when using spinal/local anaesthesia versus general anaesthesia (P < 0.001) looking at elective EVAR procedures in North America.6 Percutaneous access could also assist short stay EVAR for patients without a high BMI or heavily calcified femoral vessels. Malkawi et al. have shown reduced operative time and fewer access related complications with percutaneous access.18 However none of the SEVAR patients in this study were delayed from discharge by wound problems or were re-admitted with wound issues.

The main cost drivers in aneurysm repair patients are length of stay (LOS), time in the intensive-care unit, blood product usage and EVAR device costs.19 Elective EVAR rarely requires ITU stay or blood products. Device costs are outside of physician control. The remaining clinical cost variable is therefore LOS. In our study, SEVAR patients median LOS was 1 day (IQR = 0) compared to 4 days (IQR = 2) for standard EVAR. This reduced procedural costs from £13,360 (SD = 4520, CI = ±1074) to £9844 (SD = 1840, CI = ±628) for the SEVAR group (P < 0.0001). The overall impact of this saving for the vascular unit depends on the number of SEVAR cases performed. Average procedure costs fell in our unit as we performed proportionately more SEVAR cases, rising from 30% in the first half of the study period (mean cost £12,102 (SD = 4017, CI = ±795)) to 45% in the second half of the study period (mean cost £10,330 (SD = 2892, CI = ±757)). This gain occurred without any associated increase in hospital re-admission after discharge.

This study was a clinical feasibility study, assessing the success of introducing a specific short stay programme into daily practice in a single unit. It was not a controlled comparison of outcomes with and without SEVAR in the same time period. We felt that this would be too difficult to do in a blinded fashion in the same institution. Clearly patients selected for short stay using day case criteria will have fewer co-morbidities, better social support, and have the potential to achieve a short LOS. The important finding of this study was that an established pathway is required in order for this potential to be realised. Prior to the commencement of this protocol, such patients were not prepared for short stay, and failed to achieve early discharge.

Conclusion

In conclusion SEVAR protocol can reduce hospital stay for selected patients. With experience we have extended the use of SEVAR to more patients with modified, less restrictive selection criteria. The outcome from a larger cohort of such patients requires further study to define the full potential for SEVAR to reduce LOS and costs.

Disclosures

None.

Funding

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Conflict of Interest

None.

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References