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REVIEW

Short Stay EVAR is Safe and Cost Effective

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WHAT THIS PAPER ADDS

This is a systematic review aimed at evaluating current evidence for short stay endovascular aneurysm repair (EVAR) safety and feasibility. By reducing length of stay through a short stay EVAR pathway, clinicians have the opportunity to reduce patient morbidity and improve cost effectiveness.

Objective: Reducing length of stay (LOS) following surgery offers the potential to improve resource utilisation. Endovascular aneurysm repair (EVAR) is now delivered with a low level of morbidity and as such may be deliverable as a "23 hour stay" intervention. This systematic review aims to assess safety, feasibility and cost effectiveness of a short stay EVAR pathway.

Methods: A database search of Ovid MEDLINE (1996 — April 2018) and Embase (1974 — April 2018) was completed. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used. A Newcastle—Ottawa Scale was applied to assess study bias.

Results: In total, 570 papers were identified through the literature search, of which 32 abstracts were screened. This led to nine papers being assessed for eligibility. From five suitable studies, 450 (75%) patients were successfully discharged the same or next day after EVAR. Complications most often occurred within 3 hours of surgery, and major complications requiring intensive treatment unit admission occurred within 6 hours. Readmission rates were 0—5% for those discharged early, with no difference in 30 day readmission. Early discharge led to a statistically significant cost saving of £13,360 (LOS four days) to £9844 (LOS one day).

Conclusion: Selected patients can safely undergo EVAR using a short stay pathway. A period of monitoring 6 h post-operatively for low risk patients would be sufficient. Reducing length of stay after EVAR in the UK from the current median of three days to 1.5 days would free 4361 bed days and lead to a saving of approximately £1,800,000 annually.

Keywords: Abdominal aortic aneurysm, Day case, Endovascular aneurysm repair, Length of stay, Short stay
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INTRODUCTION

Day case and short stay operations are becoming increasingly prevalent and are now the accepted practice for interventions, such as laparoscopic cholecystectomy.[1] Reducing length of stay (LOS) following surgery has the ability to reduce cost, improve resource utilisation, and prevent complications associated with prolonged hospitalisation.[2,3] Improvements in surgical technique and peri-operative care have allowed endovascular aneurysm repair (EVAR) to be delivered with significantly reduced peri-operative mortality and morbidity in comparison with open elective aortic aneurysm repair.[4] This presents an opportunity to reduce LOS by introducing a short stay intervention pathway in select patients.

To allow same or next day discharge following surgery, it must be proven that this practice is safe and does not place patients at risk of developing complications out of the safety of a hospital environment. In order to implement this strategy, those at an increased risk must be identified early during pre-operative assessment using objective measures. Although some have suggested such criteria for performing short stay EVAR, none has been validated. The advantages of short stay EVAR are potentially manifold. Prompt discharge may prevent the occurrence of complications such as hospital acquired infections, prevent de-conditioning in already frail patients, and make EVAR more cost effective, freeing resources that are increasingly rationed in modern healthcare systems.[5] Furthermore,

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accurate pre-operative risk stratification may allow targeted use of level 2 and 3 facilities, thus preventing inappropriate use of critical care facilities. The aim of this study was to examine evidence for the safety and utility of a short stay care pathway for EVAR.

METHODS

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRSIMA) guidelines were used for the design of this systematic review. S.S. completed a database search of Ovid MEDLINE (1996 — April 2018) and Embase (1974 — April 2018) using the terms "EVAR", "endovascular aneurysm repair", "abdominal aortic aneurysm", "outpatient", "short stay", "day case", "ambulatory", and "length of stay". References of the eligible studies were reviewed and, if relevant, included. Inclusion and exclusion criteria for paper selection were set by S.S. and B.P. Review articles, studies not in the English language, or studies investigating open aneurysm repair were excluded. Abstracts were screened and those addressing LOS, had >10 cases, included AAA EVAR (simple or complex), and that presented original data not cited in other included abstracts were read in full. Papers that did not specifically address same day or early discharge following EVAR were excluded.

S.S. and B.P. reviewed the final papers; conflicts were resolved by discussion. Variables such as patient demographics, short stay protocol uptake, operative details, failed early discharge, and cost analysis were extracted and collated. In order to assess bias, the Newcastle—Ottawa Scale (NOS) was applied. No further data were requested from the authors.

RESULTS

Search results

In total, 570 papers were identified through the literature search, of which 32 abstracts were screened. This led to nine papers being assessed for eligibility and resulted in the inclusion of five studies, specifically looking at same day or short stay discharge following EVAR (Fig. 1). Bias was assessed using the NOS and can be seen in Table 1. Owing to the use of a pre-selection process, discussed later, the cohort had intentional bias regarding post-operative risk and outcomes, which would not have been appropriate to control for.

The design of the selected papers can be found in Table 2. Two studies aimed for discharge on the same day as surgery, and three aimed for discharge one day post-operatively. Four studies had a specific short stay pathway, which pre-selected low risk patients for discharge

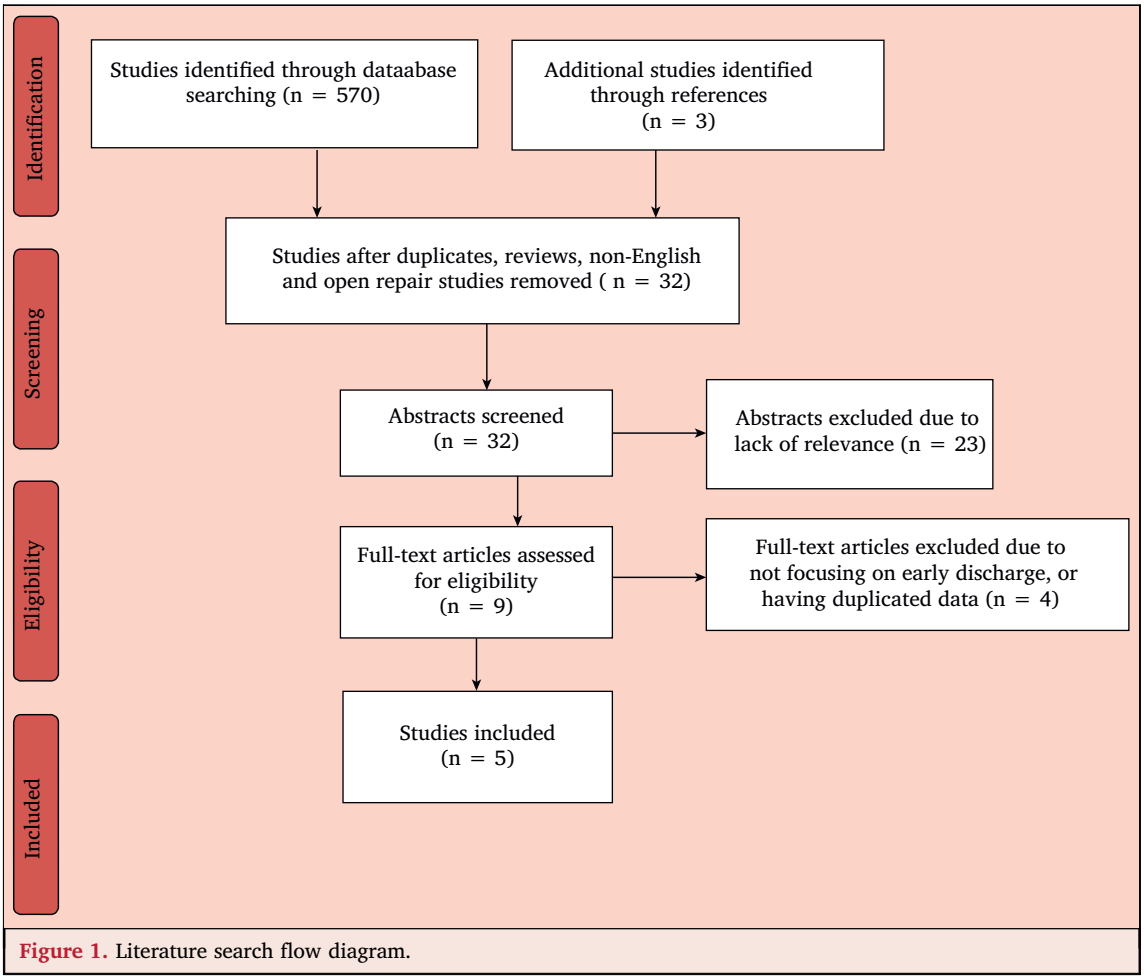

Figure 1. Literature search flow diagram.

Table 1. Newcastle–Ottawa bias scale of included studies

Reference	Selection (max 6*)	Comparability (max 2*)	Outcome (max 5*)
Al-Zuhir et al.[6]	***		**
Dosluoglu et al.[8]	***		**
Lachat et al.[7]	***		**
Moscato et al.[10]	***		***
Krajcer et al.[9]	***		***

Star grading set out as per Newcastle-Ottawa cohort guidelines, more stars indicate higher quality. Note no study controlled for confounding as pre-selection was intentional therefore no stars scored for comparability in any study.

on post-operative day 0 or 1, and made additional arrangements in order to facilitate early discharge and follow up. The total number of patients who successfully underwent same or next day discharge across all studies was 449/601 (75%). This represented 449/882 (50%) of the total EVAR case load (Table 2).

Patient selection

In total, 87% of patients included were males with average ages ranging across the studies of 70–76 years, with a range across all studies of 55–97 years. These reported demographic data were not split between early and late discharge (Table 2). In the studies with a short stay pathway patients were specifically selected prior to surgery for early discharge.[6,7] Inclusion criteria were factors thought to predict operative success and good social networks to facilitate early discharge (Table 3). Exclusion criteria were significant comorbidities or technical factors that increased the risk of procedural complication. Patients who underwent emergency surgery for aneurysm rupture and those who underwent conversion to an open procedure were excluded in all studies. Reasons for ineligibility were divided into technical (e.g., emergency, fenestrated EVAR, etc.), medical (unstable comorbidities), and social (lack of carer availability). Technical factors accounted for 62% of exclusions, medical 24%, and social 14%.

Table 2. Study design and demographies of included study populations

Study	Sample size (n)	Men, n (%)	Year	Design	SDD pathway	SDD target	Successful SDD, n (%[a])	SDD % of case load[b]	Mean follow up (mo)
Al-Zuhir et al.[6]	101	94 (93%)	2009–11	Prospective	Yes	POD 1	27 (81)	27/117 (23)	1.5
Dosluoglu et al.[8]	79	79 (100%)	2011–12	Prospective	Yes	POD 0	45 (70)	44/73 (60)	8.3[d]
Lachat et al.[7]	104	–	1999–02; 2011–12	Prospective	Yes	POD 0	100 (96)	100/249 (40)	3
Moscato et al.[10]	67	53 (79%)	2012–13	Retrospective	No	POD 1	48 (72)	48/67 (79)	1
Krajcer et al.[9]	250	208 (83%)	2014–2016	Prospective	Yes	POD 1	230 (92)	230/376 (62)[c]	1

SDD = same day discharge; POD = postoperative day; EVAR = endovascular aortic repair.
[a] % of patients preselected for SDD who successfully discharged as planned. Note this may not be equal to total sample size of study.
[b] SDD % of total endovascular aneurysm repair case load.
[c] This represents only those who were screened, not necessarily all of the EVAR case load.
[d] 8.3 ± 6.6 (range, 1–24).

Table 3. Selection criteria for short stay pathway as defined in the included prospective studies

Selection criteria for short stay pathway	Al-Zuhir et al.[6]	Lachat et al.[7]	Dosluoglu et al.[8]	Krajcer et al.[9]
Inclusion criteria				
Asymptomatic		X		
Favourable anatomy	X	X	X	X
Informed consent		X		
Technically successful		X	X	X
Able to mobilise post-operatively			X	
Transfer time to hospital if readmission <60 min		X		
Adult observer for first 24 h	X	X	X	
Transport available peri-operatively	X			
Exclusion criteria				
Fenestrated, uni-iliac and internal iliac artery embolisation	X			
Serious intra-operative complications		X	X	
Procedure time >4 h		X		
Incomplete sealing of access vessel		X	X	
Comorbidities[a]:	X		X	X
Home >50 miles from hospital			X	

"X" marks the inclusion/exclusion criteria used to pre-select low risk patients by the authors named at the top of the columns.
[a] American Society of Anesthesiologists grade >3, body mass index >35, dyspnoea grade >2, myocardial infarction <6 months, angina classification <2, cerebrovascular disease <1 year, diabetes mellitus, estimated glomerular filtration rate < 60, advanced liver disease, cognitive impairment, chronic obstructive pulmonary disease on oxygen therapy, cardiac failure, >80 years.

Those selected for the short stay pathway were assessed post-operatively to ensure they were still eligible for early discharge. Those who had significant intra-operative complications were not discharged early. Peri-operative factors that were found to have a significant relationship with LOS included abdominal aortic aneurysm (AAA) diameter, estimated blood loss, and operating time. Average AAA diameter for same day discharge was 5.3 ± 0.5 cm vs. 6.1 ± 1.3 cm for those discharged after >2 days (Table 4). Estimated blood loss and operative time was 115 ± 90 (20—300) mL and 79 ± 24 (50—132) minutes for same day discharge vs. 275 ± 259 (25—1000) mL and 147 ± 88 (55—341) minutes, respectively, for those discharged after > 2 days.[8]

Operative technique

Anaesthetic technique varied between studies, reflecting differences in practice between different institutions. Al-Zuhir et al.[6] used general anaesthetic only, Krajcer et al.[9] excluded those needing general anaesthetic, whereas others used general or regional techniques, depending on comorbidities and American Society of Anaesthesiologists' (ASA) grade (Table 4). Dosluoglu et al.[8] did not find a strongly significant relationship between anaesthetic technique and time to discharge.

Percutaneous access was used more frequently in patients who underwent same day discharge (Table 4). Al-Zuhir et al. opted to use femoral cut downs for all of their patients.[6] Dosluoglu et al. found a strongly significant relationship between use of percutaneous access and time to discharge ($p = .016$).[8] All patients who underwent same day discharge had percutaneous access vs. 60% of those discharged on day >2; the cohort average was 84%.[8]

Complications and discharge

In the studies that pre-selected individuals onto a short stay pathway, there was a 70—96% chance of successfully undergoing early discharge (Table 2). Al-Zuhir et al. reported this to account for 40% of their total EVAR case load.[6] Factors that delayed discharge in pre-selected patients included transport problems, urinary retention, post-operative rehydration, access vessel complications, and graft implantation. By contrast, in the studies that analysed complications in a mixed cohort of both low and high risk patients, myocardial infarction, haemorrhage, and deterioration of comorbidities, such as congestive cardiac failure and respiratory failure, were seen.[8,10] Krajcer et al. completed univariable regression analysis and found increased access vessel diameter and lack of congestive heart failure instilled increased odds of successful early discharge.[9]

Those patients who successfully underwent early discharge had a readmission rate of 0—5%. Reasons for readmission included severe post-implantation syndrome,[8] access vessel problems,[7] acute kidney injury, ischaemic cardiomyopathy, chronic obstructive pulmonary disease, and diverticulosis.[9] Moscato et al. found no difference in 30 day readmission rates with length of hospital stay.[10]

Cost analysis

Moscato et al. found costs associated with the operation itself to account for 80.3% of the cost, with 58% of the total cost being attributed to the endograft.[10] Al-Zuhir et al. showed a large cost benefit of early discharge with a statistically significant reduction of £13,360 (LOS four days) to £9844 (LOS one day),[6] a finding replicated by Lachat et al. (Table 4).[7] This cost benefit increased with increased uptake of early discharge. Al-Zuhir et al. found that with an increased uptake onto the SDD protocol from 30% to 45% of patients, there was a strongly significant ($p < .001$) average EVAR cost reduction from £12,102 to £10,330.[6]

DISCUSSION

Short stay EVAR appears to be feasible and may confer a significant reduction in resource usage and cost. With specific selection criteria same day discharge was possible for 50% of the EVAR caseload in busy aortic centres.[7] A robust method of patient selection onto a short stay pathway is clearly vital to this process, ensuring that only those who have a low risk of complication are discharged early. In addition to identifying physiological indicators of potential early discharge, placing patients onto the short stay integrated care pathway was noted to modify patient expectations of their hospital stay, making patients more

Table 4. Variables associated with early discharge

Study	Early discharge patients (n)	Mean ± SD max. aortic diameter (mm)	Percutaneous access	General anaesthetic	Readmission	Mean cost saving
Al-Zuhir et al.[6]	27	60 ± 1[a]	0 (0)	27 (100)	0 (0)	£3516 ($p < .001$)
Dosluoglu et al.[8]	44	53 ± 5	38 (86)	36 (82)	1 (2)	–
Lachat et al.[7]	100	57 ± 7[a]	88 (88)	–	4 (4)	€2171 ($p < .05$)
Moscato et al.[10]	48	–	42 (88)	82[a]	2 (4.4)	–
Krajcer et al.[9]	230	51 ± 8	216 (100)[b]	0	(1.6)[c]	–

These figures specifically apply to numbers seen in groups who underwent early discharge, unless otherwise stated. Data are *n* (%) unless otherwise indicated. SD = standard deviation; ICU = intensive care unit.

[a] For all groups, early and late discharge.

[b] Number specific to patients who were successfully 'fast-tracked' i.e. percutaneous access, no ICU admission, no general anaesthesia and successful next-day discharge. 230 patients discharged early, however 216 patient completed all elements of fast-track pathway.

[c] Only percentage, no number documented.

amenable to early discharge. Prior knowledge of a plan for prompt discharge could potentially help practical care planning such as transport home and the availability of carers to receive patients.[6]

Other practical elements to consider when introducing a short stay pathway include ensuring adequate pre-assessment, availability of hospital records and investigations on the day of surgery, and prompt arrival in a suitably resourced facility to allow cases to be performed as early as possible in the day. Patients on the short stay pathway should be placed at the start of the operating list to allow a period of monitoring post-operatively, to ensure that patients are stable and safe to leave.[3] Following discharge there should be early follow up with nurse telephone calls and early clinic appointments. Where specific selection criteria were used,[7] it was found that 70—96% of patients could be discharged early as planned. Reasons for delay included both predictable and potentially preventable problems such as social care issues, urinary retention, and worsening comorbidities. In the studies that looked at complications in both high and low risk patients, worsening of medical comorbidities, such as myocardial infarction and respiratory failure, contributed to delayed discharge. It is intuitive that this was avoided by carefully patient selection.

Method of anaesthesia has been suggested as an influencing factor on LOS after EVAR.[11] The choice of anaesthetic technique varied, with some completing all EVAR cases under general anaesthetic, while other centres altered their technique depending on medical comorbidities and ASA grade. No significant relationship between general anaesthetic and length of hospital stay was found, which conforms with current European AAA management guidelines recommending the use of either general or locoregional anaesthetic techniques.[5—10]

Percutaneous access has been shown to be associated with reduced LOS.[5] Data included in this review was consistent with this, showing a strongly significant relationship with early discharge, being used in 100% of patients who were successfully discharged on the same day, as opposed to 60% who spend $>$2 days in hospital.[10] However, Al-Zuhir et al. undertook femoral cut downs for all of their patients and still successfully undertook 40% of their EVAR caseload under a short stay pathway.[6] From these data, it is unclear if percutaneous access was more commonly used in patients who were at lower risk of complications, or if percutaneous access itself inferred a reduced risk of complication. It was felt to be a combination of the two factors.

Patients that were discharged early had smaller aneurysms, and this is likely to reflect the presence of globally favourable anatomy in fitter patients rather than a direct effect of the aortic diameter. This is supported by the fact that operative time and blood loss was also higher in the patients with longer length of stay, although this could be both a cause and an effect.[8]

The main concern with early discharge is complications occurring after discharge when patients are not in a suitable environment to receive immediate attention, resulting in preventable morbidity and potential mortality. Reassuringly, the rate of readmission following early discharge, regardless of pre-selecting a short stay pathway, ranged from 0% to 5%, in keeping with a national readmission rate of 5.8%.[12] Moscato et al. found that all complications requiring intensive care unit admission occurred within the first 6 h post-operatively, with the majority occurring immediately following surgery.[10] Lachat et al. examined over 1000 cases and found that the most frequent complication was access vessel obstruction or bleeding, and this occurred within the first 3 h for all patients.[7] It is reassuring that after a prescribed period of observation (i.e., 3—6 h) access complications are very unusual. In cases where there is doubt a duplex ultrasound could be performed.

This study shows that not only would a short stay pathway be feasible, but is potentially beneficial for both patients and healthcare systems. The UK National Vascular Registry recorded 2907 infrarenal EVAR procedures performed in 2017, with a median hospital stay of three days. If this can be reduced to 1.5 days by introducing a national short stay EVAR protocol discharging 50% of patients on post-operative day 0 or 1, there is the potential to save 4361 bed days in hospital. Based on a hospital cost of £400/night, this equates to a potential saving of approximately £1,800,000, depending on whether the requirement for post-operative level 2—3 beds could be reduced by identifying low risk patients.[12]

Although these studies suggest that early discharge following EVAR is feasible, there are significant limitations within the literature. The main limitation is the low number of publications with a relatively high risk of bias, as seen in the NOS ratings. As previously mentioned intentional bias was applied by pre-selecting low risk patients; however, variable inclusion and exclusion criteria were used by different studies. This could have resulted in a degree of heterogeneity between these groups, and thus limits how far conclusions from the data of one study's low risk group could be applied to another. To adequately address the safety and impact of a short stay discharge programme for EVAR, a large observational study would probably be the best and most pragmatic approach. This could be run through an existing national quality improvement framework to maximise recruitment and could be conducted over a relatively short period given that the outcomes in question are all peri-operative.

CONCLUSION

Small scale feasibility studies appear to show promising results for same or next day discharge following EVAR, with no increased risk of complication in selected patient groups. There is potential for significant resource savings. A large scale prospective observational study would be required to prove that this approach is safe.

CONFLICT OF INTEREST

None.

FUNDING

None.

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