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Immediate Impact of Centralisation on Abdominal Aortic Aneurysm Repair Outcomes for a Vascular Network in the South West of England: a Retrospective Cohort Study

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Immediate impact of vascular centralisation

MINI-ABSTRACT

Centralisation of vascular services has been implemented nationally. A retrospective cohort study was undertaken to analyse the impact on patient outcomes. The process of centralisation of abdominal aortic aneurysm repair was safe for patients and had no immediate impact on outcomes.

ABSTRACT

Objective

Our aim was to assess the short-term impact of centralisation on the outcomes of patients undergoing abdominal aortic aneurysm repair in a vascular network in the South West of England.

Background

The centralisation of vascular services has been implemented nationally across the NHS to improve patient outcomes. The full impact of these major changes has not yet been fully analysed.

Methods

A retrospective cohort study examining outcomes of patients undergoing abdominal aortic aneurysm repair, based on prospectively entered National Vascular Registry data, pre and post centralisation in the South West of England. The primary outcome was mortality at 30 days. Secondary measures included 30-day morbidity, length of hospital stay and length of intensive care unit stay.

Results

The 30-day mortality was unchanged pre and post-centralisation (11% vs 12%, $p = 0.84$). The 30-day morbidity rate was also unchanged (24% vs 25%, $p = 0.83$), as was length of intensive care unit stay (3 days vs 3 days, $p = 0.74$). Overall length of stay was not significantly different (7 days vs 5 days, $p = 0.76$). Subgroup analysis of patients with elective, ruptured and symptomatic aneurysm repair demonstrated no differences in 30-day mortality. There

was a significantly shorter stay post-centralisation for patients with symptomatic aneurysms (6 days vs. 13 days, $p = 0.006$).

Conclusions

The process of centralisation of abdominal aortic aneurysm repair in a vascular network was safe for patients and had no immediate impact on outcomes. Longer-term outcome measures and financial data will be required to further assess the benefit of centralisation.

INTRODUCTION

Vascular services in the NHS are increasingly managing complex, co-morbid patients undergoing high-risk and ever-evolving surgical procedures. High volume vascular services consistently have better patient outcomes (1, 2, 3), with more efficient utilisation of resources (4). This is dependant not only on the vascular surgeons, but a multi-speciality team comprising interventional radiologists, anaesthetists (pre-operative assessment, critical care medicine) and specialist vascular nursing.

In 2012, the Vascular Society of Great Britain and Northern Ireland (VSGBI) formally recommended the centralisation of vascular services across the UK (5), largely in response to poor outcomes for abdominal aortic aneurysm repair as compared to other countries reporting outcomes to the VASCUNET database. Several other UK disciplines have undergone similar centralisation programmes, including malignant upper gastrointestinal surgery (6) and urological oncology (7), with published improvements in patient outcomes. The recent successful implementation of centralised acute stroke services across the UK (8) has resulted in a more efficient referral pathway to carotid endarterectomy.

There were several other drivers to the changes set out by the VSGBI; there was a growing need for comprehensive emergency Consultant Vascular Surgeon and Consultant Interventional Radiology cover across the UK; with the emergence of increasingly complex vascular interventions requiring advanced 24-hour multi-disciplinary specialised services (i.e. EVAR for ruptured AAA). Additionally, recommendations from the NHS abdominal aortic aneurysm-screening programme (NAAASP) are that vascular networks have a minimum size of 800,000, with all inpatient aortic surgery carried out on a single site (9).

Although there is strong evidence in favour of centralisation, there were also those who called for caution. In particular, there were questions raised over the implementation of

services solely based on caseload (10) and concerns over the future of peripheral hospitals stripped of their services (11). Moreover, patients living within a centralised vascular network may experience longer travel times, delays in receiving emergency care and poorer overall access to a vascular specialist.

The Provision of Vascular Services 2012 (5) proposed a model of care with large vascular centres capable of organising specialist assessment within an hour of referral, with dedicated vascular theatres and anaesthetic teams, specialised radiology units running multiple imaging facilities and critical care teams trained in the management of vascular patients. Many of these themes have been picked up in NHS England's focus on 7-day services.

The aim of this study was to determine the impact of vascular surgery reconfiguration on the clinical outcomes of patients undergoing abdominal aortic aneurysm repair in the immediate period post-centralisation, compared to the previous non-centralised model.

METHODS

This is a retrospective cohort study examining outcomes of patients undergoing elective and emergency abdominal aortic aneurysm surgery, based on prospectively collected National Vascular Registry data pre and post centralisation in a vascular network serving 1.3 million people in the South West of England.

Pre-centralisation

Before centralisation, three acute hospital trusts (North Bristol NHS Trust (NBT), University Hospitals Bristol NHS Foundation Trust (UHB) and Royal United Hospitals Bath NHS Foundation Trust (RUH) accepted emergency and elective vascular admissions in part of the South West of England. Since 1991, NBT and UHB delivered alternate weeks of vascular emergency cover delivered entirely by an on-call Consultant Vascular Surgeon (12) with NBT exclusively providing out-of-hours interventional radiology cover (13). RUH accepted emergency vascular patients out of hours, with cover provided by either a Consultant Vascular Surgeon or Consultant General Surgeon. Consultant Vascular Surgeons also accepted emergency general surgical admissions. One Trust (Weston Area Health NHS Trust) ran a limited outpatient clinic service.

Post-centralisation

In our network, centralisation of vascular services occurred on 13th October 2014. After this date all vascular care in the areas listed above, serving a population of 1.3 million, was transferred to a single centre - Southmead Hospital (part of North Bristol NHS Trust). This created a unit of 11.5 whole time equivalent (WTE) Vascular Consultants and 6 WTE

Interventional Radiology Consultants, working with a large team of staff. Nine of the ten vascular surgeons working in the network transferred to North Bristol Trust. One vascular surgeon transferred their vascular activity whilst continuing to be employed by their network Trust (subsequently retired and replaced by appointment to NBT). There was in addition one new appointment to support a new Consultant of the Week Model which provides daily review of all inpatients whilst maintaining local presence to review patients within 48 hours at network sites. There was no transfer of interventional radiology consultants from network hospitals. Two interventional radiology consultants now deliver some activity at the hub and at their local hospital (day case angioplasty) and one interventional radiologist provides only day case angioplasty at a local hospital. Day case angioplasty on both non-arterial sites is supported by a vascular surgical presence.

were offered and accepted a transfer of their arterial work to the central hub. The vascular and interventional radiology specialities work closely as a combined intra-operative team. Radiology consultants cover both elective and emergency cases, with a 24-hour on call rota.

All emergency vascular presentations are transferred to Southmead from other trusts across the network, where appropriate. There is a written policy in place with the South Western Ambulance Service for bypass of the local hospital when rupture is proven. Previous work has shown no difference in time from presentation to operation since centralisation for patients with ruptured abdominal aortic aneurysm.

All elective vascular operating occurs at the vascular arterial centre. The central site holds a single weekly network Multi-Disciplinary Team Meeting (MDT), at which all major arterial cases are discussed – including open AAA and EVAR. The MDT comprises vascular surgeons, interventional radiologists, vascular nurses, vascular scientists, rehabilitation physician, anesthetist and dedicated MDT co-ordinator.

The centre now has 2 dedicated vascular theatres, one of which is a specialised hybrid design. There is a dedicated vascular anaesthetic team, interventional radiology providing 24-hour cover, a dedicated 32-bed vascular inpatient ward and extensive outpatient facilities. All outlying trusts were served by regular outpatient clinics run by the Vascular Consultants, with an inpatient referral service to the visiting consultant.

Inclusion and Exclusion Criteria

All abdominal aortic aneurysm surgery was included, this means both open and endovascular repair and surgery for asymptomatic, symptomatic intact and ruptured aneurysms.

Two nine-month periods were selected for comparison- pre- (P1) and early post-centralisation (P2). P1 was chosen as 1st March 2012 to 31st December 2012 inclusive. After this period, one specific trust moved all AAA cases to the central site. P2 was 13th October 2014 (the date of centralisation) to 31st March 2015 inclusive.

Data Extraction

Pre-centralisation data was extracted from the National Vascular Registry (NVR) and prospectively maintained trust-based systems; post-centralisation data was collected using the NVR and the local intensive care database. Sources were interrogated by three study authors (PL, MD, SP).

Outcome Measures

The primary measure of outcome was 30-day mortality. Secondary measures included 30-day morbidity rate, length of hospital stay and length of intensive care stay.

DEFINITIONS

The total length of stay was measured in days as the difference between date of admission and date of discharge in the operating hospital. Intensive care stay was also measured in days as the total stay in intensive care during the index admission, including all re-admissions to the intensive care unit.

Aortic aneurysms were grouped into elective, ruptured or symptomatic, the latter referring to acutely painful, non-ruptured aneurysms that were repaired urgently during the presenting unplanned admission. The American Society of Anesthesiologists (ASA) system was used to classify pre-operative physical status. The ASA score was taken from the NVR or, where this was not completed, was applied retrospectively to the data based on pre-operative investigations and documentation describing the patient's pre-operative physical fitness.

All elective patients pre- and post-centralisation went through the same MDT aortic aneurysm algorithm, as publicised nationally. Operative morbidity was graded according to the Clavien-Dindo (CD) classification, with a grade of three or more being recorded as serious post-operative morbidity (14).

STATISTICAL ANALYSIS

The data was analysed using SPSS statistical software (IBM SPSS Statistics USA, Version 21, 2012) for univariate and survival analysis. A series of one-way ANOVAs were used to compare continuous data for both pre and post-centralisation for any statistical difference, while cross-tabulation was used for ordinal and categorical data with Pearson chi-squared used to test the significance of any differences found. Adjusted residuals were calculated for cross-tabulations with a statistically significant difference.

Survival analysis was carried out using Kaplan-Meier survival curves with log-rank tests to assess significance. Primary and secondary outcomes were compared between both the pre and post-centralisation periods for each of the patient sub-groups (elective, ruptured and symptomatic).

RESULTS

Patient characteristics

A total of 251 patients were identified from the NVR. Of these, 151 patients were operated on during the P1 period, 100 during the P2 period. There was no difference in the demographic profiles of the two groups (Table 1). The mean age in both groups was 75 years [standard deviation (SD) 7.5], ranging from 53 to 94 years [median 76 years, interquartile range 11]. Of the P1 patients 91% were male, compared to 89% in P2. There were no patients in the P2 period who refused transfer to the central site.

There was no difference in the proportion of elective (65% vs. 65%), ruptured (9% vs. 9%) and symptomatic patients (26% vs. 26%) in the two groups (p = 0.99). Overall in this series 56% of patients had an open repair, 44% of patients had an endovascular (EVAR) procedure, and there were no differences found between groups in the ratio of open to endovascular repair (p = 0.53) (Table 1).

Thirty-nine percent of all patients in the study had an ASA of 3, followed by 26% with an ASA of 2. The majority of patients undergoing elective and symptomatic repair were classified as ASA 3 (97% and 75% vs. 5% ruptured, p = <0.0001). A greater proportion of those with ruptured and symptomatic aneurysms had an ASA of 4 (17% and 8% vs. 3% elective, p = <0.0001). Patients with ruptured aneurysms were mostly classified as ASA 5 (79% vs. 0% elective and 17% symptomatic, p = <0.0001) (Table 2).

Primary outcome

The 30-day mortality rate was not significantly different between groups, 10.6% in P1 versus 12.0% in P2 (p = 0.84) (Table 3). Sub-group analysis was performed, with no significant difference in mortality rate between P1 and P2 in elective (1% vs. 3%, p = 0.34), ruptured (35% vs. 39%, p = 0.78) or symptomatic (8% vs. 0%, p = 0.39) repairs.

Secondary outcomes

Morbidity

The rate of major morbidity, classified as Clavien-Dindo scores of 3 or above, was no different in P1 at 24%, as opposed to 25% in P2 (p = 0.83) (Table 4).

The rates of major morbidity were similar on comparison of P1 and P2 subgroups- elective repairs (11% vs 14%, p = 0.62), symptomatic repairs (23% vs 0%, p = 0.12), and ruptured aneurysms (55% vs 62%, p = 0.60).

Length of stay

There was a non-significant tendency towards a shorter overall hospital stay in the P2 group, with a median length of stay of 8 days (95% CI 6.8-9.2) in P2 versus 6 days (95% CI 4.2-7.8) in P1 (p = 0.76) (Figure 1).

When comparing subgroups, there was no difference in median length of stay between P1 and P2 in elective (5 vs 3 days, p = 0.56) or ruptured (18 vs 19 days, p = 0.23) patients. Patients in the symptomatic subgroup had a significantly shorter stay in P2 (12 vs 6 days, p = 0.012).

There were no differences in proportion of admissions to intensive care or median length of stay in intensive care. Of the P1 group, 54.3% had an intensive care stay, compared with 59% of the P2 group (p = 0.27). The median length of intensive care stay was 3 days in both groups (p 0.74) (Figure 2). There were no differences in proportion or length of intensive care stay on subgroup analysis between elective, ruptured and symptomatic groups.

DISCUSSION

The centralisation of vascular services in the NHS has been implemented with the aim of improving patient outcomes, however the impact is not yet fully known. The aim of this study was to determine the immediate impact of a newly centralised vascular service on the clinical outcomes of patients undergoing abdominal aortic aneurysm repair in the immediate period post-centralisation, during which the most turbulence and difficulty in service delivery is likely to arise. The principle finding of this study was that there were no significant differences in clinical outcomes for patients operated on for aortic aneurysm in an immediate post-centralisation period compared to a pre-centralisation period. There was no difference in the 30-day mortality between pre- and post-centralisation groups. Furthermore there were no differences in significant morbidity and length of intensive care stay between the two groups.

Average length of hospital stay decreased from 7 to 5 days, which approached significance. This could be the result of an improved inpatient service, with a 'Consultant of the Week' providing daily patient review, 7 days a week, thus providing continuity of care to ensure progressive recovery. This service is now supported by the implementation of an enhanced recovery programme for all vascular patients. The elective in-hospital mortality in both periods was in line with the 1.8% national mortality rate published by the Vascular Society (15).

This study is in line with results from studies performed in separate NHS specialities that have undergone recent centralisation and have seen improved patient outcomes, including malignant upper gastrointestinal surgery, gynae-oncology and stroke (6, 8, 16, 17). There is

consistent evidence that survival improves for patients treated in centralised gynaecological oncology units (17). With regards to UK stroke services, outcomes have been found to consistently improve with time after centralisation (8). It is also been shown that efficiency improves after centralisation, as evidenced by the number of resections performed per year in a malignant oesophagogastric centre (16).

This study did not assess the economic impact of centralisation. As the new vascular service matures, further work will be necessary to understand the important longer-term impact on patient outcomes, and the cost-effectiveness of the centralised vascular model. Current understanding of the financial impact of a centralised service remains poor. Recent single centre work has suggested that peripheral hospitals may lose income following vascular centralisation (11). A systematic review of 19 small studies assessing centralisation of cancer services reported a mixed financial picture (18). There was some weak evidence in favour of centralisation. However only one study firmly concluded that centralisation was cost-effective, and four studies found that the process increased costs to patients and their carers. Well-designed observational studies are needed to assess and make recommendations on this important aspect of centralisation, particularly during an era of financial cuts for the NHS.

Income to the non-arterial centres is maintained via a Service Level Agreement (SLA) for the provision of outpatient clinics and secretarial services. The non-arterial centres in addition continue to provide diagnostics (CTA, MRA and Vascular Labs) and day-case angioplasty.

The study is limited due to its retrospective design and lack of long-term clinical and financial outcomes. The interrogation of multiple databases and the continuous use of the National Vascular Database for operative recording during centralisation ensure that the quality of data capture was maintained throughout.

The findings demonstrate that the transition phase of centralisation of vascular services did not negatively affect patient outcomes and the process of centralisation has been safe for patients undergoing abdominal aortic aneurysm repair. The non-significant trend towards shorter inpatient stays may well be reflective of a more efficient, resourced service.

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Figure 1. Kaplan-Meier survival curve and log-rank test for the length of hospital stay (in days) of non-centralised (P1) and centralised (P2) groups

Figure 2. Kaplan-Meier survival curve and log-rank test for the length of intensive care stay (in days) between non-centralised (P1) and centralised (P2) groups