The effects of centralisation of vascular surgical services in the Bath, Bristol and Weston area on the carotid endarterectomy pathway

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ABSTRACT

INTRODUCTION Patients who experience a transient ischaemic attack are at the highest risk of having a subsequent stroke immediately after their symptoms. A carotid endarterectomy should be performed on symptomatic, surgically suitable patients who present with a greater than 50% North American Symptomatic Carotid Endarterectomy Trial stenosis of the internal carotid artery within 2 weeks of their symptoms. This study aimed to determine whether the effectiveness of the carotid endarterectomy pathway has been impacted by the centralisation of vascular surgical services in the Bath, Bristol and Weston area.

MATERIALS AND METHODS From October 2013 to October 2015, critical steps in the patient carotid endarterectomy pathway that vascular surgeons from the Royal United Hospital Bath, Bristol Royal Infirmary and North Bristol NHS Trust input into the Royal College of Surgeons National Vascular Registry were collected. The dates of patient's symptoms, referral, first scan, surgical team review and surgery were analysed.

RESULTS Carotid endarterectomy data was collected for 261 patients. Overall, no significant difference in median time (days) from symptom to surgery from precentralisation data compared with post-centralisation data was seen ($P = .175$), with 65% patients meeting the national target of symptom to surgery in less than 14 days.

DISCUSSION AND CONCLUSION Centralisation has not significantly impacted the overall efficiency of the carotid endarterectomy pathway. This study highlights areas where improvement across the vascular network is required. This includes addressing the 35% patients that are not currently meeting the 14-day target and standardising the provision of care to outlying communities. Further follow-up is required to assess the longer term effects of centralisation.

KEYWORDS

Carotid endarterectomy – Symptomatic – Transient ischaemic attack

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Introduction

Centralisation of healthcare services, also known as clinical service reconfiguration, is a process proposed by the government to generate specialised clinical networks within particular medical and surgical specialities to standardise care and optimise outcomes for patients.¹ A key factor initially driving the proposition of clinical service reconfiguration was a wealth of research that demonstrated a positive relationship between volume and outcome.^{2,3,4} The aim of these clinical networks is to improve service quality, clinical outcomes and the overall efficiency of healthcare,⁵ while minimising the geographical discrimination present in healthcare provision.⁶

In October 2014, the vascular surgical services across the Bath, Bristol and Weston area centralised. This involved the

merging of vascular surgical services from three different hospital trusts: the North Bristol NHS Trust (NBT), the Royal United Hospital Foundation Trust, Bath (RUH), and the Bristol Royal Infirmary (BRI, which provided vascular services to Weston General Hospital) to create a vascular network. This was carried out using the 'hub and spoke' model.⁷ NBT is the 'hub' hospital, where all arterial surgery is performed and the specialist vascular surgeons are based. BRI and RUH are the main 'spoke' hospitals, which continue to provide diagnostic services, daycase interventional radiology and consultant outpatient appointments.

One particular disease associated with vascular surgery is a transient ischaemic attack (TIA), which may lead to a surgical procedure called a carotid endarterectomy. A TIA is a short episode of neurological dysfunction that occurs due to a temporary disruption in blood supply to part of the brain,

where symptoms are fully resolved within 24 hours.⁸ A patient who experiences TIA symptoms should be referred onwards for a specialist assessment in a timely manner. This allows for further investigations to be requested and stroke mimics to be excluded.⁹ In accordance with the North American Symptomatic Carotid Endarterectomy Trial (NASCET),¹⁰ a greater than 50% stenosis of the internal carotid artery contributes to approximately 20% of all ischemic strokes.¹¹ The risk of this stenotic atherosclerotic disease is embolisation and interruption of the brain's oxygen supply.^{12–14} If this is diagnosed, patients should be reviewed by the vascular team and should have a carotid endarterectomy to remove the stenotic atherosclerotic disease. This procedure has been shown to be efficacious in stroke prevention.¹⁰ This is crucial as, in 2015, stroke was documented the fourth largest cause of death in the UK,¹⁵ with 31,787 people dying from a stroke in 2014.¹⁵ Stroke is also a leading cause of adult disability, with 50% of stroke survivors suffering a disability.¹⁶

Data generated and published by the Oxford Vascular Study demonstrated that the risk of stroke is highest in the first few days following TIA,¹⁷ in particular within the first 2 weeks of the onset of symptoms.^{18,19} Data from 18 different studies regarding risk of stroke post-TIA and found an average stroke risk of 5.2% at 7 days post-TIA, with the risk of subsequent stroke decreasing after the first 2 weeks.^{20,21} The National Institute for Health and Care Excellence guidelines currently state that, where appropriate, a carotid endarterectomy should be performed within 2 weeks of symptom onset and patients should have a post-operative follow-up appointment within 6 weeks, (less than 42 days).⁹ The National Stroke Strategy reports that a carotid endarterectomy should be performed within 48 hours of symptom onset.²²

The objectives of this study were to assess any impact, either positive or negative, on service provision with regards to timescales within the carotid endarterectomy pathway, since the creation of a vascular network in the Bath, Bristol and Weston area.

Methods

Data input into the Royal College of Surgeons National Vascular Registry (RCSNVR) by the operating surgeon or vascular clinical nurse specialist were collected retrospectively from 6 October 2013 to 6 October 2015 for all patients who underwent a carotid endarterectomy procedure. This included all patients who underwent surgery who had a greater than 50% symptomatic stenosis of the internal carotid artery in accordance with NASCET criteria. Data from 6 October 2013 to 6 October 2014 (1 year precentralisation) were collected from three individual hospitals: RUH, BRI, and NBT. Data from 6 October 2014 to 6 October 2015 (1 year post-centralisation) were collected from one hospital, NBT. Consent was taken by the operating surgeon or vascular clinical nurse specialist from patients to allow data to be input into the National Vascular Registry, which included the use of anonymised data for research purposes. Therefore, for this particular study, all of the collected data were

anonymised and additional patient consent was not obtained. This study was approved by the service evaluation and audit departments at the Royal United Hospital Foundation Trust, Bristol Royal Infirmary and Southmead Hospital.

The National Vascular Registry contains personal patient information, patient demographics and key clinical information regarding the patient's care pathway. Dates of critical steps in the patient pathway and other key information was collected and recorded in Microsoft Excel; these included: date of patient symptoms, date of referral, date of first carotid duplex ultrasound scan, date seen by the surgical team, date of surgery, date of follow-up appointment, patient's home postcode.

The data collection aspect of this project relied on the data from the National Vascular Registry. Where possible, missing information from the database was obtained from the respective hospitals' computer systems. However, patients were excluded from the study if the date of patient symptoms (asymptomatic patients), date of surgery or home postcode were missing from the National Vascular Registry or were unobtainable.

The number of days, medians and interquartile ranges (IQR) were calculated for the following key dates for all of the individual hospitals precentralisation, all of the hospitals combined precentralisation and the hub hospital post-centralisation:

- > symptoms to surgery
- > symptoms to referral
- > symptoms to first scan
- > first scan to surgical team review
- > surgical team review to surgery
- > referral to surgery.

Four main comparisons were made:

- > NBT precentralisation and the hub hospital post-centralisation.
- > BRI precentralisation and the hub hospital post-centralisation.
- > RUH precentralisation and the hub hospital post-centralisation.
- > NBT, BRI and RUH combined precentralisation and the hub hospital post-centralisation.

Data were collected 6 monthly during the 2-year period to determine any direct effects immediately before or immediately after centralisation. The number of days from symptoms to surgery from NBT, BRI and RUH combined precentralisation and the hub hospital post-centralisation was used for this analysis, and medians and interquartile ranges were calculated.

The patient's clinical commissioning groups were determined via their home postcode. The following analysis was made.

- > Precentralisation: the number of days from symptom to surgery for different clinical commissioning groups were compared against each other to assess for any geographical variation of service provision.

- > Post-centralisation: the number of days from symptom to surgery for different clinical commissioning groups were compared against each other to assess for any geographical variation of service provision.
- > Comparisons of the number of days from symptom to surgery before and after centralisation for each individual clinical commissioning groups were made to determine any specific impact.

The number of days, medians and interquartile ranges from a patient's surgery to their postoperative clinic appointment was calculated to determine any improvements or delays in provision of follow-up clinics caused by centralisation. The number of follow-up appointments documented on the database was calculated. In addition, the percentage of follow-up appointments that were within 42 days from the patient's surgery was calculated.

Statistical analysis

Medians and interquartile ranges were calculated and analysed using 'Minitab'. To allow for consistency with the UK Carotid Endarterectomy Clinical Audit, data analysis was performed using medians rather means.²⁵ Statistical analysis was performed using non-parametric, Mann Whitney U tests on 'Minitab 17'. The null hypothesis was defined as 'the true population medians are equal'. A *P* value of less than .05 was considered significant.

Results

In total, 261 carotid endarterectomy procedures were recorded on the RCSNVR from 6 October 2013 to 6 October 2015. Applying the preset exclusion criteria, 10% of patients were excluded from the study as they were asymptomatic and 3% were excluded as no patient home postcodes were documented; data for the remaining 228 patients were used for this study (Fig 1).

There was no significant difference ($P = .175$) between the median time from symptom onset to surgery for combined NBT, BRI and RUH precentralisation data (11 days) and the post-centralisation data (12 days; Fig 2) with 65% of the patients both pre- and post-centralisation receiving their carotid endarterectomy within 14 days of symptom onset.

There was no significant difference in the number of days from symptom to surgery between any of the three hospitals individually (NBT, $P = .187$; BRI, $P = .058$; RUH, $P = .425$) before centralisation (Table 1) and the hub hospital post-centralisation (Table 2). A slight increase in the numbers of days from symptoms to surgery was noted after the vascular network was initiated compared with NBT and RUH precentralisation: from 9 days to 12 days and from 11 days to 12 days, respectively (Tables 1 and 2). In addition, a decrease in the percentage of patients being seen within the recommended timescale was noted at NBT and RUH: from 77% to 65% and from 70% to 65%, respectively, since centralisation.

The median time from symptom to surgery precentralisation at the BRI was 22 days (Table 1), which has reduced to 12 days with the generation of the vascular network (Table 2). Precentralisation, 61% patients from the BRI were not

meeting the less than 14-day target. This has decreased post-centralisation to 35% of patients not meeting the national target.

During the 2-year data collection period (broken down into four 6-month sections) no significant disruptions to the carotid endarterectomy services were seen. A slight increase in median times of symptom to surgery, from 11 days to 12 days was seen in the 6 months directly before and directly after centralisation (Fig 3). The interquartile range was smallest in the last 6-month period of data collection (median 8.75; IQR 7.25–16) compared with the 6 months directly before centralisation (median 21; IQR 7–28).

The clinical commissioning groups show a trend of decrease in variation of service provision post-centralisation in comparison with precentralisation, although this is not

Table 1 Summary of key dates collected for patients during the carotid endarterectomy pathway, individual hospitals precentralisation

Key dates	NBT (days)				BRI (days)				RUH (days)			
	(n)	(min–max)	median	IQR	(n)	(min–max)	median	IQR	(n)	(min–max)	median	IQR
Symptoms to:												
Surgery	35	3–59	9	8–14	26	1–76	21.5	9.5–3.7	60	2–153	11	6–21.75
Referral	35	0–56	3	2–8	26	0–48	9	2.75–18	60	0–29	3	1–7.75
First scan	35	0–56	2	1–6	26	0–48	7	2.75–18.75	58	0–29	1.5	1–6.25
Surgical team review	35	0–10	3	1–5	26	0–42	0	0–5	59	0–47	0	0–4
Surgical team review to surgery	35	0–15	3	1–4	25	1–66	6	2–14.5	60	0–106	4	2–9
Referral to surgery	35	1–15	5	6	25	1–66	6	3–21.5	60	1–153	8	3.25–13

BRI, Bristol Royal Infirmary; NBT, North Bristol NHS Trust; RUH, Royal United Hospital Foundation Trust, Bath

Table 2 Summary of key dates collected for patients during the carotid endarterectomy pathway for North Bristol NHS Trust (NBT), Bristol Royal Infirmary (BRI) and Royal United Hospital Foundation Trust, Bath (RUH) combined

Key dates	Precentralisation (days)				Post-centralisation (days)			
	(n)	(min–max)	median	IQR	(n)	(min–max)	median	IQR
Surgery	121	1–153	11	7–23	107	1–129	12	7–23
Referral	121	0–56	4	1–10	107	0–124	3	1–10
First scan	119	1–56	3	1–9	106	1–123	3	1–9
Surgical team review	120	0–47	2	0–4.75	120	0–47	2	0–4.75
Surgical team review to surgery	120	0–106	4	2–9	106	0–65	4	2–7
Referral to surgery	120	1–153	6	3–12	106	1–97	6	3–10

statistically significant (Figs 4 and 5). The median time from symptom to surgery has been reduced from 24 days to 12 days in North Somerset, bringing this clinical commissioning group into line with national targets. A decrease, although not significant, in interquartile range was seen in the following clinical commissioning groups post-centralisation: North Somerset from 32.75 to 22.5, Bristol from 18.75 to 15.75 and Bath and North East Somerset from 59 to 17. No significant differences were seen between Wiltshire and South Gloucestershire clinical commissioning groups pre- and post-centralisation. An increase in median time from symptom to surgery was seen in the Somerset clinical commissioning group, from 13 days to 21 days, which means that it no longer meets national guidelines. The interquartile range for Somerset clinical commissioning group increased from 17 days (IQR 6–23 days) to 33.75 days (IQR 4.75–40.5 days; Table 5).

NBT, BRI and RUH precentralisation combined were inputting follow-up appointment information to the NVR database for 69% of their patients. Post-centralisation follow-up appointments were input to the NVR database for 61% of the patients. No significant differences were seen in patient follow-up since the vascular network was created.

The median time from surgery to follow-up precentralisation was 50 days, (IQR 27; 42–69) compared with 56 days (IQR 19; 48–67) post-centralisation (Fig 6).

Discussion

Centralisation of vascular surgical services was an idea proposed by the government to improve healthcare service provision and patient care pathways. The current literature is limited, however, and remains contradictory with regard to the benefit of centralisation.^{24,25} This study analysed data from three individual hospitals before and after centralisation to determine whether there had been any alterations in service provision of the carotid endarterectomy pathway, either positive or negative. Such knowledge is important not only for monitoring service provision but also to demonstrate the effects of centralisation to other hospitals across the UK.

The main finding of this study is that no significant differences were seen in the overall symptom to surgery data from all hospitals before and after the centralisation of services. This indicates that, overall, initiating the vascular network has had no negative impact to the patient care

Figure 3 Median number of days from symptoms to surgery before and after centralisation over 6-month periods.

Figure 5 Median number of days from symptoms to surgery in clinical commissioning group post-centralisation.

Figure 4 Median number of days from symptoms to surgery in clinical commissioning group precentralisation.

Figure 6 Median number of days from surgery to follow-up before and after centralisation.

pathway. Importantly, as a vascular network, the median number of days from patient's symptoms to surgery is 12 days, which is comparable to the national median of 13 days reported by the UK Carotid Endarterectomy Audit, Round 5.²⁵ However, it has highlighted that 35% of the patients seen in the vascular network are not meeting the national target time for their surgery from the date of their symptoms. This study looked in detail at the different components of the pathway and potential areas for delay. It can be concluded that there is no one particular part of the pathway that is causing significant delays. In some cases, however, where a larger delay was seen, factors that may have affected different timeframes within the pathway components included complicated cases that relied on multidisciplinary team discussions and patients who required further or secondary imaging such as CT or magnetic resonance imaging.

Importantly, this study has shown that centralisation has improved the services of the BRI, which includes the data generated from Weston General Hospital. It has brought the

median time (days) from symptom onset to surgery into line with national targets,⁹ with an increased in percentage of patients being seen within the target time of less than 14 days from 39% to 65%. On the other hand, a slight decrease in efficiency of service provision was seen in NBT and RUH; however, a large amount of change with regards to staffing and facilities at both of these hospitals was happening during this period, which may account for the slight delay introduced by centralisation.

With regards to the 6-month data, a trend is seen representing slight disruption of the services provided in the 6 months directly before and directly after development of the vascular network. This alteration was minimal and a promising recovery was apparent 6 months after centralisation was initialised. The last 6-month period of data collection has the smallest IQR, indicating that variations in service have decreased, supporting the implementation of a vascular network and standardisation of care.

A comparison of the clinical commissioning group with each other before centralisation demonstrated that there

Table 3 Summary of key data from clinical commissioning groups (CCG)

CCG	Precentralisation (days)				Post-centralisation (days)			
	(n)	(min–max)	median	IQR	(n)	(min–max)	median	IQR
South Gloucestershire (12A)	25	3–153	9	6.5–15.5	20	5–92	10	5–17.75
Bristol (11H)	18	1–71	14.5	8.75–27.5	34	2–62	11.5	8–23.75
North Somerset (11T)	16	6–76	24	9.75–42.5	18	5–129	12	5–27.5
Wiltshire (99N)	31	2–91	10	5–16	16	5–61	12	7–16
Bath and North East Somerset (11E)	15	2–100	9	6–65	13	1–101	13	4.5–21.5
Somerset (11X)	15	5–79	13	6–23	6	4–45	21	4.75–40.5

was some variation in the services provided to different geographical locations. Interestingly, when performing the same comparison of the clinical commissioning group post-centralisation, a decrease in variation supported by IQR (Table 3) was seen, despite one clinical commissioning group where variation seems to have increased. This is in keeping with network principle of offering equitable health-care access to patients. Somerset clinical commissioning group is an outlying group of the network that has been negatively impacted by centralisation.

The overall input of follow-up data into the database was poor. Where it was completed, there was a failure to meet the target for follow-up appointments of less than 42 days for 79% of patients before and 89% patients after centralisation. Follow-up postoperatively is important to assess the outcomes of surgery and to provide information regarding the assessment of risks compared with benefits of surgical intervention.

This study is beneficial in providing an insight into the initial effects of centralisation; however, it also opens many areas for future work and investigation to be carried out. This would involve further data collection, to assess the effects over a longer time period, especially when looking at the effect of centralisation over time, as 6-monthly data analysis may introduce seasonality effects.

It has highlighted that 35% of patients are currently not meeting the national target. As a network, this needs to be addressed. One potential objective could be to increase communication with the many other healthcare professionals who refer patients to the vascular network regarding the emphasis and importance of quick referral when patients present with symptoms suspicious of a TIA.

The study identified a negative impact of service provision to an outlying clinical commissioning group and this is another area that requires further investigation. It is important to recognise that the numbers of patients whose data are available for analysis in this particular clinical commissioning group are small, as patients may have been seen at adjacent networks. The clinical commissioning group analysis for this study was carried out on patients' home postcodes. It is recognised that the preferred method would have been to use the patients' GP postcodes but these data were

not available on the database: a prospective study could aid this aspect of the study.

Patient postoperative follow-up is currently not sufficient. This delay has been recognised and additional consultant clinics could be implemented to ensure that all patients are having their necessary post-operative follow-up appointments in a timely manner.

Limitations of this study include relying on the RCSNVR for the majority of the data collection, the retrospective design of the study and the limited time frame for follow-up.

Conclusion

Overall, centralisation has not significantly impacted the carotid endarterectomy pathway service provided across the Bath, Bristol and Weston area. Currently, the vascular network is meeting the target of less than 14 days from symptoms to surgery in 65% of patients. It appears that, since centralisation, the variation in service provision has decreased, which is a very promising outcome. It is crucial that these data are monitored further to ensure that continual progress is being made. An improvement in the service provision from one hospital in particular was seen, strongly supporting the benefit of the centralisation of services, to standardise healthcare provision.

There was no one particular area that could be highlighted as causing the delay from symptom onset to surgery but the study did show that when delays were occurring they were quite long delays. Combatting these delays will involve an increase in efficiency at each step of the pathway and an increase in healthcare promotion to our society, to emphasise the importance of stroke-like symptoms. The clinical commissioning group data emphasise a focus on providing the same level of care to all clinical commissioning groups, including the outlying communities. Data regarding patient follow-up were limited, as the National Vascular Registry's database was not always fully complete. This study has highlighted this issue, providing reinforcement of the importance of this database and of its completeness. The data collected regarding follow-up appointments showed that many appointments were delayed, highlighting the need for additional consultant clinics to allow for these follow-up

appointments. Further evaluation is required to demonstrate the outcomes of centralisation over a longer period.

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