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A strategy to meet the 'two-week' target for carotid endarterectomy in symptomatic patients

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ABSTRACT – Carotid endarterectomy (CEA) within two weeks of the index neurological event (INE) achieves maximum stroke prevention. This study assesses the impact of institution-wide policy changes on CEA performance in symptomatic patients. Between two study periods (1 January 2007 and 31 December 2007; 1 August 2008 and 31 July 2009) transient ischaemic attack (TIA) clinics, an acute stroke protocol and utilisation of vascular operating lists, were adopted. Following the changes, the interval between the INE and CEA fell from 23 (n=65; interquartile range (IQR) 9–66) to 6.5 (n=52; IQR 2–13.5) days ($p<0.001$) with 32.3% *v* 82.7% performed within two weeks ($p<0.001$). Significant improvements were seen in the time taken from onset of symptoms to presentation, and presentation to a carotid duplex and surgical review. Univariate analyses suggest this improvement is associated with the type of INE, point of presentation and the need for further imaging. Implementation of these policies has produced a significant improvement in service provision largely meeting the two-week target.

KEY WORDS: carotid endarterectomy, service provision, stroke prevention

Introduction

Stroke affects 120,000 people per annum and is associated with a 30-day mortality of approximately 25%.[1] Carotid disease accounts for 15% of all strokes and there is level 1 evidence to support the role of carotid endarterectomy (CEA) in stroke prevention in symptomatic patients with a high-grade internal carotid artery stenosis (50–99% according to North American Symptomatic Carotid Endarterectomy Trial (NASCET) criteria or 70–99% according to European Carotid Surgery Trialists' (ESCT) criteria).[2] In these symptomatic patients, the risk of stroke is highest in the first two weeks following the index neurological event (INE; an acute non-disabling stroke or transient ischemic attack (TIA)).[3] Indeed, a CEA performed within this time period prevents 185 ipsilateral strokes at five years per 1,000 CEA performed.[4] This benefit dramatically falls if CEA is delayed. In the UK, the National Institute for Health and Clinical Excellence (NICE) recommends that patients should undergo a CEA within two weeks following the INE.[5] However, a recent study of the current practice in the UK found that surgery was delayed longer than two weeks in 80% of patients following their most recent neurological symptoms.[6] Changes to individual operating practices, such as ad hoc cancellation of non-urgent cases and utilisation of cancelled theatre sessions, do not appear to make a significant impact on service provision.[7] The aim of this study was to assess the impact of institution-wide policy changes on CEA performance in symptomatic patients.

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Methods

Design

Institution-wide policy changes affecting the care of patients presenting with a TIA (a focal neurologic deficit that lasts <24 hours) or a stroke (a focal neurologic deficit that lasts for >24 hours) were implemented on 1 January 2008 at the Leeds General Infirmary. This comprised daily TIA clinics, an acute stroke protocol for patients presenting to the medical admissions unit with symptoms or signs of a focal neurological deficit, and utilisation of the next available vascular surgical operating list for patients requiring a CEA. Patients presenting to the TIA clinic or on the stroke protocol had basic investigations and were referred for an urgent carotid duplex and reviewed by a stroke physician. An urgent referral to the on-call vascular surgeon was made by the stroke physician for symptomatic patients with an ipsilateral high-grade internal carotid artery stenosis (50–99%). Once the decision was made that a CEA would benefit the patient, the vascular surgeon with the next elective list was contacted and non-urgent cases cancelled to accommodate the urgent patient. There are seven full-days and one half-day operating sessions every week in the unit. If the operating surgeon was different to the consultant taking the referral, the patient was reviewed preoperatively by the operating surgeon. CEA was performed under either local or general anaesthetic depending on patient preference.

Subjects

All symptomatic patients undergoing a CEA were included over two study periods: prior to the policy changes (group 1; 1 January 2007 to 31 December 2007) and a period starting eight months after the adoption of the changes (group 2; 1 August 2008 to 31 July 2009). Observational data were retrieved from case notes and a prospective database at the Leeds Vascular Institute.

Outcome

The primary outcome was time taken from the onset of neurological symptoms (as described by the patient) to the performance of the CEA. Information on other time points such as presentation to any healthcare professional, carotid duplex or other imaging was collected. In addition, inpatient morbidity including a perioperative stroke (defined as a new focal neurologic deficit following the CEA), wound haematoma (either treated conservatively or surgically) or cardiac complications and inpatient mortality was retrieved from a prospective database and casenotes.

Data analysis

Non-parametric analysis was used with values expressed either as frequencies (percentages) or as median values (+/− ranges) where appropriate. A Mann-Whitney U test was used to determine differences between groups. Univariate analysis was performed to identify factors associated with percentage of CEA performed within two weeks using a Chi-squared test. All analyses were performed using SPSS version 15 (Statistical Package for Social Sciences Inc, Chicago, Illinois, USA) with a p-value ≤ 0.05 deemed significant.

Results

Two study periods were audited: group 1 (prior to the policy changes) and group 2 (a period starting eight months after the adoption of the changes). During the first study period, 65 CEA were performed in symptomatic patients with high-grade internal carotid artery stenosis and 52 CEA in group 2. There was no significant difference in patient demographics, risk factors for cardiovascular disease or comorbidity between the two groups (Table 1).

The INE in group 1 was more often a TIA rather than a stroke (72.31% *v* 18.46%, table 1). This differed in group 2 which had similar proportions presenting with TIA and stroke (46.15% *v* 42.31%). Both groups included small numbers of patients with amaurosis fugax.

There was a significant reduction in the time taken from the INE to CEA from 23 to 6.5 days in group 1 and 2 respectively (Table 2). Thus, 32.3% *v* 82.7% of CEA were performed within two weeks of the INE (crude odds ratio 10.75; 95% confidence interval 4.41 to 26.20, $p<0.001$). There were significant improvements in the time taken from onset of symptoms to patient's assessment by any healthcare professional (including a stroke physician); for appropriate imaging to be performed and for a vascular surgical review (Table 2). In addition, the delay from surgical review to surgery was significantly reduced (Table 2).

Univariate analysis showed that prior to implementation of these changes, patients presenting with a stroke, requiring a neurology review or further imaging were less likely to have their CEA performed within two weeks (Table 3). In addition, presenting with amaurosis fugax or to the accident and emergency department were treated more quickly in group 1 (Table 3). These differences were not present in group 2 (Table 4).

The perioperative stroke rate did not significantly differ between group 1 and 2 (1.52% *v* 3.85%, $p=0.433$). In addition, the number of wound haematomas and cardiac complications were similar (4.84% *v* 3.85%, $p=0.623$ and 3.23% *v* 1.92%, $p=0.221$ respectively). The inpatient mortality in both groups was zero.

Discussion

Early CEA has a major role in stroke prevention in patients with high-grade symptomatic carotid stenosis.[4,8] Indeed,

Table 1. Patient demographics. Values are absolute numbers and (%), unless stated.

Demographics	Group 1 (n=65)	Group 2 (n=52)	p-value
Age (SD)	72.49 (9.91)	70.12 (9.26)	0.187
Males	46 (70.77)	34 (65.38)	0.534
Risk factors			
Smoking	40 (61.54)	33 (63.46)	0.872
Hypertension	39 (60.00)	32 (61.54)	0.798
Diabetes mellitus	6 (9.23)	7 (13.46)	0.429
Co-morbidity			
Coronary artery disease	15 (23.08)	14 (26.92)	0.627
Previous myocardial infarction	5 (7.69)	7 (13.46)	0.211
Peripheral artery disease	12 (18.46)	9 (17.31)	0.712
Respiratory disease	6 (9.23)	5 (9.62)	0.910
Index neurological event			
Stroke	12 (18.46)	22 (42.31)	0.005
Transient ischaemic attack	47 (72.31)	24 (46.15)	0.004
Amaurosis fugax	6 (9.23)	6 (11.54)	0.683

Table 2. Time taken from index neurological event (INE) to carotid endarterectomy (CEA). Values are number of days and interquartile range.

Time period	Group 1 (n=65)	Group 2 (n=52)	p-value
INE to presentation to any healthcare professional*	1 (0–16)	0 (0–1)	0.002
Presentation to carotid duplex	10 (3–48)	2 (1–8)	<0.001
Presentation to seeing a vascular surgeon	13 (4–43)	4 (1–9)	<0.001
Assessment by a vascular surgeon to operation	6 (2–18)	3 (1–5)	0.012
Onset of symptoms to operation	23 (10–122)	6.5 (4–12)	<0.001

*In accident and emergency, a GP or outpatient clinic.
INE = index neurological event.

Table 3. Factors affecting time to carotid endarterectomy (CEA) in group 1. Values are absolute numbers and percentages, unless stated.

	n	% of CEA performed within two weeks	p-value
Age			
<65	13	38.46	0.108
66–75	28	21.43	
>76	25	32.00	
Sex			
Male	46	34.78	0.126
Female	19	15.79	
Presenting symptom			
Stroke			
Yes	12	0	0.014
No	53	35.85	
Transient ischaemic attack			
Yes	47	27.66	
No	18	33.33	0.653
Amaurosis fugax			
Yes	6	100	
No	59	22.03	<0.001
Site of initial presentation			
Accident and emergency			
Yes	24	79.17	
No	41	0	<0.001
General practitioner			
Yes	38	0	
No	27	70.37	<0.001
Outpatients clinic*			
Yes	3	0	
No	62	30.65	0.254
Neurology review			
Yes	54	24.07	
No	11	54.55	0.043
Additional imaging#			
Yes	43	4.65	
No	22	77.27	0.015

*In any specialty clinic; #Of the carotid or cerebral vasculature.

recently published NICE guidelines support CEA within two weeks of the INE.[5] Implementation of daily TIA clinics, an acute stroke protocol for emergency admissions, urgent carotid imaging and utilisation of the next vascular surgical operating list have produced a 10-fold improvement in service provision. These changes have resulted in 82.7% of patients meeting the NICE target. In addition, neither urgent surgery nor CEA performed by surgeons without a special interest in carotid disease have increased complication rates.

A survey of the current practice in the UK found that only 20% of the recently symptomatic patients underwent a CEA within two weeks.[6] Individual surgeons and centres have attempted to improve this with the adoption of policies including cancellation of non-urgent cases, utilisation of cancelled theatre sessions and distribution of case load between surgeons. However, these studies have only produced modest improvements.[7] Indeed, in our study the adoption of such changes only reduced the time taken between the initial vascular surgical assessment and operation from six to three days. Therefore, it is likely that one or more other factors, such as government initiatives, the face, arm, speech, time (FAST) campaign, and increased awareness may have had a profound impact.

An essential part of the preoperative assessment of patients requiring a CEA is imaging. In particular, carotid duplex provides a highly sensitive and specific non-invasive imaging modality and has been used alone by some to assess these patients.[9] In this study, there was a significant improvement (10 to two days) in the time taken from presentation to a carotid duplex. In addition, following the policy changes, additional imaging (eg magnetic resonance angiography) was no longer associated with failure to meet the two-week target. Interestingly, no significant expansion in vascular radiology services occurred during the study periods.

The ABCD scoring system has been shown to be highly predictive of future neurological events.[10] It has been used in this institution's emergency and admission units since 2007. This, in part, may account for the observation that if patients presented to accident and emergency in group 1, they were significantly more likely to meet the two-week target. The effect of the ABCD scoring system was not formally assessed here. However, the use of this, together with TIA clinics and an emergency acute stroke protocol, should identify high-risk patients early. This in association with increased awareness, improved utilisation of vascular radiological and surgical services are likely to be the key reasons for the observed improvements.

In addition, the perception of the general public to the importance of symptoms and signs of TIAs and stroke has

Table 4. Factors affecting time to carotid endarterectomy (CEA) in group 2. Values are absolute numbers and percentages, unless stated.

	n	% of CEA performed within two weeks	p-value
Age			
<65	18	83.33	0.452
66–75	16	75.00	
>76	18	88.89	
Sex			
Male	34	79.41	0.390
Female	18	88.89	
Presenting symptom			
Stroke			
Yes	22	86.36	0.549
No	30	80.00	
Transient ischaemic attack			
Yes	24	75.00	0.175
No	28	89.29	
Amaurosis fugax			
Yes	6	100	0.233
No	46	80.43	
Site of initial presentation			
Accident and emergency			
Yes	27	85.19	0.621
No	25	80.00	
General practitioner			
Yes	9	77.78	0.668
No	43	83.72	
Outpatients clinic*			
Yes	16	81.25	0.855
No	36	83.33	
Neurology review			
Yes	26	84.62	0.714
No	26	80.77	
Additional imaging#			
Yes	29	86.21	0.721
No	23	78.26	

*In any specialty clinic; #Of the carotid or cerebral vasculature.

been historically poor.[11] However, the results presented here would suggest that initiatives such as the FAST campaign have had a positive impact on the time taken for patients to present to any healthcare professional.[12]

An important caveat to this work is that the time window for CEA to achieve maximal stroke prevention is likely to be much shorter than that suggested by NICE. Nearly two thirds of patients who present with an ischemic stroke have a preceding INE within 48 hours.[13] Following the changes implemented in this centre, only 17.3% of CEA are performed within 48 hours of the INE. This study did not assess the consequences of delays to surgery. However, from the data presented here significant improvements can still be made to further fast-track high-risk patients for radiological and surgical assessments. In addition, some patients in this unit still wait an average of 72 hours from surgical assessment to operation and there may be a need for a review of coordination of services in an era of centralisation of vascular surgical care.

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