

lesions are significantly smaller and paler. The patient still has not experienced any clinical symptoms, except occasional headaches.

With appearance of two new lesions dissemination in space and time has now occurred making the diagnosis of ADEM extremely unlikely. The possibility of multiphasic disseminated encephalomyelitis is also negligible because of absence of any clinical symptoms.

Radiologically isolated syndrome diagnoses should always prompt a vigilant search for alternative causes.³ Red flags to the clinical history, laboratory and MRI findings must be carefully excluded in RIS patients. However one should bear in mind that after thorough investigation, even if several red flags are present, multiple sclerosis patients can have atypical clinical/MRI presentations. Therefore we conclude that the presented case is an unusual case of RIS very suggestive of multiple sclerosis. Immunomodulatory treatment should be considered in such patients due to destructive nature of the lesions.

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TO THE EDITOR

Delays in Carotid Endarterectomy with Symptomatic High-Grade Carotid Stenosis

Ischemic stroke is a major health care problem. In Canada, 47500 people are affected by a stroke or transient ischemic attack (TIA) each year, costing an estimated \$22.2 billion in healthcare costs and lost productivity¹. A significant percentage of cases are associated with extracranial carotid disease, and recurrent stroke is a major concern. Pooled randomised controlled trial data has shown carotid endarterectomy (CEA) to significantly reduce this risk. If CEA is performed within two weeks there is a 30% absolute five year risk reduction of ipsilateral carotid ischemic stroke. However, the benefits rapidly decline if the procedure is performed after two weeks from the index TIA or stroke event. Benefits fall to 18% with CEA at one month, and 9% with CEA beyond three months².

Evidence that CEA reduction of future stroke risk is time dependent promoted changes in clinical practice guidelines. The National Institute for Health and Clinical Excellence, American Academy of Neurology, National Stroke Association and Canadian Stroke Network now recommend CEA within two weeks of a recent TIA (cerebral or retinal) or non-disabling stroke for high-grade ipsilateral extracranial carotid stenosis. Several years after publication, the translation of these guidelines into clinical practice is still ongoing. A recent study at 12 designated stroke centres across Ontario, Canada, showed a

Table 1: Patient characteristics (n=124)

Demographics	n (SD)
Age, mean	71.2 (9.7)
	n (%)
Male sex	81 (65)
Right-sided CEA	61 (49)
Presenting symptoms/signs	
Unilateral Weakness	72 (58)
Visual field defect	41 (33)
Unilateral Sensory symptoms	16 (13)
Aphasia	14 (11)
Dysarthria	14 (11)
Other	6 (5)
Contralateral severity	
Mild	81 (65)
Moderate	3 (2)
Severe	37 (30)
Occluded	0 (0)
Unknown	3 (2)

Table 2: Number of CEAs completed within specified time frames

	14 days, n (%)	30 days, n (%)	60 days, n (%)
Overall Cohort	56 (44)	77 (60)	99 (77)
Women (n=43)	18 (42)	26 (60)	33 (77)
Men (n=81)	38 (47)	51 (63)	66 (81)
Age >75 (n=47)	23 (49)	33 (70)	41 (87)
Age ≤75 (n=77)	33 (43)	44 (57)	58 (75)
Motor deficit (n=72)	45 (63)	47 (65)	51 (71)
Visual field defect (n=41)	9 (22)	16 (39)	21 (51)
Sensory symptom (n=16)	7 (44)	8 (50)	9 (56)
Dysarthria (n=14)	6 (43)	8 (57)	12 (85)
Aphasia (n=14)	8 (57)	9 (64)	12 (85)

median event to surgery time of 30 days with only one-third of patients receiving a CEA within the two week target for moderate to severe symptomatic stenosis³. The objectives of this study were to (A) identify the steps from event to CEA and (B) determine the timing of these steps to better understand causes of CEA delay and highlight viable strategies for reducing delays.

METHODS

Study Design and Data Sources

We performed a retrospective chart-review of consecutive patients presenting to Sunnybrook Hospital, Toronto, Ontario, Canada between January 2007 and January 2010, inclusive, with symptomatic high-grade extracranial carotid artery stenosis receiving CEA within one year. Symptomatic was defined as TIA (cerebral or retinal) or acute ischemic stroke. High-grade was defined as stenosis $\geq 70\%$ of the luminal diameter as described in the NASCET. Patients were identified within the Sunnybrook Hospital health records database by International Classification of Diseases, 10th Revision CCI procedure code=1.JE.57.^^. There were no exclusion criteria.

Analysis

We calculated time intervals between date of presentation to the emergency department, initial neurologist assessment, carotid imaging, referral to a surgeon, and carotid endarterectomy. Patient age, sex and presenting neurological deficits were extracted. Contralateral carotid artery stenosis was also recorded as mild (<50%), moderate (50-69%), severe (70-99%) or occluded (100%). We compared differences between sexes in median time to intervention using the Mann-Whitney test. The relationship between time to intervention and patient age was assessed using Spearman's Rank correlation. The predictive value of presenting symptoms, age, and sex on receiving CEA within 14 days of presentation was evaluated using binary logistic regression.

Statistical analyses were performed using SPSS Inc's PASW© 18.01 Statistical Analysis software and Microsoft® Excel© 2010. All tests use a $p < 0.05$.

RESULTS

Two hundred and twenty eight patients were identified in the database by ICD-10 procedure codes. Of these, 104 patients were excluded: 99 were asymptomatic up to the time of CEA, three had stenosis less than 70%, and two had incorrectly recorded procedure codes. One hundred and twenty four patients met inclusion criteria. Mean age was 71.2 (SD=9.7), the majority were male (81 patients – 65%). Demographics are provided in Table 1. There were 63 procedures performed on the left and 61 on the right. Contralateral carotid stenosis was mild (65%), moderate (2%), severe (30%) or not recorded (2%). Presenting symptoms included unilateral weakness (58%), visual field defects (33%), unilateral sensory symptoms (13%), aphasia (11%), dysarthria (11%), and/or other symptoms (5%).

Median time from presentation to neurology consult was one day (IQR: 0 to 3 days). Median presentation to carotid imaging and surgeon consult times were one day (IQR: 0.5 to 9 days) and five days (IQR: 0.5 to 22.5 days), respectively. Median surgeon consult to carotid endarterectomy time was 14 days (IQR: 6.5 to 36 days). Overall presentation to procedure median time was 20.5 days (IQR: 8 to 54 days). Fifty six patients (44%) received carotid endarterectomy within 14 days of presentation. Seventy-seven (60%) patients received the procedure within 30 days of presentation. 99 (77%) patients received the procedure within 60 days (Table 2).

A Mann-Whitney test showed no statistically significant difference in median times between sexes. Older patient age was associated with shorter time from presentation to both carotid imaging and surgeon consult, but did not increase the proportion of patients receiving CEA within 14 days. Motor deficit was associated with shorter time to imaging, surgeon consult, and surgery (Tables 2 and 3). Binary logistic regression showed

Table 3: Time (days and interquartile range) for each step from presentation to CEA

	P-N (IQR) (n=78)	P-CI (IQR) (n=128)	P-SC (IQR) (n=128)	SC-CEA (IQR) (n=128)	P-CEA (IQR) (n=128)
Overall Cohort	1 (0-3)	1 (0.5-9)	5 (0.5-22.5)	14 (6.5-36)	20.5 (8-54)
Women (n=43)	0 (0-17.5)	1 (0-11.5)	3 (0-33)	15 (6-35)	17 (7-75)
Men (n=81)	1 (0-2.5)	1 (0.5-9)	5 (1-18)	13 (7-40)	21 (8-46)
P-value*	0.54	0.80	0.34	0.99	0.85
Age >75 (n=47)	0 (0-2)	1 (0-10.5)	4 (0.5-14.5)	10 (5-41)	19.5 (7.5-43)
Age <=75 (n=77)	0.5 (0-4.5)	2 (1-12)	6 (0.5-28)	20 (8-41)	25 (8-70.5)
P-value †	0.51	0.01	0.29	0.02	0.09
Motor deficit (n=72)	0 (0-3)	1 (0-4.5)	2 (0-13.5)	9 (4-27.5)	10 (6-29)
Visual field defect (n=41)	1 (0-21.5)	4 (1-21.5)	9 (1-28)	23.5(11-41)	34.5 (17-74)
Sensory symptom (n=16)	0 (0-1)	7.5 (0.5-28.5)	8 (2-21.5)	10 (2-55)	13 (8.5-79.5)
Dysarthria (n=14)	1.5 (0-7.5)	1 (1-10)	7 (1-21)	6 (3-26.5)	25 (7-45.5)
Aphasia (n=14)	0 (0-6.5)	0.5 (0-8.5)	4 (0.5-25)	4.5 (1.5-16)	9 (4-43.5)

P-N = presentation to neurology consultation; P-CI = presentation to carotid imaging; P-SC = presentation to surgical consultation; P-CEA = presentation to carotid endarterectomy; *Mann -Whitney test ; †Spearman rank correlation

motor deficit as the only statistically significant predictor of achieving a presentation to CEA time of <=14 days (OR=9.6; $p<0.001$) (Table 4).

Interpretation

Ischemic stroke is a major health issue and carotid endarterectomy is a procedure with a recognized benefit of future stroke risk reduction for the subgroup of patients with symptomatic, severe stenosis. Despite evidence showing a significant decrease in the procedural benefit after 15 days, the percentage of patients receiving treatment in the recommended timeframe is still small. It is clear that a large amount of effort and resources are directed to stroke care at Provincial and Federal levels. Ontario has a very well organized stroke network, with designated Stroke Care Centers and a system to expedite access to care at specialized hospitals for acute stroke patients. Sunnybrook Health Sciences Centre is one of these centers. The fact that recent reviews show only 44% of patients with severe, symptomatic carotid disease receive treatment within the recommended window suggests that a "bottle neck" may be present.

Our series demographics are similar to others published. A mean age of 71 is in keeping with previously published results from this and other centres for symptomatic patients undergoing revascularization for acute ischemic stroke^{3,4}. A roughly equivalent number of procedures were performed on the left and right. There were no significant differences in delays between sexes. Presentation was slightly different from previous series

with lower proportions of hemispheric symptoms (motor deficits, sensory symptoms, aphasia, and dysarthria) and greater proportions of visual field defects³. Older patients had shorter presentation to imaging and surgical consultation times, but no improvement in rates of CEA within 14 days.

The proportion of patients with a motor deficit at presentation who received CEA within 14 days was significantly higher ($p<0.001$) and the presence of motor deficit at presentation was

Table 4: Factors associated with higher probability of CEA within 14 days of presentation

Factor	Odds-Ratio	95% CI	P-Value
Motor deficit	9.6	2.4-38.3	<0.001
Aphasia	3.8	0.8-18.6	0.11
Sensory symptom	2.5	0.6-11.3	0.22
Sex, Female	1.3	0.5-3.7	0.59
Dysarthria	0.8	0.2-3.6	0.81
Age	1.0	1.0-1.1	0.94
Visual defect	1.0	0.2-4.7	0.96

Odds-ratios represent the likelihood of CEA within 14 days; exponential of the B in binary logistic regression.

the only factor associated with a shorter time from event to CEA. This may be because motor symptoms are easily recognized by patients and physicians and when of acute onset, have a more limited differential diagnosis and workup compared to other stroke/TIA symptoms.

Medians and IQRs showed the time from presentation to surgical consultation and from surgical consultation to surgery to cause the greatest delay. Efforts to improve public awareness and in-hospital emergency evaluation/imaging seem to have resulted in shorter times from presentation to diagnosis. Our study does not allow for identification of the causes of delay between diagnosis and surgical consultation/CEA. However, one may wonder if the attention given to stroke prevention/treatment has two different “weights” – one for diagnosis, apparently effective and likely improving; and another for subacute management (revascularization), not so effective and in need of improvement. Considering that only 44% of the patients with symptomatic, severe carotid stenosis received CEA within 14 days of presentation at a tertiary designated Stroke Care Center, significant improvements must be made to consistently deliver timely revascularization^{3,5}.

Since the “bottle neck” seems to be between diagnosis and surgical consultation/CEA, improvements may include development of multi-specialist clinics for patients with strokes/TIAs (incorporating a “stand-by surgeon” to our current model of an urgent TIA Clinic), dedicated weekly fast-track ORs for CEA, single-visit multiple modality imaging, and continuing education recognizing symptomatic, high-grade carotid stenosis as a condition warranting urgent intervention⁵.

Our study has limitations: it is a retrospective review and bias is unavoidable. We attempted to be as accurate as possible and include all patients presenting to the hospital with ischemic symptoms and symptomatic severe carotid stenosis, but may have missed very sick patients initially turned down from surgical treatment and/or repatriated to their regional hospital after urgent evaluation. As well, the time to treatment may have been inflated by some patients with medical co-morbidities not fit for treatment in the first weeks. However, it reflects current daily practice in one of the largest Stroke Care Centers in Ontario and the “real life” scenario. Identifying issues preventing easy and expedited surgical revascularization for symptomatic carotid disease was already demonstrated to be important with regards to prevention, public education and stroke diagnosis, and hopefully will have similar effects on access to treatment.

CONCLUSIONS

Rates of carotid endarterectomy within 14 days of presentation have improved, however, delays due to long presentation to surgical consultation and surgery times are still worrisome. If tertiary care centres are to set an example for timely delivery of care, improvements such as fast-track dedicated ORs, single-visit imaging and interdisciplinary clinics, and education on the urgency of symptomatic, high-grade carotid stenosis must be considered. Future work comparing strategies such as these on a large scale are required to find efficient, cost-effective methods of delivering timely care.

ACKNOWLEDGEMENTS

This research was supported by a grant from the Canadian Stroke Network (Summer Research Studentship) given to Leodante da Costa.

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