The Relationship Between Socio-economic Status, Geography, Symptomatic Carotid Territory Disease and Carotid Endarterectomy


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Objective: recent evidence suggests a strong association between socio-economic status and atherosclerosis. However, little information exists on the relationship between socio-economic status, symptomatic carotid disease and rates of carotid endarterectomy (CEA). The aim was to evaluate the Carstair Deprivation Score (CDS) of (1) patients admitted with symptomatic carotid disease, and (2) those undergoing CEA in one health board.

Method: the CDS score was determined from the post-codes of all patients admitted with a diagnosis of transient ischaemic attack (TIA) or stroke due to cerebral infarction (ISD codes 433.1, 433.09, 435, 437.1; ICD-10: 165.2, 163, 163.2, G45.1, G45.3, G45.9) between 1st April 1995 and 31st March 2000. Expected and actual rates for each of the CDS (1 to 7) were determined by direct and indirect methods of standardisation allowing for age and sex. A similar analysis was performed for patients undergoing carotid endarterectomy. Results were analysed using the Mantel-Haenszel test. Only first time admissions and CEA were included.

Results: 1203 patients were admitted with the main diagnosis of symptomatic carotid disease. The admission rate of symptomatic patients was less than expected in the more affluent group (Carstair 1, p = 0.005) and significantly higher in the most deprived group (Carstair 7, p = 0.001). In comparison 192 patients underwent CEA. There were no differences between the expected and actual rates of CEA in each CDS, but the rates tended to be higher in the most affluent group. Geographical variation was also demonstrated with an increased rate of CEA in those patients living in the cities and a reduced rate in those in the rural communities.

Conclusion: patients from deprived socio-economic groups had a higher rate of symptomatic carotid disease, but this was not matched by an increased rate of CEA. This suggests that socio-economic inequalities in the prevalence of symptomatic carotid artery disease and treatment exist.

Key Words: Carotid endarterectomy; Stroke; Transient ischaemic attack; Socioeconomic group; Geographical.

Introduction

In 1991 the European and North American symptomatic carotid trials clearly demonstrated the benefit of carotid endarterectomy (CEA) in addition to best medical therapy in the prevention of stroke in patients with severe stenosis.1,2 However, in the United Kingdom CEA remains an underutilised method of stroke prevention.3 In Scotland, despite a 6-fold increase in the numbers of CEA performed between 1989 and 1995 there are increasing geographic inequalities with a 19-fold variation in the incidence of CEA between health boards.4 This was attributed to variations in referral practice rather than any regional difference in the rate of hospitalised stroke or transient ischaemic attack (TIA).

Socioeconomic status (SES) has been shown to correlate with cardiovascular morbidity and mortality. In particular, atherosclerosis of the carotid artery both at an early and advanced stage has been shown to be more common in patients of lower socio-economic groups.5-7 In asymptomatic men with no evidence of significant carotid stenosis or plaque, there has been shown to be a graded inverse association between SES and intima-media thickness of the carotid artery even after adjustment for risk factors.5 Stroke rates have also been shown to be increased in lower socio-economic groups for both sexes, as have mortality rates for ischaemic stroke.6,7 There is a paucity of information on the relationship between socio-economic status, symptomatic carotid disease and rates of CEA. The aim of this study was to describe, for the first time, socio-economic factors influencing the incidence of CEA within the catchment population of a University Vascular Unit.
Methods

The vascular unit referral area comprises the Grampian, Highland, Orkney Shetland health board areas and serves a population of 773,920. In this analysis we have not included patients from the Highlands and Islands who also undergo CEA in our unit as we do not have comparable figures for the rates of hospital admissions with symptomatic disease and population numbers required for the socio-economic analysis. The CEA rate (number of CEAs performed per head of the population) was compared with admission rates for TIA and stroke due to cerebral infarction (CVA) (CVA/TIA). The CEA and CVA/TIA rate was obtained from the Scottish Morbidity Record 1 (SMR 1) of hospital discharges. The accuracy of SMR 1 data for main clinical diagnosis has previously been shown to be 89%. Patients undergoing bilateral CEA were only included for the first procedure and only first time patient admissions with carotid territory disease were considered. Patients with symptoms of stroke or TIA were admitted to wards throughout the Grampian University Hospitals NHS trust including general medical and stroke units. The patients undergoing CEA were admitted to the vascular unit.

Socio-economic analysis was performed using Carstairs Deprivation Scores (CDS).9 The CDS allows quantification of relative deprivation or affluence in different localities and is generally applied to the populations of post-code sectors. In this analysis, the scores were calculated from census output areas, which are smaller than post-code sectors. This helps to identify pockets of deprivation. The score is calculated from four variables: overcrowding, male unemployment, low social class, and car ownership.9 The CDS has seven categories, ranging from the most affluent (1) to most deprived (7) which are derived from the overall scores.

The CDS was determined from the post-codes of all patients admitted with possible carotid territory symptoms over a 5 year period (1st April 1995 to 31st March 2000). The International classification of disease codes (ninth, valid until 1st April 1996 and tenth revision, ICD-9, ICD-10: 1) categories used were ICD-9: 433.1, 433.09, 435, 437.1 and ICD10.1: 65.2, 163, 163.2, G45.1, G45.3, G45.9. Expected and actual rates for each of the CDS (1 to 7) were determined by direct and indirect methods of standardisation allowing for age and sex. A similar analysis was performed for patients undergoing CEA. Results were analysed using the Mantel-Haenszel test.

The rates of admission for patients with TIA and stroke due to cerebral infarction, and rates of CEA were also analysed for the 115 electoral wards within the catchment area and the three regional areas (council areas) which represent an urban population (Area A), a mixed urban/rural population (Area B) and a rural population (Area C).

Results

The average rate per thousand per annum for patients admitted with the main diagnosis of TIA or stroke due to cerebral infarction was 0.4434 and for those undergoing CEA was 0.0708. Thus there was a seven-fold difference between those presenting with possible carotid territory symptoms and those undergoing CEA. It is estimated that 160 patients per million of the population per year may benefit from CEA.4 With a catchment area of 523,400 we should be performing 84 CEA per year. The population in this area is fairly endogenous and thus issues relating to racial differences can be excluded.10
One thousand two hundred and three patients were admitted with the main diagnosis of symptomatic carotid disease. The admission rate of symptomatic patients was less than expected in the more affluent group (Carstair 1, \( p < 0.005 \)) and significantly higher in the most deprived group (Carstair 7, \( p < 0.001 \)). The differences in the expected, assuming equal distribution, and the actual rates for each CDS are shown in Figure 1. In comparison, 192 patients underwent CEA during the 5 year time period. There were no differences between the expected and actual rates of CEA in each CDS (Fig. 2).

If we look at the distribution of admissions of patients with symptoms of TIA or stroke due to cerebral infarction by electoral wards and rates of CEA (Figs 3 and 4) we can see that there is considerable variation. These differences are likely to be attributed to geographical factors. Out of the 115 electoral wards there are only three which deviated significantly from than the expected number of patients admitted with symptoms. These three wards all had higher than expected rates of admission. If we consider the rates of admissions for patients with symptomatic disease and rates of CEA according to the three regional (council) areas, it can be seen that the number of CEA/per symptomatic patient was higher in Area A which represents the largest city at which the vascular unit is based (Table 1). This area also had a higher than expected number of CEAs performed per head of population. The most rural area (C), had a significantly lower than expected CEA rate and had the lowest ratio of CEA/symptoms. The socio-economic status of area C is not lower than that of Areas A and B.

**Discussion**

This study has shown that patients from deprived socio-economic groups have a significantly higher rate of symptomatic carotid disease. This, however, is not matched by an increased rate of CEA in this group of patients. Furthermore, patients from more affluent socio-economic groups had a rate of symptomatic carotid disease that was significantly less than that expected but yet tended to have a higher rate of CEA. We are unable to comment on patients with TIs or strokes who are managed solely in the community. However, these data suggest that socio-economic inequalities in the prevalence of symptomatic carotid artery disease and treatment exist.

The prevalence of risk factors for stroke can explain some of the socio-economic differences in stroke risk.
The Renfrew/Paisley study has shown large differences in stroke rate by deprivation category or social class. However, these differences were attenuated after adjustment for risk factors.\textsuperscript{11} The Malmo diet and cancer study, have shown an association between occupational status and carotid atherosclerosis in both sexes. However, after adjustment for risk factors this association persisted for women only.\textsuperscript{12} The effect of early life factors are somewhat controversial\textsuperscript{11,13} but adult socio-economic position, lifestyle and biological risk markers have been shown to be important determinants of cardiovascular health.\textsuperscript{13}

In the U.S.A. stroke mortality rates have not fallen since 1990 and wide variations in cardiovascular death rates amongst varying socio-economic and geographic groups have been shown to exist.\textsuperscript{14} This implies that there are major discrepancies in the use of proven approaches such as primary and secondary prevention to control cardiovascular disease. Thus lower socio-economic groups may not be receiving adequate preventive treatment to counteract their increased prevalence of risk factors.

This study also suggests that patients who are socially deprived may be less likely to undergo CEA once they have experienced a cerebrovascular event. It could be argued that this may be due to a type 1 error in view of the smaller numbers undergoing CEA, compared to those patients admitted with symptoms. We have performed the same analysis for all 259 patients undergoing CEA in the unit from 1991 to end of March 2000, and again have shown no significant difference between the socio-economic status and rates of CEA. The results, however, do show the similar trend of higher than expected numbers of CEA in the more affluent Carstairs category 1 and 2 which is illustrated in Figure 2. This is even more pertinent considering that cerebrovascular disease has been shown by this and other studies to be less prevalent in this affluent group. It could be argued that patients from deprived socio-economic groups may have more co-morbidity and thus relative contraindications for

Table 1. Rates of symptoms and CEA in the 3 regional (council) areas served by the Vascular Unit.

<table>
<thead>
<tr>
<th>Area</th>
<th>Number of patients admitted with symptoms</th>
<th>Number of CEAs (Actual numbers)</th>
<th>CEA/symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area A</td>
<td>520</td>
<td>98 **</td>
<td>1/5</td>
</tr>
<tr>
<td>Area B</td>
<td>172</td>
<td>30</td>
<td>1/6</td>
</tr>
<tr>
<td>Area C</td>
<td>511</td>
<td>64 *</td>
<td>1/8</td>
</tr>
</tbody>
</table>

\* p < 0.05 lower than expected by Mantel-Haenszel.
\** p < 0.01 higher than expected.

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surgery. However, we like many other units, are performing CEA on patients with increasing comorbidity and age. Differences between the socioeconomic groups may be due to a different pattern of disease with perhaps an increased incidence of symptomatic intercranial vessel disease rather than carotid disease in socially deprived patients. However, this is unlikely to account for the differences demonstrated in this paper as the Oxford study has clearly shown 81% of strokes are due to cerebral infarction and 80% of these occur within the carotid territory and are embolic in origin.

The geographical variation demonstrated in this study has shown that there is an increased rate of CEA in those patients living in the cities and a reduced rate in those in the rural communities. In this study this was not related to CDS and is likely to occur as a result of the increased utilisation of vascular disease.

While CEA remains an underutilised method of reduction. There is no doubt that CEA prevents stroke prevention. The fact that CEA is now generally achievable in either the ECST or the NASCET is crucial in terms of increasing both the clinical and cost-effectiveness of the procedure as a means of stroke reduction. There is no doubt that CEA prevents stroke and that strokes are expensive in both human and economic terms. CEA should thus be made available to those who require it, including those in the lower socioeconomic groups.

In conclusion, this study has shown that socioeconomic and geographical inequalities in the prevalence of symptomatic carotid artery disease and treatment exist. Proven primary and secondary prevention therapies need to be aggressively applied to prevent the morbidity and mortality of cerebrovascular disease.

References


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