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Short Report: Epidemiology

HbA_{1c} measurement and relationship to incident stroke

R. Robson[1], A. S. Lacey[2], S. D. Luzio[2], H. Van Woerden[3], M. L. Heaven[2], M. Wani[4], J. P. J. Halcox[2], L. Castilla-Guerra[5], J. Dawson[6] and J. Hewitt[3]

[1]Department of Geriatric Medicine, North Middlesex NHS Trust, London, UK, [2]College of Medicine, Swansea University, Swansea, UK, [3]Department of Primary Care and Public Health, Cardiff University, Cardiff, UK, [4]Department of Geriatric Medicine, Morriston Hospital Swansea, Swansea, UK, [5]Department of Internal Medicine, Hospital de la Merced, University of Seville, Spain and [6]Institute of Cardiovascular and Medical Sciences, University of Glasgow, Glasgow, UK

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Abstract

Aims To determine the proportion of people with diabetes who have HbA_{1c} measured, what proportion achieve an HbA_{1c} level of < 58 mmol/mol (7.5%), the frequency of testing and if there was any change in HbA_{1c} level in the year before and the year after an incident stroke.

Methods This study used the Secure Anonymised Information Linkage (SAIL) databank, which stores hospital data for the whole of Wales and ~ 65% of Welsh general practice records, to identify cases of stroke in patients with diabetes between 2000 and 2010. These were matched against patients with diabetes but without stroke disease. We assessed the frequency of HbA_{1c} testing and change in HbA_{1c} in the first year after stroke. Estimation was made of the proportion of patients achieving an HbA_{1c} measurement ≤ 58 mmol/mol (7.5%).

Results There were 1741 patients with diabetes and stroke. Of these, 1173 (67.4%) had their HbA_{1c} checked before their stroke and 1137 (65.3%) after their stroke. In the control group of 16 838 patients with diabetes but no stroke, 8413 (49.9%) and 9288 (55.1%) had their HbA_{1c} checked before and after the case-matched stroke date, respectively. In patients with diabetes and stroke, HbA_{1c} fell from 61–56 mmol/mol (7.7–7.3%) after their stroke ($P < 0.001$). Before the study, 55.0% of patients with stroke had an $HbA_{1c} \geq 58$ mmol/mol compared with 65.2% of control patients, these figures were 62.5% and 65.3% after the stroke.

Conclusions The frequency of diabetes testing was higher in patients who had experienced a stroke before and after their incident stroke compared with control patients but did not increase after their stroke. Glucose control improved significantly in the year after a stroke.

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Introduction

After experiencing a stroke, people with diabetes are more likely to have another stroke and to have earlier mortality than those who have not had a stroke [1]. The National Health and Nutrition Examination Survey study [2] has shown that, over a period of 9 years (between 1999 and 2008), there was an improvement in several cardiovascular risk factors including HbA_{1c} in people diagnosed with diabetes. Diabetes is common in patients with stroke but guidelines do not give specific recommendations concerning diabetes management after stroke, either in terms of frequency of HbA_{1c} testing or blood glucose control. What level of glycaemic control is achieved after a stroke and whether lowering of HbA_{1c} levels after a stroke through aggressive blood glucose control is beneficial is not known [3].

We aimed to determine the proportion of people with diabetes who have HbA_{1c} measured, what proportion achieve an HbA_{1c} level of < 58 mmol/mol (7.5%), the frequency of testing and if there was any observed change in HbA_{1c} level in the year before and after an incident stroke.

Methods

The Secure Anonymised Information Linkage (SAIL) databank stores hospital data for the whole of Wales, as well as for ~ 65% of Welsh general practices [4]. Once a general practice has voluntarily signed up to SAIL, data submission are facilitated annually. All historical general practice records are uploaded and made available for retrospective

Correspondence to: Jonathan Hewitt. E-mail: hewittj2@cardiff.ac.uk

What's new?

- This is the first description of HbA$_{1c}$ assessment in the year before and the year after an incident stroke.
- The study considers the Secure Anonymized Information Linkage (SAIL) databank, which is a large epidemiological resource, representative of the Welsh population.
- HbA$_{1c}$ levels were found to decrease in the year after a stroke by 4 mmol/mol (0.4%).
- Despite falls in HbA$_{1c}$ levels the frequency of HbA$_{1c}$ testing did not change in the year after a stroke.

analysis, with patient records being present based on the period of registration with the given practice. Nationwide Welsh hospital data are submitted annually to SAIL and processed by the NHS Wales Informatics Service.

A study window between 2000 and 2010 was used to select incident cases of stroke in Welsh hospitals, identified using International Classification of Diseases-10 codes I61 and I64. These individuals were then linked to data available in general practice records contained within SAIL by an encrypted National Health Service (NHS) number, where version 2 READ codes C10 and further subcodes (e.g. C101) were used to identify patients who had diabetes before their incident stroke, and READ codes 42W (including subcodes) and 44 TB, 44TC, 44TL were used to select HbA$_{1c}$ measurements in the year before and after the incident stroke. We only included patients who survived at least 1 year after stroke.

A control group was formed by selecting (without replacement) at least eight patients per case, matched by age and sex from the Welsh population that had diabetes. None of the control patients had reported any admission for stroke.

We determined the frequency of HbA$_{1c}$ testing and change in HbA$_{1c}$ levels in the first year after stroke, using one-sample *t*-tests (unpaired). The frequency group was a subset of the case–control group where each person survived the first year after stroke and was registered with a SAIL general practitioner for the years before and after stroke, and the HbA$_{1c}$ analysis was a subset of the frequency group, where all persons had at least one HbA$_{1c}$ measurement in the year before and after stroke. Finally, estimation was made of the proportion of both cases and controls who achieved an HbA$_{1c}$ measurement at or below 58 mmol/mol (7.5%).

Results

A total of 1741 patients met our inclusion criteria. Their mean (± SD) age was 72.3 (± 10.56) years. Of these, 1173 (67.4%) had their HbA$_{1c}$ checked in the year before their stroke and 1137 (65.3%) after their stroke. In the matched control group of 16 838 patients with diabetes but no stroke [mean (± SD) age 72.3 (± 10.27) years], 8413 (49.9%) and 9288 (55.1%) had their HbA$_{1c}$ checked before and after the case-matched stroke date, respectively.

Patients with diabetes had a higher mean frequency of HbA$_{1c}$ testing by their general practitioner before an incident stroke, with no change in frequency in the year after stroke. The patients with diabetes who had not experienced a stroke underwent a small increase in frequency of testing. These results are shown in Table 1.

In those who had experienced a stroke, the HbA$_{1c}$ level was 4 mmol/mol (0.4%) higher before their stroke compared with the control group ($P < 0.001$). A year after the index stroke, a decrease in HbA$_{1c}$ levels was observed in those in the case group, in both men and women, compared with the control group, where no change was observed (Table 2).

In the year before the study commenced, 55.0% of cases had an HbA$_{1c} \leq 58$ mmol/mol (7.5%) compared with 65.2% of controls, with the equivalent figures in the year after the stroke being 62.5% of cases and 65.3% of controls.

Discussion

Using the SAIL databank we examined diabetes control and monitoring in a large and generalizable cohort of stroke survivors. The frequency of diabetes testing was higher in patients with diabetes who had experienced a stroke before and after their incident stroke compared with control patients, but the frequency of testing did not increase after their stroke. We found glucose control, measured using both the HbA$_{1c}$ level and the percentage of patients achieving a target HbA$_{1c}$ level, improved significantly in the year after a stroke and became similar to that in patients with diabetes who had not experienced a stroke.

We found that the annual rate of testing was 78% in the year preceding stroke and 76% in the year after stroke. This is lower than the UK national audit results for patients with Type 2 diabetes, where 91.3% had an annual HbA$_{1c}$ in 2011–2012 [5]. The discrepancy may be explained by two factors. Firstly, we were not able to detect HbA$_{1c}$ measured in secondary care, a limitation of the SAIL databank. The national audit estimated secondary care HbA$_{1c}$ measures to account for just under 4% of their results. Secondly, our results are from the time period 2006–2010 compared with the latest national diabetes audit from 2011 to 2012. It is likely that, partly as a result of the audit itself, the frequency of testing has increased in this period in the UK as a whole. Our data support that by showing an increase in HbA$_{1c}$ testing in the control group.

The patients with diabetes who had experienced a stroke had a higher baseline rate of testing in the year preceding their stroke than the control group. This may reflect clinical concern regarding their HbA$_{1c}$ levels, which we found to be, on average, 4 mmol/mol (0.4%) higher in the year before their stroke than those of the control group.

Table 1 The annual frequency of HbA_{1c} testing in the year preceding and the year following an incident stroke

	Year before		Year after			
	Number Measured	Mean frequency	Number Measured	Mean frequency	*P*	*N*
Case group	1173	1.36	1137	1.35	0.91	1741
Men	676	1.41	651	1.41	0.90	978
Women	497	1.30	486	1.28	0.75	763
Control group	8413	1.03	9288	1.14	< 0.001	16838
Men	4474	1.05	4917	1.17	< 0.001	8745
Women	3939	1.00	4371	1.10	< 0.001	8093

Table 2 Average HbA_{1c} measurements before and after incident stroke

	Mean HbA_{1c}, mmol/mol (%)				
	Before	After	Mean difference (95% CI)	*P*	*N*
Case group	61 (7.7)	56 (7.3)	−0.38 (−0.46, −0.29)	< 0.001	1007
Men	60 (7.6)	56 (7.3)	−0.38 (−0.49, −0.28)	< 0.001	582
Women	61 (7.8)	57 (7.4)	−0.36 (−0.5, −0.2)	< 0.001	425
Control group	56 (7.3)	56 (7.3)	−0.01 (−0.03, 0.01)	0.47	7703
Men	56 (7.3)	56 (7.3)	−0.01 (−0.03, 0.01)	0.48	4118
Women	56 (7.3)	56 (7.3)	0 (−0.03, 0.02)	0.76	3585

The rates of HbA_{1c} testing after stroke did not increase. UK national guidelines recommend monitoring of HbA_{1c} every 2–6 months in patients with Type 2 diabetes [6]. Our findings were clearly below these guidelines. There are several possible explanations. Stroke frequently causes disability and reduced healthcare access, meaning that HbA_{1c} testing may not be easily available for all. Additionally, in those people with major disability, or those who receive end-of-life care, frequent HbA_{1c} monitoring may not be indicated

We also aimed to assess change in HbA_{1c} levels after stroke. We found the HbA_{1c} level was reduced substantially after a stroke, reaching the same level as in patients without stroke. A drop of 4 mmol/mol (0.4%) after a stroke will lead to better diabetic outcomes [7] and indicates an improved level of diabetes control overall. What level of post-stroke HbA_{1c} represents the optimum level after a stroke is still to be determined and warrants future study. The present study only considered HbA_{1c} levels in patients who survived for 1 year after stroke and not in those who died; therefore, this finding is more likely to represent improved control of diabetes rather than a higher premorbid HbA_{1c} level in patients who died from their stroke.

The national audit of diabetes care, which has already been discussed, showed that 65.8% of patients tested had an HbA_{1c} level within the 58 mmol/mol (7.5%) range or lower. This level reflects the definition of adequate control levels set by UK guidelines [6]. To aid comparison, the present study used this threshold. There was a marked rise in the number of patients with diabetes achieving this level in the year after stroke, from 55 to 62.5%, in the present study sample.

Other possible reasons for the levels of HbA_{1c} found are inadequate monitoring or failure to optimize treatment. Evidence exists relating to inadequate diabetic control after stroke. A case–control study was performed comparing 2830 patients with cerebrovascular disease against 24886 patients without [8]. There were established diagnoses of diabetes in 982 patients in the stroke survivor group and in 5163 patients in the control group. A total of 895 patients (88.3%) in the stroke survivor group were receiving treatment, but only 59.2% of this group had adequate control.

Post-stroke HbA_{1c} levels may also be affected by certain factors directly related to stroke disease itself. Empowering patients, through knowledge, can help individuals take control of their diabetes management [9]. In people with cognitive impairment after stroke this is likely to be more challenging and to contribute to inadequate risk factor control. Carers or family members are relied upon in this situation to help encourage and monitor medication concordance, promote lifestyle advice and support access to healthcare professionals.

In the present examination of a large national database, we found that HbA_{1c} levels improved in people who had a stroke. It appeared that these individuals represented a high-risk population before their stroke, with a higher baseline frequency of HbA_{1c} testing, which did not change. The degree of HbA_{1c} testing was substantially below the recommended UK guidelines. Future studies should consider HbA_{1c} levels in patients with diabetes who have had a stroke who are left severely disabled after their stroke to assess whether the improvement in HbA_{1c} level and static level of testing

observed in the present study were influenced by the healthcare needs of this group of stroke survivors.

Funding sources

None.

Competing interests

None declared.

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