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Acute upper gastrointestinal haemorrhage in west of Scotland: case ascertainment study

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Abstract

Objectives: To determine the incidence and case fatality of acute upper gastrointestinal haemorrhage in the west of Scotland and to identify associated factors.

Design: Case ascertainment study.

Setting: All hospitals treating adults with acute upper gastrointestinal haemorrhage in the west of Scotland.

Subjects: 1882 patients aged 15 years and over treated in hospitals for acute upper gastrointestinal haemorrhage during a six month period.

Main outcome measures: Incidence of acute upper gastrointestinal haemorrhage per 100 000 population per year, and case fatality.

Results: The annual incidence was 172 per 100 000 people aged 15 and over. The annual population mortality was 14.0 per 100 000. Both were higher among elderly people, men, and patients resident in areas of greater social deprivation. Overall case fatality was 8.2%. This was higher among those who bled as inpatients after admission for other reasons (42%) and those admitted as tertiary referrals (16%). Factors associated with increased case fatality were age, uraemia, pre-existing malignancy, hepatic failure, hypotension, cardiac failure, and frank haematemesis or a history of syncope at presentation. Social deprivation, sex, and anaemia were not associated with increased case fatality after adjustment for other factors.

Conclusions: The incidence of acute upper gastrointestinal haemorrhage was 67% greater than the highest previously reported incidence in the United Kingdom, which may be partially attributable to the greater social deprivation in the west of Scotland and may be related to the increased prevalence of *Helicobacter pylori*. Fatality after acute upper gastrointestinal haemorrhage was associated with age, comorbidity, hypotension, and raised blood urea concentrations on admission. Although deprivation was associated with increased incidence, it was not related to the risk of fatality.

Introduction

Acute upper gastrointestinal haemorrhage is a common reason for admission to hospitals in the United Kingdom. Until recently, knowledge of the epidemiology of this problem was based on small series with inadequate data on the denominator of the population. These series have reported case fatality (the proportion of cases dying) rather than population based mortality, which better reflects need. A recent large multicentre population based study of acute upper gastrointestinal haemorrhage in four English health regions found an incidence twice as high as expected.¹ However, this was lower than the incidence reported in north east Scotland,² which then had the highest reported incidence in the United Kingdom.

We report the epidemiology of upper gastrointestinal haemorrhage in the west of Scotland and compare it with contemporaneous English data.¹ We investigate the effect of social deprivation and identify risk markers of case fatality. Our data were gathered as part of a prospective audit of outcome of treatment for acute upper gastrointestinal haemorrhage in all hospitals admitting adults with acute upper gastrointestinal haemorrhage in the six health boards in the west of Scotland. To our knowledge, this is the only multicentre population based study in the United Kingdom to have included all adult patients treated for acute upper gastrointestinal haemorrhage in a single large geographical area.

Subjects and methods

All adult patients treated for upper gastrointestinal haemorrhage in the acute admitting units of the 19 hospitals in the west of Scotland were prospectively identified over the six months from September 1992 to February 1993 inclusive.

Cases were defined as patients aged 15 years or over who had been admitted with an initial diagnosis of acute upper gastrointestinal haemorrhage. Cases occurring in inpatients admitted for other illness were also included. Cases subsequently shown not to have sustained an upper gastrointestinal haemorrhage were excluded. Standard definitions of haematemesis and melaena were used when abstracting data from clinical records.³

Cases were identified using different identification methods at each site appropriate to local record keeping systems. These included reference to admission records, ward records, records at operation and endoscopy, discharge letters and records, and patient administration systems. Because of known problems with the use of routine data sources for identifying cases⁴ at least two different identification methods were used at each site to ensure complete case ascertainment. The case records of at least 95% of identified cases were reviewed, but at one hospital only 60% of case records were retrievable owing to misfiling of records.

The Carstairs deprivation score, which is based on four census variables (unemployment among men, domestic overcrowding, car ownership, and low social class), was used as a measure of socioeconomic deprivation.⁵ Higher Carstairs scores indicate reduced affluence. The scores used in the study were derived from the 1991 census.⁶ Deprivation scores were assigned to cases according to their postcode sectors. These were divided into quarters instead of Carstairs' deprivation categories⁵ because of the large number of patients at the most deprived end of the scale.

Factors associated with case fatality were determined by multiple forward stepwise logistic regression using SPSS.⁷ Cases with missing data were excluded from analyses.

Results

A total of 1882 adult cases were coded. This includes 61 patients whose acute upper gastrointestinal haemorrhage occurred while they were inpatients for other reasons and 61 patients who were transferred

from other hospitals. Table 1 shows summary details of the patients' ages, sex distribution, and diagnoses.

In eight cases the final outcome of the episode was not recorded owing to incompleteness of the clinical record. No postcode could be traced in 24 cases, and the recorded postcodes were not valid in 52.

Incidence

The adult population of the area from which these patients were admitted was 2 184 285 at the 1991 census, giving an overall incidence of 172 per 100 000 people aged 15 and over per annum (95% confidence interval 165 to 180).

The incidence rose sharply with age, being 5.7 times higher among those over 75 than among those aged 15 to 29; $P < 0.00001$), and it was twice as high among men as among women ($P < 0.00001$). Table 1 also shows that the incidence of acute upper gastrointestinal haemorrhage also rose with increasing

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Table 1 Patient characteristics by incidence of and mortality and case fatality from acute upper gastrointestinal haemorrhage

	No of patients	Incidence (95% CI) (per 100 000 per year)	No of deaths	Mortality (95% CI) (per 100 000 per year)	Case fatality (%)
All cases	1882	172 (165 to 180)	153	14.0 (11.9 to 16.4)	8.1 (6.9 to 9.6)
Sex:					
Male	1208	236	89	17.4	7.4
Female	674	116	64	11	9.6
Statistics:					
Relative risk (95% CI) for women		0.49 (0.45 to 0.54)		0.63 (0.46 to 0.87)	1.29 (0.95 to 1.76)
χ^2 for trend (p value)		229 (<0.00001)		7.96 (0.005)	2.67 (0.1)
Age group (years):					
15-29	251	84	2	0.7	0.8
30-44	316	111	5	1.8	1.6
45-59	410	176	23	9.9	5.6
60-74	500	260	56	29.2	11.2
≥ 75	405	480	67	79.3	16.6
χ^2 for trend (p value)		635 (<0.00001)		261 (0.00001)	80 (<0.00001)
Deprivation score (quarters):*					
1 (most affluent)	316	114	27	9.7	9.4
2	389	144	20	7.4	5.4
3	433	159	45	16.5	11.6
4 (least affluent)	668	247	52	19.2	8.5
χ^2 for trend (p value)		141 (<0.00001)		14.6 (<0.0002)	0.24 (0.6)

*Excludes 76 cases in which deprivation score was missing.

Table 2 Patients' diagnoses*

Diagnosis	No of patients	No of deaths	Case fatality (%)	Odds of death (95% CI)†
Mallory-Weiss syndrome	125	2	1	0.2 (0.0 to 0.7)
Oesophagitis	330	12	8	0.4 (0.2 to 0.7)
Oesophageal varices	107	30	20	5.2 (3.3 to 8.2)
Oesophageal ulcer	59	10	7	2.4 (1.2 to 4.8)
Gastric ulcer	201	17	11	1.1 (0.6 to 1.8)
Gastric erosion	76	3	2	0.5 (0.1 to 1.4)
Gastritis	226	10	7	0.5 (0.3 to 0.9)
Duodenal ulcer	319	19	12	0.7 (0.4 to 1.1)
Duodenal erosion	42	0		
Duodenitis	142	2	1	0.1 (0.0 to 0.6)
Malignant tumour	36	10	7	4.6 (2.2 to 9.6)
Other	132	15	10	1.5 (0.9 to 2.7)
No cause documented	545	51	33	1.3 (0.9 to 1.8)
All patients	1882	153	8.1	

*378 patients had two or more recorded diagnoses.

†By logistic regression, controlling for age, sex, and source of admission.

Table 3 Presenting features and odds ratios for case fatality in unifactorial and multifactorial analyses

Risk factor	No of cases	Odds ratio (95% CI)	
		Unifactorial analysis	Multifactorial analysis*
Demographic factors			
Age (years)			
15-29	228	0.00 (0 to >100)	0.00 (0 to >100)
30-44	258	0.34 (0.13 to 0.93)	0.80 (0.19 to 3.4)
45-59	367	1.0 (reference)	1.0 (reference)
60-74	464	1.8 (1.0 to 3.1)	1.8 (0.80 to 4.2)
≥75	304	3.4 (2.0 to 5.9)	4.5 (2.0 to 10)
Sex (female) (reference male = 1)	567	1.3 (0.89 to 1.9)	
Clinical measurements			
Urea (mmol/l)			
<6.5	669	1.0 (reference)	1.0 (reference)
6.6-7.9	155	2.7 (0.95 to 7.4)	1.9 (0.44 to 8.5)
8.0-24.9	678	8.3 (4.3 to 16)	5.5 (2.0 to 15)
≥25	63	36 (16 to 80)	18 (5.3 to 59)
Creatinine (mmol/l)			
<200	1286	1.0 (reference)	
≥200	64	5.8 (3.2 to 11)	
Haemoglobin (g/l)			
>100	1214	1.0 (reference)	
80-99	203	3.3 (2.1 to 5.4)	
<80	192	3.8 (2.4 to 6.2)	
Blood pressure (mm Hg):			
Diastolic			
>70	1231	1.0 (reference)	1.0 (reference)
60-69	261	10 (6.2 to 16)	3.8 (1.8 to 7.7)
<60	116	3.8 (2.4 to 6.0)	3.1 (1.7 to 5.6)
Systolic			
≥110	1362	1.0 (reference)	
100-109	136	2.1 (1.2 to 3.9)	
90-99	65	6.5 (3.6 to 12)	
<90	46	9.8 (5.1 to 19)	
Pulse (beats/minute)			
<100	1009	1.0 (reference)	
≥100	61	0.6 (0.43 to 0.91)	
Comorbidity:			
Cardiac failure	25	9.2 (4.0 to 21)	9.4 (3.2 to 28)
Hepatic failure	33	23 (11 to 48)	43 (14 to 133)
Jaundice	82	7.3 (4.4 to 12)	
Respiratory failure	4	4.3 (0.44 to 41)	
Disseminated malignancy	71	6.8 (4.0 to 12)	3.8 (1.8 to 8.1)
Other major disease	304	2.4 (1.6 to 3.6)	1.8 (1.0 to 3.1)
Presenting symptom:			
Haematemesis	1019	1.9 (1.2 to 2.9)	2.0 (1.1 to 3.5)
Syncope	67	4.5 (2.5 to 8.1)	3.0 (1.3 to 7.0)
Melaena	688	1.2 (0.82 to 1.8)	
Coffee ground vomiting	339	0.5 (0.30 to 0.92)	
Medical history:			
Oesophageal varices	72	4.1 (2.3 to 7.3)	
Peptic ulcer	465	0.68 (0.44 to 1.1)	
Hepatic disease	129	3.0 (1.8 to 5.0)	
Upper gastrointestinal surgery	164	1.2 (0.68 to 2.2)	
Previous upper gastrointestinal bleed	449	1.1 (0.74 to 1.7)	
Dyspepsia	333	0.34 (0.17 to 0.65)	
Respiratory disease	145	2.1 (1.2 to 3.5)	
Renal disease	11	2.9 (0.61 to 13)	
Cardiac disease	246	3.2 (2.1 to 4.9)	
Drug treatment:			
Systemic steroid	33	0.82 (0.19 to 3.5)	
Non-steroidal anti-inflammatory drug	405	1.2 (0.81 to 1.9)	
Acid blocking drug	440	0.82 (0.53 to 1.3)	
Anticoagulant	37	1.1 (0.34 to 3.7)	
Alcohol consumption:			
Not recorded as heavy	992	1.0 (reference)	
Heavy	377	0.64 (0.38 to 1.1)	
Intoxicated on admission	151	0.33 (0.12 to 0.91)	
Smoking	654	0.95 (0.62 to 1.5)	

†Based on 1344 acute admission cases having complete data records (including creatinine values).

Carstairs deprivation score, being 2.2 times greater in the most deprived quarter than in the most affluent quarter ($P < 0.00001$).

Mortality

There were 153 deaths among the 1882 patients, resulting in an overall population mortality of 14.0 per 100 000 per annum (11.9 to 16.4). The population mortality increased sharply with increasing age (113 times greater among those over 75 than among those aged 15 to 29; $P < 0.00001$) (table 1), and mortality among men was 1.6 times greater than among women ($P = 0.005$). The population mortality in the most deprived quarter was double that in the least deprived quarter ($P < 0.0002$).

Case fatality

The proportion of case fatalities was 8.1% (6.9% to 9.6%). Case fatality among the oldest age group was 20 times that among the youngest ($P < 0.00001$) (table 1), but there was no significant difference in case fatality between the sexes or in association with the Carstairs deprivation score.

The case fatality of patients admitted after acute bleeds was 6.7% (5.6% to 8.1%). Deaths were significantly more frequent among those who bled as inpatients (42%, $P < 0.00001$) or after having been transferred from another hospital (16.4%, $P < 0.00001$).

Diagnoses

Table 2 shows diagnoses by age, sex, and death rate. No diagnosis was recorded in 542 cases; 308 cases had two recorded diagnoses, 60 had three, and 10 had four. The commonest recorded diagnoses for cases with multiple diagnoses were oesophagitis (153, or 41% of these cases), gastritis (112, 30%), duodenitis (107, 28%), duodenal ulcer (106, 28%), and gastric ulcer (73, 19%). Gastric ulcers were more common in women. Duodenal ulcers and duodenitis were more common in men. Oesophagitis, oesophageal ulcer, gastric ulcer, and malignancy were more common in elderly people, while the Mallory-Weiss syndrome, gastritis, and duodenal ulcer were more common in young people. Oesophageal varices, oesophageal ulcer, and gastrointestinal malignancy were associated with increased risks of death. The Mallory-Weiss syndrome, oesophagitis, gastritis, and duodenitis had significantly low risks of death.

Risk factors for case fatality

Table 3 shows the case fatality odds ratios for each clinical risk factor recorded at the time of admission of emergency cases. Among the factors not associated with increased case fatality were a history of previous upper gastrointestinal haemorrhage, upper gastrointestinal surgery, peptic ulceration, and dyspepsia. Non-steroidal anti-inflammatory drugs, systemic steroids, acid blocking drugs, and anticoagulants were also not risk factors for case fatality; neither was there a relation with Carstairs deprivation score.

Table 3 shows that many risk factors on admission were associated with increased case fatality when they were considered in isolation. Logistic regression was used to determine the risk factors that best predicted death among these emergency admissions. When

these factors were considered together in this multifactorial analysis many of the associations with risk lost significance. Factors selected were age, uraemia, diastolic hypotension, cardiac failure, hepatic failure, pre-existing malignancy or other major pre-existing disease (such as rheumatoid arthritis or inflammatory bowel disease), and presentation with frank haematemesis or syncope (table 3). Among the factors not selected in the regression model were haemoglobin concentration, creatinine concentration, pulse, and a history of oesophageal varices.

Discussion

The incidence of acute upper gastrointestinal haemorrhage in the west of Scotland in this study was much higher than that previously reported in the United Kingdom. The areas covered by the health boards in the west of Scotland are geographically distinct from the rest of Scotland, which minimises cross boundary flow of patients. This resulted in good matching between cases and data on the denominator of the population, which improves the reliability of the estimates of incidence. Forty per cent of case records were not available for review at one hospital, so the true incidence would have been higher.

Deprivation and *Helicobacter pylori* infection

We believe that this is the first study in the United Kingdom to show a link between socioeconomic deprivation and an increased incidence of upper gastrointestinal bleeding. Peptic ulceration is the commonest disease underlying acute upper gastrointestinal haemorrhage in the United Kingdom.²⁻⁸ The incidence of peptic ulceration is higher in Scotland and the north of England than further south.⁹⁻¹⁰ This difference has been the subject of speculation for some time⁹⁻¹⁰ but remains unexplained. There is now a recognised association between *Helicobacter pylori* infection, socioeconomic group,¹¹ and childhood living conditions,¹² and an increased prevalence of *Helicobacter pylori* infection has recently been found in the north of England and Scotland.¹³ Peptic ulcer bleeding has been found to be more common among less affluent patients in Germany¹⁴ and Africa,¹⁵ but these studies lacked adequate data on the denominator of the population.

Although this study is subject to the usual cautions about applying population characteristics such as deprivation scores to individual people (the so called ecological fallacy), such an association is clinically plausible. This relation between Carstairs deprivation scores and incidence of upper gastrointestinal haemorrhage may be related to the reported greater prevalence of *Helicobacter pylori* associated with reduced socioeconomic group or crowded childhood living conditions. Although socioeconomic deprivation was associated with an increased risk of developing upper gastrointestinal haemorrhage, it did not seem to be associated with differences in the underlying disease processes or with clinical outcome indicated by case fatality.

Age

The findings of a greater incidence among men and elderly people and of a greater case fatality among elderly

Key messages

- The incidence of upper gastrointestinal haemorrhage in the west of Scotland was 67% higher than the highest incidence previously reported in the United Kingdom
- A substantial part of this excess incidence may be attributable to socioeconomic deprivation
- The overall population mortality from upper gastrointestinal haemorrhage may increase as the elderly population increases because both incidence and case fatality rise steeply with age
- A reduction in the overall case fatality from acute upper gastrointestinal haemorrhage will be best achieved by reducing case fatality among elderly patients

people and patients who bled after having been admitted for other disease are compatible with other studies.^{1-2 16} The fivefold increase in incidence from the youngest to the oldest age groups coupled with the 20-fold increase in case fatality gives a dramatic increase in age specific population mortality among elderly people of more than 100 times that among young people. With an increasing proportion of elderly people in the population, there may be an apparent increase in crude death rates from acute upper gastrointestinal haemorrhage even if improved clinical management results in an improved crude case fatality. This has implications for resources in planning clinical services for acute upper gastrointestinal haemorrhage. Reductions in crude case fatality may be achieved by targeting clinical resources (such as endoscopic intervention) towards elderly patients.

Risk factors

The relative proportions of individual diagnoses and case fatalities are similar to those of Rockall et al,¹ except for gastrointestinal malignancy, which was less common and had a lower case fatality in our study. The findings of this study are broadly compatible with other studies that have shown an increased risk of case fatality associated with coexisting disease, hypotension or shock, and the onset of haemorrhage in inpatients.^{1-2 16-22} The finding that anaemia at the time of admission might not be strongly associated with case fatality after adjustment for other factors including blood urea concentration has not, to our knowledge, previously been reported.

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Conflict of interest: None.

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Water fluoridation, tooth decay in 5 year olds, and social deprivation measured by the Jarman score: analysis of data from British dental surveys

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Abstract

Objective: To examine the effect of water fluoridation, both artificial and natural, on dental decay, after socioeconomic deprivation was controlled for.

Design: Ecological study based on results from the NHS dental surveys in 5 year olds in 1991-2 and 1993-4 and Jarman underprivileged area scores from the 1991 census.

Setting: Electoral wards in three areas: Hartlepool (naturally fluoridated), Newcastle and North Tyneside (fluoridated), and Salford and Trafford (non-fluoridated).

Subjects: 5 year old children (n = 10 004).

Intervention: Water fluoridation (artificial and occurring naturally).

Main outcome measure: Ward tooth decay score (score on the "decayed, missing, and filled tooth index" for each electoral ward).

Results: Multiple linear regression showed a significant interaction between Jarman score for ward, mean number of teeth affected by decay, and both types of water fluoridation. This confirms that the more deprived an area, the greater benefit derived from fluoridation, whether natural or artificial ($R^2 = 0.84$, $P < 0.001$). At a Jarman score of zero (national mean score) there was a predicted 44% reduction in decay in fluoridated areas, increasing to a 54% reduction in wards with a Jarman score of 40 (very deprived). The area with natural fluoridation (at a level of 1.2 parts per million—higher than levels in artificially fluoridated areas) had a 66% reduction in

decay, with a 74% reduction in wards with a Jarman score of 40.

Conclusion: Tooth decay is confirmed as a disease associated with social deprivation, and the more socially deprived areas benefit more from fluoridation. Widespread water fluoridation is urgently needed to reduce the "dental health divide" by improving the dental health of the poorer people in Britain.

Introduction

Despite over a hundred studies consistently confirming the efficacy, non-discriminatory benefit, safety, and cost effectiveness of adjusting the level of fluoride in the water supply to 1 part per million (ppm), most of the British population does not have a fluoridated water supply, which would halve the amount of tooth decay in British children.¹ The Water (Fluoridation) Act 1985, now consolidated in the Water Industry Act 1991, has been ineffective: no new water fluoridation schemes have been implemented since the act came into force over 10 years ago. The wording of the act has been interpreted by the privatised water companies as giving them discretion to ignore the legitimate requests of health authorities.² This unfortunate situation has serendipitously allowed a "natural experiment" to arise in Britain. An estimated five million British people have had water fluoridation for at least 10 years.¹ The rest still carry the burden of a disease, which could be halved in 5 year old children,³ and they acted as a non-fluoridated control group for our ecological study.