ORIGINAL ARTICLE

Iatrogenic causes of falls in hospitalised elderly patients: a case-control study

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Objective: To explore risk factors associated with falls and to evaluate a strategy used by nurses to predict and prevent falls in a hospitalised cohort of elderly patients.
Design: A case-control study of risk factors for falls in hospital.
Setting: A district general hospital in the UK.
Subjects: Altogether 181 patients in an acute integrated medical unit who had fallen were matched for age with 181 patients in the next bed who had not fallen.
Results: It was found that 46% (84 of 181) of the fallers were taking one or more benzodiazepines compared with 27% (48 of 181) of the control patients (p<0.001). More fallers 20% (34 of 181) had their benzodiazepines prescribed during their current admission compared with 7% (13 of 181) of the control patients (p<0.001). Temazepam was the main benzodiazepine used by over 95% of cases and controls. Overall 25% (45 of 181) of the fallers had fallen before during the current admission. The logistic regression analysis showed that only a previous fall, benzodiazepine intake, and the need for maximum assistance were significant predictors of falling in hospital, odds ratios were 5.6 (95% confidence interval (CI) 2.7 to 11.6), 2.3 (95% CI 1.4 to 3.7), and 3.1 (95% CI 1.9 to 5.2) respectively. Most fallers had been identified at risk of falling (125; 69%) by ward staff and in 113 (90%) of those preventive measures had been undertaken. Falls were least likely to occur during visiting hours with a peak incidence during night-time.
Conclusion: There is a need for evidenced based successful fall prevention strategies but our study also reinforces an urgent public health message that an alternative to benzodiazepines should be sought for night sedation for older patients.

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Falls and related injuries are a serious clinical and public health problem in acute and non-acute care settings and the community.[1] For inpatients falls are associated with increased duration of stay in hospital and a greater chance of unplanned readmission or of discharge to residential or nursing home care.[2] Many potentially modifiable medical and environmental risk factors have been identified. For example, the use of benzodiazepines in elderly patients has been found to be associated with an increased incidence of falls, morbidity and mortality, but a large number of these patients still being prescribed benzodiazepines.[3–6] Despite the presence of strong evidence that falls are preventable, they still remain a major cause of morbidity in hospitalised elderly patients with paucity of evidence for successful preventive strategies. The aims of this case-control study were therefore to explore risk factors associated with falls and also evaluate a risk assessment and prevention strategy in a hospitalised cohort of elderly patients.

SUBJECTS AND METHODS

The study was conducted over a four month period at a 650 bed district general hospital in South Yorkshire. The integrated medical unit has 168 beds on seven wards, admitting unselected patients on the basis of need.

Falls

Every working day one of us visited each of the seven medical wards and identified all falls that had occurred since our last visit and were recorded in the ward incident book. A fall was defined as "an incident in which a patient suddenly and involuntarily came to rest upon the ground or surface lower than their original station". Patients who fell several times were only recruited once. For each fall, an age matched control patient was selected who was a patient in the nearest bed

(same room) and who had not yet fallen during his or her current admission. After each fall, the control patient and their primary nurse were interviewed and case notes reviewed. Several assessments were performed including orientation, disability, and visual status. Orientation in time, place, and person was recorded. Disability was classified as independent for dressing, transfer, mobility, and personal hygiene; needing minimal assistance (one person) or maximal assistance (two persons). Recorded information included demographic data, clinical history, all medications including benzodiazepines use and whether prescribed in or out of hospital, and fall details including the time and location of the fall and injuries sustained.

For each patient admitted nurses use a risk assessment tool, which includes information on age, gender, steadiness, physical and mental disabilities, and continence status to predict which patient is at risk of falls. A simple unweighted scoring system was used in which the presence or absence of each factor gave a risk score for each patient. Patients were then defined as low or high risk. For the high risk patients preventive measures such as making sure that the call system is within reach, padded cot sides in place, low bed, mattresses on the floor, and constant supervision were implemented. The prevention plan is reviewed at least once daily.

Statistical analysis was performed with the SPSS version 10. Characteristics of fallers and controls were compared with Wilcoxon rank sum test. A logistic regression analysis was also undertaken to identify factors, which might predispose hospitalised patients to fall. We used fallers and controls as grouping criteria and included the following variables in the model: age, sex, previous falls, stroke, dementia, arthritis, and Parkinson's disease, short acting benzodiazepines, antihypertensives, diuretics, antiarrhythmics, other medications, orientation, disability, and visual impairments. Each variable was

Table 1 Baseline characteristics of fallers and control patients; values are number (%)

Variable	Fallers (n=181)	Controls (n=181)
Mean (SD) age	73.3 (13)	73.7 (13)
Gender (female)	94 (52)	87 (48)
Stroke*	63 (35)	44 (24)
Arthritis	38 (21)	31 (17)
Postural hypotension	7 (4)	2 (1)
Previous falls*	48 (27)	11 (6)
On a benzodiazepine*	84 (46)	48 (27)
On two benzodiazepines	15 (8)	3 (2)
Benzodiazepines prescribed in hospital*	36 (20)	13 (7)
Antihypertensives	67 (37)	60 (33)
Diuretics*	61 (34)	83 (46)
Disoriented in time, place, or person*	48 (27)	15 (8)
Needs maximum assistance*	79 (44)	33 (18)
Partially sighted or blind	11 (6)	11 (6)

*p≤0.05.

Figure 1 Distribution of falls over 24 hours (visiting hours 14:00 to 20:00).
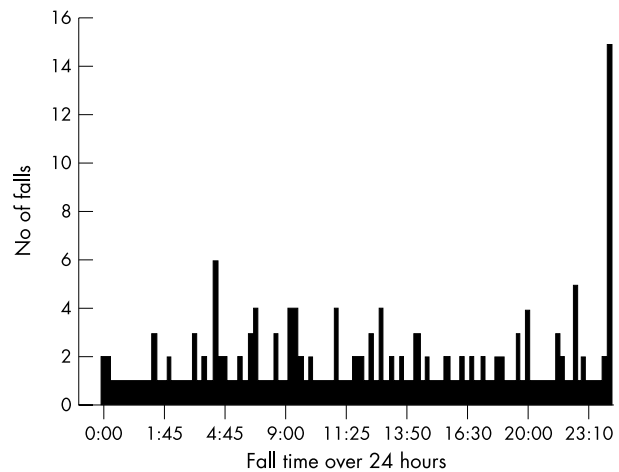
first analysed separately against the dependant variable (that is, fall v control). Then those variables with significant association with the outcome variable (p<0.05) were entered with other variables into the final model. Important interactions between variables were also investigated.

RESULTS
Overall 181 fallers and 181 control patients were recruited to the trial. Table 1 shows the characteristics of fallers and control patients included in the trial.

We found 46% (84 of 181) of the fallers taking one benzodiazepine compared with 27% (48 of 181) of the control patients (p<0.001), and 8% (15 of 181) fallers on two or more benzodiazepines compared with 2% (3 of 181) controls. More fallers 20% (34 of 181) had their benzodiazepines prescribed during their current admission compared with 7% (13 of 181) control patients (p<0.001) (table 1). Temazepam was the main benzodiazepine used by more than 95% of cases and controls. Other individual benzodiazepines include zopiclone, nitrazepam, and diazepam. Overall 25% (45 of 181) of the fallers had fallen before during current admission. Fallers were more likely to be disorientated, dependent (needing two persons for assistance), and had a previous stroke compared with control patients. Fallers and control patients did not differ in sex, visual impairment, postural hypotension, and additional health problems including arthritis and Parkinson's disease and intake of medications other than benzodiazepines except for diuretics.

The logistic regression analysis showed that only a previous fall, benzodiazepines intake, and the need for maximum assistance were significant predictors of falling in hospital,

odds ratios were 5.6 (95% confidence interval (CI) 2.7 to 11.6), 2.3 (95% CI 1.4 to 3.7), and 3.1 (95% CI 1.9 to 5.2) respectively (table 2). More control patients than fallers were using diuretics (46% v 34%, p = 0.018) and the use of any diuretic was associated with a lower risk of falls but this didn't reach statistical significance (odd ratio 0.67, 95% CI 39 to 1.0; table 2).

Most falls occurred beside the bed (64%), or in the bay (16%), with very few falls taking place in the corridor, day room, bathroom, or toilet. Most fallers had been identified at risk of falling (125; 69%) by ward staff and in 113 (90%) of those preventive measures have been undertaken. Despite the high numbers of falls, serious injuries were uncommon but 33 (18%) patients had some injuries, which needed further intervention.

Figure 1 shows the timing of the fall over 24 hours. Falls were least likely to occur during visiting hours (14:00 to 20:00) with a peak incidence just before midnight.

DISCUSSION
The main findings of this study were the high rate of short acting benzodiazepines intake among fallers and in over 40% of these patients benzodiazepines were prescribed during their current hospital stay compared with control patients. Forty five (25%) of the fallers had fallen before during the current admission and a previous fall, benzodiazepine intake, and the need for maximum assistance were the most significant predictors of falling in hospital. Falls were least likely to occur during visiting hours with a peak incidence just before midnight. Most fallers had been identified at risk of falling by

Table 2 Logistic regression analysis of risk of falls using a number of predictor clinical variables

Variable	Regression coefficient	Standard error	p Value	Odd ratio for unit change	95% CI
Age (years)	0.010	0.009	0.298	1.0	0.99 to 1.03
Gender	−0.343	0.231	0.138	0.72	0.45 to 1.12
Previous stroke	0.373	0.267	0.162	1.5	0.86 to 2.5
Additional health conditions†	0.227	0.257	0.376	1.3	0.76 to 2.1
Previous falls	1.723	0.371	0.000*	5.6	2.7 to 11.6
Prescribed a benzodiazepine	0.826	0.248	0.001*	2.3	1.4 to 3.7
On a diuretic	−0.449	0.245	0.068	0.67	0.39 to 1.0
Disorientated	0.023	0.301	0.939	1.0	0.57 to 1.9
Needing maximum assistance	1.132	0.257	0.000*	3.1	1.9 to 5.2

*p≤0.05. CI, confidence interval.
†Including dementia, Parkinson's disease, chronic obstructive pulmonary disease, arthritis, and other chronic diseases.

ward staff and in almost all of them the preventive measures put in place were largely unsuccessful.

Nearly all benzodiazepine prescriptions in hospital were for temazepam given as a sleeping tablet. In very few cases the indications for the drug was epilepsy, muscle spasm, alcohol withdrawal, or premedications and we only found a weak positive correlation between prescription of benzodiazepine in hospital and cognitive state ($r = 0.17$; $p = 0.023$). Most previous studies have found that the risk of falls was greater for users of long acting benzodiazepines,[7] but almost all patients in this study were prescribed a short acting compound. It is also interesting to note that most falls occurred during the night, the period during which these drugs would be expected to impair psychomotor function.[8] We also found fewer fallers than control patients were on diuretics, and the use of diuretics may be protective against the risk of falls but this didn't reach statistical significance. However, the protective effect from diuretics has been reported before.[9][10]

The simple risk assessment tool used by nurses was successful in predicting falls among elderly hospital patients but the preventive measures put in place were largely unsuccessful. A key prevention measure of the risk assessment tool is constant supervision and support for high risk patients. With falls more likely to occur at night but not during visiting hours, this may raise the question that the number and/or availability of nursing staff was linked to the occurrence of falls. Could the high rate of inappropriate benzodiazepine prescriptions in hospitalised patients, variation in the rate of falls during the day, and the largely unsuccessful preventive strategies be a surrogate indicator of staffing levels in the hospital? The association between the number and composition of nursing staff in hospitals and risk of falling has been raised before. Some studies did report a relationship between the rate of falls in hospitals and the number of nursing staff.[11][12] Other studies did not find a relationship between the two.[13][14] But undoubtedly, hospitals in the UK are currently short of nurses and other related professionals and increased numbers of nurses are required to meet increasing demands in service and management.[15]

The main limitations of our study lie in lack of data on the relationship between the rate of falls, staffing levels, and dose of benzodiazepines. However, numbers and skill mix of nurses and other related staff in relation to the workload should not differ between different wards. Also we have no data on the appropriateness of benzodiazepine prescription for night sedation in hospital.

In conclusion, the high rate of benzodiazepine prescriptions in hospital with the timing and place of falls and the largely unsuccessful preventive strategies raise the possibility of a link between falls and staffing levels. There is a need for evidence based successful falls prevention strategies but our study also reinforces an urgent public health message that an alternative should be sought to benzodiazepines for night sedation for older patients.

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