Falls Presenting to the Accident and Emergency Department: Types of Presentation and Risk Factor Profile

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Summary
The aim of this study was to evaluate the type and frequency of falls presenting to an inner city casualty department, and to identify modifiable risk factors in these patients.

A prospective descriptive study evaluated those over 65 years presenting to an inner city casualty department with falls. Over a 4-week recruitment period, all consenting subjects completed a semi-structured questionnaire regarding their falls and cognitive status. Those with unexplained (UF) or recurrent falls (RF) underwent a more detailed assessment: history and examination, gait and balance assessment, visual acuity measurement and neurocardiovascular investigations (including orthostatic blood pressure, carotid sinus massage and head-up tilt testing).

Of 200 patients with falls, 188 were interviewed; 29% could recall a reason for falling (accidental) and 30% had UF or RF. A cohort of 26 cognitively normal patients with UF and RF was fully investigated. In 23/26 patients risk factors for falls were found (median: three risk factors). These included: culprit medication (10), gait abnormalities (9) and carotid sinus hypersensitivity (19).

Falls are a common presenting complaint yet a fall is readily explained in less than one-third of cases. Investigation of RF and UF has a high yield for possibly modifiable cardiac and non-cardiac risk factors. Targeted multi-disciplinary rapid assessment of patients attending the Accident and Emergency Department because of a fall might reduce the number of hospital admissions.

Keywords: Carotid sinus hypersensitivity, Falls, Accident and Emergency, Modifiable risk factors.

Introduction
Falling in elderly people is a common problem. The annual incidence of falls in those over 65 years living in the community has been reported consistently to be between 28% and 35%; this increases to in excess of 40% for those over 75 years [1, 2].

Falls result in psycho-social and physical morbidity, i.e. restrictions in activities of daily living [3], changes in health status [4], nursing-home placement; social isolation [5], increased hospitalization [6] and increased mortality [7]. Ten per cent to 15% of falls result in serious injury. In the UK, 34% of admissions to hospital from the Accident and Emergency Department (A&E) are as a direct result of a fall [8] and 25% of these patients have a prolonged hospital stay [9].

Falls are a common presenting complaint to A&E. Many units are now setting up guidelines for the management of falls in this setting, yet little is known either about the clinical characteristics of falls in elderly patients who present to A&E or the benefits of risk factor modification. Guidelines for risk factor modification have not been evaluated in the UK. In 1991, a King's College Institute of Gerontology report suggested that although the management of injury in A&E was good, there was no generally agreed policy on elderly people with falls and that subsequent investigation of fallers was less than adequate [10].

The objective of this study was to characterize falls in elderly patients presenting to an A&E and to characterize modifiable risk factors for fallers.

Method
All patients who presented with a fall to A&E of the Royal Victoria Infirmary during a randomly assigned 28-day period in August and September 1994 were screened. A fall was defined as 'inadvertently coming to rest on the ground or other lower level with or without loss of consciousness' [7].

Fallers were initially screened for cognitive impairment (10-point mental test score) and those who scored < 10 were evaluated more fully using the Folstein mini-mental state examination (MMSE) [11]. Those who scored less than 25/30 on MMSE were classified as cognitively impaired, deemed inappropriate for classification of falls according to history.
and were excluded from further study. In the remainder, patients were classified according to the description of the index fall and the number of previous falls:

**explained fall:** A simple slip, trip or environmental hazard resulting in the fall.

**unexplained fall:** No apparent cause of the fall.

**recurrent fall:** Three or more falls (including the index fall) within 2 years.

**explained loss of consciousness:** Myocardial infarction, stroke, haemorrhage, overdose, status epilepticus. The diagnosis of loss of consciousness was made or within 7 days of presentation.

**unexplained loss of consciousness:** Loss of consciousness remained unexplained after routine assessment and/or investigation.

Patients with either cognitive impairment or explained falls or explained loss of consciousness were not studied further. Those with unexplained falls, recurrent falls or unexplained syncope were further investigated. Patients who had injury that precluded investigation (those in traction or non-weight bearing) and those who lived outside a 15-mile radius of the A&E department were also excluded.

Further investigation included a detailed history, clinical examination, routine biochemistry and haematology profile. Information about functional ability (Barthel index) [12], cognitive function (MMSE) and mood (Yesavage depression scale) [13] was also detailed. Neurological and cardiovascular investigations included: visual and auditory acuity measurements, gait and balance assessment [14], 12-lead ECG, orthostatic blood-pressure measurement [15], carotid sinus massage (CSM) [16] (whilst supine and during head-up tilt to orthostatic blood-pressure measurement [15], carotid sinus testing, autonomic function tests, head-up tilt testing with GTN or isoprenaline provocation [18] and carotid sinus massage after administration of atropine.

The following diagnostic criteria were applied:

**visual impairment:** a corrected visual acuity of 3/60 or worse in either eye measured using a Snellen Chart with a spotlight at 3 m [19].

**gait abnormality:** neurological or musculoskeletal impairment causing a distinctly abnormal gait pattern (for example, cerebrovascular accident, Parkinson's disease, foot drop).

**balance abnormality:** inability to maintain four positions for 10 s with the eyes open (feet apart, feet together, semi-tandem and tandem) [20].

**depression:** a score of greater than 5/15 on the Geriatric Depression Scale [13].

**culprit medications:** medications known to contribute to recorded abnormal blood pressure or heart-rate responses [21].

**orthostatic hypotension:** a symptomatic fall in systolic blood pressure exceeding 20 mmHg after 1 min of standing unsupported [15].

**carotid sinus hypersensitivity:** asystole exceeding 3 s (cardio-inhibitory sub-type), a fall in systolic blood pressure exceeding 50 mmHg in the absence of cardio-inhibition (vasodepressor sub-type) or both (mixed sub-type) during 5 s of carotid sinus massage [16].

**vasovagal hypersensitivity:** a classic history of a precipitating event with symptomatic hypotension with or without bradycardia induced by prolonged head-up tilt (70° for 30 min) [17] or by prolonged head-up tilt during GTN or isoprenaline provocation [18].

**arrhythmia:** sinus pause exceeding 2 s, prolonged sinus bradycardia, slow atrial fibrillation, supraventricular tachycardia or ventricular tachycardia associated with symptoms which improved with appropriate therapy or, in the case of drug-induced bradycardia, with cessation of treatment [22].

**benign positional vertigo:** episodic vertigo with a duration of less than 1 min provoked by rapid positional change. A positive Hallpike manoeuvre was additionally helpful in making the diagnosis [23].

The index fall was attributed to a specific neurocardiovascular diagnosis only if patients experienced symptoms during these tests, i.e. either dizziness, presyncope, loss of consciousness, or the sensation of falling.

**Results**

During the recruitment period, 200 patients presented with falls to A&E, i.e. 44% of all attenders over 65 years. One hundred and eighty-eight agreed to take part in the
Table II. Risk factors for different types of falls

<table>
<thead>
<tr>
<th>Falls</th>
<th>Unexplained (n = 6)</th>
<th>Recurrent (n = 2)</th>
<th>Unexplained and recurrent (n = 10)</th>
<th>Unexplained LOC (n = 8)</th>
<th>Total (n = 26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMSE (median)</td>
<td>30</td>
<td>29</td>
<td>29</td>
<td>29</td>
<td>29</td>
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<tr>
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<td>1</td>
<td>0</td>
<td>3</td>
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<td>3</td>
<td>2</td>
<td>6</td>
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<tr>
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<td>1</td>
<td>5</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Balance abnormality</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Vasovagal syndrome</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Orthostatic hypotension</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Benign positional vertigo</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
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<tr>
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<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>≥ 4 medications</td>
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<td>1</td>
<td>2</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Culprit medications</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>

LOC = Loss of consciousness; MMSE = mini-mental state examination.

study [average age 79 (SE 8) years, 141 women]. Ninety-two per cent presented between midnight and 20h00. Twenty-six per cent were cognitively impaired, 29% had an explained fall, 19% had unexplained and/or recurrent falls, 15% had explained loss of consciousness and 11% had unexplained loss of consciousness (Table I).

Thirty per cent of patients were admitted to hospital. Of those admitted, 48% had no significant bony or soft-tissue injury. Injuries in fallers were: long-bone fractures (n = 29), other fractures (n = 17) and lacerations requiring sutures (n = 18) (Table I).

Thirty-six consecutive patients with unexplained falls, recurrent falls and unexplained loss of consciousness who lived within a 15-mile radius and who did not have a fracture precluding investigation were invited to attend for further investigation. Twenty-six agreed to further study, two did not reply to contact and eight refused investigation. Twenty-one of 26 were women, 18 presented with unexplained or recurrent falls [mean age 79 (SE 9) years], and nine had unexplained loss of consciousness [mean age 80 (5) years]. The cohort of patients were all community-dwelling: six lived in either sheltered or warden-controlled accommodation and 21 were living alone. All patients had normal cognitive and physical function (median MMSE 29/30, median Barthel score 20/20) (Table I).

Risk factors for falls were identified in 23 (88%)—a median of three per patient (range 0–7). Risk factors included: visual acuity defect (23%), gait abnormalities (35%), balance abnormalities (19%), depression (31%), four or more prescribed medications (27%), culprit medication (39%) and benign positional vertigo (8%) (Table II).

Culprit medications were identified as contributing to neurocardiovascular abnormalities in ten patients. Culprit medications were associated with cardio-inhibitory CSS (beta-blockers, n = 3), postural hypotension (major tranquillizers, n = 2 and diuretics, n = 2) and in vasodepressor CSS (diuretics, n = 3 and anti-hypertensives, n = 2).

Abnormal cardiovascular findings were present in 20/26 patients: orthostatic hypotension (19%), carotid sinus hypersensitivity (73%), vasovagal hypersensitivity (15%) and arrhythmia (8%) (Table II). Of those with carotid sinus hypersensitivity the sub-types were: cardio-inhibitory (n = 9), vasodepressor (n = 7) and mixed (n = 3) (Table III).

During carotid sinus massage seven patients had witnessed LOC but after recovery patients denied this, demonstrating amnesia for LOC. Other symptoms during CSM were presyncope (n = 8) and dizziness (n = 2) (Table III).

Attributable diagnoses were assigned if symptoms were reproduced during investigations: four patients had orthostatic hypotension, eight had cardio-inhibitory carotid sinus hypersensitivity, three had mixed carotid sinus hypersensitivity, three had vasovagal hypersensitivity, two had arrhythmia and two had benign positional vertigo.

Discussion

The description of a fall as 'inadvertently coming to rest on the ground or other lower level with or without loss of consciousness' has previously been used by others studying intervention strategies for falls in elderly people [7]. It is important to include the presence of loss of consciousness, because 30% of older patients with cardiovascular syncope present only with falls and deny loss of consciousness. This is probably because of amnesia for loss of consciousness and may be related
Table III. Carotid sinus hypersensitivity: prevalence and associated symptoms

<table>
<thead>
<tr>
<th>Falls</th>
<th>Unexplained (n = 6)</th>
<th>Recurrent (n = 2)</th>
<th>Unexplained and recurrent (n = 10)</th>
<th>Unexplained LOC (n = 8)</th>
<th>Total (n = 26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carotid sinus hypersensitivity (total)</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>7</td>
<td>19</td>
</tr>
<tr>
<td>mixed</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
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<tr>
<td>vasodepressor</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>cardio-inhibitory</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Symptoms during CSM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOC and amnesia</td>
<td>0</td>
<td>0</td>
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<td>3</td>
<td>7</td>
</tr>
<tr>
<td>presyncope</td>
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<td>8</td>
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<tr>
<td>dizziness</td>
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<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

CSM = Carotid sinus massage; LOC = loss of consciousness.

to impaired cognitive function. Amnesia for loss of consciousness is a well recognized phenomenon in epilepsy but has only recently been described for cardiovascular syncope [23, 24]. Falls are common. Up to 30% of the over-65s and 40% of the over-75s fall at least once a year. It is important not to consider all falls as medical problems. A number of previous reports have identified risk factors for falls including those highlighted in this present study: impaired vision [25], culprit medications [21], polypharmacy [26], depression [27], gait abnormalities [28] and orthostatic hypotension [29]. Cardiovascular disorders such as carotid sinus hypersensitivity or vasovagal hypersensitivity have not been previously identified.

Patients with explained falls were excluded from further investigation because it was felt that the falls were accidental and that the gain from targeting unexplained falls or recurrent falls would be higher. None the less it is possible that elderly patients rationalize the reason for falling and assume they have tripped or slipped. Further study of this group is required.

Patients with abnormal cognitive function were also excluded because the classification of falls was dependent on the patients' ability to describe the index fall. Those with an MMSE of less than 25 might not give a reliable history. Up to 26% of fallers presenting to A&E were cognitively impaired. Classification of falls in this group may depend on witness accounts or on other clinical characteristics independent of the history. Although these patients were excluded from this study, they are at risk of serious fall injuries and may also have remediable risk factors.

Almost half of all attenders presented because of falls, yet there are no validated guidelines for the investigation and management of these patients in the UK. A recent report by the Institute of Gerontology, King's College London, concluded that 'there was a lack of a recognized procedure for dealing with falls as they presented and in their subsequent treatment... there was little consideration given to the cause (of the fall) either underlying or immediate' [10]. Post-fall intervention studies will help to develop validated guidelines for this population.

Thirty per cent of patients in this series were admitted to hospital, yet only half of this group had sustained an injury. Patients with explained syncope were most likely to be admitted. There was no difference in admission rates for the other clinical sub-groups. It is conceivable that rapid access to a post-fall facility might reduce the numbers requiring hospital admission. Studies of post-fall intervention strategies in A&E are under way.

Carotid sinus hypersensitivity and carotid sinus syndrome are increasingly recognized as attributable causes for unexplained falls and syncope in elderly people. Hypersensitivity is almost exclusively a disease of ageing. It is particularly associated with cerebrovascular disease, cardiac disease, peripheral vascular disease and hypertension. In a consecutive series of carotid sinus syndrome patients, whose symptoms were alleviated by pacing, over 30% had presented with unexplained falls before pacing. Serious injuries were common within this group—25% had sustained a fracture before presentation, half of which were of the femoral neck. Whether carotid sinus massage should be routinely performed in A&E requires further evaluation. Rapid access to a post-fall facility would ensure that carotid sinus massage was carried out under controlled conditions and by clinicians with experience in the interpretation of the results.

In conclusion, falls are a common presenting complaint in elderly people attending the Accident and Emergency Department. Falls resulted in hospital admission in over one-third of patients in this series. Those with no apparent explanation for falls constitute one-third of all cases and have many risk factors, both cardiac and non-cardiac, which might be amenable to
intervention. A rapid access post-fall intervention strategy would identify modifiable risk factors and might reduce hospital admission from the Accident and Emergency Department.

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