Experience of a rapid access falls and syncope service at a teaching hospital in Kuala Lumpur

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INTRODUCTION

Falls represent major health care issues among the older population and are the leading reasons for visits to the emergency department. It has been reported that 30-60% of community-dwelling older adults sustain at least one fall each year.[1] Falls in older adults commonly result in serious physical, psychological, social and economic consequences. In addition to the commonly feared osteoporotic fractures and subdural haematoma, the pathological fear of falling or post-fall syndrome also leads to physical frailty from activity avoidance and depression.[2] Furthermore, falls are also major causes of institutionalisation among our older population.

The published literature consistently report an overlap between falls and syncope.[3-5] Syncope is defined as a transient loss of consciousness associated with reduced postural tone and spontaneous recovery. In the Framingham cohort, the incidence of syncope is reported to be 6.2 per 1000 person-years, and this increases rapidly with age.[6] Structured approaches have been recommended for the investigation both falls and syncope, with evidence for cost effectiveness from reduced hospitalization and unnecessary investigations.[7, 8]

Previously published studies into the evaluation of falls and syncope in a specialist unit have only been conducted in Europe and USA.[7, 9] Our objective was, therefore, to report the experience of a dedicated falls and syncope service in Malaysia, a middle-income country in South-East Asia.

MATERIALS AND METHODS

The Falls and Syncope Service at the University of Malaya Medical Centre (UMMC), Kuala Lumpur, Malaysia, was established in 2014 with the intention of providing integrated, rapidly accessible services for patients who presented to primary care and the emergency department following an index fall or syncopal event. The service was provided by two cardiologists, one geriatrician, one medical specialist, one medical officer and four medical laboratory technicians trained in the investigations and management of falls and syncope. The medical centre serves as a training hospital for a large medical school, a tertiary referral hospital and a local general hospital for the Petaling District, Lembah Pantai and Seputeh with a catchment population exceeding 300, 000. Individuals aged 60 and over currently make up 7.5 % of the local population.[10] Patients were referred to this service through the emergency department, primary care department and other specialty clinics and wards if they presented with syncope, pre-syncope or falls based on published management algorithms.[11]

The demographic characteristics and clinical information of consecutive patients attending our service since its establishment till December 2016 were collected in a falls and syncope registry. Structured clinical history taking and targeted physical examinations were conducted on each new patient referred to the service, guided by an electronic medical record system template (EMR®, UMMC, Malaysia). Each patient was then investigated for orthostatic hypotension (OH), carotid sinus hypersensitivity (CSH), vasovagal syncope (VVS), and/or autonomic dysfunction according to clinical indication. The indications for each test would be described in the relevant sub-sections below. All haemodynamic tests were performed using synchronised, non-invasive, beat-to-beat blood pressure and electrocardiograhy (ECG) monitoring (Taskforce®, CNSystems, Austria). Verbal consent was sought for all individual tests after detailed explanation of the procedure and clinical rationale for the tests. All patient identifiable records were retained within the hospital server. Missing information inaccuracies within the dataset were consolidated by interrogating existing hospital records and extracted anonymously for the purpose of this study.

Active/Passive Stand
Individuals who reported symptoms during posture change were investigated with an active or passive stand. Following at least 10 minutes of supine rest, patients were then required to rise to the standing position within 30 seconds with the assistance of at least two members of staff to ensure safety. Patients were immediately interrogated for the presence of any symptoms and advised to report the occurrence of any symptoms while standing. If a symptom was reported, the patient would also be asked if it resembled any symptom they experienced prior. Individuals who were unable to stand independently or who had transfer difficulties were investigated with a passive stand. This involved a 3-minute

70o head-up tilt on a tilt table (as described in the next section) after 10 minutes' supine rest. Synchronized continuous blood pressure and ECG recordings were obtained throughout 10 minutes of supine rest and during the 3 minutes of standing.

The presence of initial orthostatic hypotension (IOH), conventional orthostatic hypotension (COH), or delayed OH (DOH) will be recorded according to consensus committee definitions.[12]

Head-up Tilt-table Test
Those with unexplained falls or syncopal symptoms not associated with posture change or cardiac syncope were evaluated with a head-up tilt-table test (HUT). The HUT was not always indicated, as individuals with isolated syncopal or pre-syncopal episodes with clear prodromes and associated symptoms were diagnosed clinically. Tilt-table tests were conducted using one of two published protocols. The first line protocol was the 20: 15 Italian protocol. Those who had a negative 20: 15 HUT with compelling history for neurally-mediated syncope or who were physically unable to tolerate being tilted upright for 35 minutes were investigated with a front-loaded glyceryl trinitrate (GTN) HUT test. Brief descriptions are offered below as the protocols have been described in detail elsewhere.[13, 14]

20: 15 "Italian Protocol"
The patient was first asked to assume the supine position on a commercially available tilt-table with armrests and footrests, with 1-2 pillows, for 10 minutes. The patient was then secured to the tilt-table at the waist and thigh with cushioned Velcro strips supplied by the manufacturers. The patient was tilted to a head-up position at a 70o angle for 20 minutes. If positivity criteria as described below was not met, 400 µg sublingual GTN will be administered and the patient remained at the HUT position for a further 15 minutes.

Front-loaded GTN tilt
Following 10 minutes' supine rest, the patient was tilted to the 70° HUT position. 800 µg GTN would be administered sublingually immediately. The test would be discontinued at 20 minutes or when positivity criteria was reached.

The positivity criteria was defined as the reproduction of symptom (usually syncope) in tandem with hypotension and/or bradycardia/asystole characteristic of the vasovagal response. Where haemodynamic changes occurred along without symptom reproduction, the test was considered a false positive test.[13]

Carotid Sinus Massage
Investigation with carotid sinus massage (CSM) was limited to those aged 50 years and over with sudden, unexplained falls or loss of consciousness with no obvious precipitant or prodrome, or preceded by sudden neck movements. Carotid sinus massage was avoided in those with established cerebrovascular disease or known carotid stenosis. After 10 minutes' supine rest, firm, longitudinal massage would be applied on both carotid sinuses, located at a point of maximal pulsation between the angle of the mandible and superior border of the thyroid cartilage,[13] for 10 seconds,

beginning on the right. This manoeuvre would first be performed in the supine position, followed by a 70° tilt on a tilt-table with a foot plate.[15] The positivity criteria was achieved if asystole of at least 3 seconds and/or systolic blood pressure reduction of 50 mmHg or greater was observed after CSM.

Autonomic Function Test
Autonomic function tests would only be performed among those with persistent, intractable OH or associated conditions, such as Parkinson's disease and diabetes mellitus, suggestive of neurogenic OH. This was conducted using newer computational tests as well as traditional challenge tests.[16, 17] The additional advantage of the computer-dependent tests of heart rate variability (HRV) and baroreflex sensitivity (BRS) is that they can be used as biofeedback for treatment strategies for OH and VVS.[18]

Heart Rate Variability. Heart rate variability (HRV) was assessed during 10 minutes' supine rest. The low frequency (LF), high frequency (HF) and total power spectral density (PSD) was derived from the 10 minutes' continuous ECG recordings with the autoregressive technique using the commercially available software.[19]

Baroreflex Sensitivity. Baroreceptor sensitivity (BRS) was also evaluated during 10 minutes' supine rest using the sequence method. Sequences where increases or decreases in heart rate corresponded to decreases or increases in blood pressure over three or more consecutive beats were detected automatically, and the slope of change was determined in mmHg/ms.[20]

Valsalva Ratio. The ratio of between longest R-R interval shortly after performing the Valsalva manoeuvre to the shortest R-R interval was calculated. The Valsalva manoeuvre was standardised by asking the patient to blow into a mouthpiece at a pressure of 40 mmHg for 15 seconds in a comfortable seated position.

Inspiratory to Expiratory Ratio. This test was conducted in the supine position to minimise the risk of orthostatic symptoms. The patient was instructed to inhale and exhale at a rate of six breaths per minute. The average inspiratory to expiratory (I/O) ratio was determined from the maximum and minimum heart rates over three breath cycles.

30: 15 Ratio. This was obtained during an active or passive stand by calculating the ratio of the longest R-R interval around the 30th beat to the shortest R-R interval around the 15th beat after standing.

Postural Blood Pressure Drop. The difference between the average systolic and diastolic blood pressure for 20 beats before standing and the minimal systolic and diastolic blood pressure during the active or passive stand were determined.

Isometric Contraction. The maximal diastolic blood pressure response during sustained handgrip maintained at 30 % of the maximum voluntary contraction using a handgrip dynamometer for 3 minutes or up to the point of exhaustion was recorded.

Table I: Sociodemographics, Comorbidities and Medication Histories of Patients

Characteristics	n = 205 (%)	Mean (SD)
Age (Years), median (IQR)	75 (81-65)	70 (17)
Female Gender, n (%)	126 (62)	
Comorbidities		
Diabetes, n (%)	65 (32)	
Heart disease, n (%)	50 (24)	
Atrial fibrillation, n (%)	10 (5)	
Hypertension, n (%)	113 (55)	
Stroke, n (%)	31 (15)	
Hypercholesterolaemia, n (%)	69 (34)	
Asthma/COPD, n (%)	16 (8)	
Parkinson's disease, n (%)	7 (3)	
Depression, n (%)	14 (7)	
Hypothyroidism, n (%)	9 (4)	
Dementia, n (%)	10 (5)	
Osteoarthritis, n (%)	27 (13)	
Osteoporosis, n (%)	17 (8)	
Hearing problem, n (%)	15 (7)	
Visual problem, n (%)	32 (16)	
Medication Histories		
Cardioactive Drugs, n (%)	112 (55)	
ACE Inhibitors, n (%)	34 (17)	
Angiotensin II Antagonists, n (%)	24 (12)	
Beta-Blockers, n (%)	39 (19)	
Alpha-Blockers, n (%)	12 (6)	
Calcium Antagonists, n (%)	54 (26)	
Diuretics, n (%)	24 (12)	
Anti-anginal Drugs, n (%)	17 (8)	
Psychoactive Drugs, n (%)	16 (8)	
Antidepressants, n (%)	13 (6)	
Antipsychotics, n (%)	6 (3)	
Sedatives, n (%)	3 (2)	
Anticonvulsants, n (%)	11 (5)	
Antidiabetic Agents, n (%)	44 (22)	
Insulin Preparations, n (%)	11 (5)	

SD, standard deviation; IQR, interquartile range; COPD, chronic obstructive pulmonary disease; ACE, angiotensin converting enzyme

Table II: Presenting Symptoms and Precipitating Factors of Patients

Precipitating factors	Dizziness (n = 92) (%)	Syncope (n = 72) (%)	Falls (n = 130) (%)
Head turning, n (%)	15 (16)	1 (1)	10 (8)
Posture change, n (%)	54 (59)	21 (29)	52 (40)
Prolonged standing, n (%)	25 (27)	7 (10)	19 (15)
Lying flat, n (%)	7 (8)	3 (4)	7 (5)
Hot weather, n (%)	5 (5)	6 (8)	2 (2)
After meals, n (%)	7 (8)	10 (14)	10 (8)
Palpitation, n (%)	11 (12)	5 (7)	2 (2)
Chest pain, n (%)	2 (2)	2 (3)	0 (0)
Micturition, n (%)	4 (4)	5 (7)	4 (3)
Defecation, n (%)	2 (2)	5 (7)	6 (4)
Other, n (%)	7 (8)	7 (10)	10 (8)

Nineteen (9 %) patients report the presence all the three symptoms of dizziness, syncope and falls. Figure 2 showed the percentages of patients with overlapping of symptoms

Table III: Diagnoses of Patients

Characteristics	n = 205 (%)	Dizziness (n = 92) (%)	Syncope (n = 72) (%)	Falls (n = 130) (%)
Orthostatic hypotension, n (%)	53 (26)	33 (36)	16 (22)	43 (33)
Reflex syncope, n (%)	48 (23)	32 (35)	31 (43)	37 (28)
Vasovagal syncope, n (%)	44 (22)	29 (32)	30 (42)	34 (26)
Carotid sinus hypersensitivity, n (%)	5 (2)	3 (3)	3 (4)	5 (4)
Situational syncope, n (%)	2 (1)	1 (1)	1 (1)	2 (2)
Cardiac syncope, n (%)	8 (4)	3 (3)	5 (7)	5 (4)
Arrhythmia, n (%)	6 (3)	3 (3)	3 (4)	4 (3)
Others*, n (%)	47 (23)	29 (32)	8 (11)	42 (32)

* inclusive of multifactorial falls. Totals exceed 100% as more than one diagnosis may coexist in each individual.
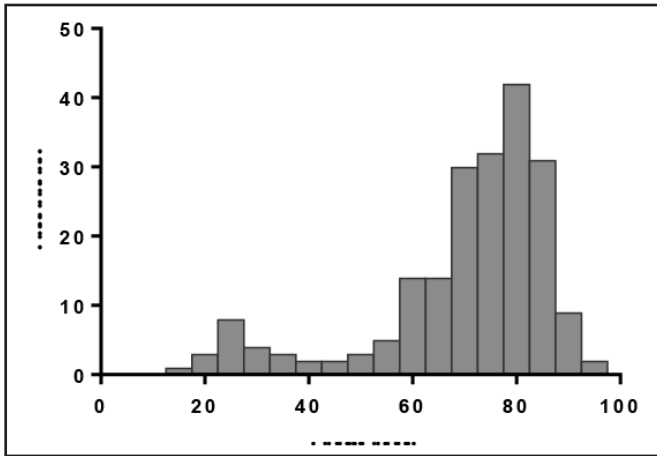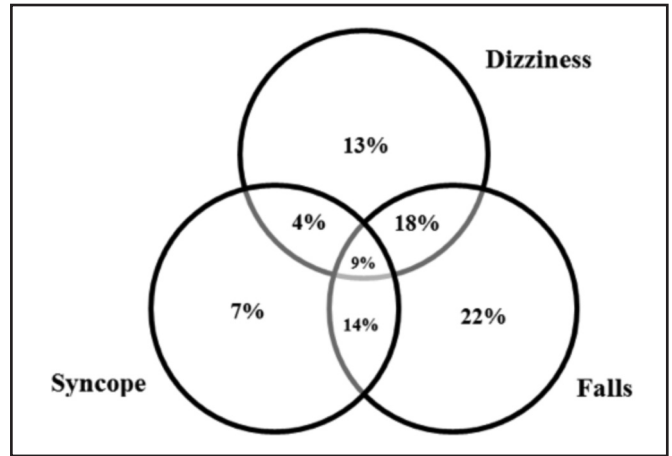
Fig. 1: Age distribution of patients (n = 205).

Fig. 2: Percentage of patients with dizziness, syncope, falls and overlaps in presenting symptoms.

Cold Pressor Test. The maximal diastolic blood pressure rise was recorded while the free hand was immersed up to the wrist in ice-cold water for 1 minute.

Data Analysis
Data analysis was performed using the SPSS Statistical Package version 20.0. Normal distribution was determined by visually inspecting histogram. Basic characteristics were summarized in means with standard deviations or medians with interquartile ranges in parenthesis or frequencies with percentages for continuous and categorical variables respectively.

RESULTS
Sociodemographics, comorbidities and medication histories
Two hundred and five patients were referred to the Falls and Syncope Service over the 29-month period. The median age (interquartile range) was 75 (65 to 81) years. Figure 1 showed the age distribution of patients referred to the service with bimodal peaks at 25-30 years and 75-80 years.

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Presenting Symptoms and Precipitating Factors
One hundred and thirteen (55 %) patients reported symptoms of dizziness and 72 (35 %) had one or more episode(s) of syncope. One hundred and thirty (63 %) had fall(s) and 52 (26 %) sustained injury(ies). Precipitating factors with respect to the presenting symptoms were summarised in table II. Forty-five individuals (22 %) presented with symptoms of falls with no co-existing symptoms of dizziness or syncope. These individuals were not more likely to report precipitating factors of posture change or prolonged standing compared to those with and without falls with symptoms of dizziness and syncope (Odd ratio, OR = 0.560, 95 % Confidence interval, CI = 0.269 to 1.165).

Diagnoses
The most common diagnosis was orthostatic hypotension (26 %), followed by reflex syncope (23 %) and cardiac syncope (4 %). Diagnoses with their respective presenting symptoms were summarised in Table III. Individuals presenting with falls alone without accompanying symptoms of dizziness or syncope were not less likely to be diagnosed with orthostatic hypotension, reflex syncope or cardiac syncope (OR = 0.629, 95 % CI = 0.322 to 1.227).

DISCUSSION
We have described the experience of a dedicated falls and syncope service developed to conduct structured evaluation of two closely associated and common medical conditions. The majority of our patients were female and fell within the elderly age group. Fifty-five percent patients had a pre-existing diagnosis of hypertension and 55 % were also on cardioactive drugs, while one-third were diabetics. Falls were the commonest symptoms reported by patients referred to the service, followed by dizziness and syncope, but an overlap existed between the three symptoms, with 9% reporting the presence of all three.

Bimodal peaks could be observed in the age distribution of our patient with a sharp increase around the age of 70 years. These findings were in tandem with those found in the Framingham cohort.[6] This demonstrates that falls and syncope are age-dependent conditions. The basic demographics of our patients differ from those reported previously by other similar services, with a much higher preponderance of hypertension and diabetes.[21] This suggests the presence of regional variations characteristics of falls and syncope, therefore limiting the applicability of current published evidence which have been mainly generated from Western Europe and North America.

The overlap between falls, syncope and dizziness demonstrated in our study has been previously reported.[22, 23] Falls and syncope are commonly managed as two separate entities with syncope often considered a neurological or cardiological condition while falls are often under-reported

with the management often targeted solely at the resultant injury which led to the presentation of emergency medical services.[24] Factors which deem falls and syncope indistinguishable in the elderly were cognitive impairment, poor recall of the event and a lack of witness accounts.[3] Furthermore, amnesia for loss of consciousness is well-documented in individuals with a subsequent diagnosis of CSH or VVS presenting as unexplained falls.[5, 25] Both falls and syncope are also related to potentially avoidable escalating healthcare expenditure in terms of hospitalization costs, unnecessary investigations and institutionalization costs.[26-28] Furthermore, robust evidence exists for the structured evaluation and multidisciplinary approach for both conditions.[28, 29]

The diagnosis of OH, reflex syncope and cardiac syncope were made in 53 % of all attenders regardless of presentations. When we considered only those with isolated symptoms of falls with no accompanying symptom of dizziness or syncope, these individuals were not less likely to report precipitating symptoms of posture change or prolonged standing and were not less likely to be diagnosed with OH, reflex syncope or cardiac syncope. This has important clinical implications, in that the absence of dizziness and syncope in the individuals presenting with falls does not exclude the diagnosis of hypotensive or bradycardic disorders. Our findings are consistent with previous studies involving individuals with unexplained falls, which established the presence of amnesia of loss of consciousness in individuals diagnosed with CSH and VVS.[25]

Approximately a quarter of our patients with any symptom presentation was diagnosed with OH. The number of patients with OH in our study was slightly higher as compared to those found in the Evaluation of Guidelines in Syncope Study 2 conducted in Italy.[30] This may be accounted for by age differences, the much higher proportion of individuals with diabetes and the higher use of cardioactive drugs among our clients.[31, 32] Diabetes is associated with autonomic neuropathy, as well as hypertension and cardiovascular diseases increasing the need for cardioactive drugs. Both autonomic neuropathy and cardioactive medications are associated with OH. A number of studies looking at the effect of withholding fall-risk-increasing medications such as psychotropic and cardiovascular drugs reported a symptom improvement after stopping the medications.[33, 34] The presence of a falls and syncope service with structured processes ensures the methodical documentation of medications use and that healthcare personnel involved in the service are trained in medication review. Furthermore, careful targeted monitoring can also be ensured as medication dose reduction and withdrawal are associated with exacerbation of the underlying medical condition which may then require finer dose adjustments or replacement with alternative treatments.

The establishment of rapid access falls and syncope services have been shown to improve the management of patients presented with unexplained falls and syncope.[7, 22, 35, 36] Our experience has also demonstrated that such services can also be adapted for a healthcare service based in a middle-income Asian nation. The diagnosis of OH, reflex syncope or cardiac

syncope was achieved in 72 % of those presenting with syncope, and 65-71 % of those with falls and dizziness respectively as evidence of the effectiveness of a structured approach achieving diagnostic yield comparable to that of previous studies.[22, 30] Our study was observational in nature, with our patient mix reliant entirely on referral patterns by primary care, trauma and emergency and other medical specialties. The proportion of falls attributable to syncope disorders may therefore be falsely high, as individuals referred may be more likely to be suspected to suffer from syncopal disorders. Our findings concerning the overlap patterns between dizziness, falls and syncope will therefore need to be confirmed in population based studies involving representative samples. Future studies should also be directed at assessment of the health economic implications of setting up such unit in a middle-income country.

CONCLUSION

We have successfully established a falls and syncope service in a busy teaching hospital based in Kuala Lumpur. The majority of our patients exceeded the age of 65 years. The symptoms of falls, syncope and dizziness overlapped in 40 % of patients. The diagnostic yield of 72 % for patients with syncope evaluated by our service is comparable to that of similar services developed previously. Further research should evaluate the suggested overlap in representative community samples, and also seek to determine the cost-effectiveness of the falls and syncope service in our middle-income country.

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