Maturitas 84 (2016) 32–37

Contents lists available at ScienceDirect

Maturitas

journal homepage: www.elsevier.com/locate/maturitas

Anticholinergic burden is associated with recurrent and injurious falls in older individuals

Anam Zia [a], S. Kamaruzzaman [a,b], Phyo Kyaw Myint [c], M.P. Tan [a,b,d,*]

[a] Ageing and Age-Associated Disorders Research Group, University of Malaya, Kuala Lumpur, Malaysia
[b] Department of Medicine, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia
[c] AGEING, Epidemiology Group, School of Medicine & Dentistry, Institute of Applied Health Sciences, University of Aberdeen, Aberdeen, United Kingdom
[d] Centre of Innovation in Medical Engineering, University of Malaya, Kuala Lumpur, Malaysia

ARTICLE INFO

Article history:
Received 21 June 2015
Received in revised form 11 October 2015
Accepted 12 October 2015

Keywords:
Falls
Timed up and go
Functional Reach
Anticholinergic Cognitive Burden
Scale
Aged

ABSTRACT

Objective: While the anticholinergic activity of medications has been linked to cognitive decline, few studies have linked anticholinergic burden with falls in older people. We evaluated the relationship between anticholinergic burden and recurrent and injurious falls among community-dwelling older adults.
Study design: This case-control study was performed on 428 participants aged ≥65 years, 263 cases with two or more falls or one injurious fall in the preceding 12 months, and 165 controls with no falls in the preceding 12 months. Anticholinergic burden was determined using the anticholinergic cognitive burden (ACB) scale. Upper and lower limb functional abilities were assessed with timed up and go (TUG), functional reach (FR) and grip strength (GS). Logistic regression analysis was employed to calculate the mediation effect of TUG, FR and GS on ACB associated falls.
Results: Univariate analysis revealed a significant association between an ACB score of ≥1 with falls (OR, 1.8; 95% CI; 1.1–3.0; $p = 0.01$) and significantly poorer TUG and FR. The association between ACB≥1 and falls was no longer significant after adjustment for either TUG (OR for ACB associated falls, 1.4; 95% CI, 0.88–2.4; $p = 0.14$) or FR (OR for ACB associated falls, 1.4; 95% CI, 0.89–2.4, $p = 0.12$) but remained significant with GS.
Conclusion: The association between recurrent and injurious falls and the use of any medications listed in the ACB scale was mediated through gait and balance impairment but not by muscular weakness, providing a novel insight into the potential mechanistic link between ACB and falls. Future studies should determine whether TUG and FR measurements could help inform risk to benefit decisions where ACB medications are being considered.

1. Introduction

More than a third of older adults fall each year and amongst those who fall, 20–30% suffer moderate to severe injuries [1]. Falls are the primary reason for 85% of all injury-related hospital admissions and more than 40% of nursing home admissions [2]. The annual costs attributable to falls and fall-related complications have been estimated to be billions of dollars worldwide [3]. The risk of recurrent falls multiplies after the first fall and a substantial proportion of recurrent and injurious falls lead to a decline in functional health [4–6].

Several medications have been associated with the increased probability of falling and many drugs frequently prescribed to older people have anticholinergic activity [7,8]. While anticholinergic activity is usually associated with peripheral and central effects, ranging from confusion, sedation, and inability to concentrate to frank delirium [9], newer studies have related anticholinergic drugs with increased hospitalisation [10], cardiovascular diseases and mortality [7,11]. In addition, recent studies have reported the anticholinergic cognitive burden (ACB) of drugs to be associated with poor mobility, functional decline, psychomotor slowing [12–15] as well as falls among older adults [16–18].

Previous studies had not evaluated community-dwelling older people at particularly high risk of recurrent falls. Furthermore, previous studies had not evaluated mobility and balance performance in relation to the use of anticholinergic drugs in a single study. We hypothesized that the use of drugs with ACB leads to falls through their effects on mobility and balance. Therefore, the objective of this

* Corresponding author at: Department of Medicine, Faculty of Medicine, 50603 Kuala Lumpur, Malaysia. Fax: +60 3 79494613.
E-mail addresses: Dr.anamzia@yahoo.com (A. Zia), Shahrulk@gmail.com (S. Kamaruzzaman), mptan@ummc.edu.my (M.P. Tan).

http://dx.doi.org/10.1016/j.maturitas.2015.10.009
0378-5122/

Table 1
Characteristics and anticholinergic cognitive burden among fallers and non-fallers.

Characteristics	Fallers[a] (*n* = 263)	Nonfallers[b] (*n* = 165)	Mean difference (95% CI)	*P* value[c]
Age, mean (±SD)	75.3 (7.3)	72.13 (5.5)	3.1 (1.8–4.4)	<0.001
BMI, mean (±SD)	23.75 (4.1)	24.13 (4.0)	0.4 (0.3–1.2)	0.33
Characteristics	**Fallers[a] (*n* = 263)**	**Nonfallers[b] (*n* = 165)**	**OR (95% CI)**	***P* value[d]**
Male, *n*(%)	84 (31.9)	55 (33.3)	1.0 (0.7–1.6)	0.76
Smoking, *n*(%)	15 (5.7)	7 (4.2)	1.3 (0.5–3.4)	0.50
Alcohol, *n*(%)	23 (8.7)	17 (10.3)	0.8 (0.4–1.6)	0.59
Medical history				
Diabetes, *n*(%)	95 (36.1)	29 (17.6)	2.6 (1.6–4.2)	<0.001
Visual problems, *n*(%)	132 (50.2)	51 (30.9)	2.2 (1.5–3.3)	<0.001
Hypertension, *n*(%)	155 (58.9)	74 (44.8)	1.7 (12–2.6)	0.004
Circulatory diseases, *n*(%)	45 (17.1)	14 (8.1)	2.2 (1.2–4.2)	0.01
Hearing disorders, *n*(%)	28 (10.6)	7 (4.2)	2.6 (1.1–6.3)	0.01
Neoplasm, *n*(%)	6 (2.3)	10 (6.1)	0.36 (0.1–1.1)	0.04
Arthritis, *n*(%)	68 (25.9)	38 (23.0)	1.1 (0.74–1.8)	0.51
Osteoporosis, *n*(%)	25 (9.5)	16 (9.7)	0.97 (0.5–1.8)	0.94
Asthma, *n*(%)	18 (6.8)	9 (5.5)	1.2 (0.5–2.9)	0.56
Thyroid disorders, *n*(%)	17 (6.5)	15 (9.1)	0.69 (0.3–1.4)	0.31
Orthostatic Hypotension, *n*(%)	62 (23.6)	29 (17.6)	1.4 (0.88–2.3)	0.14
Physical performance scores, *n*(%)				
TUG ≥ 13.5 s	134 (51)	34 (20.6)	3.9 (2.5–6.2)	<0.001
FR ≤ 18 cm	78 (29.7)	13 (7.9)	4.8 (2.6–9.1)	<0.001
Reduced RGS	201 (76.4)	89 (53.9)	2.7 (1.7–4.2)	<0.001
Reduced LGS	212 (80.6)	101 (61.2)	2.9 (1.8–4.6)	<0.001
Total ACB Score, *n*(%)				
ACB ≥ 1	75 (28.5)	29 (17.6)	1.8 (1.1–3.0)	0.01

SD, standard deviation; OR, odds ratio; CI, confidence interval; ACB, anticholinergic cognitive burden; TUG, timed up and go, FR, functional reach; LGS, grip strength in left hand; RGS, grip strength in right hand; reduced grip strength ≤20 kg women, ≤30 kg men.

[a] Recurrent or injurious falls in the past 12-months.
[b] No falls in the past 12 months.
[c] Student's *t*-test.
[d] Chi-squared test.

study was to examine the association between ACB of drugs with falls and subsequently employing statistical modelling to evaluate the mediating effects of mobility and balance on anticholinergics associated falls among community dwelling older adults.

2. Methodology

2.1. Study population

All fallers recruited into the Malaysian Falls Assessment and Intervention Trial (MyFAIT) [19] were enrolled into the study. Fallers were adults aged ≥65 years who attended the emergency department, Primary Care clinics and Geriatric clinics due to falls. The inclusion criteria was the history of at least two falls or one injurious fall over the past 12 months as these factors are considered to be associated with the amplified risk of future falls [20]. Control subjects ≥65 years old with no falls over the past 12 months included community dwelling volunteers recruited through media and word-of-mouth advertising. The participants with severe physical disabilities (unable to stand), clinical diagnosis of dementia and major psychiatric illness were excluded from the study. All study participants provided written informed consent.

2.2. Study variables

2.2.1. Basic characteristics and blood pressure

Both cases and controls were evaluated with a structured history; which included enquiry regarding falls, sociodemographic details and medical history. Blood pressure readings were obtained in the supine position and at 1st, 2nd and 3rd minute of standing using the Omron (HEM-7200). A fall was defined as "an unexpected event in which the person comes to rest on the ground, floor or lower level" [21]. Orthostatic hypotension was defined as a drop of 20 mmHg in systolic and 10 mmHg in diastolic blood pressure during three minutes of standing.

2.2.2. Physical function

The timed-up and go (TUG) and functional reach (FR) tests were conducted to provide indicators of gait speed and balance respectively. The TUG test is considered as an appropriate clinical tool to measure functional mobility among older adults [22]. For TUG, the participants were instructed to walk a distance of 3-m at their normal pace, from and back to a seated start position, on a 46 cm high arm-chair. Functional reach was defined as the distance between arm's length and maximal forward reach achieved using a fixed base of support [23]. The participants were instructed to stand with their feet shoulder width apart next, and to raise their arm at 90°, parallel to the wall. A one-metre ruler was placed at shoulder (acromion) height, parallel to the participant's arm and the distances were recorded at the location of the 3rd metacarpal. After noting down the initial reach, the final distance was recorded (in centimetres) as the participants leaned forward without stepping or losing the balance. The difference between the two measurements was recorded as the FR of the participant.

Participants were instructed to grip the Jamar dynamometer with maximal strength with their dominant hand, followed by their non-dominant hand while seated and elbows bent at 90°. Three readings for each hand were obtained, the average of which was considered as the final grip strength. All the above tests were demonstrated with one trial run. Shoes were kept on for these tests and walking aids were allowed for TUG if required.