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Is there such a thing as a mechanical fall?

Jiraporn Sri-on, MD^{a,b,*}, Gregory Philip Tirrell, BS^a, Lewis A. Lipsitz, MD^{c,d}, Shan Woo Liu, MD, SD^a

^aEmergency Department, Massachusetts General Hospital, Boston, MA 02114, USA

^bEmergency Department, Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand, 10300

^cHebrew Senior Life, Institute for Aging Research, Boston, MA, USA

^dBeth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, 02215, USA

Abstract

Objectives: The term *mechanical falls* is commonly used in the emergency department (ED), yet its definition and clinical implications are not established. It may be used to attribute falls to extrinsic factors in the environment exonerating clinicians from conducting a thorough assessment of the fall's underlying intrinsic causes. We conducted this study to determine how clinicians assess “mechanical” and “nonmechanical” falls; we explored conditions, fall evaluation, and outcomes associated with these diagnoses.

Methods: This study was a secondary analysis of a retrospective study at 1 urban ED. Data were obtained from medical records of patients aged 65 years and older who presented to the ED for a fall. We compared the associated conditions/causes, the ED fall evaluation, mortality, ED revisits, subsequent hospitalizations, and recurrent falls between the 2 terms.

Results: We had a sample size of 350 patients: 218 (62.3%) with “mechanical falls” and 132 (37.7%) with nonmechanical falls. There was little difference among associated conditions between the 2 fall labels other than mechanical falls had more associated environmental causes but fewer syncope causes. However, more than a quarter of nonmechanical falls had associated environmental factors as well. Similarly, there was little difference in the fall evaluation, ED revisit rates, recurrent falls, subsequent hospitalizations, and death between the 2 groups.

Conclusions: The term *mechanical fall* is unclear, inconsistently used, and not associated with a discrete fall evaluation and does not predict outcomes. We propose eliminating the term because it inaccurately implies that a benign etiology for an older person's fall exists.

1. Introduction

The term *mechanical falls* has become commonly used in emergency departments (EDs), yet its definition and clinical implications have not been established. It may be used to attribute falls to extrinsic factors in the environment and excuse clinicians from conducting a thorough assessment of underlying intrinsic causes in the patient. Given that a third of older

*Corresponding author at: Emergency Department, Vajira Hospital, Navamindradhiraj University, 681 Samsen Road, Dusit District, Bangkok, Thailand, 10300. Tel.: +66896840010. Jiraporn.rew@gmail.com (J. Sri-on), gregt89@yahoo.com.

adults in the United States fall annually and 2.3 million nonfatal falls were treated in EDs in 2010 [1], a figure that is likely to increase as the elderly population grows [2], it is important to understand what is often termed *mechanical falls* in the ED.

The term *mechanical fall* is not well defined in academic research, and it is open to interpretation what differentiates a mechanical from a nonmechanical fall [3,4]. The term implies that an external mechanical force or object caused the fall. Although more than 25% of community-dwelling older adults have falls related to slipping, tripping, or stumbling [5,6], external factors are seldom the sole cause of an elderly patient's fall. In almost all cases, patients' comorbidities and health status are involved: a younger person in the same environment probably would not have fallen. Because elderly fall patients are at high risk for recurrent falls [7,8], evaluation of fall patients should determine modifiable fall risk factors. We hypothesized that the use of the term *mechanical fall* may lead to a less thorough evaluation of the elderly fall and may not adequately assess elderly fall etiology.

We conducted this secondary analysis of a retrospective study to determine what ED clinicians do to assess what they call "mechanical" and "nonmechanical" falls; we explored what conditions or pathologies ED clinicians attribute to these labels, whether the labels led to a specific fall evaluation approach, and what outcomes are associated with these diagnoses.

2. Methods

2.1. Study setting

This "mechanical fall" study was a secondary analysis of a retrospective study that described the evaluation of ED fall patients presenting to 1 urban, level 1 trauma center, academic hospital ED [9].

2.2. Study population

We included patients aged 65 years and older who presented to the ED for a fall from January 1, 2012, through December 31, 2012, who had been assigned an *International Classification of Diseases, Ninth Revision*, "E" code of a fall (E880-E886 and E888) and had visited a primary care physician affiliated within the hospital's network in the past 3 years. We excluded patients who were transferred from other hospitals to reduce the potential of missing study data.

2.3. Data collection

We adapted our data collection form from the recommendations of the American Geriatrics Society/British Geriatrics Society Clinical Practice Guideline for Prevention of Falls in Older Persons 2010 [10] and the Geriatric Emergency Department (GED) Guideline [11]. Details of the adaption have been described elsewhere [9].

One emergency physician and 1 research assistant performed the data abstraction. We met once a week to clarify terms and discuss the progression of data collection. The study's principal investigator (SL) supervised data collection and monitored the quality of data

abstraction. We randomly sampled 5% of 350 patient's charts to test for interrater agreement using Cohen κ coefficient.

There is no standard definition for what constitutes a "mechanical fall." "Mechanical fall" is a subjective term which is often associated with a slip or trip leading to a fall. We did not define "mechanical fall" ourselves; rather, we recorded the number of falls which were described as a "mechanical fall" by clinicians (ED residents and/or ED attending) in the patients' electronic charts.

2.4. Outcomes

We first examined conditions/factors associated with mechanical vs nonmechanical falls. The categories for conditions associated with the fall were taken from the practice guideline of Baraff et al for elder falls [12]. Data for such conditions/factors were taken from the history of the present illness section of the clinician note.

We then explored whether patients labeled as having a mechanical fall vs patients who were not described as having had a mechanical fall had discrete ED evaluations. We examined the ED evaluation of elderly fall patients in 4 categories: (1) history, (2) physical examination (PE), (3) diagnostic evaluation, and (4) safety assessment. Key history elements consisted of factors associated with falls as identified by the GED Guideline [11] and included the location of fall, comorbidities and other health problems, fall history, loss of consciousness or alteration of mental status immediately before or after the fall, activities of daily living, alcohol consumption, and certain medications. Key elements of the PE included an examination of gait, balance, foot problems, orthostatic hypotension, muscle strength, and cognition. Key elements of the diagnostic evaluation include complete blood count, electrolyte panel, electrocardiogram (ECG), x-ray, and computed tomography (CT). Finally, key elements of the safety assessment before discharge are a get-up and go test (a test for assessing physical mobility) [13] in the ED and a physical therapy (PT) evaluation (gait, balance, and muscle strength) before disposition from ED. Finally, we explored whether mechanical vs nonmechanical labels predicted follow-up events, 30-day and 6-month mortality, frequency of ED revisits, subsequent hospitalizations, and recurrent falls.

2.5. Data analysis

We compared differences in associated conditions/factors of the fall, evaluation, and follow-up events between mechanical- and nonmechanical-labeled patients. Proportions were presented for categorical data and compared using χ^2 or Fisher exact test. Continuous data were presented as means with SDs if normally distributed and medians with interquartile ranges (IQRs) if nonnormally distributed; a t test was used to compare data if normally distributed and Wilcoxon rank sum test was used for nonnormal data. We analyzed all data using STATA software (version 13.0).

3. Results

A total of 450 patients were eligible for inclusion in this study. One hundred were excluded: 40 because they were improperly assigned an *International Classification of Diseases, Ninth Revision*, code; 29 because they were transferred from other hospitals; 22 because they

revisited for the same fall; 8 because they were duplicate charts; and 1 because the chart was inaccessible due to legal reasons. Our final analysis was based on 350 patients. In terms of reliability of chart review, the κ value was 0.84 (95% confidence interval, 0.67–1.00).

Two hundred eighteen patients (62.3%) had what was described as a mechanical fall, and 132 patients (37.7%) had nonmechanical falls. Mechanical and nonmechanical falls were similar in terms of age, sex, race/ethnicity, primary insurance, residence, and Charlson comorbidity index score (Table 1).

Overall, there was no clear discrete difference in the associated conditions between the 2 fall labels other than mechanical falls had more associated environmental factors than nonmechanical falls (57.3% vs 28.8; $P < .01$) but fewer syncope causes (0.9% vs 12.9%; $P < .01$). However, more than a quarter of nonmechanical falls also had associated environmental factors. Mechanical fall patients fell indoors less frequently than nonmechanical fall patients (54.1% vs 70.4%; $P < .01$) and had fall location recorded less frequently (22.9% vs 13.6%; $P = .03$). Mechanical fall patients lost consciousness or had an altered mental state less frequently than nonmechanical fall patients (4.6% vs 25.0%; $P < .01$) and also had a lower rate of dementia (9.6% vs 18.9%; $P = .01$).

Overall, there was no difference between the frequencies of recorded recommended PE between patients termed mechanical vs nonmechanical fall (Table 2). Emergency department clinicians examined gait, balance, orthostatic hypotension, and foot problems in less than a quarter of all elderly fall patients.

More than half of all elderly fall patients had some diagnostic investigation. Although the rate at which ECGs and CTs were performed for mechanical fall patients was less than for nonmechanical fall patients, there were no differences in the number of patients with abnormal ECGs (ECG abnormalities [11.6% vs 5.2%; $P = .23$] or CT abnormalities [40.4% vs 31.3%; $P = .20$]). The most common ECG abnormality that we found was atrial fibrillation (6/11 [54.5%]). Few elderly fall patients had a PT evaluation or performed the get-up and go test before disposition from the ED (Table 2).

In terms of disposition and short- and long-term outcomes, the ED disposition of patients was similar in terms of discharge to place of preadmission residence, admission to the hospital, and admission to the observation unit. There were similar ED revisit rates, recurrent falls, subsequent hospitalizations, and death between mechanical and nonmechanical fall patients (Table 3).

4. Discussion

Our exploration of the term *mechanical fall* revealed that mechanical vs nonmechanical falls are not clearly differentiated by the associated conditions/factors surrounding the fall nor do the terms guide a fall evaluation or predict outcomes.

The term *mechanical fall* implies that an external force (eg, environmental) caused the patient to fall and/or that there is no underlying pathology of concern and/or the patients did not pass out first. Our exploratory data show that these implications are often not true of falls

which are described as mechanical in nature. Both mechanical and nonmechanical fall patients had high rates of worrisome causes, such as poor balance, and high rates of comorbidities associated with them. Furthermore, our study found that the term *mechanical fall* was not used consistently; a quarter of nonmechanical fall patients had an environmental cause for their fall.

Our study showed little overall difference between the fall evaluations of the 2 groups indicating labeling patients as having mechanical falls does not lead to a distinct evaluation approach. In some instances, the evaluation of mechanical fall patients was less comprehensive than the evaluation of nonmechanical fall patients. In our study, ED clinicians asked fewer mechanical fall patients about their fall history than they asked of nonmechanical fall patients. A history of previous falls is one of the most important key history items for elderly fall patients [6–8]. This information can help prevent future falls and substantial morbidity, and many studies have recommended asking elderly fall patients this key history element [6–8]. Evaluating a patient's fall risk factors is not any more or less applicable for elderly patients based on the cause of their fall. Mechanical falls may seem reassuring but are still a sign of potential decline.

For follow-up events, there were similar rates of ED revisits; subsequent hospitalization; recurrent falls; and death at 7 days, 30 days, and 6 months after discharge from the ED. More importantly, there were very high rates of recurrent falls, ED revisits, and hospitalizations in the mechanical fall group, indicating that there is likely some underlying pathology in these so-called mechanical falls.

Our study shows that nothing distinguishes a mechanical fall from a nonmechanical fall. The terms *mechanical* and *nonmechanical* are not clearly defined. There are no particular conditions/etiologies associated with them, and there are no associated discrete, nonoverlapping evaluations of mechanical and nonmechanical fall patients. The terms also do not predict outcomes, suggesting that they are not useful. In past years, the terms *intrinsic* and *extrinsic* have been used to describe falls. However, it is clear now that falls are multifactorial. All fall patients need a thorough evaluation at least following GED guideline to determine the etiology of the fall to impact outcomes.

5. Limitations

This study was conducted at a single hospital. The results of this study may not be generalizable to EDs in other areas. Our sample size was relatively small. The number of patients with undesirable outcomes was limited. In addition, chart reviews are limited in their ability to accurately measure quality of care. There is a potential for missing data if the patients sought care outside our hospital's network. Causes of falls were based on ED charts and not some independent criterion standard evaluation. Finally, the rate of recurrent falls may be lower than the actual rate depending on how often patients reported these events to their health care provider.

6. Conclusion

In conclusion, our data show that the term *mechanical fall* is unclear and inconsistently used; the terms *mechanical* and *nonmechanical falls* overlap to a great extent and do not describe distinct entities, nor do they lead to a specific evaluation or predict outcomes. We propose eliminating the term *mechanical fall*. A fall, mechanical or not, is often a sentinel event leading to a decline in the older patient.

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Table 1

Demographic data between mechanical and nonmechanical fall patients

Variable	Mechanical, n = 218 (%)	Nonmechanical, n = 132 (%)	P
Age, mean $\pm$ SD	80.5 (8.9)	79.3 (8.4)	.20
Sex (male), n (%)	145 (66.5)	80 (60.6)	.26
Race/ethnicity, n (%)			
White	201 (92.2)	126 (95.5)	.23
Black	6 (2.7)	4 (3.0)	1.00
Hispanic	4 (1.8)	0 (0)	.30
Asian	8 (3.7)	2 (1.5)	.24
Other	1 (0.5)	0 (0)	1.00
Primary insurance, n (%)			.08
Medicare	191 (87.6)	143 (85.6)	
Commercial	14 (6.4)	14 (10.6)	
Company	7 (3.2)	0	
Welfare	0 (0)	1 (0.8)	
Self-pay	5 (2.3)	4 (3.0)	
Other	1 (0.5)	0	
Residence, n (%)			.68
Home with relative(s)	77 (35.3)	39 (29.5)	
Home alone	106 (48.6)	76 (57.6)	
Assisted living	28 (12.8)	15 (11.3)	
Skilled rehab facility	4 (1.8)	1 (0.8)	
Acute rehab facility	1 (0.5)	0	
Homeless	1 (0.5)	0	
Unknown	0	1 (0.8)	
Charlson comorbidity index, mean (SD)	6.8 (3.0)	6.6 (2.9)	.49
ED length of stay, median (IQR), h	5 (3–7)	6 (4–8)	.01
Hospital length of stay, median (IQR), d	3 (1–5)	2 (1–4)	.12

Table 2

The conditions/associated factors of fall and the key evaluation elements among mechanical and nonmechanical older adult ED fall patients

	Mechanical, n = 218 (%)	Nonmechanical, n = 132 (%)	P
Conditions/associated factors of fall			
Environment	125 (57.3)	38 (28.8)	<.01
Poor light source	7 (3.2)	0	.05
Uneven or slippery surfaces	77 (35.3)	22 (16.7)	<.01
Loose rugs	13 (6.0)	2 (1.5)	.06
Steep stairs	10 (4.6)	3 (2.3)	.39
Objects in pathway	12 (5.5)	7 (5.3)	.94
Lack of handrails	4 (1.8)	1 (0.8)	.65
Inappropriate furniture	5 (2.3)	2 (1.5)	.72
Aging/functional decline	59 (27.0)	44 (33.3)	.21
Weakness	12 (5.5)	14 (10.6)	.08
Poor balance	48 (22.2)	33 (25.0)	.52
Vision impairment	2 (0.9)	0	.53
Syncope and presyncope	2 (0.9)	17 (12.9)	<.01
Other medical problems	4 (1.8)	9 (6.8)	.02
Delirium	3 (1.4)	6 (4.6)	.09
Foot and footwear problem	4 (1.8)	1 (0.8)	.65
Unclear	38 (17.4)	39 (29.6)	<.01
History key elements			
Indoor	118 (54.1)	93 (70.4)	.01
Outdoor	50 (22.9)	21 (15.9)	.01
Not recorded	50 (22.9)	18 (13.6)	.03
Fall history asked about	60 (27.5)	57 (43.2)	<.01
Loss of consciousness/Altered mental status	10 (4.6)	33 (25.0)	<.01
Alcohol use	42 (19.3)	26 (19.7)	.92
Polypharmacy (≥ 5 medications), n (%)	151 (71.6)	95 (71.9)	.93
Independence with ADLs	90/115 (78.3)	47/73 (64.4)	.04
Dementia	21 (9.6)	25 (18.9)	.01
Prior hip fracture	18 (8.2)	7 (5.3)	.29
Physical examination key elements			
Gait and/or balance evaluation	35 (16.1)	25 (18.9)	.49
Orthostatic evaluation	22 (10.1)	21 (15.9)	.11
Cognitive assessment (orientation to time, place, person)	216 (99.1)	130 (99.5)	.61
Muscle strength test	132 (60.5)	67 (50.8)	.07
Foot problem evaluation	3 (1.4)	2 (1.5)	.08
Investigation evaluation			
Complete blood count	116 (53.2)	83 (62.9)	.07
Electrolyte panel	116 (53.2)	83 (62.9)	.07

	Mechanical, n = 218 (%)	Nonmechanical, n = 132 (%)	P
ECG, n = 127	69 (31.6)	58 (43.9)	.02
New ECG abnormalities, n = 11	8 (11.6)	3 (5.2)	.23
Atrial fibrillation	5 (7.2)	1 (1.7)	.24
Sinus bradycardia	2 (2.9)	1 (1.7)	1.00
ST abnormality	1 (1.5)	1 (1.7)	1.00
X-ray, n = 275	178 (81.7)	97 (73.5)	.07
CT, n = 184	104 (47.7)	80 (60.6)	.02
CT abnormality, n = 67	42 (40.4)	25 (31.3)	.20
Head CT abnormality, n = 56	33 (31.7)	23 (28.8)	.66
Soft tissue injury	17 (16.4)	8 (10.0)	.21
Fracture	10 (9.6)	5 (6.3)	.41
Subarachnoid hemorrhage	1 (1.0)	5 (6.3)	.09
Subdural hematoma	1 (1.0)	4 (5.0)	.17
Cerebral hemorrhage	1 (1.0)	0	1.00
Cerebral contusion	1 (1.0)	0	1.00
Safety assessment before ED disposition			
Get-up and go test	8 (3.7)	0	.08
Patients have PT evaluation	26 (11.9)	20 (15.2)	.39

Abbreviation: ADLs, activities of daily living.

Table 3

The outcomes among mechanical fall and nonmechanical fall

ED disposition place	Mechanical fall, n = 218 (%)	Nonmechanical, n = 132 (%)	P
Discharge to place of preadmission residence, n = 187	120 (55.1)	67 (50.8)	.74
Transfer to hospital, n = 92	57 (26.2)	35 (26.5)	.94
Discharge to place of preadmission residence, n = 38	19 (33.3)	19 (55.9)	.04
Discharge to skill rehab facility, n = 53	38 (66.7)	15 (44.1)	.04
Institutionalization, n = 1	0	1 (2.9)	.90
Transfer to observation, n = 67	37 (16.9)	30 (22.7)	.19
Discharge to place of preadmission residence, n = 38	23 (62.2)	26 (86.7)	.02
Discharge to skill rehab facility	14 (37.8)	3 (17.7)	.02
Discharge to nursing home	0	1 (3.3)	
New nursing home, n = 4	4 (0.9)	0	.63
Revisit within 30 d	34 (15.6)	28 (21.2)	.18
Revisit within 6 mo	94 (43.1)	55 (41.7)	.79
Recurrent fall in 30 d	14 (6.4)	12 (9.1)	.36
Recurrent fall in 6 mo	45 (20.6)	34 (25.8)	.27
Subsequence hospitalization in 30 d	23 (10.6)	16 (12.1)	.65
Subsequence hospitalization in 6 mo	71 (32.7)	38 (28.8)	.46
Death within 30 d	1 (0.5)	1 (0.8)	1.00
Death within 6 mo	3 (1.4)	6 (4.6)	.07