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Physiological, Pharmacological and Environmental Factors Related to Falling in Geriatric Oncology Inpatients: A Case Control Study in a Major Cancer Center

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Abstract

Background: Although older adults are at an increased risk for falls, those with a cancer diagnosis are even more likely to experience falls and related injuries. 44% of this major cancer center's admissions are 65 years and older and over 90% are cancer related diagnosis.

Purpose: The purpose of this study is to examine fall-related variables in oncology patients age 65 and over who have fallen during an inpatient admission and those less than 65 years of age who have fallen during an inpatient admission.

Methods: Retrospective case-control study of oncology inpatients that have fallen over the course of 18 months were matched with non-fallers admitted during same time frame for age, diagnosis, and gender. These cases were representative of the target population (to strengthen the external validity).

Results: Result of 181 fallers, 45% (n=81) were 65 years or older. These fallers (mean age 71.9 years) were matched to non-fallers (mean age 73.78). Seven variables were statistically significant predictors of falling in univariate logistic regression analysis. These were the presence of Orthostatic Hypotension (OH) (odds ratio 4.61; 95% CI 1.24-17.16) administration of chemotherapy (2.30; 1.05-5.05), benzodiazepines (6.66; 2.16-20.56) and diphenhydramine (3.59; 1.23-10.48). History of a previous fall (3.5; 1.03-11.90) and the use of assistive devices (6.96; 1.92-25.28) were also significant. Although the presence of Chemo Induced Peripheral Neuropathy (CIPN) was not independently significant in older fallers, inpatient oncology patients with CIPN were 3 times more likely to fall (3.05; 1.87-4.97).

Discussion: Fall history and assistive devices are included in risk assessments however potentially inappropriate medications and presence of CIPN are often not included in fall screening tools. Evaluation of OH may also provide valuable safety strategies for reducing falls in the oncology inpatient.

Keywords: Falls; Oncology inpatients; Chemoinduced peripheral neuropathy; Orthostatic hypotension

Introduction

Approximately 700,000 to 1,000,000 patients fall in hospitals each year [1,2]. Falls are second only to medication errors as the most common adverse event occurring in acute care hospitals each year and are the leading cause of injury related death in adults over the age of 65[3]. In 2013, the total cost of fall injuries was 34 billion (78% paid by Medicare) and the total cost may reach over 70 billion by 2030 [4,5]. When an inpatient falls, hospitalization may be prolonged, with a resulting increase in care costs and potential discharge to a rehabilitation setting instead of home [6]. It has been estimated that up to 11,000 inpatient falls result in death each year [7,8]. As a result of the prevalence of this iatrogenic problem in acute care settings, falls and falls with injury were identified by centers for medicare and medicaid services as a hospital acquired condition [9]. Additional cost for injuries sustained as a result of a fall during hospitalization may not be available for reimbursement [10] making the prevention of patient falls and injuries from falls a major goal in health care [11].

Although older adults are at an increased risk for falls, those with a cancer diagnosis are even more likely to experience falls and related injuries [12-16]. Studies have shown that falls occur in about 33% of older adults with cancer versus 29% of those without cancer [17]. According to the institute of medicine, the number of cancer diagnoses in older adults is expected to increase by 67% in the next 20 years. [18] Studying falls in older adult cancer patients is complex due to the heterogeneity of the population related to cancer diagnosis and comorbidities. In retrospective review of hospice patients, a fall rate of 22% was found in hospice patient sample [19]. A prospective review of falls identified chemo-induced peripheral neuropathy as a common symptom in cancer patients who received taxane therapies [20]. The prostate cancer patient undergoing androgen deprivation therapy was reported to have an increased risk of fall related fractures compared to controls [21].

Capone et al. [22] identified characteristics that may be unique and therefore predictive for cancer patients who fall. Likewise Kline, Thom, Quashie, Bronson and Dowling [23] sought to develop a fall risk assessment instrument at Memorial Sloan Kettering cancer center to identify specific risk factors for falling in the hospitalized patient with cancer. Hospitalized cancer patients regardless of age, are more likely to have injuries after a fall [24].

The cancer patient is particularly at risk for an injury sustained as a result of a fall related to coagulopathies (uncontrollable bleeding from thrombocytopenia or non-prophylactic anticoagulation therapies) and bone related issues [25]. These conditions can include fractures due to bone metastases, osteoporosis or bone loss and hypercalcemia. A retrospective review of cancer patients hospitalized in an acute care setting identified a fall rate of 27.5% and injury rate of 43.9% [26].

An additional concern related to fall risk are the medications prescribed to patients may increase their risk for falls. For the elderly there a list of Potentially Inappropriate Medications (PIMs), found on beers criteria [27] which when prescribed, may have side effects which out weight the benefit the patient will receive. Studies have found 21-41% of cancer patients are prescribed>1 PIM. [28] It is not known if some PIMs create a greater risk for falls than do others.

Application of a comprehensive fall program utilizing Lean and rapid improvement techniques reduced fall and falls with injury on a medical oncology unit [29]. An evidenced based practice model

resulted in a protocol incorporating purposeful rounding into a broad fall prevention program targeting a medical oncology blood and marrow transplant unit [30-32].

As a cancer institute, we recognize that our patients are more vulnerable to falls and fall related injury. A comprehensive fall and injury prevention program was implemented for all inpatient areas utilizing the AHRQ toolkit [33] and the Institute for healthcare improvement "How-to guide: Reducing patient injury from fall for injury reduction [1].

Validated instruments for measuring fall risk and identifying injury risk; the Morse Fall Scale (MFS) [34,35] and the ABCS scale were used for all hospitalized patients. Additional components of the safety program include targeted interventions for fall and injury prevention based on risk assessment, post incident interdisciplinary huddles, and electronic health record patient education guidelines [36,37].

In spite of the comprehensive fall prevention program, patients continue to fall and sustain injuries during their hospitalization [38]. This study is an attempt to capture physiologic and environmental factors, which may be related to an inpatient fall event.

Purpose/Objective: To examine the relationship between variables in oncology patients age 65 and over and those less than 65 years of age who have fallen during an inpatient admission. Research questions:

1. 1. Is there a difference in predictive factors of inpatient falls in oncology patients over and under the age of 65 years of age?
2. 2. Is there a difference between older fallers and older nonfallers and the use of potentially inappropriate medications?

Methods

Design

Retrospective electronic health record review of patients that have fallen during an 18 month time period. Case control match of non-fallers during same time frame matched for age, diagnosis, and gender.

Setting

An NCI comprehensive cancer center with magnet designation located in the south eastern United States on the florida gulf coast providing inpatient and outpatient adult oncology care. There are 204 designated inpatient beds with an annual daily census of 160 and 58000 patient days. Twenty-seven clinics provide over 300,000 ambulatory visits yearly. There are approximately 9500 surgical procedures annually.

Sample

The sample consisted of all patients 65 years of age and older and those under 65 who fell while hospitalized. There was a case control match of non-fallers during the same time frame matched for age and diagnosis. Each inpatient fall generated a safety report. This form includes location of fall, contributing factors, classifications of medications, time of day and recommendations of the post fall huddle members. Nursing documentation and patient education around the patient fall was evaluated most frequently by the patient care manager.

The Electronic Health Record for each inpatient experiencing a fall was reviewed for data collection. Any inpatient fall that sustained a fall, with or without injury over an 18 month time frame. Case control non-fallers were matched for age and admission diagnosis.

Procedure

The primary investigator conducted the electronic medical record review and maintained the data in a secure folder on password protected computer. All patient private information was de-identified per HIPPA 164.514(b)(2)(i) and (ii) before data analysis.

The following information was abstracted from the electronic medical record: age, gender, injury assessment, fall risk assessment score pre and post fall, and time of fall. Evidence of fall or injury prevention interventions in place was collected. The patient's past medical history, admission diagnosis, medications classifications, post op day or transplant day if indicated was also recorded. Treatment or cancer symptoms including peripheral neuropathy, orthostatic hypotension, cognitive impairments, or previous fall history was also abstracted from the health record. Additional analysis of the fall incident will include fall category, bed exit or bathroom relationship, and whether physical therapy was involved in the patient care.

Data Analysis

Research question 1: Age as a moderator of fall risk factors. A series of logistic regression models tested whether age (categorized as 65 and over or under 65) moderates the relationship between risk factors and a fall. First, each factor was tested as a univariate predictor of a fall. Next, if the factor is a statistically significant (p<.05) predictor of a fall, age was tested as a moderator. Because age likely will be tested as a moderator of multiple effects, a bonferonni-holm approach will be used to adjust nominal alpha. (The number of tests is unknown until we determine which factors are related to falls). Effect size (and 95% confidence interval) was used to determine the magnitude of the moderation effect of age. With 360 participants split equally among fallers and non-fallers, we will have 80% statistical power to detect odds ratios of 1.35 or greater with a nominal alpha of .05. With age as a covariate entered in the model at an effect size of 0.3 (medium), the odds ratio we can detect increases to 1.4 (these values are contingent on the nominal alpha based on the number of models we run).

Research question 2: Difference in PIM use between older and younger fallers. The chi square test was used to compare the proportion of older and younger fallers who were using PIM at the time of the fall. Because this question only involves one comparison, no adjustment to alpha was necessary. With a nominal alpha of .05, and a sample size of 180 fallers (about 43% older), we have 80% statistical power to detect about a 20% difference in PIM usage.

Results

Of 181 fallers, 45% (n=81) were 65 years or older. These fallers (mean age 71.9 years) were matched to non-fallers (mean age 73.78). Several variables were statistically significant predictors of falling in univariate logistic regression analysis (Table 1).

Covariate	Level	Faller N=181 n (%)	Non-faller N=181 n (%)	Parametric P-value*	Non-parametric P-value**
Gender	F	74 (40.88)	95 (52.49)	0.027	0.035
	M	107 (59.12)	86 (47.51)		
Peripheral neuropathy	N	111 (61.33)	150 (82.87)	<.001	<.001
	y	70 (38.67)	31 (17.13)		
Orthostatic hypotension	N	156 (86.19)	174 (96.13)	<.001	0.001
	y	25 (13.81)	7 (3.87)		
Benzodiazepines	N	143 (79.01)	173 (95.58)	<.001	<.001
	y	38 (20.99)	8 (4.42)		
Chemotherapy	N	136 (75.14)	161 (88.95)	<.001	<.001
	y	45 (24.86)	20 (11.05)		
Opioids	N	110 (60.77)	129 (71.27)	0.035	0.046
	y	71 (39.23)	52 (28.73)		
Diphenhydramine	N	157 (86.74)	175 (96.69)	<.001	<.001
	y	24 (13.26)	6 (3.31)		
Anti-HTN medication	N	175 (96.69)	108 (59.67)	<.001	<.001
	y	6 (3.31)	73 (40.33)		
Fall history	N	122 (80.79)	175 (96.69)	<.001	<.001
	y	29 (19.21)	6 (3.31)		
Assistive devices	N	129 (76.79)	176 (97.24)	<.001	<.001
	y	39 (23.21)	5 (2.76)		
Cognition intact	N	37 (23.72)	0 (0)	<.001	<.001
	y	119 (76.28)	181 (100)		

* The parametric p value is calculated by ANOVA for numerical covariates and chi-square test for categorical covariates.
** The non-parametric p-value is calculated by the Kruskal-Wallis test for numerical covariates and Fisher's exact test for categorical covariates.

Table 1: Univariate association with falls status.

These were the presence of Orthostatic Hypotension (OH) (odds ratio 3.79; 95% CI 1.61-8.92.) administration of chemotherapy (2.63; 1.48-4.66), benzodiazepines (5.48; 2.50-11.98) opioids (1.60; 1.03-2.48) and diphenhydramine (4.20; 1.70-10.38). Table 2 reflects the odds ratios of history of a previous fall (6.5; 2.67-15.86) and the use of assistive devices (9.79; 3.86-24.82) were also significant.

Covariate	Level	N	Odds ratio (95% CI)	OR P-value	Type3 P- value
Gender	M	193	1.59 (1.05-2.41)	0.028	0.028
	F	169	-	-	
Peripheral neuropathy	y	101	3.02 (1.85-4.92)	<.001	<.001
	N	261	-	-	
Orthostatic hypotension	y	32	3.79 (1.61-8.92)	0.002	0.002
	N	330	-	-	

Benzodiazepines	1	46	5.48 (2.50-11.98)	0<.001	<.001
	0	316	-	-	
Chemotherapy	1	65	2.63 (1.48-4 .66)	0<.001	<.001
	0	297	-	-	
Opioids	1	123	1.60 (1.03-2.48)	0.037	0.037
	0	239	-	-	
Diphenhydramine	1	30	4.20 (1.70-10.38)	0.002	0.002
	0	332	-	-	
Anti HTN medication	1	79	0.05 (0.02-0.13)	<.001	<.001
	0	283	-	-	
Falls history	y	35	6.50 (2.67-15.86)	<.001	<.001
	N	297	-	-	
Assistive devices	y	44	9.79 (3.86-24.82)	<.001	<.001
	N	305	-	-	
Cognition intact	N	37	113.71 (6.68-1935.97)	0.001	0.001
	y	300	-	-	

Table 2: Univaraiate logistic regression predicting falls.

None of the non-fallers had cognitive impairment whereas a large portion of the fallers did (113.71; 6.68-1935.97). Although the presence of Chemo Induced Peripheral Neuropathy (CIPN) was not independently significant in older fallers, inpatient oncology patients with CIPN were 3 times more likely to fall (3.02; 1.85-4.92).

Discussion

Fall history and assistive devices are included in risk assessments however potentially inappropriate medications and presence of CIPN are often not included in fall screening tools. Consistent with Memorial Sloan Kettering identifying medications and peripheral neuropathy as positive predictive variable in the inpatient oncology patient. [23] Evaluation of OH may also provide valuable safety strategies for reducing falls in the oncology inpatient. Patients identified with Cognitive Impairment (CI) should be placed on all strategies and interventions to reduce the fall risk associated with CI [39,40]. Safety education in this patient group should extend to family and caregivers along with all direct care team members [41]. Modification of the current risk screening tool to include these variables will need to be tested in the older hospitalized oncology patient [42].

Conclusion

When falls and injury data are reported to the National Database of Nursing Quality Indicators (NDNQI) according to rates and by classification of fall or by level of injury, a simple run graph cannot tell the back story. Utilizing descriptive statistics, such as measures of central tendencies and frequencies to examine circumstances and patient characteristics of falls, a unique portrait of potential vulnerable patients immerges [43]. The inter-professional team can develop strategies to target these findings and can then evaluate specific outcomes of the interventions [44]. Evaluation of the statistical and descriptive results for eighteen months of falls of oncology inpatients will be shared with an interprofessional team focused on fall and injury reduction throughout the center. Findings of this study will be utilized in development of a geriatric oncology interdisciplinary plan of care with emphasis on fall and injury reduction.

References

1. Boushon B, Nielsen G, Quigley P, Rutherford P, Taylo J, et al. (2012) Transforming care at the bedside: How-to guide: Reducing patient injuries from falls. Institute for Healthcare Improvement: Cambridge, MA.

2. Overcash JA, Beckstead J (2008) Predicting falls in older patients using components of a comprehensive geriatric assessment. Clin J Oncol Nurs 12: 941-949.

3. Stone CA, Lawlor PG, Savva GM, Bennett K, Kenny RA (2012) Prospective study of falls and risk factors for falls in adults with advanced cancer. J Clin Oncol 30: 2128-2133.

4. Capone LJ, Albert NM, Bena JF, Tang AS (2013) Serious fall injuries in hospitalized patients with and without cancer. J Nurs Care Qual 28: 52-59.

5. Bouldin EL, Andresen EM, Dunton NE, Simon M, Waters TM, et al. (2013) Falls among adult patients hospitalized in the United States: prevalence and trends. J Patient Saf 9: 13-7.

6. Agostini J, Baker D, Bogardus S. Making health care safer: A critical analysis of patient safety practices. File inventory. Evid Rep Tech Assess pp: 281-299.

7. Thompson FE (1999) Chronic diseases and their risk factors: The nation's leading causes of death. CDC.

8. Ingram DD, Malec DJ, Makuc DM, Kruszon MD, Gindi RM, et al. (2018) National center for health statistics guidelines for analysis of trends. Vital and health statistics series 2, Data evaluation and methods research 1-71.

9. Web-based injury statistics query and reporting system. CDC.

10. Lloyd BD, Williamson DA, Singh NA, Hansen RD, Diamond TH, et al. (2009) Recurrent and injurious falls in the year following hip fracture: A prospective study of incidence and risk factors from the Sarcopenia and Hip Fracture study. J Gerontol A Biol Sci Med Sci 64: 599-609.

11. Ronda GH (2008) Patient safety and quality: An evidence-based handbook for nurses. rockville : Agency for healthcare research and quality , U.S. Department of health and human services.

12. Wong CA, Recktenwald AJ, Jones ML, Waterman BM, Bollini ML, et al. (2011) The cost of serious fall-related injuries at three Midwestern hospitals. Jt Comm J Qual Patient Saf 37: 81-87.

13. Centers for Medicare & Medicaid Services (2006) Medicare program; proposed changes to the hospital inpatient prospective payment systems and fiscal year 2007 rates; proposed rule. 42 CFR Parts 409, 410 et al. 71: 47869-48351

14. Medicare program: Changes to the hospital inpatient prospective payment systems and fiscal year 2009 rates; payments for graduate medical education in certain emergency situations; changes to disclosure of physician ownership in hospitals and physician self-referral rules; updates to the long-term care prospective payment system; updates to certain IPPS-excluded hospitals; and collection of information regarding financial relationships between hospitals. CMS 73: 48433-49084.

15. Allan-Gibbs R (2010) Falls and hospitalized patients with cancer: A review of the literature. Clin J Oncol Nurs 14: 784-792.

16. Toomey A, Friedman L (2014) Mortality in cancer patients after a fall-related injury: The impact of cancer spread and type. Injury 45: 1710-1716.

17. Spoelstra SL, Given BA, Given CW (2012) Fall prevention in hospitals: An integrative review. Clin Nurs Res 21: 92-112.

18. Adams K, Janet MC (2003) Priority areas for national action: Transforming health care quality, Washington: National academies press.

19. Pearse H, Nicholson L, Bennett M (2004) Falls in hospices: A cancer network observational study of fall rates and risk factors. Palliat Med 18: 478-481.

20. Tofthagen C, Overcash J, Kip K (2012) Falls in persons with chemotherapy-induced peripheral neuropathy. Support care cancer 20: 583-589.

21. Myint ZW, Momo HD, Otto DE, Yan D, Wang P, Kolesar JM (2020) Evaluation of fall and fracture risk among men with prostate cancer treated with androgen receptor inhibitors: A systematic review and meta-analysis. JAMA Netw Open 3.

22. Capone LJ, Albert NM, Bena JF, Tang AS (2012) Predictors of a fall event in hospitalized patients with cancer. Oncol Nurs Forum 39: E407-E415.

23. Henriksen K, Battles JB, Keyes MA, Grady ML (2008) Advances in patient safety: New directions and alternative approaches Rockville (MD): Agency for Healthcare Research and Quality.

24. Pautex S, Herrmann FR, Zulian GB (2008) Factors associated with falls in patients with cancer hospitalized for palliative care. J Palliat Med 11: 878-884.

25. Sattar S, Alibhai SMH, Spoelstra SL, Puts MTE (2019) The assessment, management, and reporting of falls, and the impact of falls on cancer treatment in community-dwelling older patients receiving cancer treatment: Results from a mixed-methods study. J Geriatr Oncol 10: 98-104.

26. Goodridge D, Marr H (2002) Factors associated with falls in an inpatient palliative care unit: an exploratory study. Int J Palliat Nurs 8: 548-556.

27. American Geriatrics Society Beers Criteria (2019) American geriatrics society 2019 updated ages beers criteria® for potentially inappropriate medication use in older adults. J Am Geriatr Soc 67: 674-694.

28. Saarelainen LK, Turner JP, Shakib S, Singhal N, Hogan DJ, et al. (2014) Potentially inappropriate medication use in older people with cancer: Prevalence and correlates. J Geriatr Oncol 5: 439-446.

29. Wolf L, Costantinou E, Limbaugh C, Rensing K, Gabbart P (2013) Fall prevention for inpatient oncology using lean and rapid improvement event techniques. Herd 7: 85-101.

30. Opsahl AG, Ebright P, Cangany M, Lowder M, Scott D, et al. (2017) Outcomes of adding patient and family engagement education to fall prevention bundled interventions. J Nurs Care Qual 32: 252-258.

31. Dykes PC, Burns Z, Adelman J, Benneyan J, Bogaisky M, et al. (2020) Evaluation of a patient-centered fall-prevention tool kit to reduce falls and injuries: A nonrandomized controlled trial. JAMA Netw Open 3: 1-10.

32. Miller L, Limbaugh CM (2008) Applying evidence to develop a medical oncology fall-prevention program. Clin J Oncol Nurs 12: 158-160.

33. Ganz D, Huang C, Saliba D, Miake-Lye I, Hempel S, et al. (2013) Preventing falls in hospitals: A toolkit for improving quality of care. Ann Intern Med 158: 390-396.

34. Morse JM (2006) The modified morse fall scale. Int J Nurs Pract 12: 174-175.

35. Morse JM (2006) The safety of safety research: The case of patient fall research. Can J Nurs Res 38: 73-88.

36. Oliver D, Healey F, Haines TP (2010) Preventing falls and fall-related injuries in hospitals. Clin Geriatr Med 26: 645-692.

37. Isomi MML, Susanne H, David AG, Paul GS (2013) Inpatient fall prevention programs as a patient safety strategy. Ann Intern Med 158: 390-396.

38. Hempel S, Newberry S, Wang Z, Booth M, Shanman R, et al. (2013) Hospital fall prevention: A systematic review of implementation, components, adherence, and effectiveness. J Am Geriatr Soc 61: 483-494.

39. Bruera E, Bush SH, Willey J, Paraskevopoulos T, Li Z, et al. (2009) Impact of delirium and recall on the level of distress in patients with advanced cancer and their family caregivers. Cancer 115: 2004-2012.

40. Lakatos BE, Capasso V, Mitchell MT, Kilroy SM, Lussier CM, et al. (2009) Falls in the general hospital: Association with delirium, advanced age, and specific surgical procedures. Psychosomatics 50:218-226.

41. Tucker S, Sheikholeslami D, Farrington M, Picone D, Johnson J, et al. (2019) Patient, nurse, and organizational factors that influence evidence-based fall prevention for hospitalized oncology patients: An Exploratory Study. Worldviews Evid Based Nurs 16:111-120.

42. LeLaurin JH, Shorr RI (2019) Preventing falls in hospitalized patients: State of the science. Clin Geriatr Med 35: 273-283.

43. Capone LJ, Albert NM, Bena JF, Morrison SM (2010) Characteristics of hospitalized cancer patients who fall. J Nurs Care Qual 25: 216-223.

44. Lyse Harden K, Wall P, Galunas L, Eastman DJ, Frederick TS (2021) Managing falls: Implementation of a three-intervention initiative to improve quality of care for patients with cancer. Clin J Oncol Nurs 25: 188-193.