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Mortality in cancer patients after a fall-related injury: The impact of cancer spread and type

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ABSTRACT

Background: Cancer patients are at an increased risk of dying following an injury, of which among the elderly is predominately caused by falling. In addition, patients with certain types of cancer are more prone to bone injury. However, studies are needed that examine the role of cancer site and metastasis on the relationship between cancer and death following traumatic injury.
Methods: A total of 4201 cancer patients from 2000 to 2009 in the Illinois Hospital Discharge and Illinois Trauma Registry, and 4201 patients without cancer met eligibility criteria (e.g., fell and were injured; 50–96 years old). A multivariable logistic regression analysis was conducted to assess the relationship between cancer and death following traumatic injury, including models stratified by cancer site and metastasis.
Results: The demographic characteristics, prevalence of comorbid conditions, and injury severity and type did not differ substantially between patients with and without diagnoses for cancer. In the main adjusted model, patients with cancer were more likely to die during the course of hospitalization after a fall than those without cancer (OR = 2.58; CI 95%: 1.91–3.49). Patients with metastatic malignancies had a higher risk of in-hospital death than patients without metastasis (adjusted OR = 3.59 and OR = 2.18, respectively). Patients with diagnoses for all specific cancer sites, except prostate and breast, were also significantly more likely to die.
Discussion: Cancer patients with and without spread over the age of 50 years are more likely to die in-hospital after a fall than elderly patients without cancer. However, this relationship may exist only for patients with specific cancer types.

Introduction

Approximately one in three community-dwelling elderly fall each year, with reoccurrence rates between 15% and 25% [1–3]. Of those that seek medical treatment, 20–30% suffer moderate to severe injuries [4]. Nonfatal unintentional fall-related injuries are increasing dramatically [5], as are fall-related deaths. From 1999 to 2009 falls were the most common cause of death from unintentional injury in people 50 and older, and are the cause of 60–80% of all injuries in the elderly—increasing in proportion with age [5]. During this time the adjusted mortality rate increased 64% from 15.1 to 24.8 deaths per 100,000 people in this age group [6,7]. Falls increase mortality through a variety of pathways including: pulmonary embolisms resulting from deep venous thrombosis (DVT) at the site of fractured bone, infection (e.g., from the injury, surgery, or hospital-acquired), or from surgical complications [8,9]. Furthermore, risk of injury and death from falling increases with age, as does the incidence of many chronic conditions, which may also increase the risk of injury or complicate recovery [4,5,7,10].

Cancer patients may be particularly vulnerable to decreased bone density from cancer treatments and the disease itself. Radiation can damage bone blood supply. The pelvic/hip region is one of the most vulnerable regions to suffer radiation damage, significantly increasing fracture risk [11,12]. Hormone therapies, chemotherapy, and bone cancer (or bone cancer metastasis) can also disrupt bone-cell homeostasis leading to bone loss [13–15]. Chemotherapies and hormone therapies that can decrease bone density are used to treat a variety of cancers [14,16]. Several studies indicate that cancer patients are at an increased risk for fracture, particularly patients with primary lung, prostate, breast,

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multiple myeloma, and bone cancer or patients with metastasis to the bone or other types of metastasis excluding bone [12,17–19].

In addition to an increased fracture risk, having cancer increases the risk of in-hospital mortality after an injury from a trauma [20–25]. Only one of these studies assessed mechanism of injury [20] and found that the relationship between cancer and in-hospital mortality was only significantly higher when the cause of the injury was a fall (OR = 2.35, 95% CI: 1.67–3.25).

The association between cancer and in-hospital morality after a trauma (e.g., a fall) may be attributed to: a disruption of normal clotting, immunodeficiency from chemotherapy, and/or an overall decrease in the patient's physical reserve [22,24]. However, studies completed in this area have not examined the role of cancer metastasis [20–25]. Most people that die of cancer have cancer metastasis [26] and 85–90% have delirium in the days and hours before death [27], which significantly increases the risk of falling [28,29]. Therefore, the relationship between cancer and in-hospital mortality after a fall may only exist for patients with advanced cancer, and the fall injury is simply a marker in the causal pathway of the final terminal phase of the illness.

As patients with specific cancer types are more prone to fracture, cancer type may also be an effect modifier in the relationship in question, which has not been examined in previous work [20–25]. In addition, these past studies have relied on data solely from trauma registries, which focuses on patients with more severe injuries, as patients with less severe injuries are generally not taken to trauma centers [30].

Studies are needed that include a comprehensive patient population treated in facilities with and without specialised trauma teams that is large enough to adequately assess the risk of in-hospital mortality after a fall-related injury in patients with a malignancy, as well as evaluate the role of two potentially important risk modifiers: (1) the role of advanced cancer (i.e., cancer spread) and (2) cancer type. This study, a retrospective cohort study of patients treated in hospitals with and without specialised trauma units addresses these research gaps.

Methods

Data source

We conducted a retrospective cohort study using two State of Illinois medical record databases: the Illinois trauma registry (ITR) and the Illinois hospital discharge (HD) dataset. We received data for years 2000–2009 for both datasets. The University of Illinois at Chicago institutional review board approved this research (approval no. 2012-0116).

Illinois trauma registry

All of the State's level 1 and 2 trauma centers ($n = 62$) are required to report all patients (1) sustaining traumatic injuries (ICD-9-CM external injury codes E800-995) and admitted to a trauma center for >12 h, (2) transferred to a level I or II center, or (3) are dead-on-arrival (DOA) or die in the emergency department [31]. The ITR contains data on demographics (age, gender, race/ethnicity), exposure (mechanism of injury), health outcomes (diagnoses, measures of injury severity, hospital procedures, disability status on discharge), and economics (payer source).

Hospital discharge database

In Illinois a large proportion of elderly patients suffering injuries from falls are not treated at hospitals with trauma teams or when they do arrive at Level I or II trauma facilities the trauma team is not activated. Therefore, we also included patients from the hospital discharge database in order to capture the group of injured patients not treated by specialised trauma teams. The HD is based on billing records and includes nearly all inpatient cases treated for more than 23 h in Illinois hospitals for any medical reason. All but 3% of the hospitals in Illinois are included [32]. The hospital discharge database includes variables on patient demographics (age, gender), exposure (mechanism of injury), health outcomes (diagnoses, hospital procedures, discharge status), and economics (hospital charges, payer source). The Illinois Hospital Association (IHA) compiles, maintains, and conducts quality control of the dataset.

Inclusion criteria

Data from a 10-year time span (2000–2009) from the ITR and HD were merged and deduplicated. Duplicates were identified using probabilistic linkage methods. Cases were matched on treating hospital, date of birth, gender, residential ZIP code, date of admission, date of discharge and ICD-9 diagnosis codes. In the initial step of the case selection, we identified all patients (1) 50 to 96 years of age, (2) with an external cause of injury code for a fall (E-Code E880–E889), and (3) sustaining an injury (ICD-9 N-Code 800.0–959.9), excluding patients with diagnoses only for trauma complications and late effects. If a patient was identified in both registries, the trauma registry data was utilised because it is more comprehensive. Of the 2540 patient records included from the trauma registry, a total of 339 cases were not in the hospital discharge dataset. These were cases that were treated for less than 24 h and as outpatients would not appear in the hospital discharge dataset.

Defining cancer patients by site and metastasis

From the group of elderly patients injured through falls described above, we identified all cases diagnosed with cancer. Patients were coded as having cancer if they had an ICD-9 diagnosis code for a malignant neoplasm (140.0–208.9). Cancer types were grouped into the following categories by ICD-9 diagnosis codes: gastrointestinal (150.0–159.9), lung and bronchus (162.0–162.9), breast (women only; 174.0–174.9), prostate (185.0–185.0), urinary tract (188.0–189.9), and lymphatic and hematopoietic (200–208.9). Cancer of the prostate and breast were categorised separately due to specific bone loss concerns for these patients [13,18,33–35]. Sub-categories with few deaths were not reported separately for this study ($n = 892$ cases, $n = 33$ deaths), but were included in the "any cancer" category. Although the case fatality rate across these sub-categories was equivalent to the overall cancer group, there were insufficient cases in the subgroups to conduct stratified models.

We noted cancer spread if a patient had (1) a malignant neoplasm to a secondary site (196.0–198.8) or (2) ICD-9 codes corresponding to two primary malignant neoplasms with no secondary cancer site. Those under the category of malignancy "without specification of site" (199.0–199.1) were marked as metastatic cases if they had an ICD-9 code of 199.0 ("disseminated") and non-metastatic cases if they only had the ICD-9 code 199.1 ("other"). Patients with diagnoses of only benign neoplasms, carcinoma in situ, and neoplasms of an unspecified nature were not considered cancer cases.

Selection of the comparison group

For the final dataset, we randomly and proportionally sampled one elderly adult injured from a fall without a malignant neoplasm diagnosis (code 140.0–208.9) for each case identified within the respective dataset of origin (TR and HD) using the random sampling procedure in SAS (PROC SURVEYSELECT).

Primary outcome variable

In-hospital mortality was the primary outcome variable assessed through discharge status codes in both datasets. Deaths occurring prior to arrival at the hospital (i.e., persons who died at the scene of injury) and those occurring during the initial assessment within the emergency room were not used to calculate the in-hospital mortality.

Covariates

Demographic characteristics, place of injury, and type of fall are described. ICD-9-CM NCODES were used to assess body region and type of injury based on the Barell classification matrix [36]. The new injury severity score (NISS) was used as a measure of injury severity [41]. We use the cut-off of NISS > 16 to identify individuals suffering major injuries that are serious, severe and life threatening.

Each patient in the TR and HD has up to 25 and 9 ICD-9 diagnosis codes, respectively, listed in their record and these were used to calculate the Charlson Comorbidity Index, which examines the major comorbid conditions that impact overall survival [37] and evaluate trauma complications. We identified trauma complications associated with increased in-hospital mortality using ICD-9 codes identified in the work by Osler et al. [38]. Length of stay in the hospital (LOS; days), need for mechanical ventilation and surgical intervention were also assessed. Trauma centers may have higher post-trauma survival rates than other hospital types [39,40], we hence controlled for level of trauma care. The only variable used in the multivariable analysis with missing values was the NISS variable (n = 368; 8.8%). Instead of using listwise deletion to remove these cases, we imputed the observed group mean.

Statistical analysis

We used SAS software for all statistical analyses (v.9.2; SAS Institute Inc., Cary, NC). Appropriate parametric (Pearson's chi-square) and non-parametric tests (Wilcoxon Rank Sum) were used to evaluate bivariate relationships. ANOVA modelling was used to compare mean differences in continuous metrics. We also examined the survival curves of patients with and without a cancer diagnoses. Time of entry was the date of hospital admission and survival status was censored at the date of death.

Multivariable logistic regression models were developed using a manual stepwise procedure based on the log likelihood method. Variables were candidates for the final model based on a priori knowledge, as well as preliminary statistical tests. The main model assessing the relationship of cancer (all diagnoses combined) on mortality included: age (continuous), gender (dichotomous), treatment in a facility with specialised trauma care (dichotomous), mechanical ventilation (dichotomous), surgical intervention (dichotomous), new injury severity scores indicating serious injuries (NISS ≥ 16; dichotomous), and complications associated with increased mortality in trauma patients (continuous; cumulative frequency of distinct diagnostic codes).

All variables in the final model were statistically significant. The main model was stratified by cancer type and cancer spread. The stratified multivariable models included the variables listed above unless they were redundant. Multicollinearity was examined through the tolerance scores in multiple regression; all scores were at or above 0.91. Adjusted odds ratios and 95% confidence intervals are presented. A two-sided p-value less than 0.05 was considered statistically significant.

Results

Table 1 presents demographic characteristics by cancer status. The sample was comprised of 8402 trauma patients (4201 with cancer), of which 63.3% were women. Almost 70% of the patients (n = 5862) were treated in facilities without specialised trauma care teams. The age distribution was nearly identical between cancer and non-cancer patients, except that a greater proportion of patients without cancer were in the youngest group. Race was only available in the TR; the distribution of race/ethnicity was (cancer and non-cancer patients, respectively): white non-Hispanic, 90.7% vs. 90.1%; black non-Hispanic, 2.9% vs. 5.2%; white Hispanic, 1.5% vs. 1.5%; Asian, 0.2% vs. 0.1% and other, 4.8% vs. 3.0%.

Of the patients with cancer diagnoses, 19.5% suffered multiple injuries compared to 22.1% of the comparison group. Based on other proxy measures of injury severity, cancer and non-cancer patients did not differ substantially by mean NISS, requiring mechanical ventilation, or surgical intervention (Table 2). Across the different types of injuries, patients with and without cancer diagnoses suffered similar types of injuries, except patients with cancer suffered slightly fewer fractures of the extremities (Table 2). There was also little difference between the groups when comparing the frequency of the most severe types of brain injuries (Type 1 and 2 based on Barrel matrix; excludes concussions only): 9.1%, cancer cases vs. 8.4% in the comparison cases (p = 0.310). The mean cumulative Charlson Comorbidity Index scores and distribution of specific items were nearly identical between groups (data not shown).

Cancer patients were more likely to suffer from specific medical complications associated with traumatic injury (cancer vs. non-cancer cases, respectively): cerebral edema/anoxic encephalopathy (0.9% vs. 0.4%; p = 0.005), hypotensive shock (2.3% vs. 0.8%; $p < 0.001$), acute respiratory failure (1.6% vs. 0.7%; $p < 0.001$), septicemia (1.8% vs. 0.8%; $p < 0.001$), and cardiac arrest (0.5% vs. 0.2%; p = 0.009).

In-hospital mortality

Of the 255 deaths in this study, 191 were in cancer patients. Notably, in-hospital mortality was greatly increased in cancer

Table 1
Demographic characteristics of patients with and without a diagnosis of cancer, patients 50 years and older admitted to Illinois hospitals for injuries following a fall in Illinois, 2000–2009.

	Patients with cancer (n = 4201)	Patients without cancer (n = 4201)	p Value
Mean age (sd)	77.9 (10.0)	77.8 (11.7)	0.633
50–59 years	274 (6.5)	469 (11.2)	
60–69 years	600 (14.3)	527 (12.5)	
70–79 years	1319 (31.4)	1059 (25.2)	
80–89 years	1595 (38.0)	1582 (37.7)	
90 years and up	413 (9.8)	564 (13.4)	
Sex			
Male	1850 (44.0)	1233 (29.4)	<0.001
Female	2351 (56.0)	2968 (70.7)	

Table 2
Injury severity measures and types of injuries in patients with and without a diagnosis of cancer, patients 50 years and older admitted to Illinois hospitals for injuries following a fall in Illinois, 2000–2009.

	Patients with cancer (n = 4201)	Patients without cancer (n = 4201)	p Value
Measures of injury severity			
Mean length of stay in days (sd)	6.0 (5.2%)	5.2 (9.0%)	<0.001
In-hospital mortality	191 (4.6%)	64 (1.5%)	<0.001
Required mechanical ventilation	114 (2.7%)	85 (2.0%)	0.045
Required surgical intervention	1830 (43.6%)	1917 (45.6%)	0.059
Mean new injury severity score (sd)	6.9 (5.6%)	7.1 (5.3%)	0.136
1–15 (Minor/Moderate/Serious)	3851 (91.7%)	3874 (92.2%)	
16–24 (severe)	290 (6.9%)	268 (6.4%)	
25 and up (critical)	60 (1.4%)	59 (1.4%)	0.624
Any fracture*			
Skull (cranial)	29 (0.7%)	41 (1.0%)	0.187
Other head and face (facial)	95 (2.3%)	101 (2.4%)	0.718
Vertebral column injury	261 (6.2%)	257 (6.1%)	0.892
Torso	470 (11.2%)	428 (10.2%)	0.148
Upper extremity	428 (10.2%)	562 (13.4%)	<0.001
Lower extremity	1670 (39.8%)	1844 (43.9%)	<0.001
Any internal injury*			
Traumatic brain injury	356 (8.5%)	324 (7.7%)	0.215
Spinal cord injury	2 (0.1%)	7 (0.2%)	0.182
Torso	72 (1.7%)	76 (1.8%)	0.804
Any open wounds*			
Other head and face	366 (8.7%)	369 (8.8%)	0.938
Torso	5 (0.12%)	5 (0.12%)	1.000
Upper extremity	69 (1.6%)	56 (1.3%)	0.280
Lower extremity	20 (0.5%)	28 (0.7%)	0.311

* May have more than one injury type.

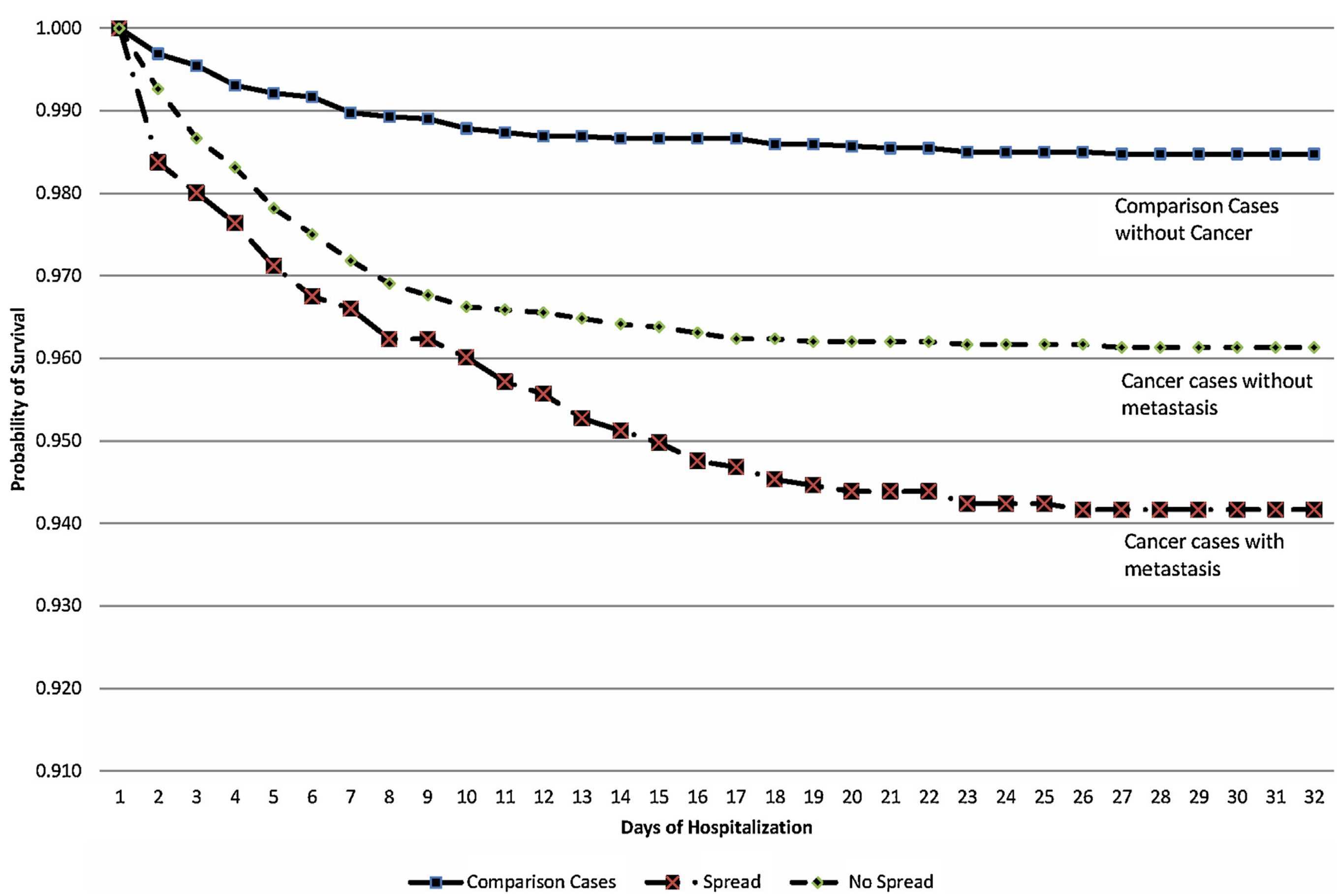

Fig. 1. Survival after an unintentional fall by cancer and cancer spread status.

Table 3
Logistic regression analysis of the relationship between cancer diagnosis and in-hospital mortality by cancer site and metastasis vs. patients without cancer, among patients 50 years and older patients admitted to Illinois hospitals for injuries following a fall in Illinois, 2000–2009.

	Cancer patients with diagnosis	Deaths among cancer patients	Unadjusted odds ratio	CI 95%	Adjusted odds ratio	CI 95%	*p*-Value
Any cancer	**4201**	**191**	**3.08**	**(2.31, 4.10)**	**2.58**	**(1.91, 3.49)**	<0.001
Any cancer—with spread	1385	79	3.91	(2.79, 5.46)	3.59	(2.51, 5.15)	<0.001
Any cancer—without spread	2816	112	2.68	(1.96, 3.66)	2.18	(1.56, 3.03)	<0.001
Gastrointestinal (GI)	**543**	**31**	**3.91**	**(2.53, 6.07)**	**3.24**	**(2.03, 5.19)**	<0.001
GI—with spread	217	16	5.12	(2.91, 9.02)	5.27	(2.82, 9.82)	<0.001
GI—without spread	326	15	3.13	(1.76, 5.55)	2.27	(1.22, 4.23)	0.010
Lung and Bronchus	**706**	**44**	**4.30**	**(2.90, 6.36)**	**4.23**	**(2.73, 6.54)**	<0.001
Lung and bronchus—with spread	302	19	4.33	(2.56, 7.32)	5.86	(3.14, 10.96)	<0.001
Lung and bronchus—without spread	404	25	4.28	(2.66, 6.87)	3.54	(2.10, 5.95)	<0.001
Breast (women only)	**322**	**6**	**1.23**	**(0.53, 2.86)**	**1.61**	**(0.64, 4.04)**	0.307
Breast (women only)—with spread	128	3	1.55	(0.48, 5.01)	1.97	(0.55, 7.06)	0.298
Breast (women only)—without spread	194	3	1.02	(0.32, 3.26)	1.38	(0.40, 4.73)	0.611
Prostate	**536**	15	1.86	(1.05, 3.29)	0.93	(0.47, 1.81)	0.821
Prostate—with spread	155	8	3.52	(1.66, 7.47)	1.90	(0.82, 4.41)	0.134
Prostate—without spread	381	7	1.21	(0.55, 2.66)	0.57	(0.23, 1.37)	0.207
Urinary tract	**182**	**11**	**4.16**	**(2.15, 8.03)**	**3.01**	**(1.45, 6.24)**	<0.001
Urinary tract—with spread	63	4	4.38	(1.55, 12.43)	3.58	(1.12, 11.44)	0.031
Urinary tract—without spread	119	7	4.04	(1.81, 9.01)	2.87	(1.19, 6.91)	0.019
Lymphatic and hematopoietic	**1068**	**52**	**3.31**	**(2.28, 4.80)**	**2.60**	**(1.74, 3.88)**	<0.001
Lymphatic and hematopoietic—with spread	46	5	7.88	(3.02, 20.60)	7.20	(2.42, 21.47)	<0.001
Lymphatic and hematopoietic—without spread	1022	47	3.12	(2.13, 4.57)	2.45	(1.62, 3.71)	<0.001

Multivariable models adjusted for treatment in a facility with specialised trauma care, age, gender, injury severity, mechanical ventilation, surgical intervention, and trauma complications.

patients by about 3-fold (4.6% vs. 1.5%; $p < 0.001$). The survival curves show that the in-hospital death rate was most precipitous for patients with diagnoses of metastatic cancers (Fig. 1). The Case Fatality Rate (CFR) at each major injury severity level for cancer and non-cancer patients was the following, respectively: NISS 1–15 (minor/moderate/serious), 3.6% vs. 1.1%; NISS 16–24 (severe), 12.9% vs. 6.4%; and NISS 25 and up (critical), 45.2% vs. 24.0%. The unadjusted and adjusted odds ratios stratified by cancer site and indication of metastasis are presented in Table 3 (all estimates are vs. patients without cancer). In the adjusted model, following an injury from a fall, older patients with a cancer diagnosis were more likely to die during the course of the index hospitalization (adjusted OR = 2.58; 95% CI = 1.91, 3.49). The association was stronger among cancer patients with indication of metastasis (adjusted OR = 3.59; 95% CI = 2.51, 5.15), but remained significant among those without indication of metastasis (adjusted OR = 2.18; 95% CI = 1.56, 3.03). In the adjusted models, the relationship between metastatic cancer and in-hospital mortality was strongest among patients with primary cancers of the gastrointestinal system, lung and bronchus cancer, and lymphatic and hematopoietic tumours. Patients with diagnoses of breast and prostate cancer did not show a significant positive association with increased in-hospital mortality.

Discussion

In this analysis, we found that cancer significantly predicted in-hospital mortality after a fall in patients 50 and older. The strength of the association of the main model (all cancer sites combined, regardless of metastasis) was similar to those reported in prior studies which range from 1.8 to 4.8 [20–23], despite that almost 70% of the patients in our study were treated in facilities without specialised trauma care teams. Patients with cancer diagnoses did not differ substantially from the patients without cancer diagnoses across most demographic characteristics, injury type and severity, and other non-cancer comorbid conditions.

Metastasis appears to be a strong effect modifier in the relationship between in-hospital mortality after a fall-related injury, but the role of cancer site was less clear. Although patients with certain cancer types are more likely to suffer fractures [17], no study has explored whether patients with specific cancer types are more likely to die during the course of hospitalization after an injury.

Most patients that die of cancer have metastasis [26]. Hence, if an advanced cancer patient is dying and falls, the relationship in question may only exist for this subset of cancer patients. Wutzler et al. [21] noted that cancer patients or their families may stop medical interventions or complete "Do Not Resuscitate" orders due to their pre-existing cancer, which would increase in-hospital mortality after a trauma in these patients. The strength of the association between in-hospital mortality and cancer diagnosis was elevated in patients with cancer spread, but was not absent in patients without spread indicating that metastasis alone does not explain the relationship in question.

In the stratified models, patients with breast and prostate cancer did not have increased odds of in-hospital mortality. Although there were many patients with diagnoses of breast and prostate cancer, very few of these patients died during their hospitalization. The fact that the association was closer to parity for prostate and breast may be biased by better screening and treatments available for these cancers. Further analysis is needed to look at the role of screening and treatment histories on survival following an injury.

Limitations

Cancer patients were grouped by tumour site and spread status based on ICD-9 diagnosis codes, but there is wide variation in tumour progression, size, and aggressiveness within each category. ICD-9 codes in both registries were used to bill the patient/insurer and should be accurate. However, we did not have access to pathology reports which would have allowed us to validate the diagnoses listed in the medical records, as well as characterise the clinical staging of the cancer. In addition, it is possible that some patients with metastatic cancers or cancers in full remission were misclassified in the cancer group. In addition, some patients in the comparison group may have had undetected malignancies.

The cancer type categorizations used in the analysis were based on ICD-9 coding, but many subgroups could not be evaluated because of small numbers. Different cancer types can have different courses of progression, which would likely affect post-injury fatality rates. A larger study group and/or more cancer deaths in specific sites would have allowed us to further examine specific cancer types to better evaluate the role of cancer site. Furthermore, the confidence intervals for the odds ratios of cancers with and without spread overlap in all instances. It is unclear if this is the result of inadequate power to differentiate between the two groups or a reflection of an absence of a clinical difference between the two groups of patients. In addition, it is possible that patients diagnosed with cancer, in particular those with advanced stage malignancies, are more likely to have advanced directives with do not resuscitate orders which may explain differences in mortality.

In longitudinal studies, even short periods of follow-up such as a single hospitalization stay, time dependent variables are often both potential confounders and outcomes along the causal pathway. In this analysis, some of the covariates are treated as proxy measures of injury severity. However, because they are potential outcomes in their own right, there is concern that they may bias the model estimates of the relationship between cancer and in-hospital mortality. Generally, over-specified models that include covariates along the causal pathway result in a conservative bias of the parameter estimates of interest. Omission of these covariates from the main model in this study (requiring mechanical ventilation, and medical complications following trauma) had only a minor effect on the relationship between cancer and in-hospital mortality (adjusted OR = 2. 82; 95% CI = 2.10, 3.77).

The findings from this study do not tell us about overall mortality since we do not have information on all pre-hospital deaths or deaths occurring after discharge. It is possible that long term mortality – 30 and 365 day – may be similar between the two groups, but the patients with cancer simply die earlier because of compromised immune systems and higher susceptibility to medical complications following an injury. However, based on the Charlson Comorbidity Index in which we omitted cancer, the group with cancer did not have substantially more comborbidities compared to the comparison cases.

Conclusion

Our study of patients 50 years and older injured from falls treated in facilities with and without specialised trauma teams confirms the relationship between cancer and in-hospital mortality reported in prior studies. Cancer site may be an important factor, as our findings identified specific cancer sites associated with differential in-hospital case fatality rates. The findings also indicate the strength of the association between in-hospital mortality and cancer diagnosis was higher in patients with cancer spread, but remained significantly elevated among patients without spread. Our study provided an initial understanding on these subjects, but further research is needed to confirm these findings, in particular studies that evaluate mortality during the initial period following discharge.

Conflict of interest statement

All authors declare that they have no conflicts of interest that may be relevant to the submitted work.

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Author contributions

April Toomey was directly involved with the study concept and design, statistical analysis, and drafting and editing the manuscript. Dr. Lee Friedman had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Dr. Lee Friedman was directly involved with the study design, data acquisition, statistical analysis, and drafting and editing the manuscript.

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