Autologous Stem Cell Transplantation

The predictive value of the Morse Fall Scale in hospitalized patients

Vivian Dee, MSN, APRN-BC, Juan Toro, MD, MSCI, Shuko Lee, MS, Paula Sherwood, RN, PhD, CNRN, FAAN, and David Haile, MD

BACKGROUND: Falls are common in hospitalized patients undergoing autologous stem cell transplantation (ASCT). Research demonstrates that preventing patient falls requires knowledge of the risk factors and the circumstances preceding the patient’s fall.

OBJECTIVES: To identify risk factors related to falls in recipients of ASCT and assess the predictive value of the Morse Fall Scale (MFS).

METHODS: Of the 288 patients who underwent transplantation during the study period, 14 were fallers. Twenty controls were randomly selected. The study used descriptive case-control analysis and simple logistic regression to analyze the data.

FINDINGS: Eight fallers and four non-fallers had high MFS scores. The logistic regression model indicated that patients with high MFS scores were 5.3 times more likely to fall and that for each day patients experienced diarrhea, their risk of fall increased 1.2 times.

THE INSTITUTE OF MEDICINE REPORT To Err Is Human: Building a Safer Health System, released in 2000, depicted the preventable adverse events of care that patients experienced in the United States, and one year later, Crossing the Quality Chasm: A New Health System for the 21st Century reported six dimensions that the healthcare industry needs to embrace to improve the U.S. healthcare system. The latter report stressed that care should be safe, effective, efficient, timely, patient-centered, and equitable (Berwick, 2002).

In response to these findings of inefficiency and ineffectiveness, the U.S. government enacted the Section 5001(c) of Deficit Reduction Act of 2005, which identified 14 hospital-acquired adverse conditions (including falls) that could have been prevented with the use of evidence-based guidelines. This prompted the Centers for Medicare and Medicaid Services (CMS) to implement payment changes to healthcare organizations designed to encourage fall prevention; in 2008, CMS discontinued fall-related reimbursement (CMS, 2015).

Patient Falls
Fall-related injuries during hospitalization may lengthen a patient’s stay, and falls may be a burden in terms of reduced quality of life and increased healthcare costs (Nassar, Helou, & Madi, 2014). A systematic review by Heinrich, Rapp, Rissmann, Becker, and König (2010) found that fall-related expenses in the United States were higher per patient per year (2,073 U.S. dollars [USD] per purchasing power parities [PPP]) than in Finland (1,059 USD per PPP) or Sweden (1,608 USD per PPP). Clinically, nurses play a significant role in preventing falls and improving patient safety. Patient falls are a nursing performance indicator, as listed by the National Database of Nursing Quality Indicators (n.d.), a quality improvement program that measures improvement efforts of nursing care in relation to patient outcomes. However, studies on falls often take place in general settings, and the results of these studies reflect the variations in fall cause by setting (see Table 1).

The chemotherapy drugs that patients receive following a diagnosis of cancer may compound other fall risk factors. Spoelstra et al. (2013) reported a
higher rate of falls among older adults with cancer compared to the same age groups without a cancer diagnosis. The toxicities of chemotherapy, such as peripheral neuropathy, could cause falls. For instance, in a prospective, descriptive study of patients receiving paclitaxel, docetaxel, oxaliplatin, or cisplatin, participants reported at least one symptom of neuropathy (Tofthagen, Overcash, & Kip, 2012). Fallers who have symptoms of neuropathy have an increased risk of falls with each cycle of chemotherapy (Tofthagen et al., 2012).

The recommendation of stem cell transplantation after completion of cancer treatment warrants a preparative regimen of additional chemotherapy at a higher dose. Such preparative regimens involve high-dose chemotherapy and/or total body irradiation to reduce tumor burden; these treatments are administered before autologous stem cell transplantation (ASCT) (Gyurkocza & Sandmaier, 2014). For instance, melphalan is a preparative regimen used in ASCT for patients with a diagnosis of multiple myeloma. High doses of preparative regimens have been reported to cause toxicities. To illustrate the toxicities of preparative drugs, Giralt et al. (2009) identified mucositis, nausea, vomiting, alopecia, diarrhea, and rash as side effects. Other unwanted effects of the treatment are peripheral neuropathies, infertility, interstitial lung disease, and hepatic sinusoidal obstructive syndrome. Moffett, Barnhouse, Murray, Evenson, and Donegan (2015) reported that patients in neutropenic precaution because of a weakened immune system who were in isolation rooms experienced increasing fatigue; the combination of these factors elevated their risk of fall and injury.

In addition, patients who will undergo transplantation often have significant comorbidities that could require various medications, including antiemetic, antihypertensive, anxiolytic, or hypoglycemic medications or medications for neuropathy or insomnia.

To improve fall outcomes in the ASCT population, understanding the risk factors of patients undergoing ASCT is important. Knowing specific triggers inherent to these patients will allow a more efficient strategy of mitigating falls in this population. This study aimed to (a) identify risk factors and circumstances related to patient falls in recipients of ASCT at the Audie L. Murphy Veterans Hospital (ALMVH) in San Antonio, Texas, and (b) assess the predictive value of the Morse Fall Scale (MFS), one of the most commonly used scales to assess fall risk.

### Methods

Researchers performed a retrospective case-control study on patients who received ASCT at ALMVH; patients who fell were compared to controls. The authors reviewed the electronic health records of all patients who underwent transplantation from January 2010 to August 2015 and were diagnosed with either multiple myeloma or lymphoma. Prior to transplantation, patients with multiple myeloma received a preparative regimen of melphalan, whereas those with lymphoma received either carmustine, etoposide, cytarabine, and melphalan or cytoxan, carbustine, and etoposide. Patients included in the study had been admitted for high-dose chemotherapy followed by ASCT during the selected time period. Those who were excluded from study participation had undergone allogeneic stem cell transplantation or had a diagnosis other than multiple myeloma or lymphoma. The ASCT population at ALMVH was aged 30–73 years, and interdisciplinary, personalized fall interventions

### Table 1

<table>
<thead>
<tr>
<th>SETTING</th>
<th>FALL REASON</th>
<th>STUDY</th>
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<tbody>
<tr>
<td>Community</td>
<td>Multiple chronic diseases (e.g., arthritis, visual impairment, hypertension, chronic obstructive pulmonary disease, diabetes mellitus, heart disease)</td>
<td>Sibley et al., 2014</td>
</tr>
<tr>
<td>Emergency department visit</td>
<td>Antipsychotics</td>
<td>Hampton et al., 2014</td>
</tr>
<tr>
<td>Hospital</td>
<td>Zolpidem, new loop diuretics</td>
<td>Kolla et al., 2013</td>
</tr>
<tr>
<td>Hospital</td>
<td>Dementia</td>
<td>Pi et al., 2016</td>
</tr>
<tr>
<td>Mental health inpatient</td>
<td>Psychotropic drugs, poor nutrition, older age (aged older than 70 years), mental disorders, lack of sleep, previous fall</td>
<td>McMinn et al., 2016</td>
</tr>
<tr>
<td>Outpatient and home</td>
<td>Chemotherapy, neuropathy, older age (age range not specified)</td>
<td>Tofthagen et al., 2012</td>
</tr>
<tr>
<td>Outpatient and inpatient</td>
<td>Upper and lower body weakness, postural hypotension</td>
<td>Rehm, 2017</td>
</tr>
<tr>
<td>Nursing home</td>
<td>Antidepressants, new loop diuretics</td>
<td>Berry et al., 2012</td>
</tr>
<tr>
<td>Surgery</td>
<td>Delirium</td>
<td>Freter et al., 2015</td>
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</table>
were used (see Figure 1). For this study, older adults are defined as being aged older than 60 years.

ALMVH uses the multiple-item MFS as a screening tool on admission, after a fall, daily, and when a significant change occurs in a patient’s condition (Veterans Health Administration, 2004); the MFS is a quick way to detect a patient’s odds of falling. For this study, significant change is defined as any new onset of toxicity related to chemotherapy or complications of hospitalization or transplantation. Oliver, Healey, and Haines (2010) have reported the scale to be a valid and reliable tool for measuring fall risk, which accounts for its use at ALMVH. Effective overall fall prevention relies on the ability of the MFS to predict fall risk accurately. A toolkit sensitive enough to predict falls, like the MFS, will allow staff to identify patients who are at risk for falling (O’Connell, Baker, Gaskin, & Hawkins, 2007).

Multiple research variables were used in this study. Independent variables, which were assigned designated scores based on the level of risk, were age, length of hospital stay (in days), days of diabetic medication use, days of antiemetic use, days of beta blocker use, days with diarrhea, days with fever, days of sedative use, fever any time (incidence), diarrhea any time (incidence), MFS score on admission, and diagnosis of multiple myeloma or lymphoma (see Table 2). On the MFS, low risk is defined as a score of fewer than 25 points, medium risk is 25–50 points, and high risk is more than 50 points; total scores may range from 0–125 points (Morse, 2008). The dependent variable was whether the patient fell. The decision to collect the data as variables for the study came from the multiple layers of risks frequently encountered during the ASCT process. The study, which was a performance improvement activity (intended to modify an existing process to improve the outcome), used descriptive analysis and simple logistic regression to analyze the data. Statistical significance was defined at p ≤ 0.05.

Researchers received approval from the research review board for this study. The study data were deidentified, and confidentiality was maintained.

**Results**

A total of 288 records of patients undergoing ASCT were reviewed. Only 14 patient falls (one repeated fall in the same patient) were identified. The injuries sustained by patients who fell were minor and included hip pain without fracture, along with bruises, abrasions, redness, or soreness to the site of injury. Twenty controls were randomly selected from the same study period. All variables (risk factors for falls) were matched from each cohort of fallers to its control group of non-fallers. The mean age of fallers was 63.6 years versus 61.4 years for non-fallers. The logistic regression analysis showed that higher MFS scores (odds ratio [OR] = 5.3, 95% confidence interval [CI] 1.16, 24.4) and more days of diarrhea (OR = 1.2, 95% CI [1.02, 1.4]) were predictors of falling among hospitalized fallers.

This study identified no significant differences between the fallers and the non-fallers in the incidence of diarrhea, mucositis, and nausea and vomiting. Seven patients who fell experienced grade 0 mucositis (no mucositis) compared to 14 non-fallers. Seven patients who fell developed mild mucositis (grade 1 or 2) compared to six non-fallers. No members of either group experienced grade 3 or 4 mucositis. No significance difference in diagnosis (multiple myeloma versus lymphoma) was noted among the patients in the faller and non-faller groups. Based on study findings, two study outcomes emerged.

**Outcome 1**

Eight fallers and four non-fallers had high MFS scores (p = 0.031). The logistic regression model indicated that patients with high MFS scores were 5.3 times more likely to fall compared to patients with low MFS scores.

**Outcome 2**

Between fallers and non-fallers, the variable of days of diarrhea was statistically significant. For every increment of one day of diarrhea, the risk of fall increased 1.2 times.

**FIGURE 1. FALL PREVENTION INTERVENTIONS BY HEALTHCARE PROVIDER**

**NURSING STAFF**
- Evaluate patient’s risk for fall.
- Generate a personalized care plan to prevent fall and injury.
- Work in partnership with interdisciplinary team members for application and assessment of a personalized care plan.
- Share patient’s fall and injury history, risk, and care plan during handoff report.
- Devise appropriate patient education materials that are easy to understand to ensure patient and caregiver engagement.
- Provide a safe space for the patient to prevent injury, should a fall occur.
- Participate in post-fall meeting (to identify factors that contributed to fall), should a patient fall.
- Participate in quality improvement efforts to improve processes.

**PHYSICIANS, PHYSICIAN ASSISTANTS, AND NURSE PRACTITIONERS**
- Determine medical interventions to reduce fall and injury risk.
- Have a pharmacist review medications that can increase fall risk.
- Screen patients for risk factors for osteoporosis, and test as needed.
- Check patients for fall risk with self-report and the Timed Up and Go test as needed.
- Involve the pharmacist and physical or occupational therapist to assess the patient as needed.

**Note.** Based on information from Veterans Health Administration, 2004.
Discussion
The nursing role in preventing falls is well defined. However, the risk factors unique to recipients of ASCT are not. Various fall risk tools are available, but the utility and testing of these instruments have been limited to populations other than those undergoing ASCT. This study brought forth and identified the risk factor that is characteristic of recipients of ASCT (days of diarrhea). The study rated eight of the fallers and four of the non-fallers as being at a high risk for fall, requiring intensive nursing interventions. Increased nursing surveillance, particularly attentiveness to call bells, is one strategy that is routinely employed in the bone marrow transplantation unit at ALMVH. During rounds, nurses are encouraged to advocate for and raise awareness of patients who are at risk of falling, particularly when days of diarrhea are increasing. If a patient is screened as being at a high risk for falls on admission, daily, or when a significant change occurs, the primary interdisciplinary team huddles on rounds to review medications that can predispose the patient to fall. The primary team assesses the patient to determine if the anti-diarrheal agent needs to be scheduled or added, as well as instructs the patient to call for help when bathroom breaks are needed or offers a bedside commode if fatigue becomes problematic. Fall intervention by the primary team includes assessment for adaptive equipment (e.g., shower chair, walker). Patient engagement is viewed as important, and giving patients independence, albeit cautiously, is emphasized. At this time, caregivers function as one of the most important allies to provide physical and social

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>FALLERS (N = 14)</th>
<th>NON-FALLERS (N = 20)</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>Days of diabetic medication use</td>
<td>3.3 ± 5.6</td>
<td>2.7 ± 4.4</td>
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<tr>
<td>Days of antiemetic use</td>
<td>8 ± 6.7</td>
<td>7 ± 4.7</td>
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<tr>
<td>Days of beta blocker use</td>
<td>6.7 ± 8.2</td>
<td>3.8 ± 5.4</td>
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<tr>
<td>Days with diarrhea</td>
<td>8.6 ± 5.1</td>
<td>4.4 ± 4.5</td>
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<tr>
<td>Days with fever</td>
<td>2.4 ± 2.5</td>
<td>2.3 ± 1.8</td>
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<tr>
<td>Days of sedative use</td>
<td>9.4 ± 7</td>
<td>5.9 ± 4.9</td>
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<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>FALLERS (N = 14)</th>
<th>NON-FALLERS (N = 20)</th>
<th>p</th>
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<tbody>
<tr>
<td>Length of hospital stay (days)</td>
<td>63.6 ± 7.4</td>
<td>61.4 ± 10.8</td>
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<tr>
<td>Days of diabetic medication use</td>
<td>21.3 ± 7.1</td>
<td>20.6 ± 8.9</td>
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<table>
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<th>n</th>
<th>n</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever, any time (incidence)</td>
<td>12</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>Diarrhea, any time (incidence)</td>
<td>13</td>
<td>13</td>
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<td>Incidence by diagnosis</td>
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<td>Multiple myeloma</td>
<td>12</td>
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<td>Lymphoma</td>
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<tr>
<td>Incidence of mucositis</td>
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<td>6</td>
<td>0.23</td>
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<tr>
<td>Incidence of nausea and vomiting</td>
<td>12</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>Morse Fall Scale score on admission</td>
<td></td>
<td></td>
<td>0.03</td>
</tr>
<tr>
<td>High</td>
<td>8</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Standard or moderate</td>
<td>6</td>
<td>16</td>
<td></td>
</tr>
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TABLE 2.
SAMPLE CHARACTERISTICS BY GROUP

Morse Fall Scale score on admission

High

Standard or moderate
Consider that early monitoring of chemotherapy toxicities, specifically days of diarrhea, which is very common in the setting of autologous stem cell transplantation (ASCT), is a predictive tool, days of diarrhea being a risk factor for falls in patients undergoing bone marrow transplantation. These multifactorial conditions, specified in the MFS, capture the circumstances associated with patients undergoing ASCT, and for this study, the suggested scoring of the MFS was appropriate, with an optimal predictive value.

The pre-engraftment period has a potential risk for fall that is specific to ASCT. Lee and Rah (2016) defined pre-engraftment as a release of inflammatory signs and symptoms consisting of rash and neutropenic fever during neutrophil recovery. This event occurs after hematopoietic stem cell transplantation. Future research should explore falls during the pre-engraftment period, as well as other tools in addition to the MFS, that can be used with patients undergoing ASCT.

Limitations
The current study was a descriptive case-control design. Although the study design allowed for examination of the relationships among variables, no attempts were made to control or manipulate the situation, as with experimental models. The population studied consisted only of ASCT recipients and was mostly male. In this study, the authors explored frequently encountered variables in the bone marrow transplantation setting; they did not explore anemia, neutropenia, or thrombocytopenia (this list is not exhaustive) because all patients who undergo ASCT experience pancytopenia when hospitalized. In addition, the sample size was small, limiting the generalizability of the findings, and the study was conducted in a single institution.

Conclusion
The current study determined that high MFS scores and days of diarrhea were risk factors for fall, which is valuable knowledge that may improve care outcomes. Nurses and other health professionals should address fall prevention while patients are undergoing ASCT. This population of patients routinely receives steroids, making their bones susceptible to injury; in addition, the frequent use of sedatives and harsh chemotherapy drugs in these patients increases their fall risk exponentially. Although the MFS is a predictive tool, days of diarrhea, which is very common in the population of patients with cancer, is not included. Further research into a fall assessment tool that is specific to patients with cancer may be warranted.

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REFERENCES


