Predictors of pressure ulcer development in patients with vascular disease

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Background: Although pressure ulcer (PU) risk factors are well known in the general population, little research is available in hospitalized surgical patients admitted with vascular diseases.

Methods: Using a retrospective medical records review, characteristics of hospitalized surgical patients with vascular diseases were assessed. Variables were based on literature review of PUs and availability of medical records and administrative data. Trained registered nurses collected data. Analyses included descriptive and comparative statistics, and multivariable modeling was used to determine predictors of PU.

*Results: In 849 adult admissions, 18.9% had a PU; 11.8% were hospital-acquired PU (HAPU). Patients were more likely to be elderly, male (n = 575; 67.7%), and Caucasian (n = 704; 83.3%). Common diagnoses were aneurysms/embolisms (43.2%) and atherosclerosis (31.2%). Patients with HAPU were more likely to be discharged to a skilled nursing or other facility compared with home (*P < .001*). In univariate analyses, 12 patient characteristics were associated with HAPU presence: Female gender, non-married status, current smoker, non-Caucasian race, non–intensive care unit (ICU) stay, primary diagnosis of atherosclerosis, higher analgesic use, higher right ankle brachial index (ABI), lower Braden score, higher blood urea nitrogen (BUN) higher serum creatinine and higher total protein levels. In multivariate analyses, nine factors predicted HAPU: Lower right ABI and Braden score, an ICU stay, low and high hematocrit values, female gender, non-White race, atherosclerosis history, and higher BUN and body mass index (BMI). The concordance index for the nine-item model was 0.854.*

Conclusion: The rate of HAPU in hospitalized surgical patients with vascular diseases was greater than expected. Assessment of important HAPU factors and implementation of interventions are needed to decrease risk and improve clinical outcomes. (J Vasc Nurs 2014;32:55-62)

"Vascular diseases" refers to a group of vascular conditions that cause arterial stenosis, occlusion, or aneurysmal dilation in the peripheral (noncoronary artery) circulation and are most commonly caused by atherosclerosis.[1] Approximately 8 million Americans or 12% of the population have vascular diseases.[1] Twenty percent of diagnosed adults are >70 years of age and men are often more affected than women.[1] Because vascular diseases are often asymptomatic, people may present with moderate to severe disease.[1] Consequences of vascular diseases are progression to cardiovascular events such as myocardial infarction or stroke and decreased quality of life related to leg pain and sedentary lifestyles.[1]

Risk of pressure ulcer (PU) development is a concern for people with vascular diseases. Specifically, when researchers used a large database and multiple regression analyses, history of peripheral arterial disease was a risk factor for development of PUs.[2] PUs are defined as localized areas of tissue breakdown that develop when soft tissue is compressed between a bony prominence (heel, ankle, foot, toe, sacrum, coccyx, back of the head, ears, or elbows) and an external surface for a prolonged period of time.[3] PUs are classified as stage 1 through 4 or as suspected deep tissue injury and unstageable, based on the extent of tissue damage.

Hospital-based healthcare providers routinely monitor hospital-acquired PU (HAPU) rates. In three university hospitals in Ireland, PU prevalence was 18.5%, and in 77% of cases, PU was hospital acquired.[4] Among patients treated in an acute care setting, PU incidence ranged from 1.5% to 10.27%[2] and in intensive care unit (ICU) settings, the rate was 27.2%.[5] In one study, overall HAPU prevalence was 10.9%, with higher rates in surgical patients.[6]

Several patient-specific factors may predict increased risk of HAPU. In three studies, one of which was carried out in an ICU setting, factors identified were immobility, friction, decreased mental status, decreased perfusion, nutritional deficiency, advanced age, skin condition including previous PU, procedures lasting >2 hours, administration of general anesthesia, skin integrity, organ system failure, and infection.[2,7,8] The only hospital factor that predicted HAPU was longer ICU stay.[9]

In previous research, some studies were conducted outside of the Unites States and none focused on hospitalized surgical patients with vascular diseases. The prevalence rates of all-cause HAPU (community-acquired PU or HAPU) and HAPU in our medical center vascular surgery step-down unit over a 14-month period were 18.9% and 11.8%, respectively. Because our PU rates

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were higher than those of other non-ICU reported rates, the primary purpose of this research study was to determine risk factors of HAPU development. Secondary goals were to develop a risk score of factors most likely to be associated with HAPU in patients. Research questions were: (1) What are the predictors of HAPU in hospitalized surgical patients with vascular diseases who are treated on a step-down unit? and (2) Can a risk score be created to identify patients at high risk for HAPU after admission to a step-down unit for vascular diseases?

METHODS

Design, setting, and sample

This retrospective medical record review was conducted at an >1200-bed Northeast Ohio quaternary care medical center after approval from the institution's ethics review board. The hospital has a national reputation for pioneering vascular surgical techniques including minimally invasive surgery, endovascular stent repair, aortic aneurysm treatment, and bypass surgeries. The sample included 849 patients with vascular diseases, who were >18 years old and were receiving hospital care on a 25-bed vascular surgery step-down unit from November 1, 2008, through December 31, 2009. Patients receiving palliative care were excluded. To determine sample size, a power analysis was completed using G Power. Using a β of 0.90 and α of 0.05, 788 cases were needed to determine differences in patients assigned to non-HAPU and HAPU groups, based on the expected HAPU rates from the literature.

Factors and measurement

Patient and environment characteristics known to be predictors or outcomes of HAPU in multiple settings[2,4,10–15] and in a general review of PU literature[8,16–18] were selected for assessment in this study if available in the medical record. In total, 31 variables were assessed for their association with HAPU: Age, gender, race, marital status, current smoker, admission source (home, emergency care, etc), mental status at admission (drowsy, confused, restless, etc), ICU stay, multiple ICU stays, number of ICU days, Braden score (and subscale scores), ankle brachial index (ABI), analgesics used, number of analgesics, patient-controlled analgesia pump present, incontinence during hospitalization, body mass index (BMI, using height and weight), serum laboratory values (glucose, sodium, blood urea nitrogen [BUN], creatinine, albumin, total protein, hemoglobin, hematocrit, serum C-reactive protein), primary medical diagnosis group, primary diagnosis-related group at discharge, discharge status, and hospital length of stay.

Data collection

Vascular disease diagnoses listed in an International Classification of Diseases-9 coding manual were identified by investigators and submitted to a data analyst working with our billing database to determine patients who had a primary discharge diagnosis that matched the identified diagnoses. Of 94 vascular diseases possible, patients cared for on the step-down unit during the study period had 40 diagnoses. The top 10 vascular diagnoses, in order of frequency, were abdominal aortic aneurysm (n = 250; 29.4%), thoracic abdominal aneurysm without rupture (n = 84; 9.8%); atherosclerotic limb with gangrene (n = 81; 9.5%), atherosclerotic limb with ulcer (n = 71; 8.4%), atherosclerotic limb and rest pain (n = 62; 7.3%), atherosclerotic limb with claudication (n = 43; 5%), thoracic aortic aneurysm (n = 38; 4.5%), atherosclerotic autologous bypass graft of limb (n = 28; 3.3%), lower extremity embolism (n = 24; 2.8%), and lower extremity aneurysm (n = 23; 2.7%). Once cases were identified, data available from the electronic medical record and billing databases were extracted by trained informatics technology and analyst personnel. For variables with more than one value available during the hospital episode of care (eg, laboratory values, Braden scores, and ABI), the admission value or the value available closest to the hospital admission date was used. Data were collected for variables not available by electronic medical record extraction by registered nurses who were trained by the principal investigator, using an investigator-developed case report form that used fill-in-the-blank and check-box formats. Assessment of quality in data collection was intermittently completed to ensure consistent interpretation of variable definitions and data collection accuracy by the data collection team.

Data analysis

Variables were compared between patients in the non-HAPU and HAPU groups by Pearson's chi-square with Yates continuity correction or Wilcoxon rank-sum test with continuity correction. A logistic regression model fit was conducted allowing for restricted cubic spline of the continuous predictors with variables that were significantly associated with HAPU on univariate analysis. Missing data were imputed using the mice imputation package for R software. Data reduction was performed by choosing factors that best approximated the fit of the full model with the least loss of information. After identification of important variables, bootstrap re-sampling was performed to bias correct this estimate. $P < .05$ was considered significant. Data analyses were performed in SAS (Version 9.2, Cary, NC; and R software, Version 2.13, Vienna, Austria).

RESULTS

Patient characteristics and factors associated with HAPU development

There were 849 admissions over a 14-month period. Of admissions, HAPU occurred in 101 (11.8%) cases. Mean (95% bootstrap confidence interval) age was 68.6 years (67.7-69.6) for the non-HAPU group and 69.1 years (66.8-71.5) for the HAPU group. In the sample, 67.7% were male and 83.3% were Caucasian (Table 1). Hospital length of stay trended to be lower among the non-HAPU group compared with the HAPU group: Mean (standard deviation) 6.90 (7.2) versus 8.45 (8.9) days ($P = .096$). Non-HAPU patients were more likely to be discharged home (less likely to require skilled nursing or other facility care) compared with HAPU group patients: 560 (76%) versus 51 (50.5%) ($P < .001$).

In total, 12 variables were associated with PU development during the hospital stay (Table 1). Of variables hypothesized to be important by investigators, higher frequency of analgesic use and low right ABI were significantly associated with HAPU. Low left ABI ($P = .055$) and lower Braden nutrition