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ORIGINAL RESEARCH

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Evaluation of the Braden scale in predicting surgical outcomes in older patients undergoing major head and neck surgery

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Abstract

Background: Being able to predict negative postoperative outcomes is important for helping select patients for treatment as well for informed decision-making by patients. Frailty measures are often time and resource intensive to use as screening measures, whereas the Braden scale, a commonly used measure to assess patients at risk of developing pressure ulcers after surgery, may be a potential tool to predict postoperative complication rates and longer length of stay (LOS) in patients undergoing major head and neck cancer surgery.

Methods: A retrospective analysis of Braden scale scores was performed on a prospectively collected cohort of patients undergoing major head and neck surgery recruited between December 2011 and April 2014. The association of Braden scale score with the primary outcomes of complications and LOS was analyzed using logistic regression and linear regression models on univariate analysis (UVA), respectively. Multivariate analysis (MVA) was performed based on a backward stepwise selection algorithm.

Results: There were 232 patients with a mean (SD) Braden scale score of 14.9 (2.8) with a range from 9 to 23. The Braden scale (β = −.07 per point; 95% CI −0.09, −0.04, P < .001) was an independent predictor of increased LOS on UVA, but not on MVA when adjusted for other variables. For overall complications, as well as type of complication, the Braden scale score was not a significant predictor of complications on either UVA or MVA.

Conclusion: In the sample population, the Braden scale did not demonstrate an ability to predict negative outcomes in head and neck surgery patients.

Level of Evidence: Level 2b individual cohort study.

KEYWORDS

Braden scale, complications, head neck surgery, length of stay

1 | INTRODUCTION

As the population ages there will be an expected increase in the number of patients undergoing head and neck oncologic surgery.[1] Being able to predict surgical outcomes, such as complications and increased length of stay, is important to be able to counsel and consent patients for surgery. Older patients with head and neck cancer are particularly vulnerable as they have frequent comorbidities related to age as well as risk factors related to their head and neck cancer such as smoking and alcohol consumption.[2]

We have previously examined whether measures of frailty (Fried's Frailty Score) and activities of daily living (Lawton-Brody, Vulnerable Elders Score) are predictors of postoperative outcomes.[3] Although the frailty score was found to be a predictor of type and grade of complications as well as length of stay (LOS), incorporating it into routine clinical practice as a screening tool would require additional time and resources. Thus, identifying other measures that are frequently already employed in clinical practice that can predict important surgical outcomes would potentially be beneficial for patients and physicians. A commonly used measure for patients being hospitalized is the Braden scale, which was designed to identify patients at risk of developing pressure ulcers after surgery. This measure is often completed by nurses as per routine care in the preoperative setting.[4,5] Items within the Braden scale assess nutrition, mobility, and sensory deprivation and thus may have value in predicting outcomes other than pressure ulcers. Previous studies have reported that the Braden scale can also identify surgical patients at risk of adverse postoperative events such as complications and increased LOS.[6-8]

The primary objective of this study was to determine if scores on the Braden scale could predict postoperative complication rates and longer LOS in patients undergoing major head and neck cancer surgery.

2 | METHODS

A prospective cohort study was performed with patients recruited between December 2011 and April 2014 at the University Health Network (UHN), Toronto, Canada. Institutional ethics board approval was obtained. Patients were included if they were ≥ 50 years and undergoing major head and neck surgery defined as (a) laryngectomy with bilateral neck dissections; (b) resection requiring free flap or regional myocutaneous flap reconstruction; (c) parotidectomy, thyroidectomy, or skin cancer resection with lateral neck dissection(s). Recognizing the differences in the risk of complications and differences in LOS between the different types of procedures included, we did include the third group as these are frequent procedures in older patients and can be considered as major head and neck procedures based on invasiveness, anesthesia time, and all require an inpatient admission. Patients were recruited from head and neck (HN) surgical clinics and consented after a decision to operate was made. Baseline sociodemographic and clinical data including comorbidity data (Adult Comorbidity Evaluation 27 [ACE 27]) was collected.[9] Perioperative data collected included: type and length of surgery, American Society of Anesthesia (ASA) score, laboratory data and complications. Severity of complications was graded using the modified Clavien-Dindo grading system.[10] LOS was recorded and patients were followed in clinic

TABLE 1 Clinical characteristics

Covariate	Full sample (n = 232)
Sex	
Female n (%)	56 (24)
Male	176 (76)
Age	
Mean (SD)	67.3 (9.6)
Median (Min, Max)	67 (50, 86)
Age categories	
50–64	95 (41)
65+	137 (59)
Tumor site	
Skin/Thyroid/Salivary gland	97 (42)
Oral cavity/OPC/Hyx/Larynx	133 (58)
Smoking status	
Quit/Non-smoker	185 (80)
Current	47 (20)
ASA	
ASA 1,2	21 (9)
ASA 3,4,5	205 (91)
Comorbidity score	
Mild/none	143 (62)
Moderate/severe	89 (38)
Operative hours	
Mean (SD)	9.2 (2.7)
Median (Min, Max)	9.1 (3.5, 20.5)
Free flap	
No	56 (24)
Yes	176 (76)
Preoperative hemoglobin	
Mean (SD)	138.8 (15)
Braden scale score	
Mean (SD)	14.9 (2.8)
Median (Min, Max)	14 (9, 23)
Braden scale categories	
1 very high risk ≤9	1 (0)
2 high risk 10-12	37 (16)
3 moderate risk 13-14	83 (36)
4 mild risk 15-18	85 (37)
5 no risk 16-23	26 (11)

Note: Numbers not adding up to 232 reflect missing data. Measured using the ACE-27 co-morbidity index.
Abbreviations: ASA, American Society of Anesthesia; Hyx, hypopharynx; OPC, oropharynx.

TABLE 2 Frequency of complication and length of stay for Clavien-Dindo grades of complication

	Grade 1 (n = 20)	Grade 2 (n = 65)	Grade 3a (n = 1)	Grade 3b (n = 9)	Grade 4a (n = 5)	Grade 5 (n = 2)
Definition of complication grade	Any deviation from normal postoperative course without need for pharmacological treatment or surgical, endoscopic, and radiological interventions.	Requiring pharmacological treatment with drug other than such allowed for Grade I complications.	Requiring surgical, endoscopic or radiological intervention. Intervention not under general anesthesia.	Requiring surgical, endoscopic or radiological intervention Intervention under general anesthesia.	Life-threatening complication requiring intensive care unit management Single organ dysfunction (including dialysis).	Death
Days stay hospital						
Mean (SD)	13.8 (4.7)	17.8 (10.3)	12 (NA)	20.7 (8.8)	32.4 (16)	71.5 (47.4)
Median (Min, Max)	15 (5, 22)	15 (3, 53)	12 (12, 12)	18 (10, 31)	28 (16, 58)	71.5 (38, 105)

TABLE 3 Predictors of length of stay on univariate and multivariate analysis

	Univariable analysis		Multivariable analysis	
Covariate	**Estimate (95% CI)**	***P*-value**	**Estimate (95% CI)**	***P*-value**
Sex		**<.001**		
Female	Reference			
Male	−0.3 (−0.48, −0.12)			
Age categorized		**.0092**		
50–64	Reference			
65+	−0.21 (−0.37, −0.05)			
Braden scale score	−0.07 (−0.09, −0.04)	**<.001**	−0.02 (−0.04,0)	.081
Smoking status		**.017**		
Quit/Non-smoker	Reference			
Current	0.24 (0.04, 0.43)			
Alcohol frequency		.18		
Others	Reference			
>1 drink/day	0.14 (−0.07, 0.35)			
Tumor site		**<.001**		**<.001**
Skin/thyroid/salivary gland	Reference		Reference	
Oral cavity/OPC/Hyx/Larynx	0.86 (0.75, 0.98)		0.68 (0.57, 0.79)	
Comorbidity score		.12		**.011**
Mild/none	Reference		Reference	
Moderate/severe	0.13 (−0.03, 0.29)		0.13 (0.03, 0.24)	
Operative hours	0.12 (0.1, 0.15)	**<.001**	0.05 (0.03, 0.08)	**<.001**
ASA		**.034**		
ASA 1,2	Reference			
ASA 3,4,5	0.3 (0.02, 0.57)			
Free flap		**<.001**		**.011**
No	Reference		Reference	
Yes	0.74 (0.58, 0.9)		0.21 (0.05, 0.36)	
Preoperative hemoglobin[a]	−0.05 (−0.1, 0.01)	.085	−0.04 (−0.07, −0.01)	**.012**

Note: Comorbidity score Measured by ACE-27.
Abbreviations: ASA, American Society of Anesthesia; Hyx, hypopharynx; OPC, oropharynx.
[a]The odds of increased LOS for every 10 g/L change.

and through the electronic chart for the first month after discharge for any new complications. The same cohort of previously reported patients was used,[3] however, for the current study a retrospective electronic chart review was performed to collect the Braden scale score. During the time period of this study, the Braden scale was collected at the UHN on patients undergoing preadmission for their major head and neck surgery. Although the initial study included patients from a second site (Sunnybrook Health Science Center) the current study included only patients from the UHN site.

The Braden scale is composed of six items including mobility, activity, sensory perception, skin moisture, friction/shear, and nutrition.[5] These six items are individually scored between 1 and 4, with a score of 1 denoting the most severe risk of pressure ulcer development and a score of 4 representing minimal risk.[11,12] Scores for each item are summated, with a total score of 9 or less regards as being "very high risk" for pressure ulcer development, 10 to 12 being regarded as "high risk," 13 to 14 as "moderate risk," and a score of 15 to 18 representing a "mild risk" of pressure ulcer development.[13]

Statistical analysis was performed using SAS 9.4 and R (R Foundation, Vienna, Austria). Descriptive data were summarized using descriptive statistics. Age was assessed as a categorical variable (grouped as age ≥ 65 years and age 50-64 years). The primary outcomes were complications and LOS. For statistical analysis the outcome grade of complication was dichotomized into Clavien-Dindo grade 1/2 vs grade 3/4/5. This cut-point was chosen as grade 3 complications require a surgical or radiological intervention and therefore felt to be a clinically important cut-point. Predictor variables for these respective outcomes were analyzed using logistic regression and linear regression models. LOS was a non-zero right skewed outcome and log transformation was applied. Multivariate analysis (MVA) was performed on each outcome separately based on a backward stepwise selection algorithm. In brief, all potential factors associated with each

TABLE 4 Predictors of overall complications on univariable and multivariable analysis

	Univariable Analysis		Multivariable Analysis	
Covariate	**OR (95% CI)**	***P*-value**	**OR (95% CI)**	***P*-value**
Sex		.3		
Female	Reference			
Male	0.73 (0.4, 1.33)			
Age categorized		.2		**.011**
50–64	Reference		Reference	
65+	1.42 (0.83, 2.41)		2.28 (1.2, 4.3)	
Braden scale score	0.94 (0.85, 1.04)	.21	1.04 (0.93, 1.15)	.51
Smoking status		.91		
Quit/non-smoker	Reference			
Current	1.04 (0.54, 1.98)			
Alcohol frequency		.51		
Others	Reference			
>1 drink/day	1.25 (0.64, 2.43)			
Tumor site		**<.001**		**.0052**
Skin/thyroid/salivary gland	Reference		Reference	
Oral cavity/OPC/Hyx/Larynx	2.56 (1.48, 4.43)		2.61 (1.33, 5.12)	
Comorbidity score		**.016**		**.0049**
Mild/none	Reference		Reference	
Moderate/severe	1.93 (1.13, 3.3)		2.42 (1.31, 4.49)	
Operative hours	1.28 (1.14, 1.43)	**<.001**		
ASA		.14		
ASA 1,2	Reference			
ASA 3,4,5	2.12 (0.79, 5.67)			
Free flap		**<.001**		
No	Reference		Reference	**<.001**
Yes	5.04 (2.39, 10.61)		5.16 (2.25, 11.8)	
Preoperative hemoglobin[a]	0.95 (0.79, 1.12)	.52		

Note: Comorbidity score Measured by ACE-27.
Abbreviations: ASA, American Society of Anesthesia; Hyx, hypopharynx; OPC, oropharynx.
[a]For every 10 g/L change in hemoglobin.

outcome ($P < .10$) or of clinical importance were put into the MVA with subsequent backward stepwise selection. Odds ratios (OR) for complications and regression coefficients for LOS were provided with 95% confidence interval (CI).

3 | RESULTS

There were 274 patients eligible for inclusion, of which the Braden scale was not available in 42 patients. Of the missing Braden scores, 15 were not available as they were recruited as part of the initial study at a secondary site and not included in the current study. A summary of the cohort is presented in Table 1. There were 203 complications which occurred in 102 patients. Table 2 presents the grade of complication with its definition, the frequency of the grade of complication and the median LOS within each category. The mean (SD) Braden scale score was 14.9 (2.8) for the entire cohort with a score range from 9 to 23. The mean Braden score in patients over age 65 years was 15 and 14.9 in the cohort between 50 and 64 years ($P = .77$). There was no statistically significant correlation between frailty score and Braden scale categories (Spearman's rank correlation coefficient – 0.07, $P = .28$). The mean and median LOS was 19 and 15 days, respectively.

The Braden scale ($\beta = -.07$ per point; 95% CI −0.09, −0.04, $P < .001$) was a predictor of increased LOS on univariate analysis (UVA) (Table 3). However, on MVA it became nonsignificant when adjusted for other variables including tumor site, comorbidity score, free flap, operative hours and perioperative hemoglobin (Table 3).

For overall complications the Braden scale score was not a significant predictor of complications on UVA (Table 4). Chi-squared test showed that there is no statistically significant association between categorical Braden scale and overall complication ($P = .18$). Based on the type of complication the Braden scale was not associated with either medical (OR 0.96 95% CI 0.86, 1.07, $P = .48$) or surgical complications (OR 0.96 95% CI 0.87, 1.07, $P = .49$) on UVA. In addition, the Braden scale was not a significant predictor of Clavien-Dindo grade 3+ complications (OR 0.96, 95% CI 0.69, 1.08, $P = .19$).

A subset analysis was also performed including only mucosal surgical cases, the majority of which (89%) required free tissue transfer. Similar to the entire cohort analysis, the Braden scale score was a predictor of LOS ($P = .043$) on UVA but was not a significant predictor on MVA ($P = .35$). For overall complications, the Braden scale score was not a significant predictor on UVA ($P = .47$).

4 | DISCUSSION

Selection of patients for major head and neck surgery requires balancing risks and benefits. Identification of postoperative risks not only helps surgeons counsel their patients preoperatively and help select patients for surgery, it also aids physicians in identifying patients at higher risk in whom interventions can be designed to potentially mitigate this risk. This is particularly relevant in older patients who have vulnerabilities specific to aging, as well as increased comorbidities.[2] In addition, patient's perception of how they balance cure with quality of life can change as patients age.[14] There is continued research on trying to find tools that can identify these vulnerabilities and predict negative postoperative outcomes such as complications or prolonged hospitalization. We have previously reported in this study sample that Fried's Frailty score was able to predict complications and LOS, however, measuring frailty, particularly phenotypic frailty, requires time and resources which may not be easily performed in the clinical setting.[3] On the other hand, the Braden scale is quick and easy to perform and frequently employed in the hospital setting often by nurses as part of the pre-admission process, as it was at the UHN.

The Braden scale incorporates functional, nutritional, and cognitive information, and thus may be able to predict outcomes other than pressure ulcers, as demonstrated by prior studies. Cohen et al evaluated the Braden scale in predicting any surgical complication in 102 patients aged 65 years and older undergoing abdominal surgery.[6] Decreasing Braden score was associated with postoperative complications (OR 1.30, 95% CI 1.06, 1.60) while controlling for age, sex, race, type of surgery and a deficit accumulation frailty index. The optimal predictive ability was a cut-point score ≤ 18, with a c-statistic of 0.744. Watkins et al evaluated the predictive role of the Braden scale on rehabilitation facility placement in 470 patients who underwent pancreatic resection.[7] On multivariate analysis, age, sex, length of stay >8 days, inpatient comprehensive complication index (CCI) and initial Braden scale score were predictive of rehabilitation placement.

The Braden scale has also undergone evaluation of its predictive or prognostic ability in non-surgical patients on a limited basis. Carazo et al retrospectively assessed the prognostic utility of Braden Scale measure in 289 hospitalized patient with heart failure.[8] Participants with at risk Braden scores (ie, ≤18) had significantly higher rates of mortality events (23 deaths over 66.1 patient-years of follow-up; 34.8 deaths/100 patient-years) when compared with participants with low risk Braden scores (>18) (55 deaths over 300.3 patient-years of follow-up; 18.3 deaths/100 patient-years, $P = .005$ by log-rank test). Overall, higher risk Braden scores were common in hospitalized heart failure patients but were not independent predictors of survival. Bandle et al also used the Braden score to evaluate whether it can predict outcomes including mortality, length of stay and discharge destination in a retrospective review of 642 heart failure patients.[15] After adjustment, higher Braden score was significantly associated with decreased 30-day mortality (discharge Braden OR 0.81 [95% CI 0.66-0.996]), decreased average LOS (admission Braden β −0.52 days [$P = .0002$]) and associated with discharge to home (OR 1.66 [95% CI 1.42-1.95]).

In comparison to some of the prior studies, our study failed to find the Braden scale to be an independent predictor of length of hospital stay and complications following major head and neck cancer surgery. We had very few patients that were discharged to an alternate level of care facility and thus could not evaluate the relationship between Braden score and discharge destination as did Watkins et al and Carazo et al. The fact that we failed to find an association between the Braden scale and complications, as compared to the study by Cohen et al, may be related to our inclusion of a younger cohort of patients, or differences in mean or median Braden scale

scores, although the latter was not reported in their paper. Additional differences in our findings compared with Cohen et al may be related to differences in the types of complications associated with head and neck surgery compared with abdominal surgery and the ability of the Braden scale to predict these complications. With abdominal surgery risk factors for pressure ulcer development would likely be similar to those for the development of complications such as postoperative ileus or urinary retention, thus potentially accounting for the Braden scale score to predict abdominal surgery complications.

Using the same cohort of patients that we found an association between Fried's Frailty score and outcomes such as complications and LOS, we failed to find an association between Braden scale score and these outcomes. The Braden scale was designed to determine risk of pressure ulcers whereas frailty measures aim to evaluate decreased physiologic reserve and increased vulnerability for adverse health outcomes. The Braden scale has some overlapping content with Fried's Frailty score in that they both evaluate activity, mobility, and nutrition, albeit with differences in terms of how each are measured. In the Braden scale, activity is measured using a range from being bed-ridden to walking freely whereas Fried's Frailty score is more detailed in terms of determining weekly kilocalorie expenditure based on certain activities. Mobility in the Braden scale is evaluated using a 4-response item to the question about ability to change and control position with a range from completely immobile to no limitations. In comparison, Fried's Frailty score measures not just mobility but speed of mobility with a timed walk test. Lastly, nutrition in Fried's score is based on actual weight loss rather than the question on usual food intake in the Braden scale. The remaining questions on the Braden scale are not relevant to measurement of physiologic reserve and vulnerability such as moisture and friction/shear. Thus, it is understandable why Fried's frailty score and not the Braden scale was predictive in evaluating outcomes following major head and neck surgery.

One of the limitations of the study was that the cohort was prospectively enrolled, but the Braden scale score was obtained retrospectively. Thus, there were patients without the Braden scale being completed. In addition, the study was not initially designed and powered for this objective and therefore the negative study may be related to being underpowered.

Although further work may validate whether the Braden scale is a useful measure to predict outcomes in head and neck cancer patients, we would suggest focusing on other measures that can be used to screen for vulnerability and predict negative outcomes.

CONFLICT OF INTEREST

None of the authors declares any conflicts of interest related to the study

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