Predictors of farther mobilization on day of surgery and shorter length of stay after total joint arthroplasty

Sylvia Gautreau, PhD
Regan Haley, MScPT
Odette N. Gould, PhD
Donald D. Canales, MA
Tara Mann, BScPT, MA
Michael E. Forsythe, MD

Accepted Jan. 7, 2020

Correspondence to:
S. Gautreau
The Moncton Hospital
Orthopaedic Surgery, Rm 6620
135 MacBeth Ave
Moncton NB E1C 6Z8
sylvia.gautreau@horizonnb.ca

DOI: 10.1503/cja.003919

Background: Mobilization on the day of total joint arthroplasty (TJA) is associated with shorter length of stay. The question of whether incrementally farther mobilization on the day of surgery (POD0) contributes to shorter length of stay has not been widely studied. The purpose of this study was to determine if farther mobilization on POD0 led to shorter length of stay and to identify the predictors of farther mobilization and length of stay.

Methods: A retrospective chart review was undertaken using data for patients who had a primary TJA and mobilized on POD0. Patients were categorized into the following 4 mobilization groups: sat on the bedside (Sat), stood by the bed or walked in place (Stood), walked in the room (Room) and walked in the hall (Hall). The primary outcome was length of stay. Predictors of farther mobilization on POD0 and length of stay were identified using regression analyses.

Results: The sample comprised 283 patients. The Hall group had significantly shorter length of stay than all other groups. There were sex differences across the mobilization groups. Simultaneous regression analysis showed that farther mobilization was predicted by younger age, male sex, lower body mass index, spinal anesthesia and fewer symptoms limiting mobilization. Hierarchical regression showed that shorter length of stay was predicted by male sex, lower body mass index, lower American Society of Anaesthesiologists physical status classification score, less pain/stiffness and farther mobilization on POD0.

Conclusion: Understanding the modifiable and nonmodifiable predictors of mobilization after TJA and length of stay can help identify patients more likely to mobilize farther on the day of surgery, which would contribute to better resource allocation and discharge planning. Focusing on symptom management could increase opportunities for farther mobilization on POD0 and thereby decrease length of stay.

Contexte : La mobilisation le jour même d’une arthroplastie totale (AT) est associée à une durée d’hospitalisation réduite. Or, le lien entre l’ampleur de la mobilisation le jour de la chirurgie (jour postopératoire 0 [JPO0]) et la réduction de la durée d’hospitalisation n’a pas été largement étudié. La présente étude visait à déterminer si une mobilisation plus importante au JPO0 réduit la durée d’hospitalisation, de même qu’à repérer les facteurs prédictifs de mobilisation importante et de durée d’hospitalisation.

Méthodes : Une analyse rétrospective a été menée à l’aide des dossiers de patients ayant subi une AT primaire et ayant été mobilisés au JPO0. Les patients ont été classés en 4 groupes en fonction de l’ampleur de leur mobilisation : assis au bord du lit (assis), debout à côté du lit ou marche sur place (debout), marche dans la chambre (chambre) et marche dans le couloir (couloir). Le principal résultat à l’étude était la durée d’hospitalisation. Les facteurs prédictifs de mobilisation importante au JPO0 et de durée d’hospitalisation ont été dégagés au moyen d’analyses de régression.

Résultats : L’échantillon comprenait 283 patients. Le groupe couloir présentait une durée d’hospitalisation significativement plus courte que les autres. Des différences entre les sexes ont été observées dans tous les groupes. Selon une analyse de régression simultanée, les facteurs prédictifs de mobilisation importante étaient un jeune âge, le sexe masculin, un faible indice de masse corporelle, une anesthésie rachidienne et un nombre limité de symptômes nuisant à la mobilisation. Une analyse de régression hiérarchique a quant à elle montré que les facteurs prédictifs de durée d’hospitalisation réduite étaient le sexe masculin, un faible indice de masse corporelle, un faible score à la classification de l’état de santé physique de l’American Society of Anaesthesiologists, une douleur ou des raideurs moindres, et une mobilisation importante au JPO0.

Conclusion : La mise en évidence des facteurs prédictifs modifiables et non modifiables de mobilisation et de durée d’hospitalisation après une AT peut faciliter le repérage des patients susceptibles d’être davantage mobilisés, ce qui contribuerait à une meilleure allocation des ressources et faciliterait la planification des congés. Accorder une attention particulière au soulagement des symptômes pourrait accroître les occasions de mobilisation importante au JPO0 et, par conséquent, réduire la durée d’hospitalisation.
The demand for total joint arthroplasty (TJA) is increasing each year because of our aging population and the impact of obesity. To address this issue, there has been a focus on reducing length of stay without adversely affecting patient safety. Mobilization as a physiotherapy intervention within the first 24 hours of TJA has been shown to reduce length of stay without jeopardizing clinical outcomes, patient safety or satisfaction. More recent research has extended these findings by showing that mobilization on the day of surgery (POD0) results in shorter length of stay without increased complications, with very few exceptions. This has led to same-day hip and knee arthroplasty for select patients in select hospitals. For hospitals where patients undergoing TJA continue to be admitted for multiple days, the focus continues to be on POD0 mobilization and reducing overall length of stay.

This study originated from a quality assurance project undertaken by our hospital’s physiotherapy department between June 2015 and July 2016 after a day-of-surgery mobilization protocol had been initiated. Physiotherapists recorded whether or not patients were mobilized on POD0, the type of mobilization, and, if there was no mobilization, the reason(s) why. The original objective was to ensure sufficient physiotherapy resources were available to consistently achieve day-of-surgery mobilization. Data from 608 patients who had undergone orthopedic surgery were collected during the quality assurance period; 487 of those had undergone TJA. The mean length of stay was 3.4 days for the patients who mobilized on POD0 and 3.9 days for those who did not mobilize on POD0 ($p < 0.001$) (unpublished data).

The question that arose from the quality assurance project was whether incrementally farther mobilization (i.e., walking in the hallway versus standing at the bedside) was predictive of shorter length of stay. We define shorter length of stay as less than 72 hours because the Canadian Institute for Health Information reported a median length of stay of 3 days for total hip arthroplasty (THA) and total knee arthroplasty (TKA) in 2017/18. As long wait times for total joint replacement adversely affect many patients across Canada, it was felt a research study investigating the extent of day-of-surgery mobilization and the predictors of farther mobilization and length of stay would contribute to the orthopedic literature. The goal of this study was to investigate the relationship between the degree of mobilization and length of stay in a sample of patients undergoing THA and TKA. We hypothesized that the farther patients mobilized on the day of surgery the shorter their length of stay would be, without increased complications. We also sought to identify the predictors of farther mobilization on POD0 that might contribute to shorter length of stay.

**METHODS**

This was a retrospective chart review of patients identified by the physiotherapy department at The Moncton Hospital as having mobilized on POD0. Inclusion criteria were any patient who had an elective unilateral primary THA or TKA between June 2015 and March 2017 and an overall length of stay less than or equal to 8 days. All surgeries were performed by 5 experienced surgeons, who performed more than 100 TJAs per year for a combined total of over 550 TJAs annually during the study period. Ethics approval was received from the Horizon Health Network Research Ethics Board.

The preoperative education available to patients at the time of the study included 1 visit to the preoperative clinic before the surgery. Patients were seen by the following members of the health care team: a registered nurse for presurgery preparation and counselling; a physiotherapist for pre- and post-TJA exercises; a pharmacist for a review of the patient’s medications; and, for patients undergoing THA, an occupational therapist. Patients also had electrocardiography, blood work and radiography on the day of the preoperative clinic visit.

All TKA procedures were performed with a standard midline incision. For THA, both lateral and posterior approaches were used. Other perioperative protocols included perioperative antibiotics, multimodal pain management and tranexamic acid utilization. Postoperative pharmacologic prophylaxis for deep vein thrombosis was provided to all patients.

Upon arrival on the orthopedic unit from the post-anesthesia care unit, each patient was assessed by a physiotherapist for motor control and ability to initiate weight-bearing exercises using walking aids. Patients who underwent TJA received standardized postoperative physiotherapy treatment including active-assistive and active range-of-motion exercises, isometric and isotonic strengthening exercises, transfer training and gait retraining. Notes were made in the electronic medical record on patients’ mobility status. On subsequent days, physiotherapy exercises were reviewed and transfer, stair training and gait reeducation continued. Patients were discharged when their vital signs were stable and they were able to safely negotiate stairs.

For the data collection, patients who met the study inclusion criteria were placed on a chronologic consecutive list. Each patient was assigned a study identification number and was allocated to 1 of the 4 mobilization groups on the basis of physiotherapy records. Group allocation was confirmed by a subsequent review of the physiotherapy notes. The 4 groups were as follows: (1) sat on the bedside and dangled (Sat); (2) stood by the bed or walked in place (Stood); (3) walked in the room (Room), to a chair, the bathroom or to the door; and (4) walked in the hallway (Hall). The electronic medical record and patients’ charts
were reviewed to record patients’ demographic characteristics, diagnosis of osteoarthritis versus rheumatoid arthritis, intraoperative data such as the American Society of Anaesthesiologists physical status classification (ASA) score, anesthesia type (spinal versus general), surgeon, pain rating on a scale of 0 (no pain) to 10 (extreme pain) recorded as patients arrived on the orthopedic unit, and postoperative pain medication. Data to calculate a Charlson Comorbidity Index (CCI) score for each patient were recorded from the patients’ charts. Complications within 30 days of the surgery were also recorded, which were defined as pulmonary embolism or deep vein thrombosis, bleed, wound infection, myocardial infarction, and stroke or transient ischemic attack. Discharge location (home, other hospital or facility, or home of family or friend) and discharge support person (spouse; significant other; family member; caregiver; friend or neighbour) were also recorded from the electronic medical record.

Physiotherapy notes were copied verbatim from the electronic medical record. Two independent physiotherapist coders (blinded to the research question) reviewed the notes and indicated whether the patient had any of the identified symptoms that might inhibit day-of-surgery mobilization. These symptoms included the following: pain or stiffness; nausea (with and without vomiting); lower extremity paresthesia (numbness); dizziness or light-headedness; and drowsiness or sleepiness. There was 93.4% agreement between the 2 raters from a total of 1415 notes examined. Discrepancies were reviewed and discussed by the first and fifth authors (S.G., T.M.) to reach consensus.

Statistical analysis

Descriptive statistics were used to summarize all main study variables. Following this, χ2 analysis (or the Fisher exact test if expected counts in cells were less than 5) and 1-way analysis of variance (ANOVA) were used to compare the 4 mobilization groups across the variables of interest. Demographic and clinical characteristics were examined for their ability to predict degree of mobilization by means of a regression with simultaneous entry. This identified the variables most predictive of the degree of mobilization. Following this, a hierarchical regression model was used to examine predictors of length of stay with demographic and clinical characteristics entered in block 1 and mobilization entered in block 2. This allowed us to test whether the degree of mobilization added a significant amount of predictive power after controlling for the effects of the variables included in block 1.

All variables were examined for normality. Sample size was estimated using G*Power. The minimum sample size for the ANOVA comparing the groups on the main study outcome of length of stay was estimated to be 180 on the basis of the following input parameters: a Cohen f medium effect size of 0.25, α of 0.05, power of 0.80 and 4 groups. For the regressions, the minimum estimated sample size was 127 on the basis of a Cohen f2 medium effect size of 0.15, α of 0.05, power of 0.80 and 12 predictors. Data collection was carried out in chronologic consecutive order until the minimum per group number according to the power analysis had been reached for all 4 groups. As seen below, these minimum sample sizes were exceeded. Effect sizes and 95% confidence intervals are reported where appropriate. SPSS Statistics version 24 (IBM) was used for the analyses.

RESULTS

The final sample comprised 283 patients, representing 53.6% of the approximately 528 patients who mobilized on POD0 during the study period. Table 1 provides descriptive data for all of the study variables and comparisons between mobilization groups. There were no significant group differences for age, body mass index (BMI), diagnosis of osteoarthritis versus rheumatoid arthritis, ASA score, CCI score, type of anesthesia, pain rating (zero-inflated, dichotomized to no pain v. pain present), surgeon, procedure type (THA v. TKA), postoperative pain medication, complications, discharge location and discharge support person. The latter 3 variables were dichotomized because of low frequencies (yes or no for complications; home or other for discharge location; family or nonfamily for discharge support). Women were significantly more likely to be in the Sat group and Room group and men were significantly more likely to be in the Hall group. Significant variations emerged across the mobilization groups for length of stay, but in general the Hall group had the shortest length of stay relative to the other groups. Table 2 shows the distribution of patient-reported symptoms across the mobilization groups. Nausea and drowsiness were experienced significantly more frequently by patients in the Sat group than by patients in the other groups.

Predictors of mobilization

A simultaneous regression model was used to determine what predicted farther mobilization. Variables in the model included demographic characteristics, medical status and patient-reported symptoms. As shown in Table 3, the model was significant (p < 0.001), accounting for 23.2% of the variance in mobilization. Variables significantly associated with a greater degree of mobilization included younger age, male sex, lower BMI, spinal anesthesia, and less nausea, numbness, lightheadedness and drowsiness.

Predictors of length of stay

A hierarchical regression was performed to determine whether the degree of mobilization was predictive of length of stay after controlling for several demographic
and clinical characteristics. Block 1 controlled for demographic characteristics (age, sex, BMI), medical status (ASA score, CCI score, anesthesia) and the patient-reported symptoms recorded by physiotherapists that might inhibit mobilization: pain/stiffness, nausea, numbness, lightheadedness and drowsiness. Mobilization was then entered in block 2. Table 4 shows the results of the hierarchical regression. The first block was significant ($p < 0.001$) and explained 22.8% of the variance in length of stay. Variables that predicted longer length of stay included older age, female sex, higher BMI, higher ASA score, more pain/stiffness and more numbness. The final block was also significant.

### Table 1. Patient characteristics and group comparisons

| Variable                  | Total n = 283 | Sat n = 76 | Stood n = 83 | Room n = 79 | Hall n = 45 | p value | $\eta^2/V$ | 95% CI       |
|---------------------------|---------------|------------|--------------|-------------|-------------|---------|----------|-------------|
| Age, yr, mean ± SD        | 65.3 ± 9.3    | 66.6 ± 9.2 | 65.9 ± 9.0   | 64.2 ± 9.9  | 64.3 ± 8.8  | 0.32    | 0.012    | 0.000 to 0.040 |
| Sex                       |               |            |              |             |             |         |          |             |
| Female                    | 164 (58.0)    | 55 (72.4)  | 45 (54.2)    | 49 (62.0)   | 15 (33.3)   | < 0.001 | 0.257    | 0.159 to 0.376 |
| Male                      | 119 (42.0)    | 21 (27.6)  | 38 (45.8)    | 30 (38.0)   | 30 (66.7)   |         |          |             |
| BMI, mean ± SD            | 33.9 ± 7.4    | 34.8 ± 8.4 | 34.6 ± 7.9   | 33.7 ± 6.5  | 31.3 ± 5.3  | 0.05    | 0.027    | 0.000 to 0.066 |
| Diagnosis                 |               |            |              |             |             |         |          |             |
| OA                        | 274 (97.5)    | 76 (100)   | 79 (95.2)    | 75 (96.2)   | 44 (100)    | 0.16    | 0.140    | 0.000 to 0.259 |
| RA                        | 7 (2.5)       | 0 (0.0)    | 4 (4.8)      | 3 (3.8)     | 0 (0.0)     |         |          |             |
| Procedure                 |               |            |              |             |             |         |          |             |
| TKA                       | 184 (65.0)    | 48 (63.2)  | 54 (65.1)    | 52 (65.8)   | 30 (66.7)   | 0.98    | 0.026    | 0.000 to 0.101 |
| THA                       | 99 (35.0)     | 28 (36.8)  | 29 (34.9)    | 27 (34.2)   | 15 (33.3)   |         |          |             |
| CCI score, mean ± SD      | 3.5 ± 1.4     | 3.5 ± 1.4  | 3.6 ± 1.7    | 3.5 ± 1.4   | 3.4 ± 1.2   | 0.87    | 0.003    | 0.000 to 0.013 |
| ASA score, mean ± SD      | 2.6 ± 0.7     | 2.6 ± 0.7  | 2.5 ± 0.6    | 2.7 ± 0.7   | 2.5 ± 0.7   | 0.16    | 0.018    | 0.000 to 0.051 |
| Anesthesia                |               |            |              |             |             |         |          |             |
| Spinal                    | 217 (76.7)    | 53 (69.7)  | 62 (74.7)    | 65 (82.3)   | 37 (82.2)   | 0.22    | 0.124    | 0.000 to 0.243 |
| General                   | 66 (23.3)     | 23 (30.3)  | 21 (25.3)    | 14 (17.7)   | 8 (17.8)    |         |          |             |
| Pain rating               |               |            |              |             |             |         |          |             |
| No pain                   | 203 (72.2)    | 51 (67.1)  | 60 (73.2)    | 53 (73.1)   | 35 (77.8)   | 0.63    | 0.079    | 0.000 to 0.193 |
| Pain present              | 78 (27.8)     | 25 (32.9)  | 22 (26.8)    | 21 (26.9)   | 10 (22.2)   |         |          |             |
| Surgeon                   |               |            |              |             |             |         |          |             |
| A                         | 66 (23.3)     | 15 (19.7)  | 24 (28.9)    | 17 (21.5)   | 10 (22.2)   | 0.54    | 0.113    | 0.000 to 0.173 |
| B                         | 31 (11.0)     | 12 (15.8)  | 7 (8.4)      | 7 (8.9)     | 5 (11.1)    |         |          |             |
| C                         | 63 (22.3)     | 13 (17.1)  | 15 (18.1)    | 22 (27.8)   | 13 (28.9)   |         |          |             |
| D                         | 60 (21.2)     | 14 (18.4)  | 18 (21.7)    | 18 (22.8)   | 10 (22.2)   |         |          |             |
| E                         | 63 (22.3)     | 22 (28.9)  | 19 (22.9)    | 15 (19.0)   | 7 (15.6)    |         |          |             |
| Pain medication           |               |            |              |             |             |         |          |             |
| Oxycodone 10 mg           | 222 (86.0)    | 52 (78.8)  | 72 (91.1)    | 61 (84.7)   | 37 (90.2)   | 0.15    | 0.143    | 0.000 to 0.267 |
| Oxycodone 5 mg            | 36 (14.0)     | 14 (21.2)  | 7 (9.9)      | 11 (15.3)   | 4 (9.8)     |         |          |             |
| Complications             |               |            |              |             |             |         |          |             |
| No                        | 277 (97.9)    | 72 (94.7)  | 82 (98.8)    | 79 (100)    | 44 (97.8)   | 0.10    | 0.142    | 0.000 to 0.260 |
| Yes                       | 6 (2.1)       | 4 (5.3)    | 1 (1.2)      | 0 (0.0)     | 1 (2.2)     |         |          |             |
| Discharge                 |               |            |              |             |             |         |          |             |
| Home                      | 275 (97.2)    | 73 (96.1)  | 82 (98.8)    | 75 (94.9)   | 45 (100)    | 0.33    | 0.117    | 0.000 to 0.235 |
| Other                     | 8 (2.8)       | 3 (3.9)    | 1 (1.2)      | 4 (5.1)     | 0 (0.0)     |         |          |             |
| Discharge support         |               |            |              |             |             |         |          |             |
| Family members            | 251 (88.7)    | 66 (86.8)  | 78 (94.0)    | 70 (88.6)   | 37 (82.2)   | 0.22    | 0.125    | 0.000 to 0.243 |
| Nonfamily                 | 32 (11.3)     | 10 (13.2)  | 5 (6.0)      | 9 (11.4)    | 8 (17.8)    |         |          |             |
| Length of stay, mean ± SD | 3.5 ± 1.2     | 3.9 ± 1.3‡ | 3.4 ± 1.0‡   | 3.5 ± 1.2‡  | 2.7 ± 1.1¶  | < 0.001 | 0.093    | 0.023 to 0.154 |

ASA = American Society of Anesthesiologists physical status classification; BMI = body mass index; CCI = Charlson Comorbidity Index; CI = confidence interval; $\eta^2/V$ = partial eta-squared measure of effect size for analysis of variance; OA = osteoarthritis; RA = rheumatoid arthritis; SD = standard deviation; THA = total hip arthroplasty; TKA = total knee arthroplasty; $V$ = Cramér $V$ (a measure of effect size for 2 nominal variables).

*Unless indicated otherwise.

†Means with differing footnote symbols were significantly different at $p < 0.05$, calculated using Tukey post-hoc comparisons. For reference, the CIHI median length of stay is 3 days for both primary THA and TKA (2017–2018).21
mobilization is expected considering the priority placed on the timely but safe discharge of patients who undergo elective TJA from busy orthopedic units. This study delineated the incremental but significant differences in length of stay by degrees of mobilization, which have some clinical relevance.

The hierarchical regression accounted for a small but significant 2.1% incremental variance ($\Delta R^2 = 0.021, p = 0.006$) beyond the block 1 variables in the prediction of length of stay. With mobilization added, only female sex, higher BMI, higher ASA score and more pain/stiffness remained significant predictors of longer length of stay, and the predictive ability of several of the block 1 variables was reduced to nonsignificant levels. Mobilization emerged as a significant predictor of length of stay, with farther mobilization contributing to shorter length of stay.

**DISCUSSION**

Previous research has established that mobilization on POD0 is linked to shorter hospital stays. In this study, we investigated whether incremental increases in mobilization on POD0 for patients who underwent THA or TKA resulted in shorter length of stay. This study confirms and extends past findings by showing that patients who mobilized farther on POD0 had a shorter length of stay. Patients who walked in the hall had a significantly shorter length of stay than all other groups, and there were no significant differences in complication rates across the mobilization groups. The lack of significant difference in length of stay between patients who stood by the bed group and those who walked in the room suggests there is little to differentiate these 2 degrees of mobilization. The overall finding of the significant association between length of stay and farther mobilization is expected considering the priority placed on the timely but safe discharge of patients who undergo elective TJA from busy orthopedic units. This study delineated the incremental but significant differences in length of stay by degrees of mobilization, which have some clinical relevance.

The hierarchical regression

### Table 2. Patient-reported symptoms recorded by physiotherapists

| Variable               | Total n = 263 | Set n = 76 | Stood n = 83 | Room n = 79 | Hall n = 45 | p value | V | 95% CI |
|------------------------|---------------|------------|--------------|-------------|-------------|---------|---|-------|
| Pain/stiffness         | 85 (30.0)     | 24 (31.6)  | 23 (27.7)    | 24 (30.4)   | 14 (31.1)   | 0.96    | 0.034 | 0.000 to 0.123 |
| Nausea                 | 73 (25.8)     | 34 (44.7)  | 21 (25.3)    | 13 (16.5)   | 5 (11.1)    | < 0.001 | 0.285 | 0.183 to 0.404 |
| Numbness               | 79 (27.9)     | 23 (30.3)  | 28 (33.7)    | 14 (17.7)   | 14 (31.1)   | 0.12    | 0.145 | 0.000 to 0.263 |
| Lightheadedness        | 59 (20.8)     | 21 (27.6)  | 18 (21.7)    | 15 (19.0)   | 5 (11.1)    | 0.18    | 0.131 | 0.000 to 0.250 |
| Drowsiness             | 25 (8.8)      | 17 (22.4)  | 7 (8.4)      | 1 (1.3)     | 0 (0.0)     | < 0.001 | 0.310 | 0.207 to 0.430 |

CI = confidence interval; V = Cramér V (a measure of effect size for 2 nominal variables).

### Table 3. Summary of simultaneous regression predicting greater mobilization*

| Variable     | B   | SE  | p value | $\beta$   | 95% CI |
|--------------|-----|-----|---------|-----------|-------|
| Age          | -0.024 | 0.010 | 0.016 | -0.212 | -0.043 to -0.005 |
| Sex          | -0.253 | 0.117 | 0.032 | -0.121 | -0.484 to -0.023 |
| BMI          | -0.019 | 0.009 | 0.030 | -0.136 | -0.036 to -0.002 |
| CCI score    | 0.038 | 0.063 | 0.54   | 0.053   | -0.085 to 0.162 |
| ASA score    | 0.057 | 0.094 | 0.55   | 0.037   | -0.129 to 0.243 |
| Anesthesia   | 0.325 | 0.142 | 0.022 | 0.133   | 0.048 to 0.604 |
| Pain/stiffness| -0.127 | 0.130 | 0.33   | -0.056 | -0.363 to 0.130 |
| Nausea       | -0.511 | 0.135 | < 0.001 | -0.215 | -0.777 to -0.244 |
| Numbness     | -0.450 | 0.131 | 0.001 | -0.195 | -0.709 to -0.191 |
| Lightheadedness| -0.315 | 0.140 | 0.025 | -0.124 | -0.592 to -0.039 |
| Drowsiness   | -0.855 | 0.211 | < 0.001 | -0.234 | -1.270 to -0.441 |

$R^2 = 0.232$

F = 7.462

p value < 0.001

ASA = American Society of Anesthesiologists physical status classification; BMI = body mass index; CCI = Charlson Comorbidity Index; CI = confidence interval; SE = standard error.

*The analysis was based on data for the 283 patients in the final sample. Sex was coded as 0 = male, 1 = female. Anesthesia was coded as 0 = general, 1 = spinal. Patient-reported symptoms were coded as 0 = no, 1 = yes.
between BMI and length of stay has been described with patients at the extreme ends of the BMI range reportedly having longer hospital stays.10 Our findings show that higher BMI was predictive of longer length of stay, but overall the evidence in the literature is mixed, because disparate methodologies, mobilization protocols and patient populations make direct comparisons challenging.3

The finding that pain/stiffness predicted longer length of stay suggests that patients who could not ambulate as far on POD0 because of pain control issues were then limited in their ability to “get ahead and stay ahead” of their recovery as described by Sculco and Pagnano.27 This concept highlights the importance of identifying and managing impediments to early mobilization and discharge in support of the well-patient model; a patient medically cleared for hip or knee arthroplasty should not become a “sick patient” as a result of their surgery.27

A key finding of the present paper is that farther mobilization on POD0 emerged as a significant predictor of length of stay: the greater the distance patients mobilized, the shorter their length of stay. Given this finding, it is important to determine which factors drive the extent of mobilization that occurs on the day of surgery. In the present study, predictors of farther mobilization included male sex, lower BMI, younger age, spinal anesthesia, and less nausea, numbness, lightheadedness and drowsiness.

The explanation for the relationship between sex and BMI on the one hand and mobilization on the other is probably similar to that offered for predictors of length of stay, as discussed earlier. Age was a significant predictor of mobilization but not length of stay, although in the hierarchical regression modelling of length of stay, age was predictive of length of stay in block 1 but was just outside of significance in the final block. Further research may be needed to further explore how age relates to these 2 outcomes.

Type of anesthesia did not predict length of stay but spinal anesthesia was predictive of farther mobilization. This suggests that the effect of general versus spinal anesthesia was more pronounced on POD0, with general anesthesia limiting patients’ mobilization. Over subsequent days the difference diminished, lessening the predictive ability of anesthesia type on length of stay. Specifically, the factors associated with mobilization related to patient status on POD0, whereas factors associated with length of stay covered an average of 3.5 days (range 2.7 to 3.9 days). This narrower versus wider time frame may explain some of the similarities and differences in the predictive variables of length of stay and mobilization.

| Table 4. Summary of hierarchical regression predicting greater length of stay* |
|---------------------------------|---------|---------|---------|---------|---------|
| Variable                        | B       | SE      | p value | β       | 95% CI   |
| Block 1                         |         |         |         |         |         |
| Age                             | 0.026   | 0.012   | 0.024   | 0.198   | 0.003 to 0.049 |
| Sex                             | 0.442   | 0.139   | 0.002   | 0.178   | 0.169 to 0.715 |
| BMI                             | 0.026   | 0.010   | 0.111   | 0.159   | 0.006 to 0.047 |
| CCI                             | 0.088   | 0.074   | 0.24    | 0.104   | –0.058 to 0.235 |
| ASA                             | 0.299   | 0.112   | 0.008   | 0.165   | 0.079 to 0.519 |
| Anesthesia                      | –0.170  | 0.168   | 0.31    | –0.059  | –0.500 to 0.160 |
| Pain/stiffness                  | 0.398   | 0.154   | 0.010   | 0.149   | 0.094 to 0.702 |
| Nausea                          | 0.205   | 0.160   | 0.201   | 0.073   | –0.110 to 0.521 |
| Numbness                        | 0.386   | 0.155   | 0.014   | 0.141   | 0.080 to 0.692 |
| Lightheadedness                 | 0.045   | 0.166   | 0.79    | 0.015   | –0.282 to 0.372 |
| Drowsiness                      | 0.299   | 0.249   | 0.23    | 0.069   | –0.192 to 0.790 |
| R²                              | 0.228   |         |         |         |         |
| F                               | 7.281   |         |         |         |         |
| p value                         | < 0.001 |         |         |         |         |
| Block 2                         |         |         |         |         |         |
| Age                             | 0.022   | 0.012   | 0.06    | 0.163   | –0.001 to 0.044 |
| Sex                             | 0.392   | 0.138   | 0.005   | 0.158   | 0.120 to 0.664 |
| BMI                             | 0.023   | 0.010   | 0.29    | 0.137   | 0.002 to 0.043 |
| CCI score                       | 0.096   | 0.073   | 0.19    | 0.113   | –0.049 to 0.240 |
| ASA score                       | 0.310   | 0.110   | 0.005   | 0.172   | 0.093 to 0.527 |
| Anesthesia                      | –0.107  | 0.167   | 0.52    | –0.037  | –0.436 to 0.223 |
| Pain/stiffness                  | 0.373   | 0.153   | 0.015   | 0.140   | –0.072 to 0.674 |
| Nausea                          | 0.106   | 0.162   | 0.52    | 0.008   | –0.214 to 0.425 |
| Numbness                        | 0.298   | 0.157   | 0.06    | 0.109   | –0.011 to 0.607 |
| Lightheadedness                 | –0.016  | 0.166   | 0.92    | –0.005  | –0.343 to 0.310 |
| Drowsiness                      | 0.132   | 0.254   | 0.60    | 0.031   | –0.368 to 0.632 |
| Degree of mobilization          | –0.196  | 0.071   | 0.006   | –0.166  | –0.335 to –0.056 |
| R²                              | 0.249   |         |         |         |         |
| ∆F                             | 7.575   |         |         |         |         |
| p value                         | 0.006   |         |         |         |         |

ASA = American Society of Anesthesiologists physical status classification; BMI = body mass index; CCI = Charlson Comorbidity Index; CI = confidence interval; SE = standard error.

*The analysis was based on data for the 283 patients in the final sample. Sex was coded as 0 = male, 1 = female. Anesthesia was coded as 0 = general, 1 = spinal. Patient-reported symptoms were coded as 0 = no, 1 = yes.

ASA = American Society of Anesthesiologists physical status classification; BMI = body mass index; CCI = Charlson Comorbidity Index; CI = confidence interval; SE = standard error.
reported that postoperative nausea and vomiting is a greater risk for females, patients with a history of motion sickness or previous postoperative nausea and vomiting, nonsmokers, and patients with postoperative opioid use. The incidence of postoperative nausea and vomiting ranges from 10% with zero risk factors present to 21% with 2 risk factors, 39% for 3 and 79% for 4. A preoperative nausea screening protocol and treatment algorithm has been recommended to identify those patients at greater risk for postoperative nausea and vomiting who could be treated prophylactically, which would allow these patients to mobilize sooner, leading to decreased length of stay and greater overall patient satisfaction. The ASA practice guidelines state that antiemetics may be preoperatively administered to patients with increased risk of postoperative nausea and vomiting but routine preoperative administration of antiemetics is not recommended. Some enhanced recovery after surgery protocols recommend that patients with a moderate risk of postoperative nausea and vomiting (i.e., those with 2 risk factors) should receive prophylaxis with dexamethasone at induction or a serotonin receptor antagonist at the end of surgery, whereas high-risk patients (those with 3 or 4 risk factors) should receive dexamethasone at the beginning of surgery and a serotonin receptor antagonist at the end of surgery.

Numbness is a symptom that can result from spinal anesthesia or from superficial nerve dissection for which time is the only remedy. There was no significant difference in numbness across the mobilization groups and it was predictive of farther mobilization. Interestingly, 31% of patients who walked in the hall reported numbness, but this group was still able to mobilize the farthest. Pre- and perioperative patient education about postoperative numbness could lessen potential anxiety about the symptom. Patients could become more comfortable if they knew that after a physiotherapist had thoroughly assessed their motor control, they could safely mobilize with the assistance of their physiotherapist and walking aids even if they were experiencing numbness.

Symptoms of lightheadedness and drowsiness can result from general anesthesia and are also side effects of opioid pain medication. To combat postoperative lightheadedness, a continued focus on allowing clear liquids up to 2 hours before surgery is recommended; this recommendation follows ASA guidelines. Fluid restriction from midnight until the time of surgery had been prescribed to reduce the risk of pulmonary aspiration but the unintended consequence was that it may have contributed to dehydration, which in turn can affect pain thresholds and recovery from anesthesia. Guidelines for fluid intake before surgery should be reviewed and highlighted with patients scheduled to undergo elective TJA, in preoperative education sessions. Multimodal analgesia is also favoured because it improves perioperative pain control, decreasing opioid use and the attendant side effects that can occur such as drowsiness and nausea.

**Limitations**

The main limitation of our study is the use of retrospective data. Potential inaccuracies in the recording of procedures and a lack of detailed clinical information are concerns. Although most of the study variables were recorded during the intraoperative period, we had no way to ascertain whether certain events such as complications within 30 days of surgery might have occurred but were not captured in the health record because patients may have presented to a hospital or a physician outside of the study hospital’s catchment area. All clinic follow-up reports were reviewed for any mention of adverse events occurring within 30 days of surgery and patients’ electronic medical records were reviewed for any visits to the emergency department or any tests or radiography that might indicate a complication within 30 days. A future study of degree of mobilization on POD0 could prospectively recruit patients with a postoperative surveillance period beyond 30 days and include other complications such as aseptic loosening and dislocation requiring revision, as well as patient satisfaction, which is another key TJA metric.

**Conclusion**

In this study, patients who mobilized incrementally farther on the day of surgery had a shorter length of stay with no increase in complication rates. Predictors of farther mobilization include younger age, male sex, lower BMI, spinal anesthesia, and fewer symptoms that inhibit mobilization such as nausea, numbness, lightheadedness and drowsiness. Shorter length of stay was predicted by male sex, lower BMI, lower ASA score, less pain/stiffness and farther mobilization on the day of surgery. Understanding the modifiable and nonmodifiable predictors of TJA mobilization and length of stay can help identify patients more likely to mobilize farther, which would in turn contribute to better resource allocation and discharge planning. Focusing on symptom management could increase opportunities for farther mobilization on the day of surgery and thereby decrease length of stay. Additional research is needed to determine the optimal balance between pain control and the management of symptoms that can limit mobilization on the day of surgery such as nausea, lightheadedness and drowsiness.

**Acknowledgement:** A research grant was received from the Atlantic Provinces Orthopaedic Society.

**Affiliations:** The Moncton Hospital, Horizon Health Network, Moncton, N.B. (Gautreau, Haley, Gould, Mann, Forsythe); Mount Allison University, Sackville, N.B. (Gould); Research Services, Horizon Health Network, Moncton, N.B. (Canal).
1. Guerra ML, Singh PJ, Taylor NF. Early mobilization of patients who have had a hip or knee joint replacement reduces length of stay in hospital: a systematic review. *Clin Rehabil* 2015;29:844-54.

2. Labraca NS, Castro-Sánchez AM, Matarán-Peñaarrocha GA, et al. Benefits of starting rehabilitation within 24 hours of primary total knee arthroplasty: randomized clinical trial. *Clin Rehabil* 2011;25:557-66.

3. Masaracchio M, Hanney WJ, Liu X, et al. Timing of rehabilitation on length of stay and cost in patients with hip or knee joint arthroplasty: a systematic review with meta-analysis. *PLoS One* 2017;12:e0178295.

4. Henderson KG, Wallis JA, Snowdon DA. Active physiotherapy interventions following total knee arthroplasty in the hospital and inpatient rehabilitation settings: a systematic review and meta-analysis. *Physiotherapy* 2017;104:25-35.

5. Pagnotta G, Rich E, Eckardt P, et al. The effect of a rapid rehabilitation program on patients undergoing unilateral total knee arthroplasty. *Ortopb Nurs* 2017;36:112-21.

6. Raphael M, Jaeger M, Van Vlymen J. Easily adoptable total joint arthroplasty program allows discharge home in two days. *Can J Anaesth* 2011;58:902-10.

7. Gulotta LV, Padgett DE, Sculco TP, et al. Fast track THR: one hospital’s experience with a 2-day length of stay protocol for total hip replacement. *HSS J* 2011;7:223-8.

8. Larsen K, Sørensen OG, Hansen TB, et al. Accelerated perioperative care and rehabilitation intervention for hip and knee replacement is effective: a randomized clinical trial involving 87 patients with 3 months of follow-up. *Acta Orthop* 2008;79:149-59.

9. Gwynne-Jones DP, Martin G, Crane C. Enhanced recovery after surgery. *HSS J* 2011;7:223-8.

10. Sibia US, MacDonald JH, King PJ. Predictors of hospital length of stay in an enhanced recovery after surgery program for primary total hip arthroplasty. *J Arthroplasty* 2016;31:2227-30.

11. Maempel JF, Walmsley PJ. Enhanced recovery programmes can reduce length of stay after total knee replacement without sacrificing functional outcomes following total hip arthroplasty. *HSS J* 2011;7:16-20.

12. Juliano K, Edwards D, Spinello D, et al. Initiating physical therapy on the day of surgery decreases length of stay without compromising functional outcomes following total hip arthroplasty. *HSS J* 2011;7:16-20.

13. Gnanakumaran S, Li F, White M, et al. The effect of early mobility in patients after total knee replacement on hospital length of stay, pain and function: a randomised control trial. *Physiother Pract Res* 2017;38:121-5.

14. Soffin EM, Yadeau JT. Enhanced recovery after surgery for primary total hip arthroplasty facilitate early discharge. *Am J Orthop* 2016;45:E337-42.

15. Turnbull ZA, Sastow D, Giambrone GP, et al. Anesthesia for the patient undergoing total knee replacement: current status and future prospects. *Local Reg Anesth* 2017;8:1-7.