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Original Article

The Association Between Pain and In-Hospital Complications and Duration of Stay After Colorectal Surgery

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ABSTRACT

Background: Pain is a subjective and multidimensional experience often inadequately managed following surgery. Postoperative pain has been shown to correlate with hospital length of stay (HLOS) and hospital complications. Given advancements in preemptive pain management approaches, reevaluation is necessary.
Aims: The purpose of this study was to examine the association between postoperative pain intensity and HLOS and in-hospital complications among patients who underwent colorectal surgery, adjusted by sociodemographic and underlying medical variables.
Setting and Patients: We used electronic medical records. Data were collected from patients who underwent colorectal surgery at a large general hospital in Israel from January 2012 to December 2018.
Design and Methods: This is a retrospective cohort study. Information on HLOS, medical diagnoses, pain intensity, use of analgesics, postoperative infections, patient sociodemographic data, chronic diseases, functionality status, and source of admission were extracted from medical records. Logistic regression analysis was used for the final model, and HLOS and in-hospital complications were the major outcomes.
Results: We enrolled 1,073 patients. Of them, 554 males (51.6%) with a mean age of 62.54 ± 16.55 years. The median postoperative pain score was 1.54 (interquartile range, 0.84; 2.16), and an in-hospital complication rate of 1.3% (n = 14). Postoperative pain was not associated with prolonged HLOS with adjustment to relevant independent variables (odds ratio, 1.399; 95% confidence interval, 0.759-2.578; $p = .282$). Contrarily, age, malignancy, assistance needed in activities of daily living, use of analgesic agents, and postoperative infection were risk factors for prolonged HLOS. Additionally, postoperative pain was not related to a higher risk of in-hospital complications.
Conclusions: Pain intensity post colorectal surgery was not a risk factor for extended HLOS or in-hospital complications. In contradistinction, tending to patient needs, adequate analgesic use, and reducing infection rates can shorten HLOS, improve health outcomes, and economize health care resources.

Introduction

Pain is an unpleasant sensory and emotional experience associated with the threat of, or actual tissue damage. Pain is a subjective measure and can be manifested through verbal articulation or via several other means; the inability to verbalize does not invalidate the possibility of experiencing pain. The multidimensional phenomenon of pain may be manipulated by biological, psychological, and social factors (Raja et al., 2020). At present, the most reliable method of clinically assessing pain is through self-reporting (Hinkle & Cheever, 2017). Most patients endure moderate to severe pain during recovery from invasive surgery (Zhang et al., 2018). Keen awareness in patient care and available resources are crucial in practicing optimal postoperative pain management (Apfelbaum et al., 2003). In a comprehensive literature review, Vivian et al. uncovered four essential predictors of postoperative

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pain: preoperative pain, anxiety, patient age, and type of surgery (Hui Yun Vivian et al., 2009). An additional study from the Michigan Surgical Quality Collaborative collected data retrospectively from a network of 52 hospitals on 7,221 patients who underwent colorectal resection (Regenbogen et al., 2016). Using a linear pain scale from 0 (no pain) to 10 (worst pain ever), the average collective pain score 1 day postoperatively was 5.1 (Regenbogen et al., 2016). Furthermore, they found that reported pain intensity was conclusively higher among those younger than 50 years of age than those older than 75 years, among woman in contrast to men, and among African-Americans, smokers, patients with various comorbidities, and those underweight (body mass index <18.5) compared with overweight patients (body mass index 25-29.9). The study also revealed that hospitals wherein the collective average pain score was lower (4.5), patients were discharged from the hospital sooner than patients in hospitals where pain scores were higher (5.8; 6.5 vs. 7.9 days, respectively). The study revealed that patients who reported lower pain levels (in contrast to higher) were at a lower risk for developing subsequent complications (20.3% vs. 26.4%, respectively), return emergency department visits (8.2% vs. 15.8% respectively), hospital readmissions (11.3% vs. 16.2%, respectively), and contraction of pulmonary complications, including pneumonia and reintubation (3.2% vs. 6.6%, respectively). In a similar context, Sarin et al. implemented an Enhanced Recovery After Surgery program among patients who underwent colorectal abdominal surgery at Mount Zion Hospital of California. Their multidisciplinary iterative strategy was demonstrable for a decrease in hospital length of stay (HLOS), 30-day all-cause readmission rates, pain, opiate analgesic consumption, and postoperative nausea, and in turn, impelled timely resumption of bowel and bladder function (Sarin et al., 2016).

Colorectal surgery is an umbrella term referring to all surgical operations involving the small and large intestines. Malignancy is the most common morbidity requiring colorectal surgical intervention. Thereafter follows diverticulosis and inflammatory bowel disease (Krutsri et al., 2021).

In the context of subsequent health outcomes, potential complications following colorectal surgery are paralytic ileus, mechanical ileus, intra-abdominal infection, infection at site of surgical incision, malabsorption syndrome and electrolyte imbalance, and surgical wound dehiscence and evisceration (Kirchhoff et al., 2010; Veen et al., 2005). These potential adventitious circumstances conjoin with complications that can incur after any type of general surgery amounting to a plethora of unwanted possibilities; they are categorized as respiratory (pneumonia, atelectasis), insufficient ambulation (deep vein thrombosis [DVT], pulmonary embolism [PE]), cardiac and vascular complications, delirium, lethargy, weakness, constipation, urinary retention, and urinary tract infection. Diligent evaluation of incision site, vital signs, indicators of shock, bleeding, and infection are all integral clinical assessments postsurgically (Hinkle & Cheever, 2017).

With advancements in preemptive pain management approaches, we postulated adapting elements of the previously described literature and examining the impact on select patient outcomes in a large general hospital. The purpose of this study was to examine the association between postoperative pain intensity and HLOS and in-hospital complications among subject who underwent colorectal surgery.

Methods

Study Population and Data Extraction

In this retrospective cohort study, we reviewed the medical records of all patients who consecutively underwent colorectal surgery at a large general hospital in southern Israel from January 2012 to December 2018. The hospital is a tertiary care university facility and is the second largest hospital in Israel tending to a regional population of nearly one million residents. This study was approved by the institutional Ethics (Helsinki) Committee (approval # SOR-0136-18) and included subjects were hospitalized in surgical wards and were older than the age of 18 years. Data were collected from integrated hospital-community online medical records. The following variables were extracted for all subjects as relevant: HLOS, pain intensity prior to and postoperation, in-hospital postsurgery complications, chronic illnesses, functionality status, medical diagnoses at hospitalization, age, sex, marital and socioeconomic status, source of admission, use of analgesic agents, and onset of postsurgical infection.

Clinical Indicators

Colorectal surgery referred to medical diagnoses as itemized in Appendix 1. Chronic diseases pertained to the following classifications: heart disease, diabetes mellitus, hypertension, chronic obstructive pulmonary disease, history of cerebrovascular accident, inflammatory bowel disease, fibromyalgia, malignancy, migraines, arthropathy, prior trauma, back pain, and mental illness. Functionality status was determined based on the activities of daily living (ADL) assessment scale, ranking subjects as either independent, or in need of assistance. Age in years was recorded. Socioeconomic status included lower, middle, or upper class. Marital status included single, married, divorced, or widowed. Hospital admission source included home, nursing facility, or transfer from another hospital. Use of analgesic drugs prior to and postoperatively referred to the following agents included nonsteroidal anti-inflammatory drugs, opiates, dipyrone, others, or none administered. Postoperative infection was defined by the presence of at least one of the following parameters: white blood cell count >10,800 or <4,800 cells per mm, body temperature >38.0°C, or positive bacterial cultures of specimens obtained from blood, urine, phlegm, or surgical incision.

Pain Measurement

Using the visual analog scale (VAS) to assess pain intensity, subjects were divided into three groups classified as: mild pain (VAS = 0-3), moderate pain (VAS = 4-6), and severe pain (VAS = 7-10). Our meticulously considered decision to group no pain (VAS = 0) with mild pain (VAS 1-3) stemmed from similarly structuralized published research (Nagaraja et al., 2018), as well as the hospital's postoperative pain management protocol, wherein pharmacological pain intervention is highly encouraged to patients from a VAS score of ≥4. Notwithstanding, analgesics are available and routinely administered to patients after surgery, irrelevant of reported pain score at carefully monitored time points. The preemptive pain management protocol includes adjunctive treatments of intravenous paracetamol, subcutaneous morphine, and oral pregabalin among a medley of other medications as elaborated in Appendix 2. Primary outcomes were (1) in-hospital complications referred to pneumonia, atelectasis, DVT, or PE, and (2) HLOS was measured in days.

Statistical Analyses

For analyzation we used the Student's t test for continuous variables (age) and the χ^2 test for categorical variables (sociodemographic characteristics, chronic illnesses, functionality status, source of admission, use of analgesics, pain intensity before and after surgery, onset of postoperative infection, in-hospital complica-

Table 1
Sociodemographic and Clinical Characteristics: Comparison Between Mild and Moderate Pain

Characteristics	VAS 0-3 Mild Pain n = 1,006 (93.8%)	VAS 4-6 Moderate Pain n = 58 (5.4%)	*p*
Age (y), mean ± SD	63.11 ± 16.36	51.93 ± 17.12	<.001
Sex			
Male	519 (51.6)	30 (51.7)	.984
Female	487 (48.4)	28 (48.3)	
Chronic diseases			
Heart disease	105 (10.5)	3 (5.3)	.206
Type 2 diabetes mellitus	235 (23.5)	14 (24.6)	.848
Hypertension	437 (43.6)	11 (19.3)	<.001
COPD	14 (1.4)	0 (0)	1.0
History of CVA	41 (4.1)	2 (3.5)	1.0
IBD	31 (3.1)	4 (7)	.114
Fibromyalgia	10 (1.0)	1 (1.8)	.458
Malignancy	616 (61.5)	23 (40.4)	.002
Migraine	13 (1.3)	1 (1.8)	.541
Arthropathy	110 (11.0)	6 (10.5)	.915
Prior trauma	32 (3.2)	1 (1.8)	1.0
Back pain	131 (13.1)	8 (14.0)	.834
Mental illness	108 (10.8)	7 (12.3)	.723
ADL			
Requires no assistance	857 (87.6)	54 (93.1)	.214
Assistance needed	121 (12.4)	4 (6.9)	
Socioeconomic class			
Low	457 (63.2)	21 (56.8)	.512
Middle	220 (30.4)	12 (32.4)	
High	46 (6.4)	4 (10.8)	
Source of admission			
Home	948 (97)	57 (98.3)	.820
Nursing institution	25 (2.6)	1 (1.7)	
Other hospital	4 (0.4)	0 (0)	
Use of analgesics before surgery			
NSAIDs	78 (8.3)	3 (5.6)	.615
Opiates	125 (13.3)	11 (20.4)	.141
Dipyrone	71 (7.6)	3 (5.6)	.791
Other pain medication	30 (3.2)	1 (1.9)	1.0
Did not use pain medication	732 (77.9)	41 (75.9)	.738
Use of analgesics after surgery			
NSAIDs	516 (52.3)	33 (56.9)	.494
Opiates	900 (91.2)	54 (93.1)	.615
Dipyrone	468 (47.4)	27 (46.6)	.898
Other pain medication	144 (14.6)	10 (17.2)	.580
Did not use pain medication	38 (3.9)	1 (1.7)	.719
VAS before surgery			
Mild pain 0-3	961 (96.8)	50 (87.7)	<.001
Moderate pain 4-6	26 (2.6)	7 (12.3)	
Severe pain 7-10	6 (0.6)	0 (0)	
Infection[a]	161 (16)	8 (13.8)	.654
HLOS (d)[b]			
Short	548 (54.5)	31 (53.4)	.879
Long	458 (45.5)	27 (46.6)	
Complications[c]	14 (1.4)	0 (0)	1.0

ADL = activities of daily living; COPD = chronic obstructive pulmonary disease; CVA = cerebrovascular accident; HLOS = hospital length of stay; IBD = inflammatory bowel disease; NSAIDs = nonsteroidal anti-inflammatory drugs; SD = standard deviation; VAS = visual analogue scale.

[a] Infection is defined as abnormal white blood cell count with fever or positive culture.

[b] HLOS (d) after surgery. Short length are values are ≤5 and long length are values >5.

[c] Complications are pneumonia, atelectasis, deep vein thrombosis, or pulmonary embolism.

tions). Categorical variables were expressed as a number and percentage (%), and continuous variables were expressed as a mean ± standard deviation, or median (interquartile range [IQR]) if non-normality distribution. Using the Shapiro-Wilk test we determined that HLOS and postoperative VAS scores were not consistent with a normal distribution. The odds ratios (OR) and their corresponding 95% confidence intervals (95% CI) were calculated for outcomes. Spearman correlation was used to measure the strength of association between two variables as well as the direction of the relationship. Parameters were assessed and a multivariable logistic regression was performed with HLOS, and in-hospital complications as dependent variables tested as binaries. Statistical analyses were performed using IBM SPSS version 26. Values of *p* less than .05 were considered statistically significant.

Results

As shown in Table 1, of 1,073 patients who underwent colorectal surgery from January 2012 to December 2018: 554 (51.6%) were male and 519 (48.4%) were female, all at a mean age of 62.54±16.55 years. Six hundred forty-three (59.9%) of the participants had prior diagnosed malignancy and 915 (85.3%) needed no assistance with ADL. One thousand six (93.8%) subjects reported mild pain (VAS 0-3) postsurgery and 58 (5.4%) reported moderate

Table 2
Univariate and Multivariate Logistic Regression Analysis on HLOS Predictors

	OR	*p*	95% CI Lower-Upper	Adjustment OR	*p*	95% CI Lower-Upper
Age	1.015	<.001	1.008-1.023	1.015	.008	1.004-1.026
Male	1.314	.027	1.032-1.672	1.274	.089	0.964-1.684
Chronic diseases						
Malignancy	1.789	<.001	1.392-2.299	1.570	.005	1.146-2.150
Hypertension	1.195	.152	0.936-1.525	1.076	.654	0.782-1.480
ADL: Assistance needed	2.579	<.001	1.747-3.807	2.015	.003	1.263-3.215
Use of analgesics after surgery						
NSAIDs	2.058	<.001	1.607-2.635	1.589	.002	1.192-2.119
Opiates	4.695	<.001	2.702-8.159	3.042	.005	1.391-6.653
Dipyrone	1.827	<.001	1.429-2.336	1.676	<.001	1.264-2.222
Did not use pain medication	0.089	<.001	0.027-0.290	0.473	.330	0.105-2.135
VAS before surgery[a]						
Moderate pain 4-6	1.676	.149	0.831-3.379	1.305	.563	0.529-3.219
Severe pain 7-10	0.926	.920	0.206-4.158	1.747	.511	0.331-9.213
VAS after surgery[a]						
Moderate pain 4-6	1.042	.879	0.613-1.772	1.399	.282	0.759-2.578
Infection[b]	10.073	<.001	6.409-15.833	8.900	<.001	5.375-14.738
Complications[c]	4.496	.022	1.247-16.209	2.917	.141	0.700-12.148

ADL = activities of daily living; CI = confidence interval; HLOS = hospital length of stay; NSAIDs = nonsteroidal anti-inflammatory drugs; OR = odds ratio; VAS = visual analogue scale.
[a] VAS before and after surgery is the reference group with "mild pain 0-3."
[b] Infections are defined as abnormal white blood cell count with fever or positive culture. [c]Complications are pneumonia, atelectasis, deep vein thrombosis, or pulmonary embolism.

pain levels (VAS 4-6). No subjects accounted for severe postsurgical pain (VAS 7-10). The median VAS score reported postoperatively was 1.54 (IQR 0.84-2.16). The median HLOS was 5 days postsurgery (IQR 4-8) and more than half of patients were discharged from the hospital within 5 days postsurgery (54.7%). Because no subjects reported severe pain (VAS 7-10) post colorectal surgery, we resulted in two study groups as opposed to our hypothesized three: group 1 with mild pain (VAS 0-3); group 2 with moderate pain (VAS 4-6). We found that on average, patients in group 2 were of a younger age than those in group 1 ($p < .001$, 51.93 vs. 63.11 years, respectively). Hypertension and malignancy were more prevalent among group 1 than in group 2 ($p < .001$). Additionally, 96.8% of the subjects who reported mild postoperative pain parallelly attested to mild pain preoperatively ($p < .001$). Nonetheless, Spearman R-test found no correlation between preoperative and postoperative pain.

HLOS

We defined short HLOS ≤5 days (median). Hospitalization surpassing 5 days was considered extended HLOS. In reference to age, we established that long HLOS was associated with older subjects in contrast to short HLOS ($p < .001$, 64.75 vs. 60.72, respectively). Furthermore, we found that more women were in the short HLOS study population ($p = .027$) than long HLOS. Malignancy and assistance needed in ADL significantly correlated with prolonged HLOS ($p < .001$). However, based on Spearman rank coefficients, no correlation was found between pain intensity post colorectal surgery and HLOS ($p = .332$, R = 0.03). We tested if postoperative pain was a risk factor for prolonged HLOS when divided into groups (median 1.54) based on pain intensity and, even after stratification, no statistical significance was present. Contrarily, our findings revealed that onset of infection consequently resulted in prolonged HLOS ($p < .001$, 41% vs. 30%), raised in-hospital complications ($p = .012$, 0.5% vs. 2.3%), and increased use of analgesics pre- and postoperatively ($p < .05$). Of the above correlations, Spearman's R test only confirmed a moderate reciprocal relationship between age and hypertension ($p < .001$, R = 0.494); all other correlations were of R below 0.7.

Table 2 presents the final model of univariate and multivariate regression analysis on HLOS predictors. As shown, age, malignancy, assistance needed in ADL, analgesic use, and postsurgical onset of infection were demonstrable for statistically significant risk factors of extended HLOS ($p < .01$). In contradistinction, postoperative pain had no impact on HLOS when tested as the dependent dichotomous variable for analysis (OR, 1.399; 95% CI, 0.759-2.578; $p = .282$). Moreover, we examined the association of HLOS and postoperative pain among patients who received opiate analgesics using multivariate and univariate regression models. In this context, results exposed that postoperative pain intensity was not a risk factor for extended HLOS after adjustment of independent variables. Additionally, we explored the association between postoperative pain and HLOS measured by coefficient of variation adjusted by independent variables, and again, no statistical significance was revealed.

In the final model of multivariate logistic regression analysis on postsurgery complications predictors we tested the association of postsurgical pain, stratified by mild pain and moderate pain, on in-hospital complications (Table 3). Pain was not found to increase probability of postoperative complications (reference = group 1). Here too, we measured coefficient of variation of pain on clinical complications and even after adjustment of independent variables no statistical significance was present. Opiate medication consumption postsurgery was discarded from the final model as all patients who contracted complications concurrently consumed opiates.

Discussion

In this study we explored the association between intensity of pain after colorectal surgery and HLOS. Based on the results, postoperative pain did not serve as a risk factor for extended hospital stay as we had hypothesized it would, nor as results obtained in previously documented studies have demonstrated.

Furthermore, the present study revealed that postoperative pain does not increase the probability of contracting in-hospital complications such as pneumonia, atelectasis, DVT, or PE. Our study used a relatively large cohort of subjects rendering the findings of reliability.

Generally, invasive surgery is recognized as causing patients to endure substantial pain that requires efficient and timely interven-

Table 3
Univariate and Multivariate Logistic Regression Analysis on Postsurgery Complications Predictors

	OR	*p*	95% CI Lower-Upper	Adjustment OR	*p*	95% CI Lower-Upper
Age (y)	1.007	.690	0.974-1.040	1.005	.813	0.963-1.049
Male	1.252	.679	0.432-3.634	1.148	.803	0.388-3.398
Chronic diseases						
Malignancy	4.013	.070	0.894-18.020	2.913	.185	0.599-14.166
Hypertension	0.750	.609	0.250-2.254	0.647	.478	0.194-2.157
ADL: Assistance needed	0.548	.564	0.071-4.227	0.382	.381	0.044-3.293
Use of analgesics after surgery						
NSAIDs	0.916	.871	0.319-2.631	0.657	.480	0.204-2.108
Dipyrone	4.128	.030	1.145-14.883	3.230	.077	0.879-11.870
VAS after surgery[a]						
Moderate pain 4-6	1	.997	-	1	.997	-
Infection[b]	3.012	.051	0.997-9.100	2.616	.137	0.737-9.280
HLOS (d): Long[c]	4.496	.022	1.247-16.209	2.924	.120	0.756-11.317

ADL = activities of daily living; CI = confidence interval; HLOS = hospital length of stay; OR = odds ratio; NSAIDs = nonsteroidal anti-inflammatory drugs; VAS = visual analogue scale.
[a] VAS after surgery is the reference group with "mild pain 0-3."
[b] Infection is defined as abnormal white blood cell count with fever or positive culture.
[c] HLOS (d) is after surgery. Short lengths are values ≤5 days.

tion conducive to reducing patient suffering and catalyzing recovery and rehabilitation; this clinically expected course of action is set in place to prevent subsequent complications. Efficacious pain management is a challenging endeavor, complexly involving not only physiological aspects, but also intertwining psychosocial considerations on an individual level, and shouldering a burden on inherent medical and economic benefits for the public at large. Postoperative pain management is not of only humanitarian value, diminishing patient suffering; adequately controlled pain lessens morbidity and mortality, shortens HLOS, and extricates superfluous health costs (Pogatzki-Zahn et al., 2017).

The present study used the VAS for pain assessment, a scale utilized widely across institutions. The method asks patients to rank their pain from 0 (no pain at all) to 10 (worst pain imaginable). Based on data obtained from 1,073 patients records we found that the median VAS score for patients who underwent colorectal surgery was 1.54 (IQR 0.84; 2.16), a value considered in clinical practice and in research literature to be notably low. Our study population was devoid of any subjects attesting to severe pain (VAS 7-10). Presumably, this effect was due to achievement of ideal administration of analgesics. Among the study population, 956 subjects (89.1%) received opiate analgesics postoperatively. This study population hospital has a rigid postoperative pain management protocol in which analgesics are administered preemptively at set time points after surgery. This policy was implemented to prevent patients from entering a state of acute pain (Appendix 2); waiting for a patient to report pain as an impetus to offer analgesics is considered subpar treatment. Patients experiencing only minimal pain are likely to exercise timely mobilization postoperatively.

A study conducted between 2015 and 2017 examining the association between postoperative pain and HLOS after knee-replacement surgery (Zhang et al., 2018) resulted in similar findings to the present study. There, extended HLOS was defined as exceeding 3 days. No significant difference was found between the average of collective pain scores within 1 day after surgery for those who were hospitalized for short HLOS (1.8 ± 0.7 days) versus those with extended HLOS (1.9 ± 0.8 days). Statistical significance was found only upwards of 3 days postoperatively wherein the collective average pain score was 1.1 ± 0.4 for short HLOS versus 1.3 ± 0.6 for long HLOS (Zhang et al., 2018).

In our study, we did not differentiate pain assessments 1 day postoperatively, rather, we synthesized all postoperative VAS assessment scores for each subject. In most cases, intense acute pain is imminent after surgery (Zhang et al., 2018). We were especially interested in exploring pain that transcended 1 day postoperation to infer its effect on HLOS. We therefore tested if the average of each patient's total VAS scores postoperatively would impact time of hospital discharge and subsequent state of health (the presence or absence of in-hospital complications).

Our study revealed significant risk factors for HLOS including age, malignancy, assistance needed in ADL, analgesic use, and onset of postsurgical infection. Statistical analyses uncovered that analgesic use (specifically of the opiate class), pre- and postoperatively, served as a significant risk factor for extended HLOS. Although opiates can potentiate effective pain reduction/obliteration, their adverse effects (nausea, vomiting, syncope, sedative effects, constipation, urinary retention, and apnea, among others) may account for increased hospitalization time (Kessler et al., 2013; Oderda et al., 2007). In a comprehensive study, Shaffer et al. found that minimizing opiate use and increasing in intravenous paracetamol for postoperative pain management has the potential to shorten HLOS, reduce opioid-related complications, and cut extraneous hospital costs (Shaffer et al., 2016). Another study that compared between a multimodal postoperative pain regimen of dexamethasone, gabapentin, ibuprofen, and paracetamol, in comparison to standard opiate treatment (morphine, among others) found that the average pain scores from day 1 postoperation to day 3 were significantly lower among those who received multimodal treatment than those administered opiate analgesics alone (Rafiq et al., 2014).

As stated, the results of the present study found that pain did not serve as a risk factor for in-hospital complications post colorectal-surgery. In an encompassing review on postoperative pain management and outcomes, the influence of epidural analgesia was discussed (Bonnet & Marret, 2006). Epidural analgesia is noted to reduce the likelihood of incurring a DVT (Bonnet & Marret, 2006). This phenomenon had already been exemplified in the 1980s (Modig et al., 1983). In that time, preventative antithrombotic treatment of low-molecular-weight heparin (LMWH) was not yet in use. At present, this treatment is known for being more than 80% effective in the prevention of DVT. Of note, patients who received both epidural analgesia and LMWH did not result in reduced DVT compared with those administered LMWH alone. Similarly, older publications documented a lower rate in respiratory/pulmonary complications among patients who received epidural analgesia (Modig et al., 1983). Today, preventive antibiotics, physical therapy, and other various interventions have al-

lowed for an impressive decrease in the occurrence of pneumonia following abdominal surgery. In addition, the use of epidural analgesia postoperatively is no longer commonplace (Bonnet & Marret, 2006). All subjects in the population of the present study were prescribed a preventative dose of LMWH 30 days postoperatively in line with the hospital protocol for DVT prevention; data consequently showed that of 1,073 patients, only two developed DVT.

According to literature, when pain management is optimally exercised, patients will recover at a faster rate and be more likely to mobilize in a timely manner—an integral step in resuming to routine activity. In tandem, patients will contract less complications such as blood clots, and pneumonia (WebMD, 2021). Regenbogen et al. showed that hospitals wherein the collective pain score on the first day postoperation was higher, an increase in postoperative complications, return emergency department visits, and hospital readmissions were of a greater prevalence than hospitals with lower reported pain scores (Regenbogen et al., 2016). Patients were hospitalized for longer periods in hospitals where the pain scores were higher (Regenbogen et al., 2016). Consistent findings were exhibited in a cross-sectional study examining the prevalence and risk factors of DVT in patients undergoing lumbar inter-body fusion surgery (Yang et al., 2015). They found that the VAS score reported on day 3 postsurgery was significantly higher in those who sustained postoperative DVT (6) in contrast to those who did not (3.33) (Yang et al., 2015).

Limitations

The VAS score for pain assessment is a subjective measure. The reported score of a patient may be influenced by cultural background, language barriers, interpersonal dynamic, and comfort level with hospital staff, and multiple other personality factors. Nonetheless, research literature recognizes VAS score to be a highly reliable measurement tool for pain assessment. It is also possible that patient charting is influenced by subjective evaluation or impression of the nurse on shift, cultural background and personal connection developed with the patient. Language barriers between patients and staff may regularly result in communication in the form of gestures and body language. This type of dialogue requires extra sensitivity and perceptiveness on behalf of the staff to understand patient needs; it is possible that this obstacle would result in inaccurate pain assessment. Furthermore, it is conceivable that digital patient charting is missing information due to the colossal workload and the desire of nursing staff to first and foremost tend to patient needs, leaving minimal time to document on the computer.

Conclusions

This study found that pain intensity post colorectal surgery was not a risk factor for extended HLOS or in-hospital complications. In contradistinction, we found that age, assistance needed in ADL, use of analgesic agents, and onset of postoperative infection served as predictors for extended HLOS. These findings place imperative emphasis on the importance of routine nursing evaluations and interventions in the hospital setting, including tending to patient needs, frequent pain assessments, optimizing analgesic use, and reducing infection rates; optimal nursing care has the potential to shorten HLOS, improve health outcomes and economize health care resources.

Author contribution statement

All authors have contributed significantly to the work and have approved the final version of the manuscript.

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Declaration of Competing Interest

None of the authors have conflicts of interests.

Supplementary materials

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CRediT authorship contribution statement

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