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Reduced Length of Hospitalization in Primary Total Knee Arthroplasty Patients Using an Updated Enhanced Recovery After Orthopedic Surgery (ERAS) Pathway

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ABSTRACT

Decreasing hospital length of stay may attenuate costs associated with total knee arthroplasty. The purpose of this study was to determine if updates to an existing orthopedic enhanced recovery after surgery (ERAS) pathway would improve length of hospitalization. Clinical and demographic data were collected on 252 primary total knee arthroplasties between January 2012 and July 2013. Pre-updated and post-updated ERAS pathway cohorts were analyzed for length of stay, clinical outcomes, and re-admissions. The mean length of stay decreased from 76.6 hours to 56.1 hours after implementation of the evidence-based orthopedic enhanced recovery after surgery pathway ($P < 0.001$). This improvement was possible without a concomitant increase in readmission rates.

In the last decade, the number of primary total knee arthroplasty (TKA) surgeries performed annually within the United States has nearly doubled [1]. Currently, there are an estimated 4 million American adults living with a total knee arthroplasty [2]. Demand for this surgery is projected to rise substantially by 2030 along with costs to the healthcare system [3].

At the time when a week-long hospitalization after total knee arthroplasty was the norm, Meyers et al predicted that any further decreases in length-of-stay would correspond with increases in post-operative complications [4]. Due to this concern, the cost control mechanisms that were instituted by many hospitals primarily focused on decreasing the cost of implants. Length of hospitalization continues to remain a major predictor of total cost of hospital care for total joint arthroplasty [5,6]. The costs of operating room and recovery services are incurred in the first day and do not vary with patient length of stay. However, the total costs of post-operative care, including nursing, supplies, physical therapy (PT), occupational therapy (OT), nutrition, and environmental services increase in direct proportion with length of hospitalization [7]. Readmission after surgery is also a major contributor to the overall costs of a joint arthroplasty program. Decreasing costs across the care continuum is only one tenet of the Triple Aim, a theory designed to improve the U.S. healthcare system through the simultaneous pursuit of three goals: improving the patient experience, improving the health of populations, and reducing cost [8]. Therefore, cost control must be achieved in the context of high-value, high-quality care and patient satisfaction [9]. To date, no research has shown that decreases in length of hospitalization after TKA can be achieved in combination with decreases in post-operative complications, readmissions, and dispositions to sub-acute care.

In 2014, Hanson et al showed decreased opioid consumption and pain, increased rehabilitation, and improved patient satisfaction in patients who had undergone primary TKA randomized to receive a continuous adductor canal nerve block (ACNB) [10]. The results of this prior study led to collaboration between the Departments of Orthopedics and Anesthesiology at our institution to modify an existing Enhanced Recovery after Orthopedic Surgery (ERAS) pathway to include ACNB. ERAS programs are unique in that they offer potential for valuable gains as improvements are implemented across the spectrum of care. The synergistic effects of these innovations in other surgical specialty ERAS programs have shown improved peri-operative outcomes including decreased length of stay, complications, and medical costs [11,12]. Early reports on orthopedic specific ERAS and fast track programs are

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promising, but good data on clinical outcome benefits of orthopedic specific ERAS programs are lacking [13,14].

The goal of our investigation was to examine the effect of an evidence-based updated ERAS clinical pathway on perioperative outcomes in patients undergoing primary TKA [10,15–17]. The primary outcome of this retrospective analysis was hospital length of stay (LOS). Secondary outcomes included: numerical rating scale (NRS) pain scores, opioid consumption, opioid-related adverse effects, 30-day readmission rates, postoperative transfusion rates, distance ambulated, and disposition location.

Material and Methods

Study Design

After approval from the internal review board, all patients who had undergone primary TKA at our institution were retrospectively identified over a period from January 2012 to July 2013. Inclusion criteria consisted of patients who had undergone surgery with a standardized care pathway that included femoral nerve block and those who had undergone surgery with the updated ERAS pathway (Table 1). Implementation of the updated ERAS pathway occurred in early 2013. Moving retrospectively from early 2013, consecutive pre-updated pathway subjects were identified in blocks by month. In similar fashion, for the updated ERAS pathway cohort, consecutive subjects were identified in blocks by month starting in early 2013 until greater than 100 subjects were identified. Patients from April 2012 through November 2012 were not considered due to an ongoing randomized study on the same patient population. It was decided a priori that any patient who was shown to have opioid dependence prior to surgery (>30 mg morphine equivalents daily) was excluded from analysis.

Orthopedic ERAS Pathway Updates

The updated ERAS pathway (Table 1) included several changes to the existing joint pathway used at our institution:

1) TKA education class: Although this class was offered as an option with the existing joint pathway, it was not required. With the updated pathway, the education class was made mandatory. As we did not know the effect of the updated ERAS pathway, no changes in expectation for discharge were described to the patients compared with the prior pathway.
2) Care companion: A specific care companion at home was made a requirement. This care companion is required to sign a contract stating availability and ability to assist the patient after discharge.
3) Medications: A transdermal scopolamine patch was applied to patients <70 years of age. All patients received 4 mg of intravenous dexamethasone at the time of surgical incision.
4) Spinal anesthesia: Spinal anesthesia was used in both the pre- and updated pathways. However in the updated pathway, a short acting spinal anesthetic agent (mepivacaine) was used to decrease spinal duration. This improved spinal resolution time made it possible to begin physical therapy upon arrival to the orthopedic hospital wards.
5) Intra-operative fluid management: A standard goal of 2 L of crystalloid fluid (Lactated Ringer's) was given to every patient in the updated ERAS pathway.
6) Tranexamic acid utilization: In the updated ERAS pathway, a standard dose of 1 g tranexamic acid intravenous (IV) was given 15 minutes prior to incision. A repeat dose of 1 g tranexamic acid IV was also given 15 minutes prior to skin closure. Intra-operative and post-operative transfusion criteria (hemoglobin < 10 g/dL with clinical signs of anemia or hemoglobin < 8 gm/dL) were not altered during the course of this study.
7) Continuous peripheral nerve blocks: Instead of a continuous femoral nerve block, a continuous adductor canal nerve block was placed in the post anesthesia care unit (PACU). The continuous adductor canal nerve block was kept in place for 48 hours, or until discharge, whichever came first.
8) Physical therapy: With the updated ERAS pathway, physical therapy was initiated on the day of surgery, after spinal resolution. Prior to the update, the first physical therapy session began the morning following surgery. All subjects had a total of four planned post-operative physical therapy sessions.
9) Postoperative oral analgesics: Prior to the updated ERAS pathway, each surgeon had a personal regimen of analgesics. After the update, a standard regimen of oral analgesics was given to every patient including acetaminophen, NSAIDs, and gabapentin. Oral oxycodone, as needed, was the primary opioid analgesic, unless contraindicated.

Outcomes

The primary outcome measured was hospital length of stay. Length of stay was defined as time from hospital arrival on day of surgery to discharge from the hospital. Secondary outcomes consisted of: NRS scores at rest, NRS scores with physical therapy, opioid consumption, treatment for nausea, packed red blood cell units transfused, 30-day readmission rate, number of falls, distance ambulated, and disposition location. All surgeries were performed through a medial parapatellar approach by one of our institution's nine different orthopedic surgeons. All nine surgeons were actively performing surgeries during both cohorts. Power analysis for this retrospective study was performed using the historical mean LOS prior to the implementation of the updated ERAS pathway (76 hours with a standard deviation of 15 hours). In order to detect a clinically significant change of 8 hours between groups, more than 100 patients were necessary in each arm to have greater than 80% power (2-sided type 1 error rate of 0.05). A total of 252 subjects were divided into two cohorts based on implementation of the updated ERAS pathway. Data on 126 pre-updated ERAS pathway subjects and 126 post-updated ERAS pathway subjects were collected and then analyzed.

Statistical Analysis

Demographic and baseline clinical characteristics were compared using the t-test or the chi-square test as appropriate. The difference in

Table 1
Enhanced Recovery after Orthopedic Surgery Pathway (ERAS).

Pre-Updated Pathway	Post-Updated Pathway
Surgery clinic	
Optional TKA education class	Required TKA education class
No specific care companion[a]	Specific identified care companion[a]
Preoperative	
Oral multimodal analgesia[b]	Oral multimodal analgesia[b]
No pre-emptive anti-emetics	Scopolamine patch
Long acting[c] spinal (preferred) or general anesthetic	Short acting[c] Spinal (preferred) or general anesthetic
Intraoperative	
No Standardized steroids	Intravenous dexamethasone
No standardization of IV fluids	2 L of Lactated Ringer's
No anti-fibrinolytics	Tranexamic acid
Postoperative	
Intermittent femoral nerve block (paused prior to physical therapy)	Continuous adductor canal block for 48 hours
Physical therapy beginning on postoperative day 1	Physical therapy session on day of surgery
No standardization of analgesics	Scheduled acetaminophen, NSAIDs, gabapentin. Oxycodone prn

[a] Care companion = pre-identified caregiver that attests to availability upon discharge of patient.
[b] Celebrex, gabapentin, acetaminophen.
[c] Long acting spinal = bupivacaine; short acting spinal = mepivacaine.