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Continuous adductor canal blockade facilitates increased home discharge and decreased opioid consumption after total knee arthroplasty☆

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ABSTRACT

Background: There is a growing interest in avoiding discharging patients to rehab to maximize outcome and minimize complications after total knee arthroplasty (TKA). In addition, use of postoperative pain pathways that minimize opioid use is critical amidst the current opioid epidemic. However, the ideal pain regimen after TKA has yet to be determined.
Methods: From July 1, 2013 to October 1, 2014 two perioperative pathways were used to address surgical pain. These included either a single shot femoral nerve block plus liposomal bupivacaine pericapsular injection (FNB + LB-PAI) or adductor canal catheter plus posterior capsule single shot block (ACC + iPACK), each with an oral analgesic protocol. Little modification occurred with regard to surgical technique, postoperative medications, or postoperative physical therapy (PT).
Results: Overall, 264 unilateral, primary TKA patients (146 FNB + LB-PAI, 118 ACC + iPACK) were included. ACC + iPACK patients had a shorter median length of stay (LOS, 2.0 vs 3.0, $p < 0.001$), more discharges home (79.7% vs 67.8%, $p = 0.002$), and less median opioid consumption (IV morphine equivalents, IVME, 20.0 vs 44.1, $p < 0.001$) than the FNB + LB-PAI group. In multivariable analysis, use of ACC + iPACK remained independently associated with shorter LOS, increased discharge home, and less IVME consumed when controlling for confounding variables. ACC + iPACK patients also had fewer opioid related adverse events (0.8 vs 5.5, $p = 0.045$) and a lower rate of MUA (0.8% vs 6.2%, $p = 0.026$).
Conclusions: We recommend ACC + iPACK with a multimodal oral analgesic protocol as the primary postoperative analgesia in enhanced recovery TKA protocols. This resulted in an easier recovery with fewer complications.
Level of evidence: Level III.

1. Introduction

Total knee arthroplasty (TKA) is a proven treatment for pain relief from debilitating arthritis but has traditionally been associated with painful postoperative course and prolonged recovery [1–3]. The advent of multimodal pain protocols and regional

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anesthesia has drastically decreased the morbidity and length of hospital stay associated with the procedure [4–6]. As a result "enhanced recovery" or "fast-track" pathways are being described to help accelerate the patient's discharge without an increase in pain, readmission, or complications [7–9].

Furthermore, two issues have gained considerable attention in the current literature, discharge destination and opioid consumption. First, post-hospital discharge rehabilitation can account for 36–55% of the total cost for TKA, and these facilities have been associated with severe adverse events and unplanned readmission when controlling for confounding variables [10–12]. Attempts to facilitate home discharge may be beneficial in not only reducing costs associated with patient care but also more importantly improving patient outcomes. Second, it has been well publicized that the United States (US) is currently in an opioid epidemic [13], with some placing it on similar magnitude of the acquired immune deficiency syndrome (AIDS) epidemic of the 1980s [14,15]. As the third leading prescribers of opioids in the US, orthopedic surgeons, in particular, arthroplasty surgeons must find a balance between managing postoperative pain and overprescribing [13]. Adjunct pain modalities to limit the amount of opioid consumption after TKA will be critical in helping patients wean off these medications quickly and avoid dependence.

However, the ideal postoperative recovery pathway has not been identified. As new regional anesthetic techniques and injectable medications became available, the protocol at our institution changed with the goal of improving patient outcomes. The purpose of this study was to retrospectively examine a Level 1 academic center's experience with two consecutive postoperative pain protocols after TKA and to investigate their effect on primary outcomes of discharged destination, opioid consumption, and length of stay (LOS). Secondary outcomes of the study were visual analogue scale (VAS), ambulation distance, and complications.

2. Methods

A retrospective chart review was performed from July 1, 2013 to October 1, 2014. All primary, unilateral total knee arthroplasty patients were identified by Current Procedural Terminology (CPT) code 27447. Patient variables commonly considered exclusion criteria in previous studies such as prior history of arthroscopy, psychiatric conditions (anxiety and depression), and preoperative opioid use were included, as well as all payer mixes [16–18]. Medicare patients being discharged to a skilled nursing facility (SNF) required a minimum three day stay per regulations during the study period. Patients with prior open knee surgery or hardware, simultaneous bilateral TKA, unicompartmental knee arthroplasty (UKA), and revision knee arthroplasty were excluded. During the study period, all surgeries were performed by two fellowship-trained adult reconstruction surgeons (SSW, MPB). In addition, all total knee arthroplasties were performed with a tourniquet and the use of either tranexamic acid (TXA) or Amicar for blood management unless contraindicated. Drains were routinely placed in all patients. There were no changes to the operative technique or preoperative evaluation. Furthermore, there was no change in the frequency, timing, or type of postoperative physical therapy received. All patients were consecutively enrolled, using the same, predefined inclusion criteria. However, during the study period, two consecutive postoperative pain protocols were utilized as described below. Patients utilized an oral multimodal pain regimen (Table 1) postoperatively. Prior to the study period, a femoral nerve catheter was placed routinely in conjunction with a knee immobilizer to allow ambulation. This was associated with decreased mobilization and fall risk based on internal audit. This prompted a change to a single shot femoral nerve block plus periarticular injection with liposomal bupivacaine (FNB + LB-PAI) that could be administered intraoperatively without the need for a catheter or maintenance. In addition, we hoped the changed from femoral catheter to single shot would enhance mobilization. However, while FNB + LB-PAI was being used routinely at our institution, new literature suggested the benefit might not be as advertised, and promising data was emerging for adductor canal catheter [18] combined with an

Table 1
Multimodal pain protocol (MPP) used postoperatively by both study groups.

Category	Drug	Route, dosage, timing
NSAID	Celecoxib	200 mg PO BID
Gabapentinoid	Gabapentin, or	300 mg PO TID
	Pregabalin[a]	150 mg PO BID
Analgesic/antipyretic	Acetaminophen	975 mg PO TID
Short acting opioid	1st Line: Oxycodone,	5–15 mg PO q3h prn
	2nd Line: Hydromorphone[b]	2–4 mg PO q3h prn
Long acting opioid[c,e]	1st Line: Oxycodone HCL	10 mg PO BID
	2nd Line: Morphine sulfate	15 mg PO BID
Opioid breakthrough	1st Line: Hydromorphone	0.5–1 mg IV q3h prn
	2nd Line: Fentanyl	25 mg IV q3h prn
Steroid[d]	Dexamethasone	10 mg IV once POD 0, 1

PO = per os, medication by mouth. BID = scheduled twice daily, TID = scheduled three times daily, q3h = every three hours, IV = intravenous, prn = as needed for pain. POD = postoperative days 0 and 1.
[a] Pregabalin continued postoperatively if home medication, otherwise Gabapentin first line due to insurance availability.
[b] Hydromorphone used if oxycodone is not effective or causes excessive nausea.
[c] Not routinely used in patients over 70 years of age.
[d] Not routinely used in diabetic patients due to associated elevation in blood sugar.
[e] Long acting opioids were used in both groups during the study period. However, given the current concern for increased opioid use in the United States this has since been eliminated as part of the postoperative pain protocol. Short acting opioids are used sparingly only as needed after non-opioid analgesics (acetaminophen, NSAIDs, gabapentinoids, and steroids) have not adequately relieved the patient's pain.

ultrasound guided infiltration of the interspace between the popliteal artery and capsule of the knee (ACC + iPACK) [19]. This prompted a second consecutive change to our postoperative pain protocol and impetus for this study.

2.1. FNB + LB-PAI

Liposomal bupivacaine periarticular injection with injectable suspension (Exparel, Pacira Pharmaceuticals, Parsippany, NJ) plus single shot femoral block (FNB + LB-PAI) was performed from 7/17/13 to 4/21/14. In the preoperative holding area a single shot femoral nerve block was placed under ultrasound guidance using 20 ml of bupivacaine 0.25%. A pericapsular injection was performed with liposome bupivacaine suspension after final component implantation by the attending surgeon (SSW, MPB) using a standardized technique [20]. A standard 20 ml vial of 0.25% liposome bupivacaine suspension was diluted to a volume of 40 ml using saline and then injected per protocol.

2.2. ACC + iPACK

Adductor canal catheter combined with an ultrasound guided infiltration of the interspace between the popliteal artery and capsule of the knee (ACC + iPACK) was used from 4/22/14 to 10/1/14. The iPACK is placed preoperatively after the spinal has been placed and is setting up. The patient is positioned supine with a flexed knee or lateral and a low frequency ultrasound probe (two to five megahertz curvilinear) is applied to the posterior popliteal skin. The probe is moved in a cephalad direction over the condyles, epicondyles, and up to the round distal femur. The popliteal artery is identified and a needle is advanced from either a medial or lateral direction under ultrasound guidance between the artery and the posterior capsule of the knee (Figure 1). Local anesthetic is evenly distributed between the posterior capsule and the artery by adjusting the needle position while infiltrating. A single shot iPACK injection consisted of 20 ml 0.2% ropivacaine with 1:400,000 epinephrine.

The adductor canal continuous perineural infusion catheter was placed in-plane using an ultrasound guidance approach with Contiplex Stimulating Tuohy (B-Braun, Bethlehem, PA) postoperative in the post-anesthesia recover unit (PACU). An initial bolus dose of 20 ml 0.2% ropivacaine with 1:400,000 epinephrine was injected prior to surgery, followed by a 0.2% ropivacaine infusion at eight milliliters per hour postoperatively (Cadd Pump, Smiths Medical, Dublin, OH). At discharge, patients were converted to an elastomeric pump (On-Q, Halyard Health, Alpharetta, GA) of 0.2% ropivacaine running at eight milliliters per hour. The continuous catheter was kept in place for three days. The patients were phoned at home each day and removed the catheter themselves.

During the study period, no complications or failures at placement were reported with the spinal, adductor canal, or infiltration techniques. There was no prolonged numbness after the block wore off in any patients. The learning curve was minimal due to the use of these blocks previously in other cases including trauma and anterior cruciate ligament (ACL) repairs. All blocks were performed by an anesthesiologist specially trained in regional anesthesia techniques. The blocks were not timed as this was not a purpose of the current study and no comparisons were made. However, the study institution utilizes a monitored preoperative block bay and parallel process whenever possible. This ensures the block is performed and ready during operating room turnover and the patient arrives in the room ready to start operating. The other advantage of this technique is the reliable wake up and short PACU stay that ensures the later cases have space in PACU. This operations optimization is one of the main advantages of this technique.

Patient demographics, comorbidities, number of previous arthroscopies, and opioid use three months prior to TKA (used as definition for chronic pain patients), type of anesthesia, and use of regional blocks were recorded. The lowest and average pain scores were recorded at three time points: in the PACU, the evening of postoperative day (POD) 0 (22:00–24:00, PM POD 0), and the morning of POD 1 (06:00–08:00, AM POD 1) prior to physical therapy. Each patient's exact postoperative pain regimen

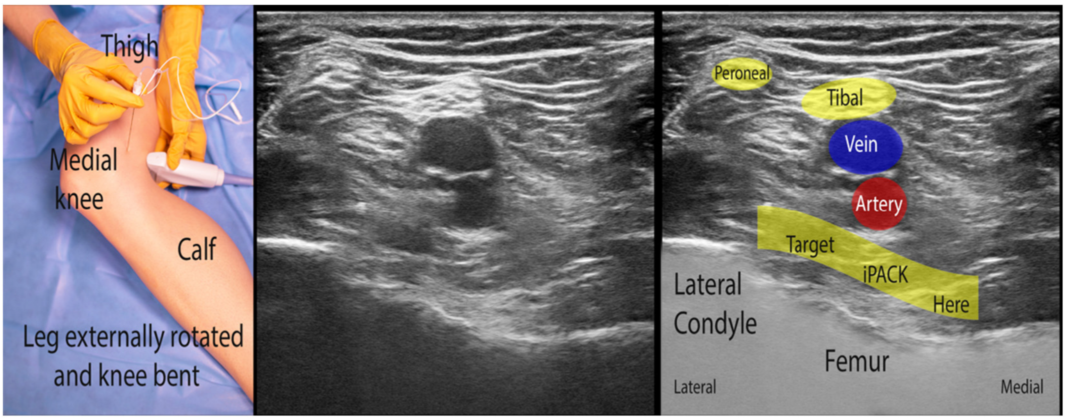

Figure 1. Placement of ultrasound guided infiltration of the interspace between the popliteal artery and capsule of the knee (iPACK) block. From left to right: placement of leg in preoperative holding after spinal has been placed. Operative knee is flexed and leg is externally rotated; Image from the transducer as placed in panel 1; image from the transducer with important structures labeled and target for placement of the needle.
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was recorded throughout the hospitalization and the intravenous morphine equivalents (IVME) in the first 24 h after PACU discharge were totaled. Physical therapy (PT) day of initiation, minutes, and total visits were measured. The primary outcome measures of the study were LOS, discharge destination, and opioid consumption in IVME. Secondary outcomes included visual analogue scale (VAS), distance ambulated during hospital stay, and complications.

Routine demographic characteristics were calculated for each postoperative primary analgesic group. Continuous variables were summarized using the mean and standard deviation or the median with 25th and 75th percentiles, while categorical variables were presented using counts and percentages. Continuous variables (ambulation distance, LOS, age, follow-up, PT total visits and duration) were tested for normality using the Kolmogorov–Smirnov test, and the Wilcoxon rank sum test used to compare perioperative pathway groups if skewed or t-test if found normal. Categorical variables (gender, American Society of Anesthesiologists (ASA) score, comorbidities, PT incidence, discharge destination and complications) were compared using either a chi-squared test or Fisher's exact test in the presence of small expected cell counts (<5).

A multivariable regression model was performed for each of the three primary outcomes. Logistic regression was used for discharge destination (Home vs SNF/Rehab) with results presented as the odds ratio (OR) with 95% confidence interval (CI). Continuous outcomes, LOS and opioid consumption, utilized a generalized regression model based on the Poisson and negative binomial distributions, respectively. Results for these models are presented using incidence rate ratio (IRR) with 95% CI. Each model included any variables that were statistically different between the two groups in the univariable analyses and included the baseline differences observed for ASA score, depression, and prior arthroscopy.

A p-value <0.05 was considered statistically significant, and SAS version 9.4 (SAS Institute Inc., Cary, NC) was used for all analyses. Analyses were performed by the Duke Department of Biostatistics and Bioinformatics (Durham, NC).

3. Results

The study population consisted of 264 consecutive patients comprised of 43.6% male with mean age of 66.2 ± 9.4 years (standard deviation). Analgesic group counts included 146 in the FNB + LB-PAI group and 118 patients in the ACC + iPACK group. The two groups were well matched (Table 2). The only differences identified at baseline in the univariable analyses were a high ASA score (ASA > 2, 61.0% vs 47.9%, p = 0.034), higher incidence of depression (26.3% vs 15.1%, p = 0.024), and a higher incidence of preoperative prior knee arthroscopy (41.5% vs 20.5%, p < 0.001) in the ACC + iPACK group. After the arthroplasty, this group also required fewer PT total visits, and fewer PT total minutes compared to the LB + PAI group (p < 0.001, Table 2).

With regard to primary outcomes, patients in the ACC + iPACK group required a shorter median LOS (2.0 vs 3.0 days, p < 0.001), less median IVME 24 h postoperatively (20.0 vs 44.1, p < 0.001) and higher frequency of discharge to home (79.7% vs 67.8%, p = 0.002, Table 3). In the multivariable analyses the use of ACC + iPACK was independently associated with decreased LOS (incidence rate ration [IRR] = 0.74, 95% CI: 0.62–0.87, p < 0.001), decreased opioid consumption (IRR = 0.46, 95% CI: 0.39–0.54, p < 0.001), and decreased discharge destination to SNF (OR = 0.54, 95% CI: 0.997–0.30, p = 0.049, Table 4).

With regard to secondary outcomes, patients in the ACC + iPACK group also had lower average VAS pain scores the evening of (PM POD 0, 3.8 ± 2.1 vs 4.5 ± 2.4, p = 0.009) and morning after (AM POD 1, 3.7 ± 2.0 vs 4.8 ± 2.2, p < 0.001). They also had further median ambulation on the day of surgery (POD 0, p = 0.001) and the first postoperative day (POD 1, 115 vs 34 feet, p < 0.001, Table 3). Finally, there was no difference in infection rate or any cause of reoperation between the two groups. However,

Table 2
Patient demographics, medical history, anesthesia type, and physical therapy variables by perioperative analgesic group.

	Overall	Group 1 FNB + LB-PAI	Group 2 ACC + iPACK	p-Value
Patients (n)	264	146	118	
Age (years)	66.2 ± 9.4	66.8 ± 9.4	65.5 ± 9.3	0.242
Male (%)	43.6	43.8	43.2	0.920
ASA > 2 (%)	53.8	47.9	61.0	**0.034**
Comorbidities (%)				
Obesity	55.3	58.9	50.8	0.191
Diabetes	22.4	19.9	25.4	0.281
Anxiety	14.0	13.7	14.4	0.869
Depression	20.1	15.1	26.3	**0.024**
Chronic pain (%)	29.6	30.1	28.8	0.815
Prior arthroscopy (%)	29.9	20.5	41.5	<**0.001**
Spinal anesthesia (%)	89.0	87.7	90.7	0.437
Physical therapy				
POD 0 (%)	72.4	75.3	68.6	0.226
Visits	4 (3, 5)	4 (4, 5)	3 (2, 4)	<**0.001**
Minutes	180 (140, 217)	191 (155, 220)	155 (120, 210)	<**0.001**
Follow-up (months)	11.8 (3.3, 13.3)	12.5 (7.4, 14.5)	7.5 (2.1, 12.2)	<**0.001**

Results presented as percentage, mean ± standard deviation, or median (25th, 75th percentiles) with p-value <0.05 considered statistically significant. FNB = single shot femoral nerve block; LB-PAI = liposomal bupivacaine periarticular injection; ACC = adductor canal catheter; iPACK = ultrasound guided infiltration of the interspace between the popliteal artery and capsule of the knee; ASA = American Society of Anesthesiologists score; POD = postoperative day; PT = physical therapy.
Bold data indicates a statistically significant P value (<0.05).

Table 3
Comparison of primary and secondary outcome measures across the two postoperative primary analgesic groups.

	Overall	Group 1 FNB + LB-PAI	Group 2 ACC + iPACK	p-Value
Patients (n)	264	146	118	
Primary outcome measures				
LOS, days	2.2 (2.0, 3.1)	3.0 (2.2, 3.2)	2.0 (1.9, 2.9)	<**0.001**
Discharge destination				**0.002**
Home with HHPT, %	27.7	31.5	22.9	
Home with OPPT, %	45.5	36.3	56.8	
Inpatient rehab, %	1.5	0.7	2.5	
SNF, %	25.4	31.5	17.8	
Opioid consumption 24 h postoperatively, IVME[a]	30.0 (15.3, 46.6)	44.1 (27.5, 56.7)	20.0 (10.0, 30.0)	<**0.001**
Secondary outcome measures				
Pain scores[b]				
PACU	3.1 ± 2.7	3.1 ± 2.8	3.1 ± 2.6	0.685
PM POD 0	4.2 ± 2.3	4.5 ± 2.4	3.8 ± 2.1	**0.009**
AM POD 1	4.3 ± 2.2	4.8 ± 2.2	3.7 ± 2.0	<**0.001**
Ambulation, ft.				
POD 0	0 (0, 2)	0 (0, 1)	0 (0, 8)	**0.001**
POD 1	64 (15, 180)	34 (6, 100)	115 (50, 250)	<**0.001**
POD 2	100 (40, 200)	100 (25, 200)	120 (60, 200)[c]	0.064
Complication				
Adverse events[d], %	3.4	5.5	0.8	**0.045**
MUA, %	3.8	6.2	0.8	**0.026**
Infection, %	1.1	0.0	2.5	0.088
Reoperation, %	0.8	1.4	0.0	0.504

Results presented as percentage, mean ± standard deviation, or median (25th, 75th percentiles). FNB = single shot femoral nerve block; LB-PAI = liposomal bupivacaine periarticular injection; ACC = adductor canal catheter; iPACK = ultrasound guided infiltration of the interspace between the popliteal artery and capsule of the knee; LOS = length of stay; SNF = skilled nursing facility; HHPT = home health physical therapy; OPPT = outpatient physical therapy.
Bolded values indicate statistical significance (p-value <0.05).
[a] Intravenous morphine equivalent dosage.
[b] Average NRS-11 pain scores in PACU, night of POD 0, and morning of POD 1 by perioperative analgesic group.
[c] Thirty five values missing as these patients were discharged home on POD 1.
[d] In-hospital opioid related events including falls, delirium, over-sedation requiring medication adjustment.

ACC + iPACK patients had fewer opioid related adverse events (falls, delirium, or over sedation requiring mediation adjustment, 0.8 vs 5.5, p = 0.045) and a lower rate of manipulation under anesthesia (MUA) (0.8% vs 6.2%, p = 0.026, Table 3).

4. Discussion

Similar to the results in the current study, many previous works have associated the use of adductor canal blockade with decreased opioid use [21,22] and shorter length of stay [16]. To our knowledge, three previous studies [16,18,23] compared adductor canal block (ACB) to a periarticular injection (PAI) but were unable to detect clinical differences in discharge status, LOS, and opioid consumption, possibly due to smaller cohorts [17,23] and use of single shot nerve blocks compared to continuous peripheral nerve catheter utilized here. In addition, the previous work did not examine discharge destination or post-hospital complications [16], and all excluded patients with preoperative opioid use or psychiatric conditions. The results of the current study found that

Table 4
Adjusted regression analysis of primary outcome measures between the postoperative primary analgesic groups. Results reported as incidence rate ratio (IRR) or odds ratio (OR) with 95% confidence interval (CI).

	Discharge destination = SNF/Rehab		LOS, days		Opioid consumption 24 h post-op, IVME	
	OR 95% CI	p-Value	IRR 95% CI	p-Value	IRR 95% CI	p-Value
ASA > 2	1.99 (1.09, 3.64)	**0.026**	1.19 (1.01, 1.40)	**0.039**	1.04 (0.88, 1.22)	0.651
Prior arthroscopy	0.51 (0.25, 1.05)	0.069	0.96 (0.80, 1.16)	0.681	1.31 (1.10, 1.57)	**0.003**
Depression	0.97 (0.47, 1.98)	0.930	1.05 (0.87, 1.27)	0.625	1.17 (0.96, 1.43)	0.122
Analgesic group = ACC + iPACK	0.54 (0.30, 0.997)	**0.049**	0.74 (0.62, 0.87)	<**0.001**	0.46 (0.39, 0.54)	<**0.001**

SNF/Rehab = skilled nursing facility or rehabilitation. LOS = length of stay; PCA = patient-controlled analgesia; LB = liposomal bupivacaine; CMA = comprehensive multimodal analgesia; ASA = American Society of Anesthesiologists score; IVME = intravenous morphine equivalent dosage. FNB = single shot femoral nerve block; LB-PAI = liposomal bupivacaine periarticular injection.
Bold data indicates a statistically significant P value (<0.05).

ACC + iPACK was independently associated with shorter LOS, decreased opioid consumption, and increased discharge to home after controlling for confounding variables. In addition, these patients had further ambulation, less pain, less opioid related adverse events, and a lower rate of MUA compared to the FNB + LB-PAI group. While the reported infection rate in the ACC + iPACK group was 2.5% versus 0% in the FNB + LB-PAI group, this was not statistically significant. Furthermore, no previous works have identified indwelling nerve catheters as an independent risk factor for infection.

The performance of the ACC + iPACK in the study was impressive, as it was independently associated with improvements in all three primary outcome measures. Furthermore, patients in this group were sicker, had more prior surgery, a higher incidence of depression, and less time with physical therapy. The reasons for this difference over the FNB + LB-PAI are likely multifactorial. The first is that a multitude of studies have questioned the efficacy of the LB formulation. Recent studies have not demonstrated superior pain relief over conventional, short acting generic injectable [24–27]. The second is that the purpose of the iPACK injection into the posterior knee is to address the innervations from the popliteal plexus and the genicular branch of the posterior obturator nerve [28]. While the posterior capsule could be easily injected intraoperatively after bony cuts have been made, a previous randomized controlled trial demonstrated that posterior capsule infiltration alone intraoperatively makes no difference in patients' pain or recovery postoperatively [29]. Therefore, the iPACK is an ultrasound guided injection instead of blind infiltration technique. Observing the spread of local anesthetic from a lateral to medial direction ensures that articular branches entering the posterior aspect of the knee are surrounded by local anesthetic and also prevents by direct needle observation inadvertently injecting into the popliteal artery. As a result, recent literature has shown benefit of the iPACK in addition to adductor canal block compared to just the adductor canal block alone [30].

Decreasing the LOS without increasing readmissions or complications has become an area of great interest. Not only do patients associate a lower LOS with higher satisfaction [31], but also decreasing LOS has been demonstrated as a cost reduction tool to reduce the hospital expenses for TKA [32–35]. This is particularly important as episode-of-care or bundled payment systems become widespread and total joint practices more standardized [36]. One of the biggest factors in decreasing LOS is the ability to minimize pain and maximize mobility after TKA with multimodal and regional anesthesia [9,18,37]. ACB has been associated with increased quadriceps strength and enhanced ambulation ability [22,38] compared to patients without the block in high-level studies. These blocks have also been associated with increased quadriceps strength [39–43], ambulating distance [44], and better ambulation ability [41,44,45] compared to femoral nerve blocks in randomized control trials and meta-analyses. These benefits of ACB may also be responsible for the reduced rate of MUA in this group compared to PAI. While the causes of arthrofibrosis are multifactorial, postoperative causes have been cited as poor patient motivation, immobility, and poor pain tolerance [46]. Patients in the ACB + iPACK group had less pain after surgery and were able to ambulate further after surgery compared to FNB + LB-PAI group during the hospitalization. These early in-house benefits may be responsible for reducing stiffness and avoiding MUA later on.

However, in the current arthroplasty climate, facilitating a safe discharge home may be more important than shortening LOS and discharge to a rehabilitation facility. Keswani et al. recently reported that SNF and inpatient rehabilitation facility (IRF) patients were more likely to have post-discharge severe adverse events and unplanned readmission when controlling for confounding variables after total joint replacement [11]. The authors also found that home discharge is the optimal strategy for minimizing rate of severe 30-day adverse events after discharge and unplanned 30-day readmissions [12], both of which may cause payment deductions in the bundled care model. Furthermore, the post-acute phase of care (after hospital discharge) has been estimated to account for 36–55% of the total cost of the episode of care for joint replacement surgery [10]. Similar to the current study, many enhanced recovery protocols have also demonstrated an increased discharge to home and decreased discharged to SNF [12]. However, unlike the current study many of these protocols involved multiple changes to the postoperative regimen including the timing and administration of physical therapy, initiating on POD 0 instead of POD 1 [47–50]. Previous studies have demonstrated that early mobilization on POD 0 has been independently linked to shorter LOS and may be a confounding variable when investigating the results of postoperative pain protocols [51]. There was no difference in the percentage of patients receiving PT on POD 0 in the current study.

This paper does include several limitations. First and most notably is the retrospective nature and non-randomized nature of the postoperative pain protocols utilized. However, the comparison of two consecutive pain pathways without changes to PT, surgical indication, perioperative evaluation, criteria for home discharge, and use of multivariate regression analysis hoped to limit bias and confounders. Second, the authors acknowledge that this is not necessarily comparing “apples to apples” [52,53] with an ACB versus PAI, however, these are two commonly used analgesic techniques in practice and the current study addresses deficiencies of previous studies using the same comparison [16,18,23]. Third, this study did not record the time it took to administer the different regional anesthesia techniques as this would have been difficult given the study design. Finally, an extensive evaluation was not performed identifying patients' preoperative function or details of their home environment which may alter discharge destination. However, recent high level studies have suggested that home environment factors and living alone are not barriers to home discharge [54].

5. Conclusion

The implementation of a comprehensive enhanced recovery program has shown to benefit the patient, surgeon, and hospital system alike. Choosing the ideal postoperative primary analgesic is critical for program success to optimize mobility, reduce length of stay, and facilitate safe discharge to home. Based on the results of this study, we recommend use of ACC + iPACK instead of FNB + LB-PAI as the primary postoperative analgesia method after primary TKA.

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