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Periarticular Ketorolac Improves Outcomes for Patients With Joint Replacements

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BACKGROUND: Effective analgesia after joint replacement allows for earlier mobilization, decreased length of stay, and reduced opioid use. The injection of the surgical area with ketorolac (Toradol) prior to closure has changed pain management in joint replacement surgery.

PURPOSE: This retrospective research study examined the difference between patients who received periarticular injections of ketorolac versus those who did not. Postoperative outcomes were measured in the two groups.

METHODS: Between January 2012 and December 2014, a random sample of 161 patient charts was reviewed to compare length of stay, distance ambulated in the first physical therapy (PT) session, and amount of opioids consumed.

RESULTS: Ketorolac injected into the tissue prior to closure significantly impacted outcomes. Patients who received the injection had statistically significant shorter stays, ambulated further distances with their first PT session, and used fewer opioids on postoperative day 1.

CONCLUSION: Periarticular ketorolac injections reduce pain and improve outcomes, which reduces healthcare costs.

Background

Approximately 700,000 hip and knee replacements are performed annually in the United States (The Joint Commission, 2017a). With the aging baby boomer population and increased life expectancy, these numbers are projected to increase. According to The Joint Commission (2017a), the demand for hip and knee replacements is expected to quadruple by 2030. Singh and Yu (2017) projected that in 2030 approximately 5 million people in the United States will require knee or hip replacements. In addition, 500,000 individuals will need a revision of a previous joint replacement. Issues such as pain control, opioid usage, length of stay (LOS), and reimbursement are going to be of great importance for patient outcomes, satisfaction, safety, and cost containment. What was once considered a several-day hospitalization is now evolving toward an outpatient procedure.

Over the past several years, pain management in the context of joint replacement has progressed from the use of epidurals, femoral nerve catheters (FNCs), patient-controlled analgesia, and various oral "cocktails" to newer and potentially more effective modalities such as periarticular injections (PAIs) and local infiltration analgesia (LIA).

Femoral Nerve Catheter Versus Epidural

Anderson, Donnelly, Groose, Chambers, and Schroeder (2014) retrospectively compared epidural analgesia to FNC for postoperative analgesia after total knee arthroplasty (TKA). They found the FNC group able to ambulate further and more likely to participate in physical therapy (PT) on the day of surgery. The FNC group also reported less pain and had less opioid consumption on postoperative day 2.

Local Infiltration Analgesia Versus Multimodal Systemic

Andersen and Kehlet (2014) performed a systematic review of randomized controlled trials investigating LIA for TKA and total hip arthroplasty (THA) to evaluate the analgesic efficacy of wound catheters and implications for LOS. Their findings revealed that overall the use of wound catheters for postoperative administration of local anesthetic was not supported and did not impact LOS. However, LIA was found to provide effective analgesia in the initial postoperative period after TKA in most randomized controlled trials when combined with multimodal systemic analgesia.

Femoral Nerve Block Versus Local Infiltration Analgesia

Hinarejos et al. (2016) performed a prospective randomized double-blind study of TKA patients who received a femoral or sciatic nerve block plus an LIA consisting

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of ropivacaine, epinephrine, ketorolac, and clonidine versus patients who received blocks and a placebo, which consisted of normal saline only. Findings showed that at 12 hours postoperative, there was a significant difference in the pain scores in the treatment group. Niemelainen, Kalliovalkama, Aho, Moilanen, and Eskelinen (2014) randomized 56 patients undergoing unilateral TKA into two groups. In the LIA group, patients got a mixture of levobupivacaine, ketorolac, and adrenaline infiltrated periarticularly. During the first 48 hours after surgery, patients in the LIA group used less oxycodone, in both cumulative and interval follow-up, than patients in the placebo group, which received saline only. This effect was most significant during the first 6 postoperative hours.

Femoral Nerve Block Versus Periarticular Injections

In a literature review by Fu, Wang, Zhang, Cheng, & Zhang (2017), six studies examined femoral nerve blocks (FNBs) compared with PAIs in the context of pain control and mobilization after TKA. Patients who had the PAI reported lower pain scores and better early mobility than patients receiving the FNB.

Femoral Nerve Block Versus Periarticular Injections With Long-Acting Analgesia

Surdam, Licini, Baynes, and Arce (2015) studied the use of Exparel (liposomal bupivacaine) as a local anesthetic compared to FNB in TKA patients. They found that patients receiving liposomal bupivacaine had improved early ambulation and decreased LOS. Liposomal bupivacaine provided similar pain relief to FNB without compromising early rehabilitation. Liu et al. (2017) performed a meta-analysis comparing PAI with liposomal bupivacaine to FNBs for pain control after TKA. From eight studies with a total of 2,407 patients, the authors concluded that PAI with liposomal bupivacaine provided a significant benefit in improving pain or decreasing the total morphine consumption. The patients receiving PAI with liposomal bupivacaine had shorter LOS than the group receiving the FNB.

At our organization, our orthopaedic surgeons began utilizing periarticular ketorolac injections (referred to simply as ketorolac injections) prior to surgical wound closure in patients having a total joint replacement starting in 2014. When the practice started, inpatient nurses observed that patients had better pain control, were getting out of bed earlier in their postoperative period, and were discharged sooner—sometimes several hours to an entire day earlier. Stemming from these observations, we wanted to examine whether the use of ketorolac injections significantly impacted pain control as measured by decreased LOS, increased early mobilization, and opioid consumption.

Methods

We are a 473-bed tertiary care teaching hospital in a university setting. Our patient population comes from a tristate regional area. After receiving institutional review board approval, we conducted a retrospective chart review of patients who had undergone either a total knee or total hip arthroplasty from January 1, 2012, to December 31, 2014. Our intention was to capture patients both pre- and postketorolac intervention. Patients were randomly sampled from a pool of 2217 who had undergone either of these procedures during that time frame. Patients were included if they had more than one joint replacement episode on different joints during this period. Three patients did not have traditional joint replacements in the context of this study and were therefore excluded from the randomized sample collected. Our groups were very similar in regard to demographic data leading to a greater tolerance of a smaller random sample size.

Patients were placed on a standardized postoperative order set. Most patients undergoing TKA received an FNB as part of their standard postoperative orders whereas patients who had undergone THA received an epidural, which was the standard prior to the introduction of periarticular ketorolac injections. In addition, patients in the ketorolac group also received a periarticular ketorolac "cocktail" injection of ketorolac bupivacaine, and epinephrine. The order set for total joints included standard orders for scheduled and as-needed opioids.

Data were collected on LOS in hours, opioid consumption while on the inpatient unit, and distance walked in PT sessions. We also noted which discipline (nursing or PT) got the patient out of bed for the first time. We chose to use PT distance walked rather than nursing documentation due to a more consistently recorded measure in exact distance (ft) as compared with nursing who documented in estimated measures (i.e., back and forth to bathroom, etc.). These data measures reflect earlier postoperative patient mobilization. Opioid consumption was converted in morphine equivalents (MMEs) with the exception of Ultram (tramadol) as direct conversion to tramadol is not recommended (Centers for Disease Control and Prevention [CDC], 2016).

Sample

No difference was noted between the group receiving the ketorolac injection versus the group not receiving the ketorolac in terms of gender, age, prior opioid consumption nor type of joint replaced. Therefore, we decided to describe the demographics as a whole rather than breaking it up into smaller, stratified groups. Our sample included 86 total knee replacements, 73 total hip replacements, and 2 unicompartmental knee replacements. Eighty-eight patients were female and 73 male. Patients ranged in age from 20 to 88 years with a mean of 62.8 years. Forty-two of the patients were on opioid therapy for pain control prior to surgery. In our sample, 43 had undergone previous joint replacements. Forty patients received the ketorolac injection prior to surgical wound closure. One hundred twenty-one patients did not receive the ketorolac injections. See Table 1.

Table 1. Sample Characteristics

Demographics (N = 161 Subjects)		
Variable	*M*	Range
Age	62.8 years	20–88 years
Category	*n*	
Gender		
Male	73	
Female	88	
Surgery type		
TKA	86	
THA	73	
UKA	2	
Previous joint replacement		
Yes	43	
No	118	
Prescribed opioid therapy prior to joint replacement		
Yes	42	
No	119	
Received ketorolac injection		
Yes	40	
No	121	

Note. TKA = total knee arthroplasty; THA = total hip arthroplasty; UKA = unicompartmental knee arthroplasty.

Results

Analysis of variance was used to determine the difference between groups: patients who received ketorolac injection prior to wound closure versus those who did not.

Average LOS for patients not receiving the injection was 64.3 hours compared with 50.96 hours for those who did, which was a statistically significant ($p < .001$) difference.

Traditionally, patients remained in bed until their first PT session on postoperative day 1. As patients were mobilizing earlier, nursing staff were now ambulating the patients for their first time on postoperative day zero. The patients who tended to mobilize earlier in their recovery were often those who received the ketorolac injection, though this finding was not statistically significant. Patients receiving the injection ambulated further distances in their first PT sessions after having already mobilized on the day of surgery. Patients who received the ketorolac injection ambulated an average of 92 ft in their first PT sessions compared with those in the nonketorolac injection group who ambulated 45 ft. This was statistically significant ($p < .001$).

On the day of surgery and on postoperative day 1, no statistical significance was found between the groups in terms of receiving as-needed opioids (day of surgery: 26.9 MME in the ketorolac group vs. 30.98 MME in the nonketorolac group; $p = .398$; postoperative day 1: 57.49 MME in the ketorolac group vs. 76.32 MME in the nonketorolac group; $p = .055$). Although the drop in MME received on postoperative day 1 was not *statistically* significant, the *clinical* significance of lower opioid consumption impacts adverse effects of opioids, including sedation, respiratory depression, dependence, and death (Colvin, Bull, & Hales, 2019). There was no difference in scheduled opioid therapy between the two groups.

Discussion

Our findings are unique as previous studies have not considered LOS in terms of hours to discharge in relation to the ketorolac injection. Surdam et al. (2015) looked at LOS in terms of hospital days, whereas our study specifically measured LOS in hours from arrival to floor to time of discharge. Our data are consistent with published literature that shows that patients receiving ketorolac injection prior to wound closure experienced reduced LOS (Surdam et al., 2015). With increasing healthcare costs, expediting discharges even by a few hours will impact hospital costs.

A meta-analysis completed by Fu et al. (2017) supported the finding that patients undergoing TKA fared better with periarticular ketorolac injection compared with FNB regarding earlier mobility. It is of clinical significance that the group receiving ketorolac injections mobilized further distances on their first PT session regardless of whether it was the actual day of surgery or 1 day postoperative. During the study, we also identified a shift in nursing practice, with nursing staff getting the patients out of bed earlier and encouraging patients to begin PT on the day of surgery. Traditionally, patients waited until postoperative day 1 for the physical therapist to facilitate their first ambulation. Patients receiving ketorolac injections got out of bed with the nursing staff (vs. PT) 37% of the time compared with only 14% when not receiving the injection. Earlier mobility is well documented to mitigate a myriad of postoperative complications including pneumonia, deep vein thrombosis, pulmonary embolus, and postoperative ileus (Clarke & Santy-Tomlinson, 2014). New joint commission performance measure for the total joint accreditation program recommends that patients ambulate on day of surgery within 4 hours of discharge from the postanesthesia care unit (The Joint Commission, 2017b).

In addition to earlier mobility, patients receiving the ketorolac injection also performed better in terms of distance walked in their first PT session. Patients who ambulated further were cleared by PT for discharge earlier. The LOS decreased from 3 days in 2012 to 2.2 days at the end of 2014. Like Anderson et al. (2014), we found that patients in the ketorolac group ambulated further and were more likely to participate in PT on the day of surgery. Because we were aiming to encourage earlier mobilization, our PT department added evening hours to increase the availability of PT for patients.

Niemelainen et al. (2014) showed that patients who received the LIA used less opioids in the first 48 hours after surgery compared with the placebo group. Niemelainen et al. (2014) also found that LIA had the greatest impact for pain control in the first 6 hours postoperatively. Hinarejos et al. (2016) found that patients who received an LIA with their FNB or sciatic nerve block

had lower pain scores 12 hours postoperative compared with those receiving a placebo. Similarly, our results showed that patients who received PAI of ketorolac had less opioid consumption through postoperative day 1.

Use of large doses of opioids is concerning because it places patients at risk for accidental overdose and dependence. In 2016, there were 17,087 deaths in the United States attributed to prescription opioids (Department of Health and Human Services, 2017). Dosages greater than 50 MME per day increase the risk of overdose by twofold (CDC, 2017). At the time of our study (2012–2014), patients often exceeded 50 MME. This was during a time when high doses of opioids to thwart pain were more widely accepted. Our patients who did not receive the ketorolac injection averaged higher opioid consumption in MMEs placing them at higher risk for accidental overdose and postsurgical opioid dependence. With opioid use and misuse at epidemic levels, we need to find ways to reduce their use. Utilization of ketorolac injections is one way this can be achieved.

Limitations

Due to the nature of a retrospective study, about 25% of our sample received the ketorolac injections, making our groups disproportionate. However, we were still able to appreciate statistical significance between groups despite our smaller sample size of patients receiving the ketorolac injection. Although patients followed a standardized postoperative order set, there were minimal variations due to individualized patient needs regarding level of pain control, side effects of pain medications, and allergies.

Another limitation to our study was related to nurse perception of patient pain. It is possible that registered nurses continued to follow the standardized postoperative order set for opioid administration without considering that many of the patients in the ketorolac injection group potentially required lower doses of opioid pain medication. During the study period, opioids were being prescribed more liberally and patients were often discharged with larger quantities of opioid than they required. Nurses are crucial in educating patients in opioid safety and strategies for tapering use.

Based on these findings, we plan to use this information to explore the patient experience on pain management. We would like to conduct prospective studies on this topic especially in the context of the use of liposomal bupivacaine compared with ketorolac injections prior to wound closure to find out if one of these methods is superior.

Conclusion

Patients undergoing hip and knee replacements need improved methods of pain control. Our study showed that ketorolac injections can reduce LOS and encourage earlier time to mobilization at a statistically significant level. We also showed that ketorolac injections reduce opioid consumption, but the difference was clinically (not statistically) significant.

References

Andersen, L., & Kehlet, H. (2014). Analgesic efficacy of local infiltration analgesia in hip and knee arthroplasty: A systematic review. *British Journal of Anaesthesia*, *113*(3), 360–374.

Anderson, B., Donnelly, M., Groose, M., Chambers, T., & Schroeder, K. (2014). Changing from epidurals to femoral nerve catheters for postoperative analgesia following total knee arthroplasty: Analysis of efficacy versus nurse perception. *International Journal of Orthopaedic and Trauma Nursing*, *18*, 4–12.

Centers for Disease Control and Prevention. (2016). *Calculating total daily dose of opioids for safer dosage*. Retrieved from www.cdc.gov/drugoverdose/prescribing/guideline.html

Clarke, S., & Santy-Tomlinson, J. (2014). *Orthopaedic and trauma nursing: An evidence-based approach to musculoskeletal care*. Chichester, UK: Wiley Blackwell.

Colvin, L. A., Bull, F., & Hales, T. G. (2019). Perioperative opioid analgesia—when is -enough too much? A review of opioid-induced tolerance and hyperalgesia. *Lancet*, *393*, 1558–1568.

Department of Health and Human Services. (2017). *The opioid epidemic by the numbers*. Retrieved www.hhs.gov/opioids/about-the-epidemic/index.html

Fu, H., Wang, J., Zhang, W., Cheng, T., & Zhang, X. (2017). Potential superiority of periarticular injection in analgesic effect and early mobilization ability over femoral nerve block following total knee arthroplasty. *Knee Surgery Sports Traumatology Arthoscopy*, *25*, 291–298.

Hinarejos, P., Capurro, B., Santiveri, X., Ortiz, P., Leal, J., Pelfort, X., … Monllau, J. (2016). Local Infiltration analgesia adds no clinical benefit in pain control to peripheral nerve blocks after total knee arthroplasty. *Knee Surgery Sports Traumatology Arthroscopy*, *24*, 3299–3305.

Liu, S., Chen, X., Yu, C., Weng, C., Wu, Y., Xiong, J., & Xu, S. (2017). Comparison of periarticular anesthesia with liposomal bupivacaine with femoral nerve block for pain control after total knee arthroplasty. *Medicine*, *96*(13), 1–9.

Niemelainen, M., Kalliovalkama, J., Aho, A., Moilanen, T., & Eskelinen, A. (2014). Single periarticular local infiltration analgesia reduces opiate consumption until 48 hours after total knee arthroplasty. *ACTA Orthopaedica*, *85*(6), 614–619.

Singh, J. A., & Yu, S. (2017). *Rates of total joint replacement utilization in the U.S.: Future projections to 2020-2040 using the national inpatient sample*. Retrieved from https://acrabstracts.or'abstract/rates-oftotal-joint-replacement-utilization-in-the-u-s-future-projections-to-2020-2040-using-the-national-inpatient-sample/

Surdam, J., Licini, D., Baynes, N., & Arce, B. (2015). The use of Exparel (liposomal bupivacaine) to manage postoperative pain in unilateral total knee arthroplasty patients. *The Journal of Arthroplasty*, *30*, 325–329.

The Joint Commission. (2017a). *Total hip and total knee replacement*. Retrieved from https://www.jointcommission.org/total_hip__total_knee_replacement_/

The Joint Commission. (2017b). *Total hip and total knee replacement inpatient performance measurement implementation guide*. Retrieved from www.jointcommission.org/assets/1/6/THKRIP_Manual2018January_New.pdf