Dexamethasone or Dexmedetomidine Adjuvants to Peripheral Nerve Blocks for Total Knee Replacement

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Abstract

Problem and Purpose: At a community hospital, Total Knee Arthroplasties (TKAs) comprise 6.5% of all scheduled procedures, approximately 40 per month. Adequate postoperative pain control is critical for avoiding complications. The adductor canal block (ACB) and the interspace between the popliteal artery and capsule of the knee (IPACK) peripheral nerve blocks (PNBs) control postoperative pain; however, they only last 12–18 hours. Addition of dexamethasone or dexmedetomidine to local anesthetics used for PNBs have been identified to prolong their duration and improve postoperative pain control. The purpose of this project was to implement a guideline on additions of dexamethasone or dexmedetomidine to ACB and IPACK PNBs for TKAs to prolong the PNB for pain control. **Methods:** A guideline regarding use of dexamethasone and dexmedetomidine was created with input from anesthesia leadership. The anesthesia staff were educated during a staff meeting, the guideline was posted in operating rooms, and staff started adding either adjunct medication to the local anesthetic used for PNBs for TKAs. Over a 15-week period, compliance with the guideline was measured, along with pain scores in the post anesthesia care unit, 8, 16, 24 hours, or until discharge after a 23-hour observation. Data was collected weekly and analyzed using a run chart and descriptive statistics. Exclusion criteria were revision TKA, anxiety or depression on medication, and chronic pain on home opioids. **Results:** 94 patients were included. 38.9% of patients receiving PNBs had dexamethasone added (n=37). No PNBs used dexmedetomidine. 61.1% of PNBs did not have any adjunct added (n=58). 30.8% of patients had severe pain scores postoperatively (n=29). 24.2% of patients with severe pain had dexamethasone added (n=7). Median compliance with guideline use was 28%. **Conclusions:** There was no association with the implementation of the guideline and increased use of adjunct medications. Patients who received dexamethasone had

less incidence of severe pain. Addition of dexamethasone to PNBs is a low-cost way to improve pain scores postoperatively. Less severe pain scores improve patient satisfaction and removes a barrier to mobilization, reducing incidence of postoperative complications.

Keywords: Adductor Canal Block, dexmedetomidine, dexamethasone, Total Knee Arthroplasty

Dexamethasone or Dexmedetomidine Adjuvants to Peripheral Nerve Blocks for Total Knee Replacement

Total knee arthroplasty (TKA) is a commonly performed orthopedic procedure, with more than 700,000 estimated procedures performed annually in the United States (Kopp et al., 2017). At an urban community hospital, TKAs comprise 6.5% of all scheduled procedures, equating to approximately 40 per month. TKAs are considered one of the most painful orthopedic procedures (Kopp et al., 2017), and adequate pain control is essential to postoperative mobility, reducing hospital stay and costs; as well as reduction in mobility related complications such as deep vein thrombosis and atelectasis (Rutherford et al., 2017). Currently at this hospital pain is controlled post operatively by adductor canal blocks (ACB) and interspace between the popliteal artery and capsule of the posterior knee (IPACK) peripheral nerve blocks (PNB), in combination with a multimodal pain control strategy using opioid and non-opioid oral analgesics during the anticipated 23-hour observation recovery period. In the past 6 months, orthopedic surgeons have requested prolonged PNBs to improve postoperative pain control. Pain scores extracted from chart review have also shown an increase in pain scores after the PNBs have worn off, about 12-18 hours. Root causes of inadequate pain control at this site are demonstrated in a fishbone diagram in figure 1. Extension of the PNB duration can be achieved by adding adjuvant medications with the local anesthetics; however, there was no policy or guideline in place at the facility. Opioids for pain control are effective but have many undesirable side effects such as respiratory depression, somnolence, and long-term dependence (Li et al., 2019). Other analgesics such as Acetaminophen and Celecoxib are used to reduce opioid consumption however have their own undesirable side effects; namely, alterations in liver function for acetaminophen and bleeding and alteration of kidney function for celecoxib (Kopp et al., 2017).

The purpose of this Doctor of Nursing Practice (DNP) quality improvement (QI) project was to implement a guideline on addition of dexamethasone or dexmedetomidine to adductor canal and IPACK nerve blocks for TKAs and evaluate the effectiveness of those adjunctive medications.

Literature Review

Dexamethasone or dexmedetomidine in addition to the local anesthetic in PNBs have been shown to increase duration of analgesia received from the block (Zhao et al., 2020). An evidence review and synthesis was conducted as shown in Appendix A to investigate the current evidence to support this practice change. All studies reviewed had a level IA rating as determined by the Johns Hopkins Nursing Evidence-based Practice Level Hierarchy of Evidence Guide (Dang, Dearholt, Bissett, Ascenzi, & Walen, 2022). Adding dexamethasone 4 mg to nerve blocks decreased pain and reduced the need for rescue analgesics (Ortiz-Gómez et al., 2017). The 4 mg of dexamethasone adjunct prolonged the adductor canal nerve block to an average of 37.9 hours compared to 1 mg dexamethasone and improved pain scores at 24 and 30 hours postoperatively (Turner et al., 2018). Increasing the dexamethasone to 8 mg significantly increased the duration of the PNBs by an average of 9 hours and reduced morphine consumption with no adverse effects noted (Wang et al., 2017). Adding dexmedetomidine 0.5 mcg/kg to local anesthetics in a PNB decreased pain and prolonged the duration of peripheral nerve blocks compared to 0.25 mcg/kg with minimal changes in vital signs and motor function (Goyal et al., 2017). In comparison, dexmedetomidine 2 mcg/kg resulted in longer duration of analgesia by about 1 hour compared to 1 mcg/kg and also decreased opioid consumption with 2 mcg/kg compared to 1 mcg/kg (Packiasabapathy et al., 2017). Contrastingly, Ortiz-Gomez et al., (2017)

noted a single dose of 100 mcg of dexmedetomidine did not affect pain scores when added to PNBs.

Based on the evidence synthesis, there was strong evidence the addition of 4 to 8 mg of dexamethasone increases PNB analgesia time and reduces pain scores with minimal adverse effects. Regarding dexmedetomidine, there is good but conflicting evidence for the addition of dexmedetomidine 1 to 2 mcg/kg perineurally to increase block duration and reduce pain scores, with minimal adverse effects.

Theoretical Framework

The quality improvement framework chosen to guide this project is the Knowledge to Action framework. Figure 2 shows a visual representation of the framework. The Knowledge to Action framework provides an avenue for knowledge translation through knowledge creation and application through an action cycle. Knowledge synthesis has been done through a literature review and was implemented after assessing barriers with adaptations to context at the facility. During implementation, knowledge use was simultaneously monitored and evaluated for outcomes. At the conclusion of the implementation phase, favorable results were shared with the staff through positive reinforcement to sustain the change and negative results were used to identify further barriers to implementation; repeating this cycle will improve implementation for future quality improvement initiatives.

Methods

Context

The previous process at this hospital is outlined in Figure 3. Anesthesia providers did not routinely add adjunct medications of any kind to their PNBs. On the day of surgery, the patient was consented for anesthesia and any PNBs. Intraoperatively, adductor canal and IPACK nerve

block were attempted after induction of anesthesia. Postoperatively, the patient either went home later that day or was admitted for a 23-hour observation and discharged home the next day barring any complications. The implemented process map is outlined in Figure 4. Implementation of a guideline regarding the use of dexamethasone or dexmedetomidine was the desired process change, guiding the anesthesia provider in determining addition of one of the drugs to the local anesthetic used for the blocks. Contextual factors relevant to the implementation are anesthesia provider independence, surgeon requests, and anesthesia department cohesion. Anesthesia providers generally practice independently regarding PNBs. Whether it be a Certified Registered Nurse Anesthetist (CRNA) or a physician Anesthesiologist, it is up to them whether or not a block is performed. If the block is outside of their abilities, they can attempt to recruit another anesthesia provider to assist with the PNB. The choice of local anesthetic drug and final concentration varies amongst providers. The anesthesia department, however, has open communication about which blocks to use, the volume, and the concentration of local anesthetic most appropriate to help guide others in learning regional anesthesia techniques. The orthopedic surgeons may also request their patient receive or not receive a regional anesthetic. Factors such as which anesthesia provider was performing the block and whether the surgery is on time have precluded the use of blocks for total knee arthroplasties. The anesthesia department had weekly departmental meetings with monthly journal clubs with the goal of keeping up to date with the latest literature, allowing for an opportunity to improve education for the staff during this QI project.

Intervention

The intervention was to create and implement a guideline regarding the addition of 4 mg of dexamethasone or dexmedetomidine 1 mcg/kg to the local anesthetic used for adductor canal

and IPACK blocks for TKAs. The guideline advised patient selection, dosages, and potential adverse effects. Exclusion criteria were any patient receiving a revision TKA, anxiety or depression on medication, and chronic pain on home opioids. Patients receiving revision surgeries were excluded because these procedures are more painful. Patients receiving anxiety and depression medications or home opioid use were excluded due to these medications altering pain response which were considered confounding variables potentially limiting the analysis of the effect of the adjuvant medications (Armstrong et al., 2020). Implementation started on September 1st with an education session at an anesthesia staff meeting, and the education presentation was emailed to all anesthesia providers to cover anyone not in attendance. Questions and feedback were sought; commitments from key anesthesia providers who routinely perform ACB and IPACK blocks for TKA were obtained. A printed copy of the guideline was placed on the PNB cart and in the orthopedic operating rooms (ORs) to help remind anesthesia providers to implement the guideline. A quick response (QR) code was also placed on the physical copies of the guideline so clinicians could scan and save a copy of the guideline on their phone for easy reference. Figure 5 depicts the guideline implemented. Check ins with the anesthesia department were performed monthly at the departmental meeting, along with data reports. At week ten of implementation, a poster with run charts and favorable data was placed in the anesthesia lounge to remind anesthesia providers to implement the guideline.

Measures

Structure goals include creation and implementation of a guideline advising use of adjuncts medications in adductor canal and IPACK nerve blocks and ensuring proper par stock of dexamethasone and dexmedetomidine in the operating room , both measured by a simple complete or incomplete. The process goal was the addition of adjunct medications to 100% of

adductor canal and IPACK nerve blocks by October 1st, measured by the total number of blocks with adjunct medications divided by all blocks performed for a TKA. The outcome goal was by October 1st, patients who receive an adjunct in their PNB for a TKA will have a pain score of less than 7 for 24 hours post PNB. This goal was measured by tracking pain scores using the 0-10 scale for pain currently in use at the hospital. Intervals for pain evaluation were on arrival to the post anesthesia care unit (PACU), 8, 16, and 24 hours post operatively or until discharge after 23-hour observation. Pain scores on arrival to the PACU determined if the PNB failed. All other pain score timing determined length of PNB analgesia.

Data collection was done through weekly chart review on the hospital's Virtual Private Network (VPN) in a private place. To ensure all eligible participants were captured, the operating room schedule was obtained each week and evaluated for any non-revision TKA being performed. Charts were reviewed for patient past medical history, home medication use, PNB documentation, and pain scores. Appendix B shows the data collection tool. PNB documentation was reviewed on the scanned anesthesia record, scanned PNB time out form, and electronic PNB note to ensure all information documented about the PNB was captured. Data was entered into REDCap, a HIPAA compliant, password protected server, accessed through a private VPN. All data saved locally from REDCap for analysis were de-identified. Quantitative data analysis was done for the process goal through the use of run charts to illustrate the percentage of blocks performed with adjuncts over time. Any further interventions applied after monthly evaluations of the data, such as education or presentations, were noted to evaluate the effect of those interventions on the run chart. Pain score data was interpreted in a table indicating number of patients with severe pain (pain rating greater than seven), for patients with no adjunct, patients who received dexamethasone, and patients who received dexmedetomidine. Descriptive statistics

of the population were obtained; the number of patients excluded, and frequency of each exclusion criteria. Common cause variation was shown by data collection of pain scores prior to the intervention. Special cause variation was assessed in the run charts by looking for trends, shifts, number of runs, and accounting for outliers of data. Qualitative data was used for evaluation of the implementation of the project to identify gaps, barriers, and successes in the implementation phase.

Ethics

The project was conducted under a Non-human Subject's Research determination from the Human Research Protections Office (HRPO) of the UMSOM Institutional Review Board (IRB). The hospital IRB agreed further onsite IRB approval was not needed prior to implementation. No conflicts of interest were noted throughout project development and implementation.

Results

During the project implementation period 127 patients were eligible, with 33 patients excluded (25.9%) for a total of 94 patients included. 38.9% of patients received dexamethasone in their PNB (n=37). No patients received dexmedetomidine. The reasons patients were excluded were for revision surgery, anxiety, depression, home opioid use, documented neuropathy, and receiving general anesthesia. Of the included patients, 30.8% had severe post-operative pain (n=29). 75.8% of those patients did not receive an adjunct in their PNB (n=22). Table 1 shows the characteristics of the population. For patients who received dexamethasone, pain scores upon arrival to the PACU range from zero to ten with an average of 0.62. At eight hours, pain scores ranged from zero to eight with an average of 3.12. At 16 hours, pain scores ranged from zero to seven with an average of 3.5. At 24 hours, pain scores ranged from zero to eight with an average

of 2.73. At discharge, pain scores ranged from zero to ten with an average of 4.03. For patients with no adjuncts added, pain scores on arrival to the PACU range from zero to ten with an average of 0.47. At eight hours, pain scores ranged from zero to ten with an average of 4.55. At 16 hours, pain scores ranged from zero to ten with an average of 4.6. At 24 hours, pain scores ranged from zero to ten with an average of 5.08. At discharge, pain scores ranged from two to ten with an average of 4.98. Figure 6 shows a run chart of compliance with the guideline implemented. The median rate of compliance with the guideline was 28.5%. There are outliers in week two, eight, and fourteen. There were only two TKAs performed in week two. Week Eight only had three TKAs performed. Week fourteen only had two TKA performed. Intervention points at weeks three, four, and ten did not influence compliance with the guideline as there was no shift in median rate of compliance. There are no runs of data as all points were fluctuating around the median, therefore there was no common cause variation of adjunct medication use and guideline implementation. Statistics obtained from the QR code placed on the printed guideline showed only one unique scan during the implementation period.

Discussion

Overall compliance with the guideline was poor. After implementation, it was found anesthesia providers maintained hesitancy with addition of adjunct medications, feared side effects of the guideline's adjunct medications, or simply forgot the guideline existed. The QR code placed on the posted guideline was underutilized, the intent was for anesthesia providers to be able to save the guideline to their cell phones to refer to at any time. Continued reminders and reporting of favorable results throughout implementation were not able to improve compliance with guideline use through decreasing anesthesia provider hesitancy. The orthopedic CRNAs who did buy into the QI initiative did not influence others to implement the guideline as

expected. Dexmedetomidine was not added to any PNBs; this was found to be due to the perceived cost of the drug by the anesthesia staff and the drug being stored in a separate location making it more difficult for staff to obtain. After further investigation into the patient charts, one anesthesia provider performed all the TKAs in weeks two, nine, and ten leading to 100% compliance in those weeks.

Pain scores overall were lower at each time mark in the patients who received dexamethasone, except for in the PACU. These results are similar to the results found in the literature review; however, further data analysis is required to determine if the decrease in pain scores is statistically significant as it was in the literature. Reasons for high pain scores in the PACU could be due to failed PNB, spinal anesthesia wearing off, and individual variability in pain tolerance or reporting. Average pain scores remained four to five for all time marks, with no large increase in pain scores that would be expected from a PNB wearing off. Further time intervals may be needed to evaluate the extent of the PNB duration both with and without adjunct medications added. Discharge pain scores are most likely unreliable as data points due to both 23-hour observation patients and patients who went home the same day were lumped into this category. Discharge times were also inconsistent; some patients were discharged before 24 hours and some more than 1 day postoperatively. For further QI implementation, data points for 23-hour observation and same day patients should be separated.

Conclusions

This QI project has shown the addition of dexamethasone to the local anesthetic used in PNBs is a low-cost way to improve pain scores over plain local anesthetic with no adjunct medications added. Overall pain scores were lower and there was less incidence of severe pain. Unfortunately, no conclusions were able to be drawn regarding dexmedetomidine. Reduction of

pain scores improves postoperative mobilization and improves patient satisfaction (Goyal et al., 2017). The guideline implemented for addition of local anesthetics did not influence the rate at which anesthesia providers added adjunct medications to their PNBs for TKAs.

To ensure sustainability of this QI project, the physical guideline will be continued to be posted in the ORs and in the anesthesia break room. Champions identified during implementation have verbally agreed to encourage other anesthesia providers to add adjunct medications to their PNBs, including the lead orthopedic CRNA. Finally, the favorable results from this QI project have been shared at an anesthesia staff meeting to help sway unsure anesthesia providers. There is potential for spread of this QI project to other hospitals, as the implementation hospital has anesthesia staff that work at other hospitals and a large rotating student nurse anesthetist population from three local nurse anesthesia programs.

Future QI initiatives should further promote the use of dexmedetomidine, measure mobility in the 23-hour stay population, and extend the time frame studied by calling patients at home to inquire about PNB quality and duration. Next steps should include patients excluded from this QI project, namely revision TKA, depression, anxiety, and chronic pain patients on home opioids.

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Table 1

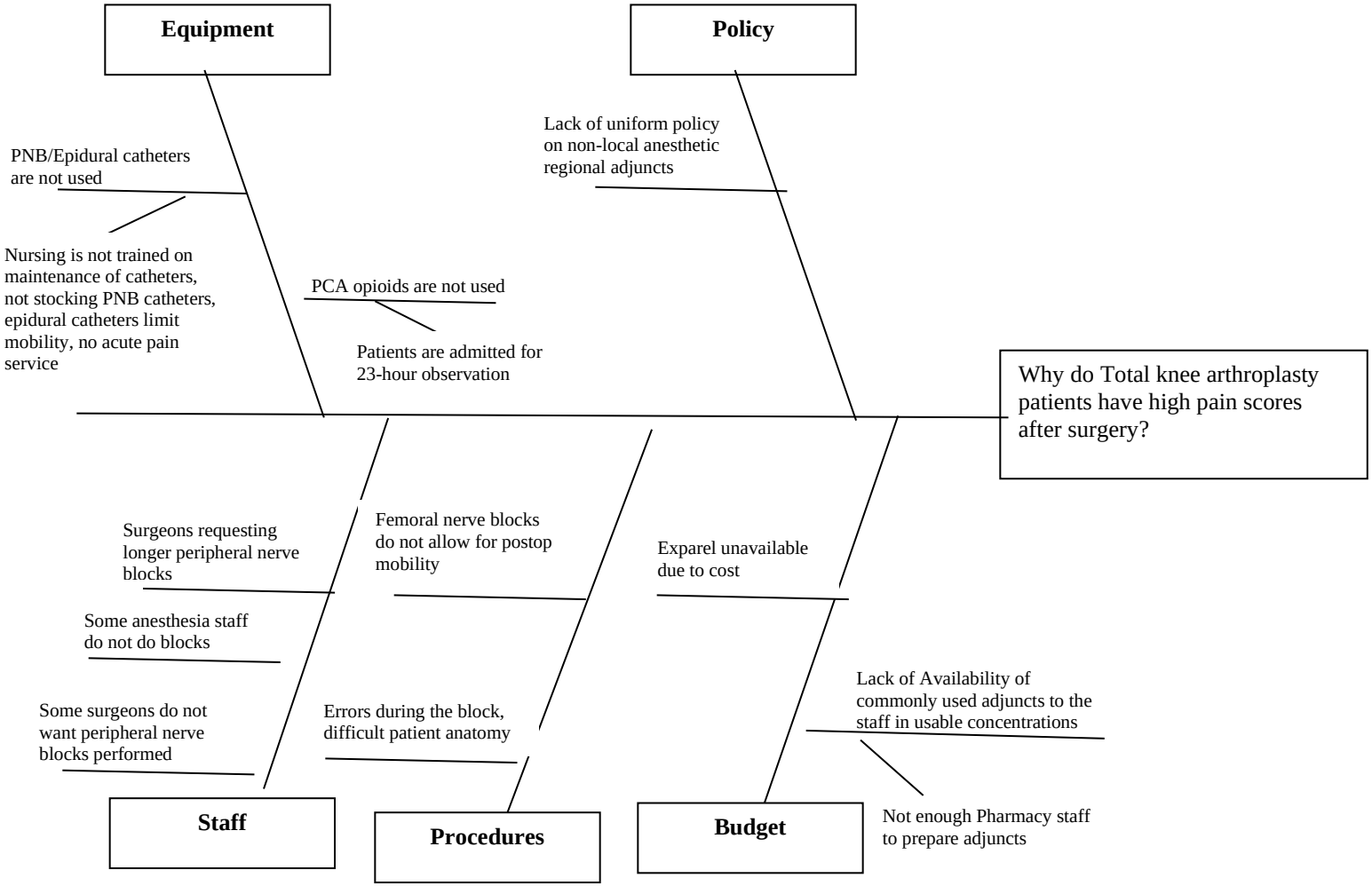
Patient Characteristics

Total Number of Eligible Patients	127	%
Number Included	94	74.1%
No Adjunct added	58	61.1
Dexamethasone Added	37	38.9
Dexmedetomidine Added	0	0
Number Excluded	33	25.9%
Revision Surgery	12	36.4
Anxiety	7	21.2
Depression	7	21.2
Home Opioid Use	4	12.1
Neuropathy	1	3
General Anesthesia	2	6
Patients with Severe Pain	29	30.8%
No Adjunct	22	75.8
Dexamethasone	7	24.2
Dexmedetomidine	0	0

Note. Patient Characteristics

Figure 1

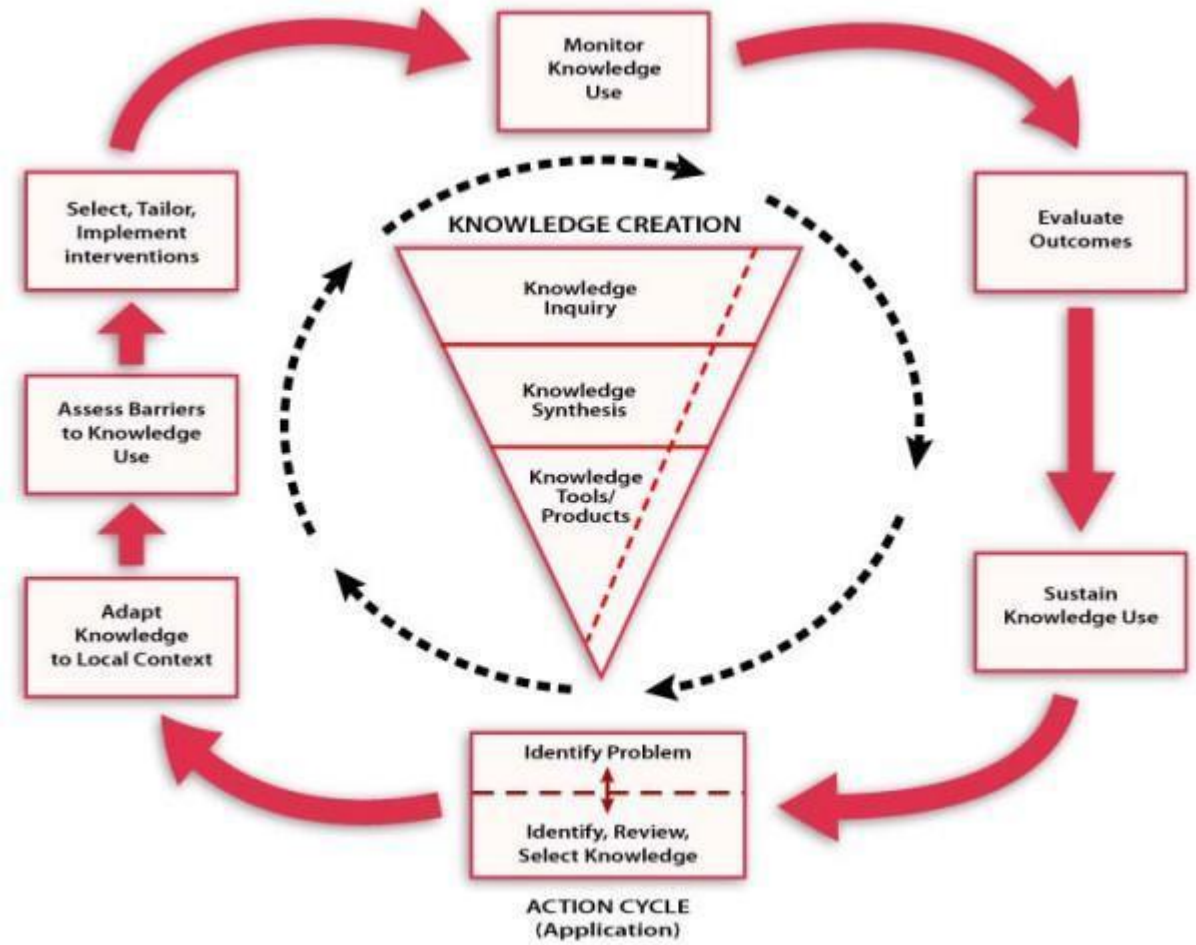
Fishbone Diagram



Note. Root cause analysis of factors contributing to postoperative pain following a total knee arthroplasty

Figure 2

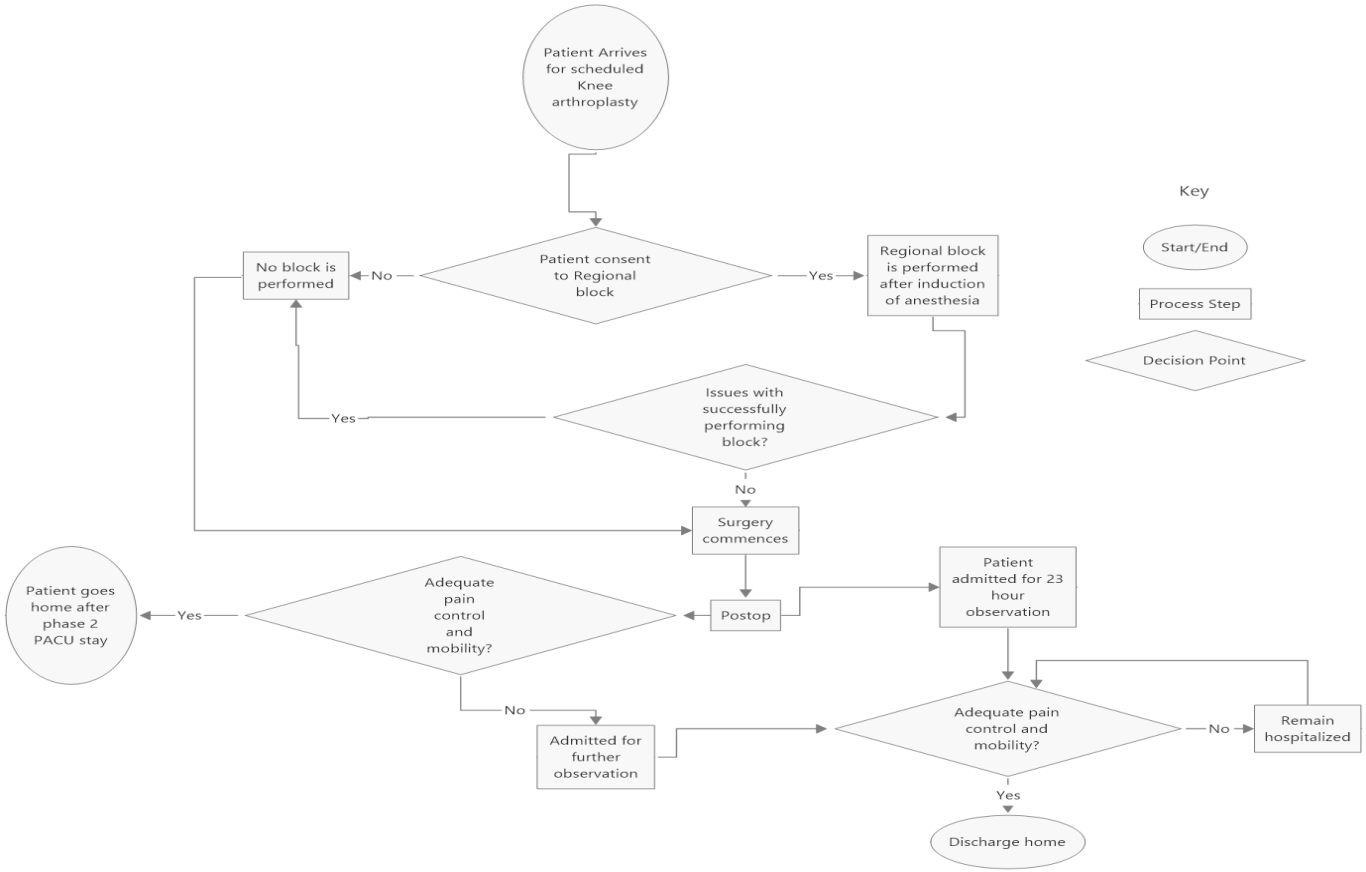
Knowledge to Action Framework



Note. Image from Graham et al.,(2006)

Figure 3

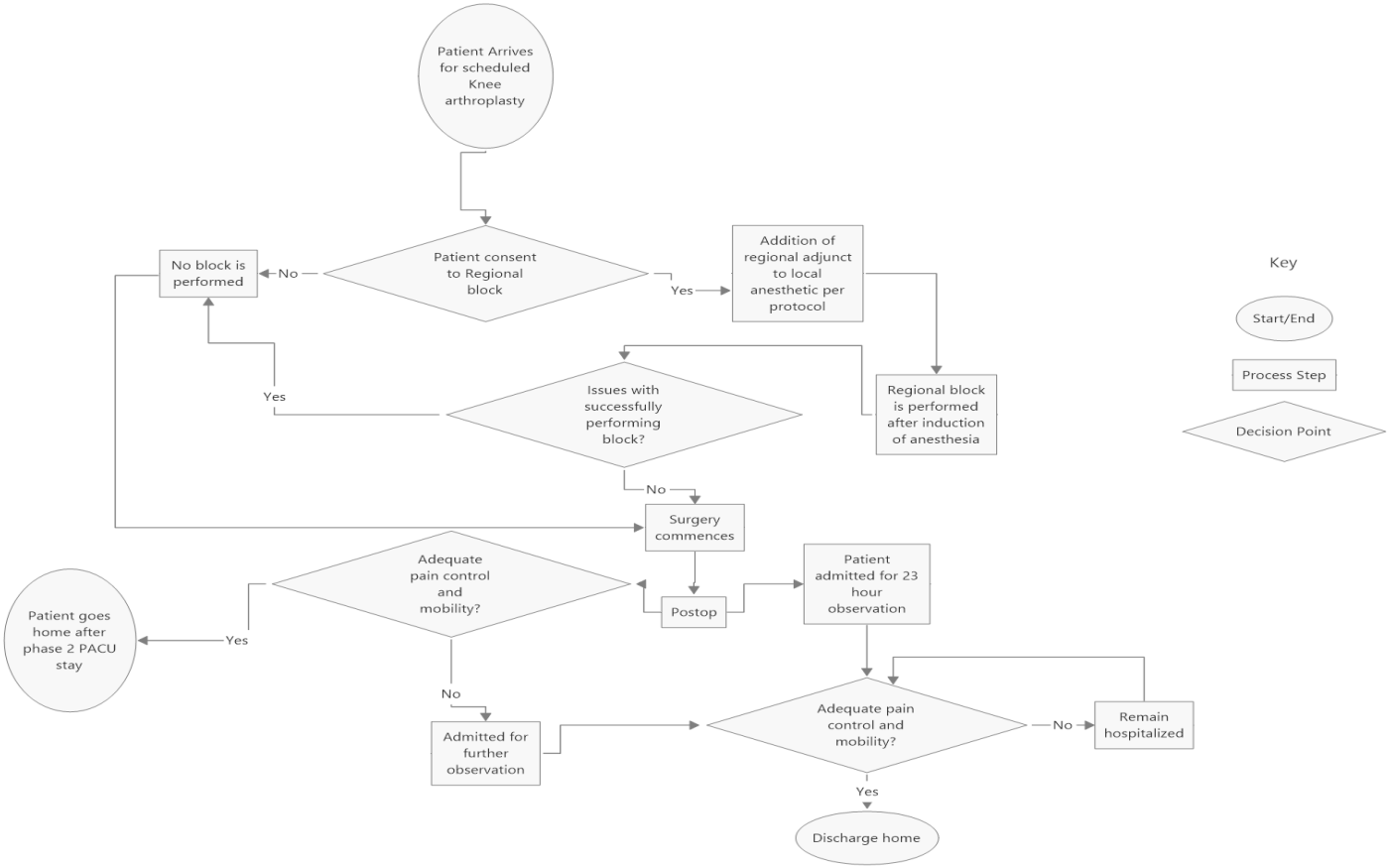
Previous workflow Process Map



Note. Process map of prior process of peripheral nerve block administration for TKA

Figure 4

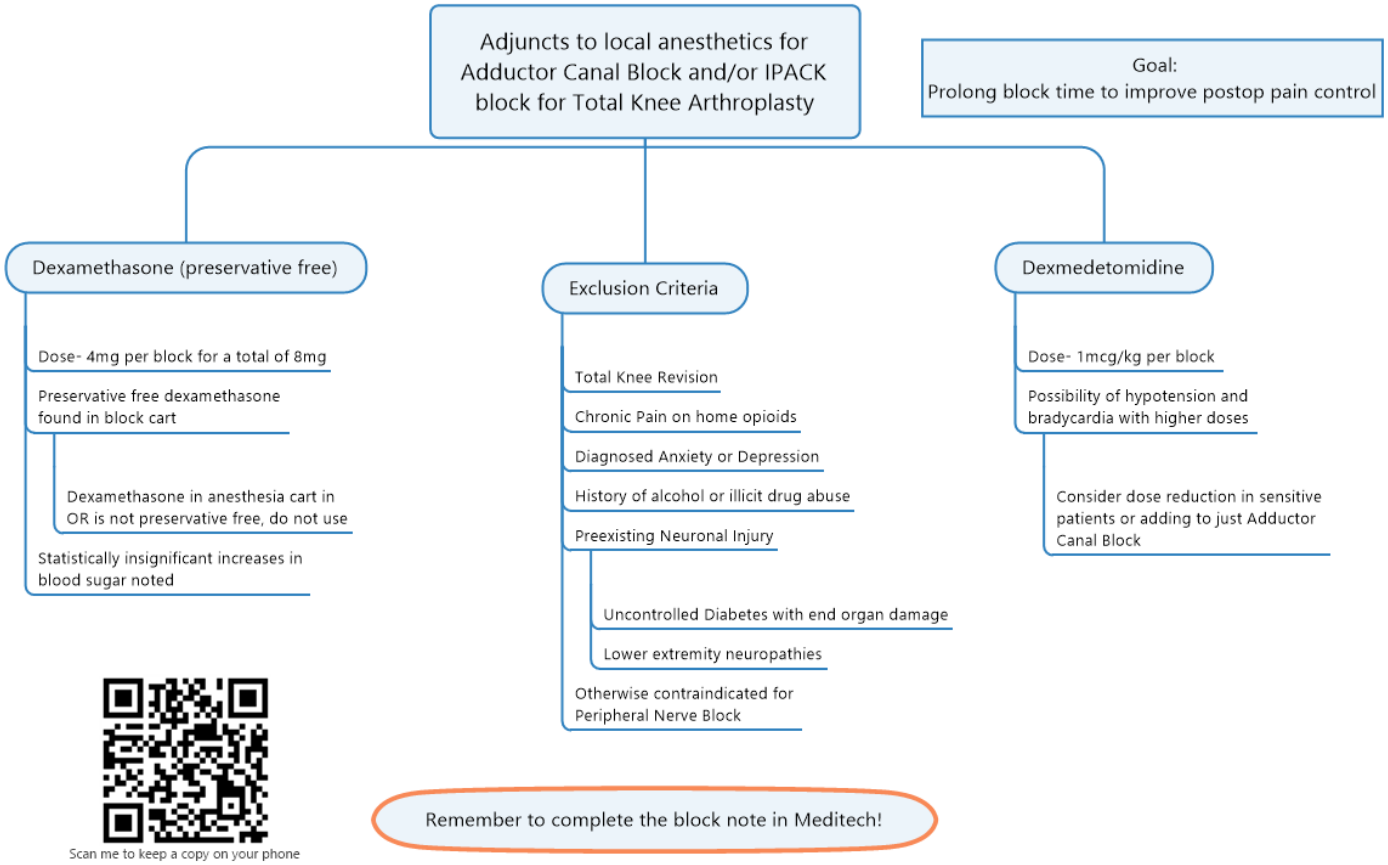
Implemented Process Map



Note. Process map with desired process change for peripheral nerve block administration for TKA

Figure 5

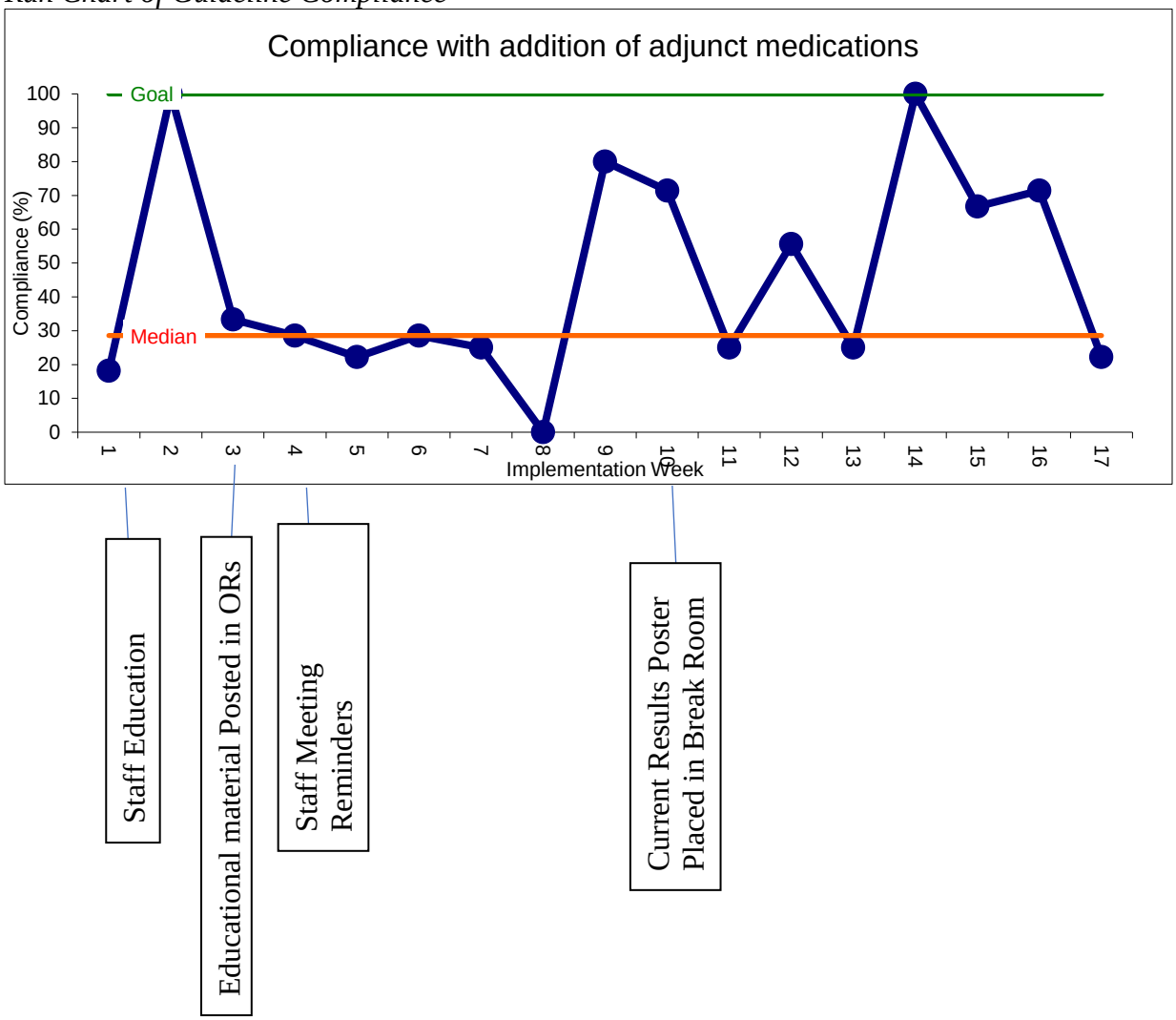
Guideline for Addition of Adjunct Medications to Peripheral Nerve Blocks



Note. Final guideline as posted in ORs

Figure 6

Run Chart of Guideline Compliance



Note. Run chart depicting compliance with the implemented guideline

Appendix A

Table 1

Evidence Review Table

Goyal, R., Mittal, G., Yadav, A. K., Sethi, R., & Chattopadhyay, A. (2017). Adductor canal block for post-operative analgesia after simultaneous bilateral total knee replacement: A randomised controlled trial to study the effect of addition of dexmedetomidine to ropivacaine. *Indian Journal of Anaesthesia*, *61*(11), 903–909. https://doi.org/10.4103/ija.IJA_277_17					**Level and Quality IA**
Purpose/ Hypothesis	**Type of Evidence Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
To evaluate the duration of analgesia after Adductor Canal Block (ACB) after simultaneous bilateral total knee replacement (SBTKR)	Randomized, controlled, three-arm parallel group study	Setting- High volume joint replacement center in New Delhi, India Population- Age 18-75, BMI 20-35 kg/m2, ASA class I or II, who are scheduled for a SBTKR. Excluded were allergies to study drugs, oral opioids in the past 3 months, pregnancy, nerve block unable to be performed, and cognitive dysfunction Sampling Technique: Convenience # eligible: 200 # accepted: 150 # in control: 49	Control- Group A Adductor canal block with Ropivacaine 10ml 0.75% plus 10ml saline Intervention- Group B Adductor Canal block with ropivacaine 10ml 0.75% plus 0.25mcg/kg dexmedetomidine plus saline to reach total volume of 20mL 2nd intervention-Group C Adductor Canal block with ropivacaine 10ml 0.75% plus 0.5 mcg/kg dexmedetomidine plus saline to reach total volume of 20mL Intervention fidelity- The anesthesiologist performing the block postop was blinded to the drugs administered. Adductor canal block was performed under ultrasound guidance. Pregabalin 75mg, etoricoxib 90mg and	DV: Duration of analgesia Secondary outcomes- 24 hour opioid consumption, success of early ambulation, level of satisfaction, and adverse effects following intervention State the instrument, reliability, and measurement procedure: Numeric rating scale 1-10 (1 being least pain and 10 being worst pain) was used to assess pain at 6, 12, 18, and 24 hours during the postoperative period. Time to first rescue analgesia and total tramadol consumption was noted at 24 hours. A physiotherapist assessed quadriceps motor strength by straight leg raise on a 0–5 scale pre-operatively and then at 24 h after the block as per the Medical	Statistical Results- The duration of analgesia (time between the block and rescue analgesia) was highest in Group C (mean 18.4 h ± 7.4). There was statistically significant difference between Group A and C (P < 0.001) and comparable results between Group A and B (P < 0.023); and B and C groups (P < 0.028). The number of steps walked by the patients were more in Group C as compared to Group A (P = 0.002). The difference between Group A and B was also statistically significant but not between Group B and C (P = 0.9). HR, BP, and SPO2 were comparable in all groups,

		# in intervention: 53 in dexmedetomidine 0.25mcg/kg 48 in dexmedetomidine 0.5mcg/kg No patients were lost to follow up Power analysis: power 80%, level of significance 0.05, error as 70. Total sample size was calculated as 45 per group. Power analysis was met Group Homogeneity: Groups were not significantly different from one another in terms of patient characteristics.	ranitidine 150mg were given the night after surgery and twice a day for 2 days for all patients. Iv tramadol 100mg first line for breakthrough pain.	Research Council Scale (0 = no voluntary contraction possible, 1 = muscle flicker, but no movement of limb, 2 = active movement only with gravity eliminated, 3 = movement against gravity but without resistance, 4 = movement possible against some resistance and 5 = normal motor strength against resistance). Other data noted was vital signs, adverse events (nausea, vomiting, shivering, giddiness, local pain, paresthesia, signs of local anesthetic systemic toxicity), as well as patient satisfaction scores at 72 hours postop with 1 -.not satisfied, 2 – satisfied and 3 -.better than expected.	Motor strength of quadriceps was comparable in all groups There was a significant number of patients with the level of satisfaction 1 ($P = 0.002$) in Group A, and level of satisfaction 3 in Group C ($P = 0.005$) Clinical Significance- There was less pain and longer duration of the block in group C (0.5mcg/kg dexmedetomidine) with minimal changes in vital signs and maintained motor function compared to control. Increased duration by 8 hours compared to placebo- Group C 18.4 h ± 7.4; Group B 14.6 ± 7.1; Group A 10.8 ± 7; Conclusions- addition of dexmedetomidine to ropivacaine results in longer duration of analgesia after adductor canal block for simultaneous bilateral total knee replacement surgery

Ortiz-Gómez, J. R., Perepérez-Candel, M., Vázquez-Torres, J. M., Rodriguez-Del Río, J. M., Torrón-Abad, B., Fornet-Ruiz, I., & Palacio-Abizanda, F. J. (2017). Postoperative analgesia for elective total knee arthroplasty under subarachnoid anesthesia with opioids: Comparison between epidural, femoral block and adductor canal block techniques (with and without perineural adjuvants). A prospective, randomized, clinical trial. *Minerva Anestesiologica*, *83*(1), 50–58. https://doi.org/10.23736/S0375-9393.16.11646-3					**Level and Quality** **IA**
Purpose/ Hypothesis	**Type of Evidence Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
Addition of perineural adjuvants to nerve blocks will improve postoperative analgesia	Prospective, randomized control trial	Setting- In hospital Population- 700 patients scheduled for total knee arthroplasty (TKA) 40 excluded, 16 not meeting inclusion criteria(contraindications to regional anesthesia), 24 declined to participate Sampling Technique: Convenience # eligible: 700 # accepted: 660 # in control: 82 # in intervention: Epidural- 83	Control- Subarachnoid block only Intervention- All peripheral nerve blocks received levobupivacaine 0.375%-20mL for femoral nerve block or 30mL for adductor Canal block. All adjuvant drugs were administered perineurally Femoral nerve block Femoral nerve block plus 4mg dexamethasone Femoral Nerve block plus 100mcg dexmedetomidine Adductor canal block Adductor Canal block plus 4mg dexamethasone Adductor Canal block plus 100mcg dexmedetomidine	DV: Postoperative Pain State the instrument, reliability, and measurement procedure: Pain was measured every hour except when sleeping using the VRS-11 scale explained to patients as 0 being no pain and 10 being “most horrible pain you can imagine”. Tool is validated with 1-3 being mild pain tolerated without rescue analgesia, 4-6 being moderate pain requiring analgesia, and 7-10 being severe pain.	Statistical Results- no differences between Femoral nerve block in pain (p=0.191) or rescue analgesics (p=0.078). Adductor Canal block with 4mg dexamethasone was significantly better in terms of pain (p=0.007) and need of rescue analgesics(p=0.013). than the other two adductor canal groups. Perineural dexmedetomidine had no effect in pain (p=0.078) or need for rescue analgesics (p=0.079) compared to the adductor canal group without adjuvants.

		Femoral Nerve Block- 84 (1 did not receive intervention) Femoral nerve block with dexamethasone 4mg- 82 Femoral Nerve block plus Dexmedetomidine 100mcg- 80 Adductor Canal Block- 83 (1 did not receive intervention) Adductor Canal Block with dexamethasone 4mg- 83 (1 did not receive intervention) Adductor Canal block plus dexmedetomidine 100mcg- 80 Power analysis: Not described. Group Homogeneity: No differences between groups besides height and ASA classification. No differences between groups in regard to comorbidities	Intervention Fidelity- Surgeons and anesthetists were blind to the addition of perineural adjuvants, with the medication prepared by a nurse according to randomized protocol. Postoperative analgesia received by all patients was Metamizole magnesium 8g/day IV, Dexketoprofen 50mg/8hr IV for 2 days. Rescue analgesia was 1st line 1g paracetamol IV, 2nd line was morphine 2mg. Rescue nerve blocks were also performed if indicated for refractory pain.		Comparing femoral nerve block (FNB) vs. Adductor canal block (ACB) groups, we found differences in pain between FNB+Dexa vs. ACB (P=0.002) and FNB+Dexa vs. ACB+Dexm (P=0.002) and also in rescue analgesia: FNB+Dexa vs. ACB (P=0.005), FNB+Dexa vs. ACB+Dexm (P=0.005) and ACB+Dexa vs. ACB+Dexm (P=0.044) respectively. Clinical significance- Dexamethasone 4mg added to nerve blocks decreased pain and need for rescue analgesics in both femoral nerve and adductor canal blocks. Dexmedetomidine has no significant effect on pain Conclusions Adductor canal block with perineural dexamethasone is an alternative to the femoral nerve block for postoperative pain

Packiasabapathy, S., Kashyap, L., Arora, M., Batra, R., Mohan, V., Prasad, G., & Yadav, C. (2017). Effect of dexmedetomidine as an adjuvant to bupivacaine in femoral nerve block for perioperative analgesia in patients undergoing total knee replacement arthroplasty: A dose–response study. *Saudi Journal of Anaesthesia*, *11*(3), 293. https://doi.org/10.4103/sja.SJA_624_16					**Level and Quality** **IA**
Purpose/ Hypothesis	**Type of Evidence Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
Comparing two doses of dexmedetomidine with bupivacaine in a femoral nerve block for postoperative pain relief after a total knee arthroplasty	Randomized controlled, prospective double blind trial	Setting- Department of Anesthesia AIIMS, New Delhi Population not defined # eligible: unknown # accepted: 60, ASA 1-II, 18-75 years of age, scheduled for a primary unilateral total knee arthroplasty # in control: Group A- 20 # in intervention: Group B- dexmedetomidine 1mcg/kg Group C- Dexmedetomidine 2mcg/kg Power analysis: significance level of 0.05 and power of 0.9,15 participants were required in each group. Power analysis was met	Control- bupivacaine 0.25% 20ml Intervention Group B- Bupivacaine 0.25% plus dexmedetomidine 1mcg/kg, total 20ml Group C- Bupivacaine 0.25% plus 2mcg/kg dexmedetomidine, total 20ml Intervention Fidelity- The femoral nerve block was done via nerve stimulator technique, the patients were randomized using a computer-generated random numbers list. The anesthesia provider administering the block, the patient, and the investigator collecting the data were blinded. All patients had a morphine PCA delivering 1mg	DV: Duration of analgesia, total morphine consumption, pain scores at rest and with movement. Adverse outcomes were also noted State the instrument, reliability, and measurement procedure: Duration of analgesia was determined by time to first use of the PCA from the time of the femoral nerve block. Morphine consumed via PCA and rescue morphine doses were measured. The visual analog scale (VAS) was used to measure pain scores (0- no pain, 10- worst possible pain) during rest at 0, 4, 8, 12, 24, and 48 hours postop. Pain was also	Statistical Results- Duration of analgesia was significantly longer in group B than Group A ($p=0.009$), and significantly longer in group C compared to group A and B $p<0.000$) There was a statistically significant decrease in morphine consumption in group C compared to Group A ($p=0.004$), but not between group A and B ($p=0.110$) and between B and C ($p=0.186$) The difference in mean rescue dose of morphine between Groups A and C was significant ($P = 0.012$), but not between other groups.

		Group Homogeneity: demographics were comparable between groups	morphine boluses, 10-minute lockout, max dose of 20mg in 4 hours. IV morphine 3mg was given for pain not controlled by PCA.	measured on motion (passive knee flexion) at 12, 24, and 48 hours postop. Adverse outcomes were defined as hypotension, bradycardia, nausea, vomiting, sedation, pruritus, neuropathy.	The median VAS score at rest was significantly lower in Group B compared to Group A at 4 and 8 h. The median VAS score at rest was significantly lower in Group C compared to Group B at 8 and 24 h. The median VAS score at rest was significantly lower in Group C compared to Group A at 4, 8, 12, 24, and 48 h. No P values provided. There was no statistically significant incidence of adverse reactions in any group. Clinical significance- Higher dose of dexmedetomidine (2mcg/kg) resulted in longer duration of analgesia by about 1 hour compared to 1mcg/kg and 2 hours compared to control. Addition of dexmedetomidine also decreased opioid consumption with 2mcg/kg and not 1mcg/kg. However, there was similar pain on movement for all groups

					Conclusions 2mcg/kg dexmedetomidine is superior in analgesia compared to 1mcg/kg without any increased adverse effects

Turner, J. D., Henshaw, D. S., Weller, R. S., Jaffe, J. D., Edwards, C. J., Reynolds, J. W., Russell, G. B., & Dobson, S. W. (2018). Perineural dexamethasone successfully prolongs adductor canal block when assessed by objective pinprick sensory testing: A prospective, randomized, dose-dependent, placebo-controlled equivalency trial. *Journal of Clinical Anesthesia*, *48*, 51–57. https://doi.org/10.1016/j.jclinane.2018.05.009					**Level and Quality** **IA**
Purpose/ Hypothesis	**Type of Evidence Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
To determine if perineural dexamethasone prolongs an adductor canal block, and to determine if 1mg and 4mg dose provide equivalent adductor canal block prolongation	Double blind, prospective, randomized controlled equivalency trial	Setting- Wake Forest Baptist Medical Center Population- 18-90 years of age presenting for a primary medial or patellofemoral unicompartmental knee replacement from July 2015 to August 2017 Exclusion criteria- contraindications to regional anesthesia, peripheral neurologic dysfunction, any diabetes mellitus, systemic corticosteroid use within 30 days, chronic opioid use, pregnancy, cognitive dysfunction Sampling Technique: Convenience	Control- 0.25% bupivacaine with epinephrine 1:400,000 Intervention-0.25% bupivacaine with epinephrine 1:400,000 with 1mg preservative free dexamethasone 0.25% bupivacaine with epinephrine 1:400,000 with 4mg preservative free dexamethasone Intervention Fidelity- All patients underwent block randomization utilizing sequentially numbered, opaque, sealed envelopes where both the patient and study observers making patient assessments were blinded to group assignment. Sensory block was determined with a 25g Whitacre spinal needle 3-5 cm above the medial malleolus,	DV: Duration of sensory blockade in the adductor canal block nerve distribution Secondary outcomes were rest and movement pain scores, time to first analgesic request, and total opioid consumption in oxycodone equivalents over 30 hours. State the instrument, reliability, and measurement procedure: Sensory block was measured at the same point of block success intraop that was marked, with a pinprick	Statistical Results 4 mg group duration (37.9 ± 10 h) was significantly prolonged when compared to both the placebo group (p=0.011) and the 1 mg group (p=0.035) 1 mg group was shown to be equivalent to the placebo group [HR =1.51 (0.75, 3.03), p=0.24 there were no significant differences in any of the group comparisons related to cumulative opioid consumption or time-to-first-analgesic request, Placebo vs 1mg p=0.29, placebo vs 1mg p=0.96, 1mg vs 4g p=0.29. For pain at rest

		# eligible: 235 # accepted: 85 # in control: 12 # in intervention: Dexamethasone 1mg- 36 Dexamethasone 4mg- 36 Power analysis: study of 50 participants per group (allowing for 10% drop-out) would have>80% power to declare the two doses clinically equivalent. A reduced sample size was recruited for the placebo control group, as the difference in duration of ACB when compared to both dexamethasone groups was expected to be large, calculated>90% power, with a 2-sided alpha of 0.05, recruiting only 15 subjects (13 total patients required in addition to allowing for 10% drop-out) to the placebo control group. Power was not met due to the study being cut off at 85 participants as a result of surgical personnel changes causing a decline in eligible procedures Group Homogeneity: was not discussed.	once block success was determined, a mark was placed at the point where sensory was tested for further testing postop. Patients received a spinal anesthetic with 12.5mg bupivacaine with 20mcg fentanyl or general anesthesia with inhalational anesthetics. No IV dexamethasone was administered. All patients had the same postoperative analgesic regimen, acetaminophen 1g ever 6 hr and celecoxib 200mg twice daily unless contraindicated. Any patient being discharged with a ongoing block were given instructions on how to evaluate the block.	assessment of 2=absence of sensation. 1=able to feel pressure, but not sharp pinprick; 0=sharp Pinprick, 0 meaning the block had resolved. This was performed every 2 hours starting 6 hours after block placement until block resolution. The non-operative leg was used as baseline 0 pinprick assessment. Block duration is defined as time from block placement to resolution. Pain was measured with the Numeric Rating Scale (NRS 0-10) at 0 (baseline preop), 6, 12, 18, 24, and 30 hours postop.	At 18 hours- Control vs 4mg was significantly different p=0.049 At 24 hours control vs 4mg was significantly different p=-0.032 Dexamethasone had lower pain scores All other times were not significate for pain at rest for any group For pain at movement At 18 hours Control vs 1mg was significantly different p=0.010, control vs 4mg was significantly different p=0.020 At 24 hours Control vs 1mg was significantly different p=0.060, control vs 4mg was significantly different p=0.0072 At 30 hours Control vs 1mg was significantly different p=0.041, control vs 4mg was significantly different p=0.021 Dexamethasone groups had lower pain scores All other times were not significant for any group Clinical significance- 4mg dexamethasone prolongs the adductor canal block to a average 37.9 hours, with pain improvement at later durations at rest and movement, but with no decrease in opioid consumption or time to first analgesic request Conclusions

					perineural dexamethasone in a dose of 4 mg, but not 1 mg, effectively prolongs a bupivacaine ACB

Wang, C.-J., Long, F.-Y., Yang, L.-Q., Shen, Y.-J., Guo, F., Huang, T.-F., & Gao, J. (2017). Efficacy of perineural dexamethasone with ropivacaine in adductor canal block for post-operative analgesia in patients undergoing total knee arthroplasty: A randomized controlled trial. *Experimental and Therapeutic Medicine*, *14*(4), 3942–3946. PubMed. https://doi.org/10.3892/etm.2017.4974					**Level and Quality IA**
Purpose/ Hypothesis	**Type of Evidence Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
To determine if adding dexamethasone to ropivacaine for an adductor canal block for a total knee arthroplasty (TKA) would prolong analgesia and reduce pain	Randomized Control Trial	Population: Elective TKA. ASA I or II greater than or equal to 18 years of age. Excluded: Severe COPD or BMI >35 kg/m2 Setting: In hospital Sampling Technique: Convenience # eligible: 200 # accepted: 195 # in control: 97 4 failed block, total studied 93 # in intervention: 98 5 failed block, total studied 93 No patients lost to follow up Power analysis: 176 required, 88 per group to	Control- 10mL 0.5% ropivacaine with 2ml normal saline Intervention- 10mL 0.5% ropivacaine plus 8mg dexamethasone Intervention fidelity- Patients were randomized upon arrival to the operating room. A nurse not involved with the study opened an envelope that determined the block drugs. The adductor canal block was performed under ultrasound guidance at the mid-thigh, with block evaluation performed at 15 and 30 minutes after the nerve block. All patients received 1g Paracetamol IV every 12 hours postop.	DV: Sensory block duration at the medial aspect of the knee determined by pinprick sensation, secondary outcome- total morphine consumption Serum C-reactive protein (CRP) and interleukin-6 (IL-6) was measured at baseline and at 3, 6, 12, 24 and 48 h post-operation Pain was estimated using NRS scoring- 0-10, resting and during movement at 6,12,18, 24, and 48 hours postop State the instrument, reliability, and measurement procedure:	Statistical Results- Mean duration of dexamethasone group was significantly longer than control- 23.42±3.35 vs. 14.67±2.96 h, P<0.05. Mean NRS score was lower in dexamethasone vs control at 6, 12, 18, and 24 hours after block placement and not significant at 48 hours, in both resting and moving. Morphine consumption in the first 24 hours postop was significantly lower in dexamethasone group- 4.23±1.80 vs.

		reach an effect size of 0.55, alpha error of 0.05 and statistical power of 95%. Power analysis was met. Group Homogeneity: No significant differences in patient demographics and clinical parameters (preoperative MAP, glucose, HR) between groups		No instrument was used. Block duration was from pinprick sensation lost until pinprick sensation returned, assessed every hour postoperatively. Return of sensation was defined as pinprick sensation equal on operative and non-operative medial knee. Total morphine consumption was the sum of morphine doses administered in the first 24 hours postop. CRP was measured by turbidimetric with a detection limit of 0.3 mg/dl, using a Hitachi 747 analyzer . IL-6 was measured using a commercially available ELISA with a detection limit of 0.1 ng/ml.	8.42±2.44 mg in the control group, P<0.05. Baseline CRP and IL-6 were comparable between the two groups. At 24 and 48 h after surgery, CRP concentration was raised in each of the two groups, but the increase was less marked in the dexamethasone group P<0.05 Mean IL-6 was lower in dexamethasone group but not statistically significant compared to control Clinical Significance - 8mg dexamethasone prolonged nerve blockade from 14.67 hours to 23.42 hours and reduced morphine consumption. No adverse effects of perineural dexamethasone was noted. Conclusion- Addition of dexamethasone to ropivacaine for ACB is able to increase the duration of analgesia and decrease early post-operative pain following TKA

Note. Evidence was graded using the Johns Hopkins Nursing Evidence-based Practice Level Hierarchy of Evidence Guide (Dang et al., 2022). All articles were retrieved from the Pubmed database.

Table 2

Evidence Synthesis Table

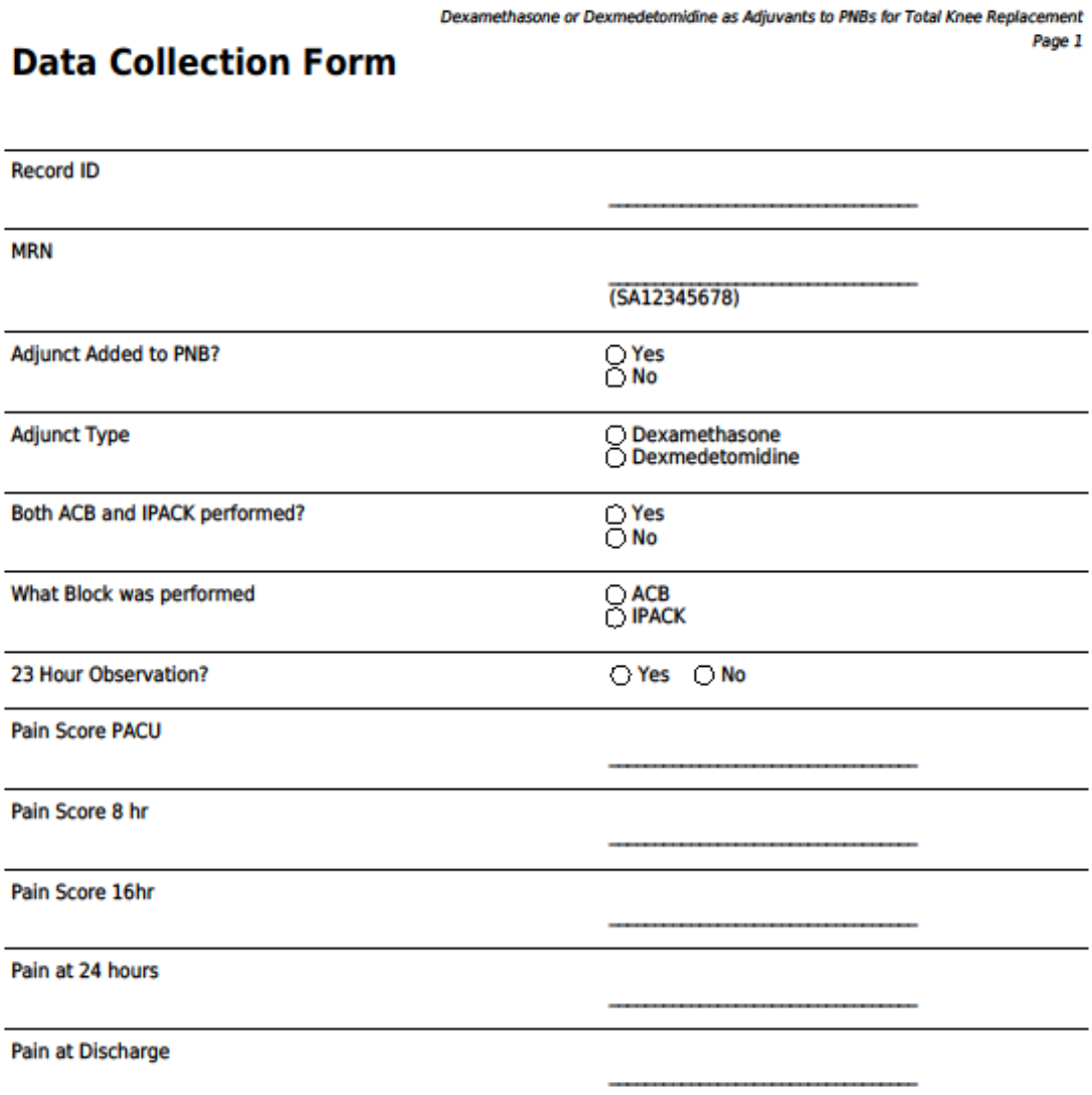
Category (Level Type)	Total Number of Sources/Level	Overall Quality Rating	Synthesis of Findings
Level 1 - Experimental study · Randomized Controlled Trial (RCT) · Systematic review of RCTs with or without meta-analysis	5	IA	The duration of analgesia (time between the block and rescue analgesia) was highest with 0.5mcg/kg dexmedetomidine group(mean 18.4 h ± 7.4), more steps walked than control with 0.25 or 0.5 mcg/kg dexmedetomidine but between both intervention groups. No adverse effects, especially in vital signs. There increased patient satisfaction with 0.5mcg/kg dexmedetomidine compared to the other groups(Goyal et al., 2017) . Higher dose of dexmedetomidine (2mcg/kg) resulted in longer duration of analgesia by about 1 hour compared to 1mcg/kg and 2 hours compared to control. Control mean 4.55 hours, 1mcg/kg 5.7 hours, 2mcg/kg 6.66 hours for duration of analgesia as measured by time to first use of PCA morphine. Addition of dexmedetomidine also decreased opioid consumption (morphine) with 2mcg/kg and not 1mcg/kg (Packiasabapathy et al., 2017 . Dexmedetomidine 100mcg has no significant effect on pain compared to adductor canal block with no adjuvants (Ortiz-Gómez et al., 2017) Dexamethasone 4mg added to nerve blocks decreased pain and need for rescue analgesics in both femoral nerve and adductor canal blocks. 4mg dexamethasone prolongs the adductor canal block to a average 37.9 hours, with pain improvement at later durations at rest (at 18 and 24 hours post block) and movement (18, 24, and 30 hours post block), but with no decrease in opioid consumption or time to first analgesic request (Turner et al., 2018). Mean duration of the dexamethasone 8mg group was significantly longer than control- 23.42±3.35 vs. 14.67±2.96 hr. There was also reduced morphine consumption. No adverse effects of perineural dexamethasone were noted. (Wang et al., 2017)
Level II · Quasi-experimental studies · Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis			
Level III · Non-experimental study · Systematic review of a combination of RCTs, quasi-experimental, and			

non-experimental studies, or non-experimental studies only, with or without meta-analysis · Qualitative study or systematic review of qualitative studies with or without meta-synthesis			
Level IV · Opinion of respected authorities and/or reports of nationally recognized expert committees/consensus panels based on scientific evidence			
Level V · Evidence obtained from literature reviews, quality improvement, program evaluation, financial evaluation, or case reports · Opinion of nationally recognized expert(s) based on experiential evidence			
Recommendations Based on Evidence Synthesis: There is strong evidence for addition of dexamethasone 4 perineurally to increase block duration and reduce pain scores. At an 8mg dose, there were no noted side effects. There is good but conflicting evidence for the addition of dexmedetomidine 1mcg/kg perineurally to increase block duration and reduce pain scores, with minimal adverse effects.			

Note. Evidence was graded using the Johns Hopkins Nursing Evidence-based Practice Level Hierarchy of Evidence Guide (Dang et al., 2022)

Appendix B

REDCap Data Collection Form



Dexamethasone or Dexmedetomidine as Adjuvants to PNBs for Total Knee Replacement
Page 1

Data Collection Form

Record ID	_____
MRN	_____ (SA12345678)
Adjunct Added to PNB?	◯ Yes ◯ No
Adjunct Type	◯ Dexamethasone ◯ Dexmedetomidine
Both ACB and IPACK performed?	◯ Yes ◯ No
What Block was performed	◯ ACB ◯ IPACK
23 Hour Observation?	◯ Yes ◯ No
Pain Score PACU	_____
Pain Score 8 hr	_____
Pain Score 16hr	_____
Pain at 24 hours	_____
Pain at Discharge	_____

Appendix B. Data collection form used for data collection using REDCap