



Impact of Single 0.25% Bupivacaine vs 0.2% Ropivacaine Adductor Canal Block on Postoperative Opiate Use After Total Knee Arthroplasty

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Introduction

Adductor Canal Block is a usual nerve block performed at University of Pittsburgh Medical Center (UPMC) for patients undergoing primary or revision total knee arthroplasty. By targeting the purely sensory saphenous nerve inside adductor canal, patients are able to participate in physical therapy at the earliest time possible without the concern of unanticipated motor weaknesses associated with, for example, a more upstream femoral nerve block (1). Early ambulation and adequate pain control have been the mainstay goals for such patients as studies have demonstrated shorter hospital stay and savings in hospital costs (2).

The motivation for this study was related to a practice change in March 2022 at our institution in switching from 0.2% ropivacaine which was our norm to 0.25% bupivacaine. The change was more related to system-wide issues including drug shortages and surgeon's preferences. Both bupivacaine and ropivacaine belong to the same drug class of amino-amide local anesthetic with bupivacaine having a longer duration of action (3). Ropivacaine is a newer drug with less of cardiac toxicity and motor blockade at equivalent concentration (4). Many studies have compared the potency of ropivacaine to bupivacaine in the setting epidural analgesia for labor pain and it's generally regarded that ropivacaine of equivalent concentration is about 60% as potent as that of bupivacaine (5). Therefore, 0.25% bupivacaine, equivalent to 0.41% ropivacaine should provide a more long lasting analgesia at the same volume with less expected postoperative opioid consumption.

With increasing number of patients receiving 0.25% bupivacaine, we are driven to find out if this change in local anesthetics makes a statistical and/or clinical difference observed in postoperative opioid consumption measured by post-anesthesia care unit morphine equivalents (PACU MME).

Methodology

Statement: This quality improvement/safety project is approved by IRB under a general IRB approved study (STUDY20070285): Acute Interventional Perioperative Pain & Regional Anesthesia Review and Assessment.

We performed data mining from March 14 2022 to June 03 2022 for all patients undergone unilateral primary or revision total knee arthroplasty at our institution and collected 125 patients eligible for this retrospective chart review study.

Inclusion criteria for this study includes: a) verification that patients received unilateral knee replacement (primary vs revision) b) patients being opioid naive c) spinal anesthesia d) local anesthetic choice of either ropivacaine 0.2% vs bupivacaine 0.25% in 18-20cc volume. 6 out of 125 patients were excluded based on this inclusion criteria.

For each patient included, the chart review was performed to look at their postoperative opioid consumption. A combination of intravenous fentanyl and hydromorphone were administered for pain control in the PACU. Some patients were able to tolerate oral pain medications in the PACU and received oral oxycodone or tramadol. Care transfer forms were reviewed to determine the specific time frame patient was in PACU. Opiate dose administered in the PACU was then converted to morphine milliequivalents (MME) and totaled for each patient.

For each category, 15 patients with the highest first reported pain score were selected and compared for median and mean of PACU MME.

	Ropivacaine 0.2%	Bupivacaine 0.25%
Age Range	60-83	51-88
Age Mean	71	70
Age Median	69	70
Weight Mean	82	84
Gender Male (%)	40	20
ASA 2 (%)	60	40
ASA 3 (%)	40	60
Anesthesia Time Mean (min)	152	166
Surgical Time Mean (min)	95	110

Results

For 0.2% ropivacaine group, their age range is from 60 to 83 years old with a mean of 71 and median of 69. In comparison, for 0.25% bupivacaine group, their age ranges from 51 to 88 years old with a mean of 70 and median of 70.

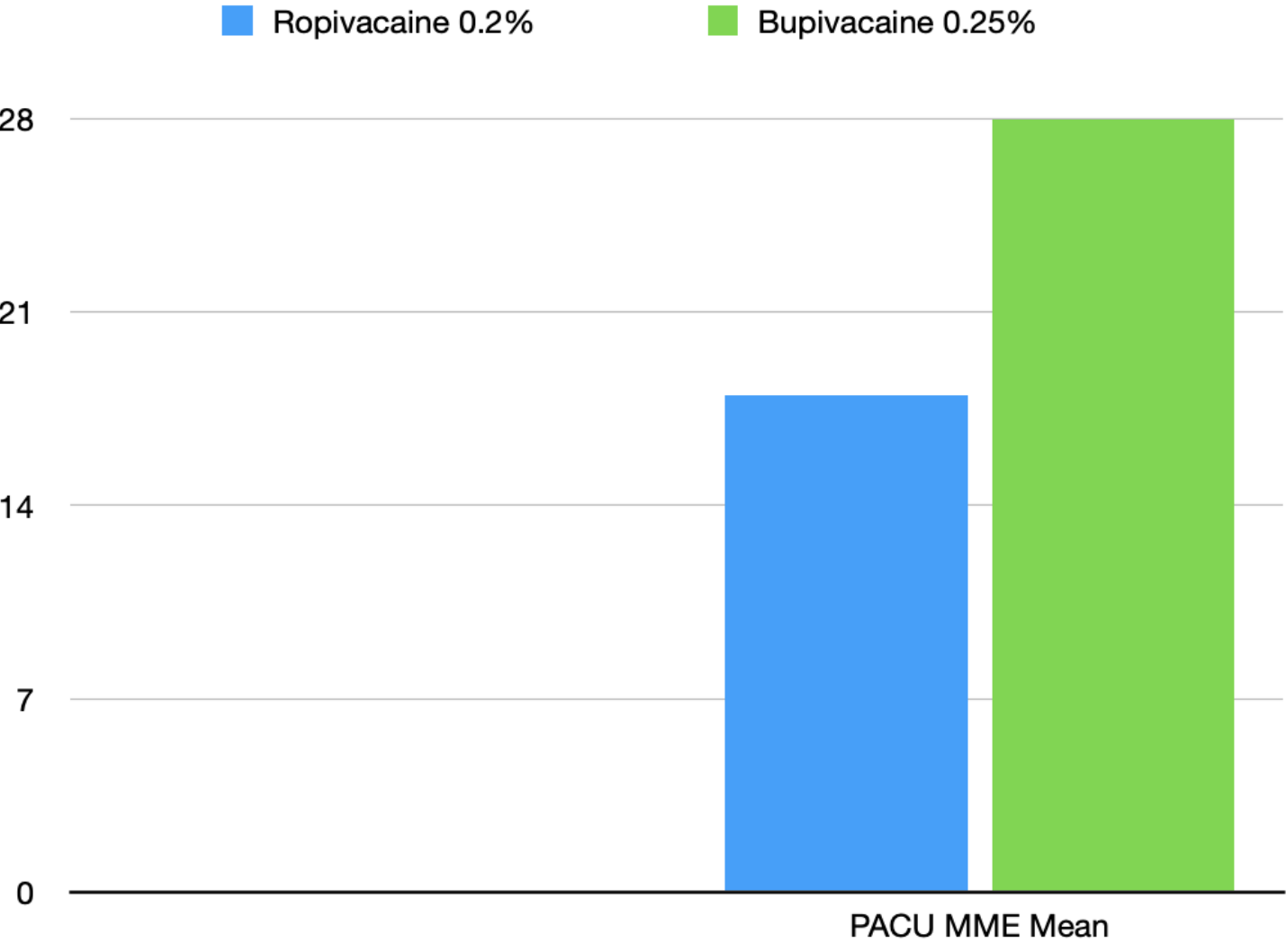
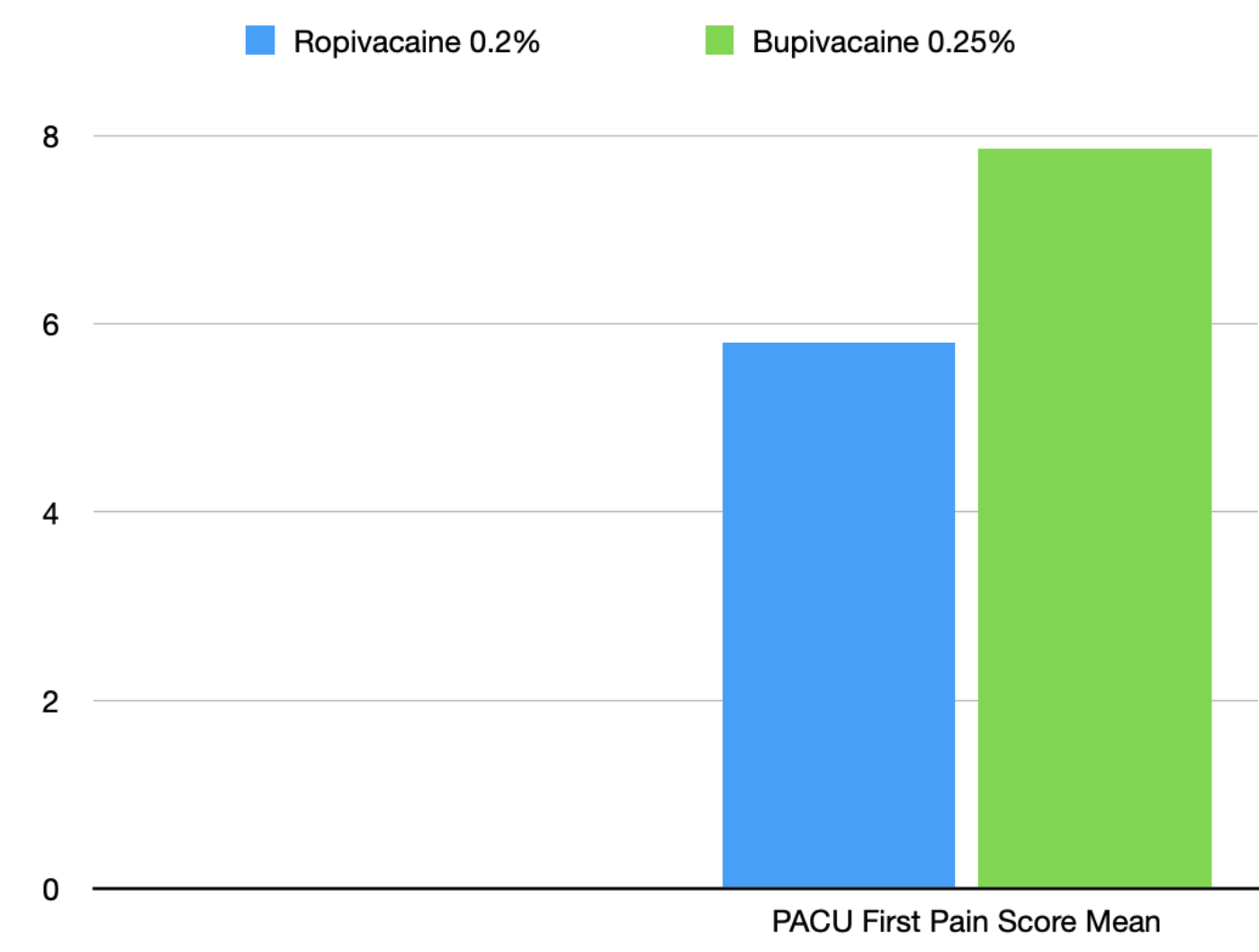
The mean weights for each groups are 82kg and 84kg separately. 40% of patients in the ropivacaine group are males whereas 20% of patients in the bupivacaine group are males. In terms of ASA class, 60% of ropivacaine group are ASA 2 where the rest are ASA 3. For bupivacaine group, 40% of patients are ASA 2 and 60% of patients are ASA 3.

In terms of the anesthesia time in the operating room, ropivacaine group has an average time of 152 min as compared to that of 166 min in the bupivacaine group. In terms of the surgical time, the ropivacaine group has an average of 95 min compared to that of 110 min in the bupivacaine group.

Finally, the mean PACU first pain scores of the ropivacaine group is 5.8 whereas the that of the bupivacaine group is 7.86. With two-tailed t test, the p value is 0.003 which is less than 0.05, suggesting statistical significance.

The mean and median of the PACU MME for the ropivacaine group are 18 and 20 separately as compared to 28 and 25 for the bupivacaine group. Two-tailed t test performed for the mean of PACU MME shows a p value is 0.1519, suggesting non-statistical significance.

	Ropivacaine 0.2%	Bupivacaine 0.25%	P value for Mean
Mean (sd) of PACU First Pain Score	5.8	7.86	0.003
Mean (sd) of PACU MME	18	28	0.1519
Mean of PACU MME	20	25	N/A



Discussion

The ropivacaine group patients share similar baseline characteristics with the bupivacaine group in terms of age, gender, weight and ASA class. It is interesting to observe that the average anesthesia and surgical time is slightly shorter for the ropivacaine as compared to the bupivacaine group.

On average, the ropivacaine group has a lower mean and median PACU MME as compared to the bupivacaine group. However, with statistical analysis, this has been shown not to be significant. However, between the ropivacaine and bupivacaine group selected, there is statistical significance in the reported first PACU pain score. With our study sample, adjusted for baseline characteristics (Age, Gender, ASA class and Weight), ropivacaine group patients tend to report a lower pain score when they first arrive in the PACU. However, their opioid consumption during the PACU stay does not seem to differ from the bupivacaine counterpart. Given 0.25% bupivacaine regarded as more potent than 0.2% ropivacaine, our observed results challenges our initial postulated conclusion.

We do recognize the small sample size of data points presented and the retrospective nature of this study. Looking forward, the study will continue to recruit more patients With a larger sample size , we could more convincingly compare the mean and median of PACU MME between the two groups. Also, in future studies, we could look into opioid consumption beyond the PACU stay as the nerve block duration can range from 4-8 hours up to 24 hours. It would be interesting to compare the total opioid consumption for as long as the block is in effect.

References/Acknowledgements

- Kim, David H., et al. "Adductor canal block versus femoral nerve block for total knee arthroplasty: a prospective, randomized, controlled trial." *Anesthesiology* 120.3 (2014): 540-550.
- Pua, Yong-Hao, and Peck-Hoon Ong. "Association of early ambulation with length of stay and costs in total knee arthroplasty: retrospective cohort study." *American Journal of Physical Medicine & Rehabilitation* 93.11 (2014): 962-970.
- Casati, Andrea, and Marta Putzu. "Bupivacaine, levobupivacaine and ropivacaine: are they clinically different?." *Best Practice & Research Clinical Anaesthesiology* 19.2 (2005): 247-268.
- Markham, Anthony, and Diana Faulds. "Ropivacaine: a review of its pharmacology and therapeutic use in regional anaesthesia." *Drugs* 52 (1996): 429-449.
- Capogna, G., et al. "Relative potencies of bupivacaine and ropivacaine for analgesia in labour." *British journal of anaesthesia* 82.3 (1999): 371-373.