Original Research Article

Comparative study of postoperative analgesia provided by butorphanol and fentanyl as an adjunct to spinal levo-bupivacaine for lower limb orthopaedic surgeries

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Abstract

Background: Subarachnoid block is one of the most commonly used anaesthetic techniques for lower limb orthopaedic surgery. In recent years levo-bupivacaine, the pure S (enantiomer of bupivacaine emerged as a safer alternative for regional anaesthesia than its racemic parent. This study was undertaken to contribute to the growing pool of knowledge by comparing the intra and post operative analgesic properties of fentanyl, an established opioid adjunct, with butorphanol, a less explored opioid. **Materials and Methods:** 70 patients between the ages of 18-80 years undergoing elective lower limb surgery and of ASA Grade 1 or 2 were randomly allocated to Group LB or LF, receiving Levobupivacaine plus Butorphanol or Levobupivacaine plus Fentanyl respectively for spinal anaesthesia. Using the Priori power analysis with α of 0.05, anticipated effect size of 0.8 and desired statistical power level of 0.9, a minimum sample size of 34 subjects was required per group for a two tailed hypothesis.**Results:** There is no statistically significant difference between the two groups It also shows the time between SAB and rescue analgesic (in hours) between the two groups. There is a statistically significant difference between the two groups i.e. Subjects in the LB group had a mean time of 6.75+/- 3.09 while those in LF group had a mean time of 5.71+/-1.54 (in hours) **Conclusion:** Optimum quality of subarachnoid block and effective postoperative pain control are essential components of the care of the surgical patient. The addition of intrathecal opioids has been shown to produce a dose sparing effect on local anaesthetic used with prolonged post operative analgesia.

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INTRODUCTION

Subarachnoid block is one of the most commonly used anaesthetic technique for lower limb orthopaedic surgery. The quest to optimize the quality of block while reducing the risk of adverse effects is ongoing. This is achieved mainly through innovation of better techniques, equipments and local anaesthetics. In recent years levo-bupivacaine, the pure S (enantiomer of bupivacaine emerged as a safer alternative for regional anaesthesia than its racemic parent. [1]Literary evidence has established that addition of opioids produces a dose sparing effect of levobupivacaine, with improved quality of block and less hemodynamic variations in peri operative period.[2,3] Fentanyl is a potent mu opioid receptor agonist that was discovered to identify an improved human health analgesic over morphine, an opioid frequently associated with histamine-release, bradycardia, hyper- or hypotension, and prolonged postoperative respiratory depression. (21) The addition of fentanyl 15 microgram demonstrates a sparing effect on the requirement of

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levobupivacaine while maintaining excellent clinical efficacy with less hemodynamic variation. Further studies may be directed to find the optimal combination of levobupivacaine and opioid with maximal hemodynamic stability and least motor block.[4,5]Intrathecal use of butorphanol is less explored in human subjects. [6] Butorphanol is an analgesic possessing mixed agonist-antagonist activity at opiate receptors. Surgical anaesthetic indications involve preoperative and preinduction supplementation, balanced anaesthesia and postoperative pain. It is a potent analgesic with favourable side effect profile. [7] From the available review of literature, it is noted that there is a lacunae in the knowledge with regard to the most efficacious opioid adjunct to spinal levobupivacaine. This study was undertaken to contribute to the growing pool of knowledge by comparing the intra and post operative analgesic properties of fentanyl, an established opioid adjunct, with butorphanol, a less explored opioid.

MATERIALS AND METHODS

This is a prospective, randomized controlled study conducted General Hospital. After obtaining approval from the hospital Ethics Committee and informed, written consent, 70 patients between the ages of 18-80 years undergoing elective lower limb surgery and of ASA Grade 1 or 2 were randomly allocated to Group LB or LF, receiving Levobupivacaine plus Butorphanol or Levobupivacaine plus Fentanyl respectively for spinal anaesthesia.Using the Priori power analysis with α of 0.05, anticipated effect size of 0.8 and desired statistical power level of 0.9, a minimum sample size of 34 subjects was required per group for a two tailed hypothesis. Based on outcome variable LVAS score at 30 minutes from earlier studies and the following formula to calculate sample size by comparing two parallel sample means in a two sided equality hypothesis, a minimum sample size of 46 was derived. At the time of Pre Anaesthetic Check up, patient history was noted; general physical and systemic examination was carried out. Patients were explained, in their native language, the nature of the study, the linear visual analog scale (LVAS) and how they are expected to answer the questionnaire. They were given a Patient Information Sheet and their initials were obtained on the Informed Consent Form. All patients received a standard premedication of Alprazolam 0.5mg and Pantoprazole 40mg on the night prior to surgery and were kept fasting overnight. An intravenous line (18 or 20G) was established at the time of shifting to the Operation Theatre and baseline vitals were recorded. (Heart Rate, Blood Pressure, Respiratory Rate, Oxygen Saturation) They were randomly allocated to either Group LB or LF and a trained anaesthesia personnel premixed the intrathecal solutions (as mentioned below) to ensure blinding of both subject and researcher. Group LB (n=35) - 3ml of 0.5% isobaric Levobupivacaine+0.5ml of Butorphanol (25mcg) Total-3.5ml

Group LF (n=35) - 3ml of 0.5% isobaric Levobupivacaine +0.5ml of Fentanyl (25mcg) Total- 3.5ml

Based on the ease of access, patients were placed either in sitting or lateral position. Under aseptic precautions, back was cleaned and draped.Dural puncture was done with a 26G Quincke spinal needle in L3-4 or L4-5 interspace using the midline approach and presence of needle in sub arachnoid space was confirmed by free flow of CSF. After injection of drug mixture, patients were made to lie in supine position with 15 degree head up. Adult patients between the ages of 18-80 years undergoing elective lower limb surgery and of ASA Grade 1 or 2 were included in the study. Patients aged less than 18 years or more than 80 years, patients with ASA Grade more than 2 Patients with documented allergy to any of the three drugs used in the study- levobupivacaine, fentanyl and butorphanol. Patients with spinal deformities or injection site infection Patients with severe respiratory, cardiovascular, neurological, liver, renal disease, morbid obesity, hemodynamic instability, coagulation disorders or psychiatric disturbances. Patients undergoing emergency surgery ,patients with documented history of opioid dependency , patients with height <150cm, patients unwilling to participate in the study were excluded from the study.

OBSERVATION AND RESULTS

There is no statistically significant difference in the gender distribution of the two groups. There is no statistically significant difference in the age distribution of the two groups. There is no statistically significant difference in the age distribution of the two groups. There is no statistically significant difference in the ASA grade distribution of the two groups. (p value- 0.46, Pearson Chi-square test) There is no statistically significant difference in diagnosis distribution between the two groups. (p value- 0.506, Pearson Chi Square test).

Table 1: Association among the cases between surgery and drug mixture

Surgery		Drug mixture		Total
		LB	LF	
1)THR	No.	10	14	24
	%	41.7%	58.3%	100.0%
2)TKR	No.	13	8	21
	%	61.9%	38.1%	100.0%
3)Arthroscopic repair ^	No.	10	9	19
	%	52.6%	47.4%	100.0%
Hip excision arthroplasty ^	No.	1	0	1
	%	100.0%	0.0%	100.0%
Meniscal trimming ^	No.	0	1	1
	%	0.0%	100.0%	100.0%
ORIF +IMIL nail ^	No.	0	1	1
	%	0.0%	100.0%	100.0%
ORIF+ TBW ^	No.	0	1	1
	%	0.0%	100.0%	100.0%
Retrograde femur nailing ^	No.	1	0	1
	%	100.0%	0.0%	100.0%
Tibial nailing ^	No.	0	1	1
	%	0.0%	100.0%	100.0%
Total	No.	35	35	70
	%	50.0%	50.0%	100.0%

There is no statistically significant difference in type of surgery distribution between the two groups. (p value- 0.442, Pearson Chi- square test)

Table 2: Comparison of Post operative LVAS scores between the two groups at different time intervals

Variables #	Group	Mean	SD	Median	IQR	t-value	p-value
PostOp-LVAS-15	LB	1.03	1.62	0.00	2.00	-0.027	0.978
	LF	0.97	1.60	0.00	2.00	Difference is not significant	
PostOp-LVAS-30	LB	1.74	2.02	2.00	3.00	-0.069	0.945
	LF	1.86	2.32	0.00	4.00	Difference is not significant	
PostOp-LVAS-45	LB	1.97	1.98	3.00	3.00	-0.924	0.355
	LF	2.40	2.27	3.00	4.00	Difference is not significant	
PostOp-LVAS-60	LB	2.57	2.20	3.00	5.00	-0.685	0.493
	LF	2.94	2.16	3.00	5.00	Difference is not significant	
PostOp-LVAS-90	LB	3.29	2.14	4.00	3.00	-1.046	0.296
	LF	3.86	2.51	5.00	3.00	Difference is not significant	
PostOp-LVAS-120	LB	3.51	2.16	4.00	3.00	-1.281	0.200
	LF	4.26	1.95	4.00	2.00	Difference is not significant	
PostOp-LVAS-150	LB	3.86	2.34	5.00	3.00	-0.300	0.764
	LF	4.09	1.38	4.00	2.00	Difference is not significant	
PostOp-LVAS-180	LB	4.09	2.01	4.00	3.00	-0.441	0.659
	LF	3.94	1.59	4.00	2.00	Difference is not significant	
PostOp-LVAS-4th hour	LB	3.74	2.02	4.00	3.00	-0.113	0.910
	LF	3.57	1.91	4.00	3.00	Difference is not significant	
PostOp-LVAS-5th hour	LB	3.17	1.64	3.00	2.00	-0.156	0.876
	LF	3.11	1.81	3.00	2.00	Difference is not significant	
PostOp-LVAS-6th hour	LB	2.66	1.80	3.00	2.00	-0.295	0.768
	LF	2.66	1.49	3.00	2.00	Difference is not significant	
PostOp-LVAS-10th hour	LB	1.26	1.42	1.00	2.00	**-2.385**	**0.017**
	LF	2.11	1.59	2.00	2.00	**Difference is significant**	
PostOp-LVAS-14th hour	LB	0.91	1.10	0.00	2.00	**-1.970**	**0.049**
	LF	1.51	1.29	2.00	2.00	**Difference is significant**	
PostOp-LVAS-18th hour	LB	0.63	1.17	0.00	1.00	**-2.225**	**0.026**
	LF	1.20	1.23	1.00	2.00	**Difference is significant**	
PostOp-LVAS-24 hours	LB	0.57	1.01	0.00	1.00	**-2.401**	**0.016**
	LF	1.20	1.18	2.00	2.00	**Difference is significant**	

Table 2 showed the comparison of duration of surgery between the two groups.There is no statistically significant difference between the two groups It also showed the time between SAB and rescue analgesic (in hours) between the two groups. There is a statistically significant difference between the two groups i.e. Subjects in the LB group had a mean time of 6.75+/- 3.09 while those in LF group had a mean time of 5.71+/-1.54 (in hours)

DISCUSSION

Optimum quality of subarachnoid block and effective postoperative pain control are essential components of the care of the surgical patient. Studies have shown that while Bupivacaine and Levobupivacaine have similar efficacy in terms of block characteristics, Levobupivacaine has a superior safety profile. 8 The addition of intrathecal opioids has been shown to produce a dose sparing effect on local anaesthetic used with prolonged post operative analgesia .[9] The merits of effective postoperative pain management include patient comfort and therefore satisfaction, earlier mobilization, fewer pulmonary and cardiac complications, a reduced risk of deep vein thrombosis, faster recovery with less likelihood of the development of neuropathic pain, and reduced cost of care. The goal of postoperative pain management is to relieve pain while keeping side effects to a minimum.[10] In our study, 70 patients between the age group of 18-80 years undergoing elective lower limb orthopaedic surgery of ASA grade 1 or 2 were included. The technique of anaesthesia chosen was spinal (subarachnoid block) and the local anaesthetic was 15mg of 0.5% isobaric Levobupivacaine. In addition, opioid adjuvants such as 25mcg Butorphanol in LB group and 25mcg Fentanyl in LF group were used. The two groups were found to be comparable with regard to distribution of age, sex, BMI and ASA grade. There was also no statistically significant difference between the two groups in terms of gauge of spinal needle used, position at the time of sub arachnoid block and the duration of surgery. Fattorini *et al* [11] observed that Levobupivacaine is a valid alternative to Bupivacaine for spinal anesthesia from their study of patients undergoing major orthopaedic surgery. Their findings showed no hemodynamic complications with Levobupivacaine group compared to Bupivacaine group. Lee YY *et al* [12] concluded that 2.6ml of 0.5% levobupivacaine can be used as an alternative to 0.5% racemic bupivacaine in spinal anaesthesia for urological surgery when a sensory block to at least T10 was required, whereas in our study we used 3ml containing 15mg of levobupivacaine achieving sensory block of T8-T10 which is ideal for orthopaedic surgeries including total hip replacement. Kumar *et al* [13] found that both 25 µg fentanyl and 25 µg butorphanol given intrathecally along with 12.5 mg of hyperbaric bupivacaine provide effective anesthesia for lower limb surgeries. The authors concluded that Intrathecal bupivacaine-butorphanol mixture provides longer duration of sensory blockade and superior analgesia than intrathecal fentanyl-bupivacaine mixture. They found that the median highest sensory level achieved and the times to reach peak sensory level were comparable among their two groups and the time of onset of maximum motor blockade were similar among their two groups. They found a statistically significant difference in LVAS at 60 minutes with mean 1.9+/- 0.2 in Bupivacaine-Fentanyl group and 1.6+/-0.8 in Bupivacaine- Butorphanol group. The authors further found that higher number of patients in the fentanyl group (22.5%) requested for rescue analgesia during the postoperative study period than the butorphanol group (5%) and the patients in the fentanyl group requested rescue analgesia earlier than patients in the butorphanol group as the average times to first request for rescue analgesia were 308.6±14.9 and 365.9±12.3 minutes, respectively. Singh *et al*[14] found that the addition of 25 µg fentanyl or 25µg butorphanol to spinal anesthesia with hyperbaric 0.5% bupivacaine intensifies the sensory blockade and increases the duration of sensory blockade without increasing the intensity of motor block or prolonging recovery to micturition. However, they found that butorphanol was significantly better than fentanyl in respect to the duration of the sensory blockade and requirement of rescue analgesia.The four classic side effects of neuraxial opioids are pruritus, nausea and vomiting, urinary retention, and respiratory depression.[15]None of our patients reported pruritis, nausea and vomiting, urinary retention or respiratory depression although the change from baseline to intra operative value of respiratory rate in the LF group showed a statistically significant difference without desaturation. Kumar *et al* [13] found five patients (12.5%) in the group receiving fentanyl- bupivacaine had pruritis compared with none in the group receiving butorphanol-bupivacaine. They found that six patients had sedation in the group receiving butorphanol-bupivacaine, as compared with none in the group receiving fentanyl; none of them had respiratory depression. They also had seven patients who required catheterisation during the postoperative period due to difficulty in voiding, although the average times to voiding were comparable among both their study groups. Singh *et al* [14] demonstrated that 25µg of fentanyl or butorphanol intrathecal have no difference regarding intraoperative bradycardia, itching or pruritus, postoperative nausea/ vomiting or psychomimetic behaviour. None of the patient in both the groups had respiratory depression.

CONCLUSION

our study shows that addition of either Butorphanol (25 mcg) or Fentanyl (25 mcg) to Levobupivacaine (0.5% isobaric) provides effective and safe anaesthesia and analgesia for lower limb orthopaedic surgeries. Spinal (subarachnoid) anaesthesia with Levobupivacaine-Butorphanol mixture resulted in a higher level of sensory block and longer period of effective analgesia as compared to Levobupivacaine- Fentanyl mixture.

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