Comparative analysis of intraoperative effect dexmedetomidine and fentanyl as an adjuvant to heavy bupivacaine in spinal anaesthesia in lower limb orthopedic surgeries

Background

Spinal anesthesia is the most widely employed procedure for lower limb orthopaedic operations, as it is very cost-effective and simple to apply. These advantages can be restricted because presently existing local anesthetic drugs have relatively short length of action. [1]

Spinal anesthesia with 0.5% heavy bupivacaine (hyperbaric) is a common technique, still there is burden of its short duration of action. To overcome this issue, there is a continuous search for an ideal adjuvant.[2] Adjuvants are mostly added to local anesthetic drugs to increase their effectiveness, speedy onset, increase the period of the block, and reduce the local anesthetics dosage, thus reduction their adverse effects.[3] Such adjuvants had been beneficial in extension of analgesia along with initiation of movement though their related side effects.[4]

Administration of opioids intrathecal such as fentanyl, morphine, and buprenorphine, allows decrease dose of the local anesthetic drug, augment analgesic effectiveness, and reduces probable toxicity and cardiovascular adverse consequences of local anesthetics. [5, 2]

Nevertheless, adverse effects such as possibly disastrous delayed respiratory depression, urinary retention, nausea, pruritus, vomiting, and constipation have provoked further study to investigate non opioid analgesic drugs with less troublesome drawbacks. [6,2,7,8]

Dexmedetomidine is a novel central alpha2-agonist that was approved by the FDA in 1999.It has sedation, anxiolytic, analgesic and sympatholytic effect that depress cardiovascular reflexes in perioperative interval. [2]

Thus, this study will be conducted for assessment of the effectiveness of addition 4 μg Dexmedetomidine to hyperbaric Bupivacaine intrathecally in lower limb orthopaedic surgeries.

Aim

This clinical comparative study aiming to evaluate the hemodynamic stability and onset and duration of motor block of using intrathecal dexmedetomidine and fentanyl as an adjuvant to heavy bupivacaine in lower limb orthopaedic surgeries.

Patients and Methods

After approval of medical institutional ethical committee, 40 patients of American Society of Anaesthesiologists (ASA) physical status 1or 2, aged between 20-60 years will be incorporated in this prospective randomized controlled study.

Inclusion Criteria

1. The patient aged range from 20 to 60 years

2. ASA 1 and 2

3. Patient prepared for elective lower limb orthopaedic surgeries.

4. Height 150-180 cm.

5. Weight 50-70 kg.

6- Either sex male or female.

Exclusion Criteria

1- Patient refusal.

2- Patient has absolute contraindication to spinal anaesthesia.

3-Patients with neurological disorders, pregnancy, local infection at the site of injection

4- Patients suffering from dysrhythmia or heart block.

5- Patients with ASA 3 or more.

An informed written consent will be taken from all the contributors.

Patients will be divided into the following groups using randomizer software.

Group D: patients will receive 3 mL volume of 0.5% hyperbaric bupivacaine and 4 µg dexmedetomidine in 0.5 mL of normal saline intrathecal (dexmedetomidine 100 µg/mL will be diluted in 12.5 ml preservative-free normal saline, 0.5 ml will be withdrawn)

Group F: patients will receive 3 mL volume of 0.5% hyperbaric bupivacaine with 25 µg fentanyl (0.5 mL) intrathecal.

Anesthetic technique

- Patients will be moved to operation table, 18G IV access is inserted and secured.

- Preloading begin15minutes before spinal anaesthesia administration with ringer lactated 20ml /kg.
- Intraoperative monitoring involves NIBP, pulse rate, ECG, SPO2.
- Patients will be divided randomly into two groups by using randomizer software.
- Baseline vital signs will be measured.

Under strict aseptic technique, after the local infiltration with 2% lignocaine, lumbar puncture is done using 25 G Quincke spinal needle, at L 3 - L 4 space after free flow of csf is verified. Instantly after spinal injection, the patient is placed in a supine position with a cushion supporting shoulders and head. O2 (4-6L/min) is provided throughout face mask.

The following parameters will be measured:

Intraoperative measurement will be collected from the time of intrathecal administration to transfer to the recovery room.

- Intraoperatively non-invasive blood pressure and heart rate will be documented, every 15 min for first 30minutes then every 30 min till the end of the surgery.
- onset time of bromage 3 motor block will be recorded (Onset of the motor block; period between the ending of intrathecal drug injection and entire motor paralysis)
- Duration of motor block will be evaluated by the time taken to return from complete Bromage motor block (bromage 3) to scale 0.

Motor block is evaluated with Modified Bromage scale [6]

Bromage 0: The patient can move the hip, knee and ankle.

Bromage 1: The patient can't move the hip but has ability to move the knee and ankle.

Bromage 2: The patient can't move the hip and knee but has ability to move the ankle.

Bromage 3: The patient can't move the hip, knee and ankle.

- Complications will be noted Intraoperative
  - nausea, vomiting, pruritis.
  - Hypotension (> 20% fall of baseline blood pressure or systolic blood pressure of <100mmHg.) will be treated with bolus dose of 6 mg ephedrine IV

- Bradycardia (pulse rate < 60 bpm), will be treated with 0.3- 0.6 mg atropine IV
- Incidence of respiratory depression defined as respiratory rate less than 9 /min and SpO2 less than 90% on room air, will be noted, it will be treated with Oxygen (2 L/min), will be administered via a mask

References

1- Zhang Y, Shan Z, Kuang L, Xu Y, Xiu H, Wen J, Xu K. The effect of different doses of intrathecal dexmedetomidine on spinal anesthesia: a meta-analysis. Int J Clin Exp Med 2016;9(10):18860-18867.

2- Reddy NG, Sekar RG, Ahmed CJ, Himabindu M, Mallika CH, Tejaswini PK. Intrathecal nalbuphine versus dexmedetomidine as an adjuvant in spinal anaesthesia for lower limb and lower abdominal surgeries. Journal of Cardiovascular Disease Research 2023;14(2): 825-83.

3- Kumar S, Choudhury B, Varikasuvu S R. A Systematic Review and Meta-analysis of Efficacy and Safety of Dexmedetomidine Combined With Intrathecal Bupivacaine Compared to Placebo. Cureus 2022;14(12): e32425.

4- Gupta A, Gupta KL, Yadav M. To evaluate the effect of addition of dexmedetomidine to hyperbaric bupivacaine intrathecally in infraumblical surgeries. International Journal of Contemporary Medical Research 2016;3(7):2136-2138.

5- Ahmed SA, Lotfy HA, Mostafa TA. The effect of adding dexmedetomidine or dexamethasone to bupivacaine-fentanyl mixture in spinal anesthesia for cesarean section. J Anaesthesiol Clin Pharmacol 2024; 40:82-89.

6- Sharma E, Gupta B, Verma RK, Devra V. Block characteristics of different doses of intrathecal dexmedetomidine when combined with low dose heavy bupivacaine for gynecological surgeries: a double blind, randomised comparative study. Sch. J. App. Med. Sci., 2017; 5(6D):2286-2294.

7-Rajasekaran S, Murugaih S, Anandan A, Ramalingam A. A comparative study of intrathecal clonidine VS dexmedetomidine in caesarean patients. Indian Journal of Clinical Anaesthesia 2018;5(1):68-74.

8- Gupta R, Verma R, Bogra J, Kohli M, Raman R, Kushwaha JK. A Comparative study of intrathecal dexmedetomidine and fentanyl as adjuvants to Bupivacaine. J Anaesth Clin Pharmacol 2011; 27:339-343.