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Original Research Article

Study of Intrathecal Dexmedetomidine and Fentanyl as an Supporting to isobaric Levobupivacaine for Lower Limb Orthopaedic Surgery

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Abstract

Administrating the combinations of other classes of analgesics with local anesthetics has used to increase the duration and reduce side effects of analgesia. Some drugs have been used as adjuvants in spinal anesthesia to prolong intraoperative and postoperative analgesia including opioids, α2 agonists, neostigmine, vasoconstrictors, etc. Clonidine and dexmedetomidine are two α2 agonists affecting via pre- and post-synaptic α2 receptors. Hence based on above data the present study was planned for Study of Intrathecal Dexmedetomidine and Fentanyl As An Supporting to isobaric Levobupivacaine for Lower Limb Orthopaedic Surgery.The present study was planned in Department of Anaesthesia, Vardhman Institute of Medical Science Pawapuri. Nalanda, Bihar. The study was conducted from January 2016 to December 2017. In the present total 50 patients undergoing the lower limb orthopaedic surgeries were enrolled. The patients were divided in two study groups based on the administration of dexmedetomidine and fentanyl. The dexmedetomidine appears to be an attractive alternative to fentanyl as an adjuvant to spinal bupivacaine in surgical procedures. It provides good quality of intraoperative analgesia, hemodynamically stable conditions, minimal side effects, and excellent quality of postoperative analgesia.

Keywords: Intrathecal, Dexmedetomidine, Fentanyl, isobaric, Levobupivacaine, Lower Limb, Orthopaedic Surgery, etc.

Introduction

Dislocations of the foot are uncommon but potentially incapacitating injuries. The mechanism of injury may vary from a simple fall to a major motor vehicle collision (MVC). The foot is a complex structure, and injuries often occur in patients who sustain multiple trauma. The clinician must understand common patterns of injury and maintain a high index of suspicion in examining the appropriate radiographs to avoid missing foot dislocations.The foot consists of 26 bones and 57 articulations.

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The foot is composed of 3 functional and anatomic regions. The hindfoot consists of the talus and the calcaneus. The midfoot consists of the navicular, the cuboid, and the 3 cuneiforms. The forefoot contains the 5 metatarsals and 14 phalanges.The foot also contains numerous accessory centers of ossification that are occasionally mistaken for avulsion injuries. The presence of a smooth cortical surface and lack of associated soft-tissue edema helps to differentiate these normal variants from fractures.The articulations between the hindfoot and the midfoot are the midtarsal or Chopart joints. These joints are the talonavicular and the calcaneocuboid joints. The articulations between the midfoot and the forefoot are termed the Lisfranc joints and consist of the 5 tarsometatarsal joints.The subtalar joint, between the talus and the calcaneus, accounts for most inversion and eversion injuries to the hindfoot. Adduction and abduction of the forefoot primarily occurs through the midtarsal joints. Flexion and extension primarily occurs at the metatarsophalangeal (MTP) and interphalangeal (IP) joints. All dislocations in the foot (with the exception of simple dislocations of the toes) are uncommon injuries. The most common of these injuries is a dislocation that involves the Lisfranc joint complex. The rarity of these injuries makes diagnosis difficult. A significant proportion of the more subtle dislocations are not diagnosed upon initial presentation. Dislocations through the Lisfranc joint complex are thought to have an incidence of about 1 in 50,000 persons with orthopedic trauma per year, representing fewer than 1% of all dislocations.Dislocations of the foot are commonly associated with other significant injuries sustained during falls or MVCs. Delay in recognition of dislocations is common because of the distracting effect of the associated injuries or because of the subtle nature of these injuries. Early reduction and immobilization may reduce morbidity.Many complications, including avascular necrosis, compartment syndrome, and degenerative arthritis, have been reported. Additionally, residual pain and loss of function is a common consequence of the complex biomechanics of the foot.The male-to-female ratio is 6:1. This differential is largely due to the higher number of young males who sustain significant trauma. Injury may occur at any age, although the more severe forms of dislocation associated with MVCs are more common in young adult males.In general, patients who experience dislocations of the foot have other injuries related to the mechanism of injury. A full history of the event should be obtained from the patient or prehospital caregivers. Occasionally, these injuries may occur with minimal trauma. This is especially true with athletes. The history in these cases is usually of increasing pain and edema over a few days, resulting in a significant limitation of mobility, decreased performance, or both. Often, the patient gives no definitive history of a single traumatic event. The presumed mechanism of injury responsible for each type of dislocation is discussed with that dislocation.Examination of the foot usually reveals an obvious deformity; however, some dislocations are accompanied by substantial soft-tissue edema. The exact nature of the injury may be unclear until radiography is performed.Neurovascular examination is critical both prior to and after any reduction.Assess the vascular status. If no pulse is palpable, urgent reduction of the dislocation is required. Confirm the absence of a pulse with Doppler studies in the emergency department (ED) if possible. Mark the position of the pulse on the skin; this simple measure confirms that a pulse was taken and that it was palpable and also indicates the ideal anatomic location for reassessment. Loss of a previously palpable pulse is a sign that urgent reduction is needed.Check for any breaks in the skin. Check for any tenting of the skin, which may necessitate urgent reduction.Findings may be subtle and nonspecific in persons who present with foot pain from a Lisfranc dislocation in which no single major traumatic event has occurred. [1] Edema and tenderness over the joint are usually present. Ecchymoses may develop after a few days. Vascular compromise is rare.The risk factors for dislocation of the foot are the same as those for any major trauma (ie, youth, alcohol intake, drug intake). However, dislocations of the foot can result from an apparently simple fall (eg, twisting one's foot in a hole in the ground when jogging).Numerous different types of dislocations of the foot are recognized.Subtalar or peritalar dislocation is a simultaneous dislocation of the talocalcaneal and talonavicular joints. Note that the talus remains in the ankle mortise. It is typically caused by falls from a height, MVCs, and severe twisting injuries (eg, basketball players who land on an inverted and plantar-flexed foot). [2] Subtalar dislocation is seen with both high- and low-energy trauma. Sporting activities, commonly basketball, are often the cause of low-energy injuries. The majority of subtalar dislocations are accompanied by fractures of the hindfoot, including osteochondral fractures, calcaneus fractures, and fractures of the posterior process and tubercles of the talus. The diagnosis of subtalar dislocation is usually made on AP, lateral, and oblique radiographs of the foot or ankle. The nature of the deformity often limits radiographic positioning. [3]The dislocation is typically medial or lateral (rarely anterior or posterior), although medial dislocation is more common (80%). Posterior dislocation may result from hyperplantar flexion. [4] Inversion injuries result in medial dislocations and eversion injuries result in lateral dislocations. The navicular bone and forefoot are displaced medially with a medial subtalar dislocation and displaced laterally with a lateral dislocation. These dislocations are frequently associated with fractures of the involved bones and a small percentage are open.The effect of direction of the dislocation on long-term prognosis is still controversial. [5, 6]Total talar dislocation: A rare dislocation, this injury typically results from very high-energy trauma. The talus is completely out of the ankle mortise and is rotated such that the inferior articulation points posteriorly and the talar head points medially.These dislocations are commonly open and result in avascular necrosis of the talus, loss of ankle motion due to traumatic arthritis, and ischemic skin loss from underlying skin pressure. Talar dislocation with associated distal fibular fracture (Weber C) has been reported. [7] When total talar dislocation injuries occur with an open wound, the talus often has associated fractures with remaining soft-tissue attachments. Initial radiographs are often obtained with nonconventional positioning. After initial reduction, CT is performed to further characterize associated injuries. [3]

Lisfranc dislocation: Dislocation fractures of the tarsometatarsal joints are referred to as Lisfranc injuries. This type of dislocation is caused by several mechanisms, including rotational forces about a fixed forefoot, axial loading in a plantar flexed foot, and crush injuries. These injuries may also be a manifestation of a developing neuropathic or Charcot joint arthropathy.Tremendous energy is usually required to subluxate or dislocate the Lisfranc joint complex. This energy frequently results in extensive soft-tissue injury. Occasionally, minor rotational injuries may cause this problem. This is particularly well described in athletes and in older patients. [8]The clinician must be careful not miss these injuries. Evaluate the alignment of the metatarsal bones with their corresponding tarsal bones on radiographs. The first, second, and third metatarsals should line up with the medial, middle, and lateral cuneiforms respectively. The fourth and fifth metatarsals should line up with the cuboid.A good starting point for evaluation is to inspect the medial aspect of the middle cuneiform to be directly in line with the medial aspect of the second metatarsal. Any disruption is indicative of a dislocation, which may have spontaneously reduced.Lisfranc dislocations are classified according to the direction of injury in the horizontal plane and include the following:

Some studies estimated that 20% of Lisfranc injuries are missed upon initial presentation to the ED. Subtle injuries to the Lisfranc joint do occur and may be difficult to diagnose. Slight widening (2-5 mm) of the space between the first and second metatarsals may be seen, as well as a widening of the space between the middle and medial cuneiforms.Metatarsophalangeal (MTP) and interphalangeal (IP) dislocation: First MTP dislocations, although rare given the inherent stability of the joints, typically result from large forces. [9] These dislocations are typically dorsal and are often open.Dislocations of the other metatarsophalangeal joints are not unusual and typically are caused by trauma. The dislocation is most frequently a lateral or dorsal displacement of the digit on the metatarsal head.IP dislocations are less common than MTP dislocations. Most occur in the first toe as a direct result of axial loading. Other dislocations: Although very rare, other dislocations in the foot have also been described.Isolated fracture dislocation of the navicular on the talus has been described. It occurs following a fall from a height and is usually treated with open reduction and internal fixation.Cuboid and cuneiform fractures are sometimes associated with tarsometatarsal dislocations, but they may present as isolated fracture-dislocation. They are unstable frequently and require open reduction and internal fixation.Administrating the combinations of other classes of analgesics with local anesthetics has used to increase the duration and reduce side effects of analgesia. Some drugs have been used as adjuvants in spinal anesthesia to prolong intraoperative and postoperative analgesia including opioids, α2 agonists, neostigmine, vasoconstrictors, etc. Clonidine and dexmedetomidine are two α2 agonists affecting via pre- and post-synaptic α2 receptors.Hence based on above data the present study was planned for Study of Intrathecal Dexmedetomidine and Fentanyl As An Supporting to isobaric Levobupivacaine for Lower Limb Orthopaedic Surgery.

Methodology

The present study was planned in Department of Anaesthesia, Vardhman Institute of Medical Science Pawapuri. Nalanda, Bihar. The study was conducted from January 2016 to December 2017.In the present total 50 patients undergoing the lower limb orthopaedic surgeries were enrolled. The patients were divided in two study groups based on the administration of dexmedetomidine and fentanyl. The Group A patients received the 2.5 mL volume of 0.5% hyperbaric bupivacaine and 5 µg dexmedetomidine in 0.5 mL of normal saline intrathecal (dexmedetomidine (100 µg/mL) was diluted in preservative-free normal saline). The Group B patients received 2.5 mL volume of 0.5% hyperbaric bupivacaine with 25 µg fentanyl intrathecal. Intrathecal injection was given over approximately 10–15 s. immediately after completion of the injection patients were made to lie supine.

All the patients were informed consents. The aim and the objective of the present study were conveyed to them. Approval of the institutional ethical committee was taken prior to conduct of this study.

Following was the inclusion and exclusion criteria for the present study.

Inclusion criteria

Patients aged between 18 and 60 years, American Society of Anesthesiologists (ASA) Classes I–II, scheduled for lower limb surgeries were included in the study.

Exclusion criteria

Patients using α2-adrenergic receptors antagonists, calcium channel blockers, and angiotensin-converting enzyme inhibitors, patients with dysrhythmia, history of allergy to study drugs, patients with coagulopathy, and patients with neurological disorders were excluded from the study.

Results & Discussion

Subarachnoid block is the most commonly used regional anesthesia technique in contemporary anesthesia practice. Motor block from subarachnoid anesthesia beyond the duration of surgery is undesirable, particularly in ambulatory setting, and this is the most important reason why subarachnoid block is not preferred in ambulatory setting. Various local anesthetic agents have been used in spinal anesthesia since their introduction.The mechanism by which intrathecal α 2 adrenoreceptor agonists prolong the motor and sensory block of local anesthetics is at the best, speculative. It may be an additive or synergistic effect secondary to the different mechanisms of action of the local anesthetics and intrathecal α2 adrenoreceptor agonists. Local anesthetics act by blocking sodium channels. α2 adrenoreceptor agonists act by binding to the presynaptic C-fibers and postsynaptic dorsal horn neurons. They produce analgesia by depressing release of C-fiber transmitters and by hyperpolarization of post synaptic dorsal horn neurons. [10-12] The complementary action of local anesthetics and α2 adrenoreceptor agonists accounts for their profound analgesic properties. The prolongation of the motor block of spinal anesthetics may be the result of binding of α2 adrenoreceptor agonists to the motor neurons in the dorsal horn. [10-11] Dexmedetomidine is eight times more specific andhighly selective α2 adrenoreceptor agonists compared to clonidine, thereby making it a useful and safe adjunct in diverse clinical applications. [13-14]The use of dexmedetomidine has been studied as an epidural adjunct by various authors who have observed its synergism with local anesthetics. It is observed to prolong the motor/sensory block duration time and postoperative analgesia without any additional morbidity. [15-16] Clinical studies exhibit potentiation of neuraxial local anesthetics, decrease in intraoperative anesthetic requirements with prevention of intraoperative awareness, improved intraoperative oxygenation, and postoperative analgesia when epidural or caudal dexmedetomidine was used in conjunction with general anesthesia. [17]

Table 1: Basic Details

Group	Bupivacaine with Dexmedetomidine	Bupivacaine with Fentanyl
Age	40 – 49	39 – 48
Sex: Males Females	 18 7	 15 10
ASA: Class I Class II	 19 6	 20 5
Weight in Kg	53.4 – 80.3	54.7 -82.6
Duration of Surgery (min)	141 – 215	138 - 210

Table 2:Groups related to Bupivacaine

Group	Bupivacaine with Dexmedetomidine	Bupivacaine with Fentanyl
Highest sensory level	T4 – T8	T4 –T7
Time from injection to highest sensory level (min)	11.1 – 13.9	12.1 – 14.3
Time of two segment regression from the highest sensory level (min)	97 – 141	71 - 99
Time for sensory regression to S1 from highest sensory level(min)	431 – 473	169 -201
Total analgesic dose in first 24 h (mg)	41 – 118	91 – 209
Time to rescue analgesia (min)	211 – 259	169 - 186
Onset to Bromage 3 (min)	8.9 – 13.1	9.9 -12.7
Regression to Bromage 0 (min)	411 – 459	141- 173

Table 3: Side Effects

Group	Bupivacaine with Dexmedetomidine	Bupivacaine with Fentanyl
Nausea	1	2
Vomiting	0	1
Pruritus	0	1
Respiratory depression	0	0
Hypotension	2	1
Bradycardia	0	0
Urinary retention	1	1

Mahendru et al.[18] compared intrathecal dexmedetomidine, clonidine, and fentanyl as adjuvants to hyperbaric bupivacaine for lower limb surgery. They observed that when dexmedetomidine and fentanyl were added as adjuvants, maximum height of sensory block achieved was T6 in both groups.Gupta et al.[19] compared intrathecal dexmedetomidine and fentanyl as adjuvants to bupivacaine. They observed that the maximum height of sensory block achieved was T5 with dexmedetomidine and T6 with fentanyl as adjuvant to local anesthetic.Similarly, Mahendru et al.[20] found no significant difference in onset of motor block between dexmedetomidine and fentanyl groups. While Yektas [21] and Ravipati [22] reported faster onset of motor block for dexmedetomidine compared to fentanyl. Other studies have also mentioned lower time to reach the highest sensory level in dexmedetomidine compared to fentanyl. [23]Lower limb fractures are very common in the geriatric population, and spinal anesthesia is very often used during their surgical repair. Regional anesthesia is the choice in elderly patients owing to lower incidence of postoperative delirium and confusion than general anesthesia [1]. Postoperative pain control is a problem in these surgeries owing to the relatively short duration of action of available local anesthetics.

Conclusion

The dexmedetomidine appears to be an attractive alternative to fentanyl as an adjuvant to spinal bupivacaine in surgical procedures. It provides good quality of intraoperative analgesia, hemodynamically stable conditions, minimal side effects, and excellent quality of postoperative analgesia.

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