Original Article

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Effect of Intravenous Dexamethasone on Prolongation of Analgesia Following Supraclavicular Brachial Plexus Block

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Abstract

Objective: Intravenous dexamethasone prolongs the duration of analgesia and motor block provided by brachial plexus block with plain 0.5% bupivacaine.

Material and Methods: After obtaining Ethical Committee's approval, informed consent was taken from the patients involved in the study. The 60 patients included in the study were divided randomly into two groups with 30 patients in each. In group P, ultrasound guided supraclavicular brachial plexus block was given with 30 ml of plain 0.5% bupivacaine without any additive followed by 2 ml of normal saline intravenously. In group D, ultrasound guided supraclavicular brachial plexus block was given with 30 ml plain 0.5% bupivacaine followed by 8 milligrams (2 ml) dexamethasone intravenously, injected after giving the block. Following this, duration of analgesia and duration of motor block was calculated for both the groups.

Results: The mean duration of analgesia in group P (plain bupivacaine 0.5% in block with 2 ml normal saline iv) was 365±20 minutes (approx 6 hours) while the mean duration of analgesia in group D (plain bupivacaine 0.5% in block with 8 mg dexamethasone iv) was 902±30 minutes (approx 15 hours). The duration of motor block noted in group P was 253±32 minutes (approximately 4 hours) and that in group D was 572±36 minutes (approximately 9.5 hours). Both these results were highly significant. ($p<0.001$).

Conclusion: Intravenous (IV) administration of dexamethasone along with supraclavicular brachial plexus block with 0.5% bupivacaine significantly prolongs analgesia as well as motor block provided by the block. As dexamethsone is still not approved for perineural use by the various drug regulatory authorities around the world including FDA and long term effects of perineural dexamethasone are still under study, IV administration of dexamethasone should be preferred over perineural use in contemporary practice of anaesthesia.

Keyword: IV dexamethasone; Brachial plexus block.

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Introduction

Brachial plexus block is a widely used and efficacious regional anaesthesia technique used for upper extremity orthopaedic surgeries.[1] Supraclavicular approach for this block is used for surgeries around the elbow and distal to it. A longer duration of analgesia postoperatively enables patients comfort and reduces morbidity. Various adjuvants have been added to local anaesthetic drugs in this block to achieve a longer duration of perioperative anaesthesia and analgesia. In contemporary practice drugs like epinephrine, sodium bicarbonate, opioids, clonidine etc have been used as additives for the same.[2,3]

Dexamethasone has also been used off label as an additive perineurally in supraclavicular block and has proven to prolong the effect of block although it is not FDA approved for use in peripheral nerve blocks.[4] Multiple studies have been conducted that have shown its safety in this use but there is still lack of literature on long term follow up of these patients.[5] More number of such long term follow up studies need to be conducted to ascertain the safety of dexamethasone perineurally before it can be used without any hesitation by contemporary anaesthesiologists. Meanwhile intravenous dexamethasone is widely used.

The mechanism of action of analgesia by dexamethasone is unclear. But it has been postulated that it inhibits synthesis of cyclooxygenase-2 in the peripheral tissues and central nervous system thereby reducing the prostaglandin production and thus inflammation and pain.[6,7] Intravenous corticosteroids have been used since a long time and single time use is very common by anaesthesiologists for its antiemetic and anti inflammatory effects and does not cause any serious side effects. Thus we conducted this study to find if intravenous dexamethasone had any effect on prolongation of duration of supraclavicular block.

Materials and Methods

We included 60 patients posted for elective upper extremity orthopaedic surgeries belonging to ASA 1 and 2 groups between the age groups of 20 to 60 years. We excluded patients who were diabetic, had hepatic or renal dysfunction, peripheral neuropathy, any associated head injury or who had any history of allergy to local anaesthetics or steroids. These 60 patients were divided into two groups of 30 each. First group received ultrasound guided supraclavicular block using 30 ml 0.5% bupivacaine plain without any additive. The second group received the same along with 8 mg dexamethasone intravenous after block application.

A standard preanaesthetic examination was done and written informed consent taken from the patients. The procedure was explained to the patient during pre anaesthetic checkup. Patients were premedicted with tablet alprazolam 0.5 mg and tablet pantoprazole 40 mg orally in the night before surgery and on the morning of surgery with sips of water. Inside the operation theatre, all standard monitors (electrocardiogram, non invasive blood pressure, pulse oximeter) were attached, baseline vitals noted and an intravenous catheter was inserted.

The 60 patients were allocated into two groups with 30 patients in each. In group P, ultrasound guided supraclavicular brachial plexus block was given with 30 ml of plain 0.5% bupivacaine without any additive followed by 2 ml of normal saline intravenously. In group D, ultrasound guided supraclavicular brachial plexus block was given with 30 ml 0.5% bupivacaine plain followed by 8 milligrams (2 ml) dexamethasone intravenously. Following the block, patients were evaluated every 5 minutes for sensory and motor block. Sensory block was examined using pinprick along the dermatomes of radial, median, ulnar and musculocutaneous nerves. Motor block was assessed using modified bromage scale for upper extremity as per department protocol. Surgery was started after adequate block was achieved.

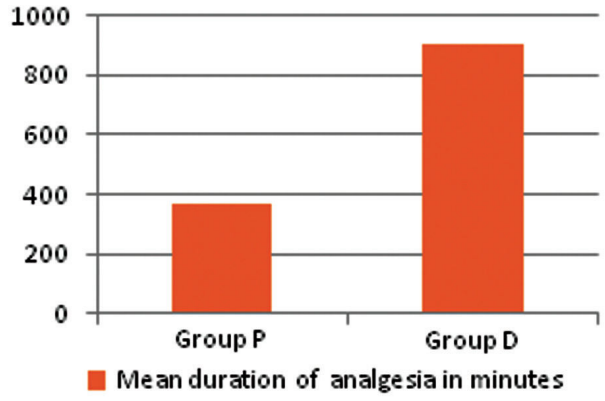
The patients with failed block were excluded from our study. After the completion of surgery, pain was assessed using VAS score. Postoperative assessment for motor block and pain was done at 2,6,10,16,24 hours. Both duration of analgesia and motor block were calculated from the time of giving drug in the block. Duration of postoperative analgesia was calculated till VAS score of patients was more than.[4] When VAS>4, rescue analgesia was used in the form of injection diclofenac 75 mg intravenously. Adverse effects like nausea, vomiting and paraesthesias in the affected limb was also noted. Any pain on tourniquet application was also noted. Patients with failed block were excluded from the study. Data analysis was done using SPSS version 21.0. Categorical data were compared using chi square test. $P<0.05$ was considered statistically significant.

Results

The study was conducted in 60 patients. Both groups were comparable in age, sex, weight, ASA

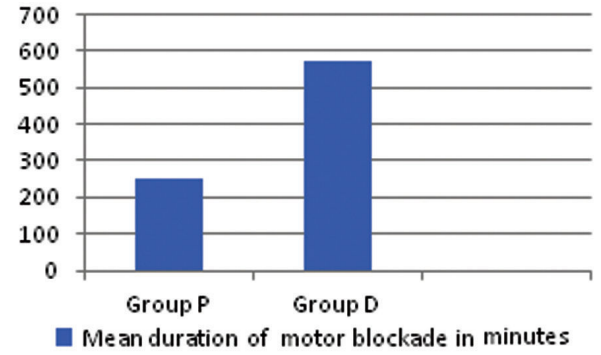
status and duration of surgery. We calculated the duration of analgesia as the time from injection of drug in supraclavicular block under ultrasound guidance to the time of demand for first rescue analgesic when the patient complained of pain with a VAS score of >4. The first rescue analgesic drug used was injection diclofenac 75 mg (intravenous). We also noted the total duration of motor block. It was calculated as the time from start of motor blockade as interpreted from the modified bromage scale for upper extremity to the recovery of full power in the affected limb.

Graph: Mean duration of analgesia in minutes.



There were no cases with failed block so no exclusions were made.

Graph: Mean duration of motor blockade in minutes.



The mean duration of analgesia in group P (plain bupivacaine 0.5% in block with 2 ml normal saline iv) was 365±20 minutes (approx 6 hours) while the mean duration of analgesia in group D (plain bupivacaine 0.5% in block with 8 mg dexamethasone iv) was 902±30 minutes (approx 15 hours)(table 1). It was highly statistically significant ($p<0.001$).

The duration of motor block noted in group P was 253±32 minutes (approximately 4 hours) and that in group D was 572±36 minutes (approximately 9.5 hours)(table 2). These results were also statistically significant ($p<0.001$).

There were no paraesthesias or tourniquet pain in either group.

The incidence of nausea and vomiting was lesser in group D but it was not statistically significant.

Discussion

Post operative analgesia plays a very important role in early recovery of the patient after any surgery. It also has a major role in the complete experience of the patient in the hospital. Regional techniques of anaesthesia are therefore becoming increasingly popular, rather preferred technique of anaesthesia, wherever applicable, as it provides good intraoperative as well as postoperative analgesia.[8] Any technique that ensures prolonged pain relief after surgery is a welcome one.

Brachial plexus block has been widely used in surgeries of the upper limb1. Supraclavicular approach for the same is very safe, effective and relatively simple to perform. Generally the local anaesthetic agents used for this block are effective for 4 to 6 hours only after the block.[9] Therefore various modalities have been used to prolong the said duration. One is the use of catheters. But again, catheters are prone to complications such as malfunction, migration or local anaesthetic systemic toxicity. The other is using adjuvants with the local anaesthetic perineurally. The commonly used adjuvants are opioids, clonidine, dexmedetomidine, ketamine, dexamethasone etc.[2,3] Dexamethasone has been commonly used perineurally but it is not FDA approved for the same.[4] Although it seems to be fairly safe but long term follow up studies are still lacking to show its toxic effects on local nerve roots.

Dexamethasone is a synthetic glucocorticoid which has anti inflammatory and immuno suppressive actions. It is a water soluble compound and has been commonly used in anaesthesia practice as an effective anti emetic for post operative nausea and vomiting. Recently its analgesic effects have been studied.

In the study conducted by us, the demographic profiles of both group regarding age, sex, weight, ASA status and mean duration of surgery were similar and not statistically significant ($p>0.05$).

We noted the mean duration of analgesia and motor block in the two groups. The mean duration of analgesia in group P (plain bupivacaine 0.5% in block with 2 ml normal saline iv) was 365±20 minutes (approx 6 hours) while the mean duration of analgesia in group D (plain bupivacaine 0.5% in block with 8 mg dexamethasone iv) was 902±30

minutes (approx 15 hours). The duration of motor block noted in group P was 253±32 minutes (approximately 4 hours) and that in group D was 572±36 minutes (approximately 9.5 hours).

The mechanism of action of analgesia by dexamethasone remains unclear. Although many studies have shown it to be due to interruption of transmission by nociceptive C fibres. Johanssen et al found reduction in transmission of nociceptive C fibres on application of corticosteroids in rats6. Other mechanisms are also involved like reduction of inflammatory mediators, ectopic neuronal discharges and inhibition of K+ channels on nociceptive C fibres.[10]

Desmet et al conducted a prospective, double-blind, randomized placebo-controlled study and compared the analgesic duration of dexamethasone in three groups: 0.5% ropivacaine plain, 0.5% ropivacaine and perineural dexamethasone(10 mg) and 0.5% ropivacaine with intravenous dexamethasone (10 mg). Analgesia in the plain bupivacaine group lasted 757 minutes (12.6 hours), whereas analgesia lasted 1,405 minutes (23.4 hours) and 1,275 minutes (21.25 hours) in perineural versus intravenous dexamethaosne respectively.[11] These results are similar to our study.

In a similar study conducted by Abdallah et al, 75 patients were divided into 3 groups: 0.5% bupivacaine plain, 0.5% bupivacaine with intravenous dexamethasone, 8 mg and 0.5% bupivacaine with perineural dexamethasone, 8 mg. Analgesic duration was around 25 hours in both groups that included dexamethasone, whereas the control group with plain bupivacaine had analgesia for 13 hours after the block ($P < 0.001$).[12] The analgesic duration in this study are also similar to our study.

There have been studies conducted and various meta analysis to see the effect of intravenous dexamethasone over postoperative analgesia and the results are promising as also in our study. In a meta-analysis by De Oliveira et al, it was concluded that IV dexamethasone decreased opioid consumption and improved postoperative analgesia compared with placebo.[13] The meta-analysis included orthopedic, laparoscopic, and ear, nose, and throat surgical procedures. Recently in 2019, Hewson D also suggested that intravenous dexamethasone has good analgesic and anti emetic effect and this drug should be used in all cases with or without peripheral nerve block.[14]

Heesen et al in their meta analysis on use of intravenous dexamethasone in the setting of spinal anaesthesia, found it to be significantly effective in prolonging analgesic duration of spinal block.[15]

In the Indian setting, a study conducted by Dhanger et al used low dose dexamethasone (2 mg) intravenously with supraclavicular block with 25 ml 0.5% bupivacaine and compared it with supraclaviular block with plain bupivacaine 0.5%.[16] They concluded that low dose dexamethasone significantly prolongs the duration of analgesia.

Perineural and intravenous dexamethasone have been directly compared in various studies with regards to analgesic efficacy and motor blockade duration. Most studies have found it to be comparable. Recently McHardy et al in their study in 2019 found no advantage of perineural over intravenous dexamethasone in terms of analgesia or motor block in interscalene block.[17]

Chong et al in their meta analysis in 2017 showed that analgesic duration of perineural versus intravenous route is comparable with the former just 3.77 hours longer duration than the latter18. They therefore question the justification of use of the perineural over the intravenous route routinely and suggest that perineural use should be limited to patients where it is of use.[19] Although perineural dexamethasone is widely used in practice and various studies have proclaimed it to be safe, long term follow up is lacking and the exact mechanism of action of perineural route is also unclear. Perineural route is also not yet approved by the drug regulatory authorities around the world. Our study shows that intravenous dexamethasone as an adjuvant to 0.5% bupivacaine prolonged analgesic duration and assured good motor blockade for a significant duration after supraclavicular brachial plexus block as compared to that with plain bupivacaine 0.5%. Thus we suggest that intravenous dexamethasone should be preferred over perineural route until bigger, long term studies and trials are conducted that ensure safety of perineural use.

There are some limitations to our study. De oliviera and some other studies have associated intravenous dexamethasone with hyperglycemia although surgical stress may also be a contributing factor for the same. We did not study hyperglycemia as a side effect in our study. Also bigger study groups need to be used to accurately distinguish the analgesic role of intravenous dexamethasone.

Conclusion

A single dose of dexamethasone 8 mg given intravenously along with supraclavicular brachial plexus block prolonged analgesic duration to

upto 15 hours compared to 6 hours with plain supraclavicular block. It also prolonged the duration of motor block significantly (9.5 hours vs 4 hours) without any major adverse effects. Dexamethasone is a cheap, easily available drug that has a high safety profile when used through intravenous route. Its analgesic and anti emetic effects make it very useful for routine use and it may be preferred over perineural dexamethasone when prolonged analgesia is required after peripheral nerve blocks.

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