Intra-articular Lidocaine versus Bupivacaine for Shoulder Reduction

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ABSTRACT

In the emergency department, the shoulder joint is the most common large-joint dislocated. The shoulder reduction can perform under Procedural sedation and analgesia or local intra-articular anesthetic injection. Intra-articular anesthesia is affordable, prevents potential side effects from intravenous sedatives, controls the pain and has a quick recovery time. This review article compares bupivacaine versus lidocaine in their safety, muscle relaxant effect, and effectiveness of anesthesia and analgesia during and after shoulder reduction.

Keywords: Lidocaine, Bupivacaine, Intra-Articular injection, Shoulder reduction, Local anesthesia

INTRODUCTION

In the emergency department (ED), the shoulder joint is the most common large-joint dislocated[1]. The unique anatomical structure of the shoulder joint gives it an extensive range of motion (ROM). However, this advantage makes the joint unstable and vulnerable to dislocation[2]. The shoulder reduction can perform under Procedural sedation and analgesia (PSA) or local intra-articular anesthetic injection[3-6].

Intra-articular (IA) anesthesia is affordable, prevents potential side effects from intravenous sedatives, controls the pain, and has a quick recovery time[4,7]. According to a review of five randomized controlled trials, there was no significant difference in the success rate of shoulder reduction between intra-articular anesthetic drugs and PSA. Also, the patients given PSA experienced more side effects (relative risk [RR] 0.16; 95% CI 0.06-0.43) and stayed longer in the emergency department. However, the incidence of PSA side effects varies significantly according to the medication used[8]. Local anesthetics are classified into two groups: esters (procaine, benzocaine) and amides (lidocaine, mepivacaine, bupivacaine, prilocaine, and articaine). Esters are no longer used as injectable anesthetics; instead, amino acids are the most widely used injectable anesthetics[9]. The anesthetic agent delivers into an articular joint by lateral or posterior approach for anterior shoulder dislocation. For lateral approach, insert 18-20-gauge in the glenohumeral joint, 1-2 cm inferior to the acromion's lateral edge in a sterile environment. Then, injects the anesthetic agent inside the glenohumeral capsule. Ultrasound can be used in this procedure to guarantee the injection is given in the proper place[10,11].

One of the most popular short-acting anesthetics utilized in shoulder reduction is lidocaine. Six randomized controlled clinical trials found that intra-articular lidocaine was cheaper, had a shorter duration of stay, and had fewer complications than intravenous sedation[12]. On the other hand, bupivacaine is one of the long-acting local anesthetic agents commonly used after joint arthroplasty. A meta-analysis of 11 randomized controlled trials found statistically significant differences in the mean visual analog scale (VAS) pain score between intra-articular bupivacaine and placebo at 24 and 48 hours after surgery. Furthermore, there was no statistically significant difference in the mean VAS pain score when narcotics use. Additionally, using intra-articular bupivacaine did not increase the incidence of adverse side effects 24 to 72 hours after surgery[13].

This review article compares bupivacaine versus lidocaine in their safety, muscle relaxant effect, and effectiveness of anesthesia and analgesia during and after shoulder reduction.

LITERATURE REVIEW

Lidocaine is a synthetic drug with local anesthetic and antiarrhythmic properties. Lidocaine stabilizes the neuronal membrane by attaching to voltage-gated sodium channels and inhibiting the ionic fluxes required for impulse initiation and conduction. Since the late 1940s, lidocaine has been frequently used in different local surgical procedures. The onset of action of lidocaine is about 45-90 seconds, and its duration is 10-20 minutes[14,15].

Bupivacaine is a synthetic drug. It can be used with and without epinephrine for local infiltration, peripheral nerve blocks, and caudal and lumbar epidural blocks. Bupivacaine inhibits nerve impulses by raising the threshold for electrical stimulation in the nerve, decreasing nerve impulse propagation, and slowing the pace at which the action potential rises. Bupivacaine reaches its peak in 30 to 45 minutes in the blood after injection. Then gradually fall over the next three to six hours to undetectable levels. The onset of action (route and dose-dependent) is 1-17 minutes, and the duration of action (route and dose-dependent) is 2-9 hours. The total dose and concentration of drug administered, the route of administration, the vascularity of the administration site, and the presence or absence of epinephrine in the anesthetic solution influence the rate of systemic absorption of local anesthetics[16].

In clinical practice, intra-articular injections of amide-type local anesthetics have cytotoxic effects on the articular chondrocytes[17,18]. The cytotoxic effects vary depending on the drug's half-life, onset, and duration of action[17,18]. While numerous in vitro research demonstrated the chondrotoxic effects of a single dose of local anesthetic administration, there are not large enough in vivo experiments to support this conclusion. As a result, there are no established recommendations or gold standard for the best anesthetic to use in clinical practice[19]. Studies showed bupivacaine has the most chondrotoxic effect and cell apoptosis compared to other amide local anesthetics, especially with high doses of bupivacaine concentrations (0.5% or higher)[17,18,20-24]. On the other hand, the studies revealed that Lidocaine at high doses

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(2% Lidocaine) caused massive chondrocyte necrosis at 24 hours after exposure, whereas 1 percent lidocaine caused a detectable but insignificant (P>0.05) decrease in cell viability 24 hours after exposure[25]. Another survey reported combining 1% lidocaine with epinephrine is the least toxic. However, there is conflicting literature on the effects of epinephrine on chondrocyte viability[26].

The primary mechanism of action for both lidocaine and bupivacaine is inhibiting the voltage-gated Na+ channel, which produces the anesthetic effect. However, local anesthetics agents like lidocaine and bupivacaine can create inhibitory action on the nicotinic acetylcholine muscle receptors[27]. Intraarticular lidocaine has additional advantage of adequate muscle relaxation during the shoulder reduction[28,29]. In contrast, another systemic review considered Intra-articular lidocaine ineffective for providing a considerable muscle relaxing effect compared to intravenous sedative agents[9]. Bupivacaine shares the same mechanism of action as lidocaine and has the property of relaxing the muscles[30]. However, Bupivacaine has not been studied as an intra-articular injection during shoulder reduction, where the degree of muscle relaxation can be measured.

In a systematic review and meta-analysis of twenty-eight trials that included 1,560 patients, intra-articular bupivacaine was injected after arthroscopic knee surgery for pain relief. There was a significantly lower VAS score at 2,4,6,12,24 hours compared to the placebo, but there was no difference between the two groups at 48 and 72 hours. Additionally, the time spent for additional analgesia was longer, and the number of the patients requiring additional analgesics were smaller[31]. Intra-articular lidocaine for shoulder reduction was compared to intravenous sedation in a clinical review of six randomized controlled clinical trials, which found that patients in the intra-articular lidocaine group had a lower rate of complications, cost, and length of stay. Furthermore, there was no significant difference in the success rate of shoulder reduction between the two groups[32].

CONCLUSION

Intra-articular lidocaine and bupivacaine are effective analgesics. But bupivacaine has a longer duration of action. Lidocaine at low concentrations has a lower chondrotoxic effect and is a safer choice compared to bupivacaine. Bupivacaine works the same way as lidocaine to relax muscles, but more research is needed to confirm this finding.

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