Efficacy of using dexmedetomidine as an adjuvant to bupivacaine

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Abstract

Dexmedetomidine is a member of the alpha-2 agonist family which is highly specific and has highly selective properties. When used as an adjuvant to Bupivacaine, it has been reported to have positive effects. In this review article, the most important efficacies of Dexmedetomidine as an adjuvant to Bupivacaine including prolonging the analgesic and anesthetic effects of bupivacaine, improving post-operative analgesia, improving analgesic effects of bupivacaine, providing better sedation, shortening the onset of block, improving local anesthesia, providing better hemodynamic stability, and reducing the consumption of analgesic substances are discussed.

Keywords: Dexmedetomidine, Bupivacaine, Adjuvant

Introduction

Dexmedetomidine is a member of the alpha-2 agonist family which is highly specific and has highly selective properties (1, 2). Dexmedetomidine has 8 times more affinity for alpha2 receptors (1620 alpha1: alpha2 selectivity) compared to clonidine, the first agonist developed and also the mostly known one (200 alpha1: alpha2 selectivity) (3, 4). It has been reported to have cardiovascular stabilizing (5), analgesic (5-20), sedative (19, 21-
33), and sympatholytic (34-37) effects. Although dexmedetomidine provide deep sedations, it has not been reported to have any significant adverse effects on respiration such as respiratory depression (38, 39). Not only does dexmedetomidine help anesthesiologists to use lower inhalational agents, but it also has opioid-sparing effects (40-44). Although dexmedetomidine has beneficial effects, it is often used as an adjuvant to local anesthetic agents such as bupivacaine. In this article, efficacy of using dexmedetomidine as an adjuvant to bupivacaine is reviewed.

**Efficacies**

Dexmedetomidine when used as an adjuvant to bupivacaine has several beneficial effects. These effects are discussed briefly in this part and sorted based on the frequency of reports. At the end of this part these effects are presented in Table 1 in the same order.

**Prolonging the analgesic and anesthetic effects of bupivacaine**

Most of the previous works which investigated the efficacy of dexmedetomidine as an adjuvant to bupivacaine have reported that it can extend the duration of bupivacaine anesthetic and analgesic effects (14, 45-82). For example, Agarwal and colleagues investigated the effects of adding dexmedetomidine to bupivacaine in blocking the supraclavicular brachial plexus (45). Their findings show that dexmedetomidine could significantly prolong the duration of sensory and motor blocks as well as duration of analgesia.

**Improving post-operative analgesia**

In addition to the prolonging the duration of analgesia, several studies have reported that dexmedetomidine can improve the quality of post-operative analgesia as well (12, 46-48, 52, 53, 59, 60, 66, 68, 72, 78, 83-103). For example, Singh and his/her colleague in a
randomized control study, investigated the effect of dexmedetomidine as an adjuvant to bupivacaine in wound infiltration for abdominal hysterectomy. They allocated their sixty patients randomly in two groups. Group I only received 30 mL 0.25% bupivacaine at the end of surgery while group II received 1.0 mug/kg dexmedetomidine diluted in 30 mL 0.25% bupivacaine. Based on their results all of the patients in group I required supplemental morphine. However, only 3 patients in group II required any morphine suplementations. This difference was statistically significant (P<0.003). Moreover, group II's requirements for post-operative analgesia was significantly less than group I's (P<0.001). Therefore, based on their results, using dexmedetomidine as an adjuvant to bupivacaine is superior in both pain relief and post-operative analgesia compared to using bupivacaine alone (103).

**Improving analgesic effects of bupivacaine**

Not only can adding dexmedetomidine to bupivacaine extend the duration of analgesia but also it has been reported to have the capability to reduce the pain score more efficiently compared to using bupivacaine alone (20, 50, 62, 71, 73, 77, 78, 89, 93, 98, 103-106). Jarineshin and colleagues compared analgesic effects of bupivacaine, bupivacaine-dexmedetomidine, and bupivacaine-fentanyl in managing the postoperative pain in pediatric operations. Based on their results, the group who received dexmedetomidine as an adjuvant to bupivacaine was significantly superior in pain tolerance and sedative effects compared to the groups who either received only bupivacaine or fentanyl as an adjuvant to bupivacaine (P<0.001) (104).

**Providing better sedation**

Several studies have reported the sedative effects of dexmedetomidine both in children and adults (45, 50, 52, 63, 66, 70, 77, 79, 81, 92, 94, 96, 104). Some studies have reported
that intranasal dexmedetomidine provides safe and effective sedation for patients especially for children who are afraid of needles (24, 25). One of the necessary requirements for having satisfaction using analgesic substances is a good, safe, and comfortable sedation which can be provided by dexmedetomidine (21, 22). Shaikh and his/her colleague investigated the efficacy and safety of using dexmedetomidine and clonidine as adjuvants to bupivacaine in patients undergoing lower limb orthopedic surgeries (86). Based on their results, dexmedetomidine is a superior adjuvant to bupivacaine compared to clonidine in many cases such as early onset of analgesia, intra-operative analgesia, stability of cardio-respiratory parameters, prolonging the post-operative analgesia, and providing sedation and comfort.

**Shortening the onset of block**

Dexmedetomidine can be used as an adjuvant to bupivacaine for shortening the onset of sensory and motor (45, 51, 52, 57, 68, 70, 73, 74, 86, 92, 107). It can shorten the onset of both sensory and motor block while prolonging the effect of block compared to bupivacaine alone. For example, Sarma and colleagues investigated the effect of dexmedetomidine on the onset of sensory and motor block in 150 patients who were divided into three groups. Group B received 0.5% bupivacaine 15mg plus 0.5 mg normal saline, group C received 0.5% bupivacaine plus 50 mug clonidine, and group D received 0.5% bupivacaine 15 mg plus 5 mug dexmedetomidine. The results show that both clonidine and dexmedetomidine were significantly superior to bupivacaine alone in both the onset of block and the duration of block (57).

**Improving local anesthesia**

Several studies indicated that using dexmedetomidine can improve the local anesthesia (46, 48, 76, 83, 84, 87, 91, 95, 98, 108). In a randomized, double-blind, up-down, dose-
finding study Raof and colleagues investigated the effect of using dexmedetomidine as an adjuvant to bupivacaine for improving the local anesthesia in patients aged 1-4 years scheduled for elective unilateral herniorrhaphy or hydrocelectomy. The patients were divide into two groups. Group B only received 0.125% bupivacaine 1ml/kg and group BD received 0.125% bupivacaine 1ml/kg plus 2mug/kg dexmedetomidine, 1mL/kg. The results show that dexmedetomidine could significantly reduce the minimum local anesthetic concentration of bupivacaine and improve postoperative analgesia (83).

**Providing better hemodynamic stability**

Compared to other adjuvants of bupivacaine, dexmedetomidine has been reported to provide better hemodynamic stability (49, 51, 52, 56, 74, 75, 79, 82, 95, 96). Santpur and colleagues investigated the hemodynamic stability and sedation in patients who received dexmedetomidine as an adjuvant to bupivacaine. The results show that using dexmedetomidine is useful for maintaining the hemodynamic stability of the patients (49).

**Reducing the consumption of analgesic substances**

Some analgesic substances have side effects too. Dexmedetomidine as an adjuvant to bupivacaine, can provide the same analgesic results while using lower dosages of these substances such as morphine (53, 61, 62, 64, 65, 67, 73, 75, 96). For example, Mohamed and colleagues investigated the effect of dexmedetomidine and ketamine when used as an adjuvant to bupivacaine. Based on their results, dexmedetomidine and ketamine when used together as adjuvants to bupivacaine can significantly reduce the total consumption of PCA morphine without causing side effects that are serious (53).
In table 1, most reported efficacies of dexmedetomidine are listed. Moreover, some efficacies that have been mentioned less frequently are also listed. The rows of the table are sorted based on the frequency of reported cases in previous literature.

Table 1: The efficacies of dexmedetomidine as an adjuvant to bupivacaine

<table>
<thead>
<tr>
<th>The efficacy</th>
<th>Reference</th>
</tr>
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<tbody>
<tr>
<td>Prolonging the analgesic and anesthetic effects of bupivacaine</td>
<td>(14, 45-82)</td>
</tr>
<tr>
<td>Improving post-operative analgesia</td>
<td>(12, 46-48, 52, 53, 59, 60, 66, 68, 72, 78, 78, 83-103)</td>
</tr>
<tr>
<td>Improving analgesic effects of bupivacaine</td>
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<td>Providing better sedation</td>
<td>(45, 50, 52, 63, 66, 70, 77, 79, 81, 92, 94, 96, 104)</td>
</tr>
<tr>
<td>Shortening the onset of block</td>
<td>(45, 51, 52, 57, 68, 70, 73, 74, 86, 92, 107)</td>
</tr>
<tr>
<td>Improving local anesthesia</td>
<td>(46, 48, 76, 83, 84, 87, 91, 95, 98, 108)</td>
</tr>
<tr>
<td>Providing better hemodynamic stability</td>
<td>(49, 51, 52, 56, 74, 75, 79, 82, 95, 96)</td>
</tr>
<tr>
<td>Reducing the consumption of analgesic substances</td>
<td>(53, 61, 62, 64, 65, 67, 73, 75, 96)</td>
</tr>
<tr>
<td>Providing better comfort</td>
<td>(86)</td>
</tr>
<tr>
<td>Providing more stable cardio-respiratory parameters</td>
<td>(86)</td>
</tr>
<tr>
<td>Causing less nausea</td>
<td>(50)</td>
</tr>
<tr>
<td>Causing less vomiting</td>
<td>(50)</td>
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Facilitating the spread of the block (95)
Reducing the response to hernial sac traction (99)
Reducing the neurotoxicity (108)
Delaying the effect of bupivacaine cardiotoxicity (in rats) (109)

Conclusion
Dexmedetomidine is used as an adjuvant to bupivacaine. Its most significant effect is prolonging the analgesic and anesthetic effects of bupivacaine. As presented in Table 1., it has several other efficacies that make it as on the best candidates for using alongside bupivacaine. Moreover, based on several studies, it has far less negative side effects than compared to other sedative substances such as clonidine. Therefore, based on the findings of other studies which have been presented in this review article, it can be concluded that dexmedetomidine is an effective yet safe adjuvant to bupivacaine compared to other candidates such as clonidine. Moreover, using dexmedetomidine as an adjuvant to bupivacaine is superior to using bupivacaine alone.

References


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