Systematic Review / Meta-analysis

Review of clinical evidence of caudal block for postoperative analgesia in children with ketamine added local anesthetics

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ABSTRACT

Background: Adding ketamine to local anesthetics used for caudal block in children is an emerging clinical practice. This review aims to resolve controversies related to this adjuvant for a caudal block in children who underwent sub-umbilical surgeries.

Methods: Between January 2010 and November 2021, PubMed, Cochrane Review, and Google Scholar were searched for a caudal block with ketamine added local anesthetics for children. After screening for eligibility and removing duplicates, 38,187 articles were found, 13 reviewed.

Discussion: Despite adding ketamine to local anesthetics used for a caudal block, it is a recent technique practiced worldwide. Ketamine showed equi-efficacious as other adjuvants used for the caudal block to control postoperative pain in children.

Conclusion: Ketamine with a 0.5 mg/kg dose is safe and effective to manage postoperative children’s pain when used as an adjuvant to local anesthetics used for caudal block.

1. Introduction

Caudal block is a widely used technique of providing analgesia by depositing local anesthetics in the epidural space through sacral hiatus, which is preferable for postoperative pain management in children, especially those who have had procedures below the umbilicus [1,2]. Caudal block is being practiced as the first line for pain control above the umbilicus [2,4]. Pediatric postoperative pain management is challenging especially those who have had procedures below the umbilicus [1,2]. Caudal block is preferable for postoperative pain management in children, especially those who have had procedures below the umbilicus [1,2]. Ketamine demonstrates to exhibit analgesic effects through epidural, caudal, and spinal routes through a variety of mechanisms including N-methyl-D-aspartate (NMDA), cholinergic, adrenergic, and 5-hydroxytryptamine receptors or 5-HT receptors, as well as adrenergic and noradrenergic receptors. Because of the evidence of neurotoxicity associated with ketamine preservatives, preservative-free formulations of ketamine are suggested for neuraxial administration [5–8].

When used with a local anesthetic, ketamine can give long-lasting postoperative analgesia with minimal side effects; caudal ketamine has a demonstrable benefit, although there are still questions [6,8,9].
For postoperative analgesia in children, this review aims to address the controversy surrounding ketamine-added caudal block by presenting the currently available shreds of evidence.

2. Methods

2.1. Protocol and registration

Under the unique identification number (UIN): reviewregistry1273, this study’s protocol has been added to the registry of systematic reviews. In contrast to other studies, the systematic review study did not require ethical approval from the ethical review committee. This systematic review has been reported in line with the Preferred Reporting item for Systematic Review and Meta-analysis (PRISMA) [10] and Assessing the methodological quality of systematic reviews (AMSTAR 2) criteria [11].

2.2. Eligibility criteria

Randomized or non-randomized controlled trials published between January 2010 and November 2021 that recruited pediatric patients in the 2–16 age group with operations below the umbilicus were eligible for inclusion. The studies we looked at did not include nonhuman studies and case reports.

2.3. Data source and searching process

Following the guidelines in Fig. 1, a systematic review of the literature was undertaken using the PubMed, Cochrane Review, and Google Scholar databases, with no language or publication type limitations. Free-text keyword searches were conducted using keywords and the Boolean operators “AND” and “OR,” as well as the search terms themselves. In this case, there were the following combinations: (caudal block) OR (caudal) OR (caudal epidural) OR (caudal epidural block) AND (Ketamine) OR (ketamine added local anesthetic) OR (ketamine adjuvant).

After reviewing the retrieved citations, abstracts were read to recuperate the clinical investigations of a ketamine-added caudal block. Additionally, the investigator double-checked references to confirm that no publications were missing from the database. Because of this, reference lists of all articles were verified twice, once using the entire text then using the title with the abstract of the article.

2.4. Data collection procedure

When two reviewers (Amanuel S, Endeshaw and Abdi T, Tesema) looked at the data by extracting, two reviewers (Esu Befekadu A, Mekonnen) looked at the full-text article to make sure it was complete. Finally, differing viewpoints were discussed and, if required, settled by a senior researcher (Assistant professor Fantahun Tarekegn Kumie).

3. Discussion

3.1. Clinical use and adverse effects

Local anesthetics alone are frequently utilized throughout the world during caudal blocks to manage pediatric postoperative pain [1,4,12]. However, it is recently becoming popular and indicated to add adjuvants including ketamine to local anesthetics during caudal blocks,
significantly to prolong analgesia and reduce the need for systemic analgesics commonly for those children undergoing sub-umbilical procedures, most commonly urologic, hernia, lower abdominal and lower limb orthopedic surgeries [4,7,8].

After the administration of caudal block with ketamine added local anesthetics, fewer adverse effects occurred but were very infrequent. Although most studies did not detect a significant difference in unwanted effects between children who had a caudal block with and without ketamine, nausea, vomiting, and extended sedation are prevalent but likely to be clinically insignificant [4,8]. Other than allergy to ketamine, no specific contraindication was identified to use ketamine added local anesthetics in a caudal block for children.

3.2. Safety

The use of ketamine added local anesthetics in a caudal block has demonstrated a good safety profile despite neurotoxicity being the primary safety concern following this technique in children [8,9]. However, there has been no evidence of this unintended side effect in clinical studies using ketamine-containing local anesthetics in a caudal block.

3.3. Dosage

The dose of ketamine (preservative-free), which is routinely used and with no negative effects, for caudal block in adjuvant to local anesthetics is 0.5-1 mg/kg [6,13] given to 0.5 up to 1.25 ml/kg (based on the dermatome level intended to be blocked) [1,14], but it has not yet been proven whether different dosages or repeated doses would have an impact and need to be looked into more.

3.4. Effect of ketamine added local anesthetics in a caudal block for children

3.4.1. Ketamine added local anesthetics versus local anesthetics alone

According to almost all randomized clinical trials, the primary impact of mixing ketamine with bupivacaine/levobupivacaine for a caudal block is that the analgesia produced is prolonged compared to local anesthetics are administered alone. Studies have also demonstrated that ketamine-added local anesthetics caudal block effectively reduces postoperative analgesic intake, particularly opioid consumption [15-18]. Only one retrospective chart analysis study found no benefit to the extended analgesia caused by mixing ketamine with levobupivacaine for caudal block compared to the control group [13].

It has been shown that the use of ketamine in the caudal block resulted in prolonged analgesia and reduced postoperative analgesic demand, but that the minimum local anesthetic concentration (MLAC) of ropivacaine is necessary for intraoperative pain control does not change [19].

3.4.2. Ketamine added local anesthetics versus other adjuvants added local anesthetics

Compared to other adjuvants, such as dexamethasone, fentanyl, morphine, and adrenaline, adding ketamine to local anesthetics for a caudal block controlling children’s postoperative pain is a recent developing trend. Adding neostigmine, midazolam, and ketamine to bupivacaine alone for caudal block in children results in decreased quantity of rescue analgesia. Increased time to initial rescue analgesic administration compared to pure bupivacaine at the same time, there were no significant differences in the number of complications that happened in the first 24 hours of the postoperative period between the four study groups [20]. Ketamine showed to be superior in prolonging the duration of analgesia and blunting neuroendocrine stress response without side effects than fentanyl when added to bupivacaine/ropivacaine for caudal block in children who underwent sub-umbilical surgery [21,22].

4. Conclusion

This review discussed the clinical use, dosage, and effect of ketamine when used as an adjuvant for a pediatric caudal block for pain control after infra umbilical surgeries. Despite unanswered questions exist, ketamine can be safely used as an adjuvant for caudal block in pediatrics for postoperative pain management to extend analgesic duration provided by local anesthetics alone with rare side effects. This adjuvant also decreases postoperative opioid consumption by prolonging the first analgesic requirement time.

Ethical approval

Because it is a systematic review, ethical approval is not applicable.

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We did not receive funding from any source.

Author contribution

All authors contributed equally on conception and design of the study, acquisition of data, analysis and interpretation of data, drafting the article or revising data content, and approval of the final the version.

Consent

Not applicable.
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