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Postoperative pain control by preventive intercostal nerve block under direct vision followed by catheter-based infusion of local analgesics in rib cartilage harvest for auricular reconstruction in children with microtia: A randomized controlled trial

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Summary *Background:* Children with microtia complain of severe postoperative pain during early postoperative days after rib cartilage harvest for auricular reconstruction. The purpose of this study was to evaluate the effects of preventive donor site wound analgesia by intercostal nerve block (ICNB) and catheter-based infusion of local analgesics on postoperative pain after rib cartilage graft for auricular reconstruction in children with microtia.
Methods: In this prospective randomized study, 66 children underwent postoperative pain control using either preventive ICNB followed by catheter-based infusion (33 patients, study group) or intravenous (IV) analgesia alone (33 patients, control group). ICNB was performed under direct vision by the surgeon by injecting 0.5% bupivacaine into each of the three intercostal spaces before perichondrial dissection. Catheters were placed in three subchondral spaces before wound closure, and 0.5% bupivacaine was infused every 12 h for 48 h postoperatively. Pain degrees were recorded every 4 h during the first 48 postoperative hours using a visual analogue scale.
Results: The study group showed significantly lower mean pain scores of the chest at rest (3.7 vs. 5.1, $p = 0.001$), the chest during coughing (4.3 vs. 5.8, $p = 0.006$), and the ear (3.0 vs. 4.1,

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$p = 0.001$) than the control group. The amount of use of rescue IV ketorolac was smaller in the study group ($p = 0.026$) than in the control group. No side effects related to the intervention were noted.

Conclusions: Preventive ICNB followed by catheter-based infusion is effective and safe in postoperative pain relief in rib cartilage graft for auricular reconstruction.

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Introduction

Acute postoperative pain is one of the most frequent patient complaints following surgical procedures. Inadequate treatment of postoperative pain continues to be a major problem after surgeries and may lead to worse outcomes, including chronic postsurgical pain.[1] Postoperative chest pain may predispose a patient to atelectasis, ventilation/perfusion mismatching, hypoxemia, and infection.[2] Adequate control of postoperative chest pain in children is especially important because the experience of severe postoperative pain in children psychologically increases pain in subsequent procedures.[3]

Children with microtia complain of severe postoperative pain during the first one to two postoperative days after auricular reconstruction because the cartilage of more than three ribs is usually harvested. However, no attempt to reduce postoperative pain after autologous auricular reconstruction has been reported. While intravenous (IV) ketorolac or opioids have commonly been used for postoperative pain control, the efficacy of pain relief is often unsatisfactory and is related to systemic side effects, including nausea, vomiting, and respiratory depression.[4,5]

While epidural patient-controlled analgesia (PCA) provides effective, long-lasting pain relief after thoracotomy in adults, its use for children is limited because they are susceptible to opioid-induced respiratory depression.[6,7] Therefore, we used an intercostal nerve block (ICNB) and catheter-based infusion of local analgesics to reduce postoperative pain and systemic analgesic requirements during the first two postoperative days after rib cartilage graft in children with microtia. ICNB has been reported to be effective in controlling post-thoracotomy pain relief in children.[8] The limitation of ICNB is its short duration of action, which has been reported to be less than 11 h.[8] Catheter-based infusion of local analgesics is an alternative that has a longer duration of action by continuous or repeated infusion.[9–11] However, conflicting results of the efficacy of catheter-based infusion have been reported because of the heterogeneous nature of the groups in the studies, necessitating future procedure-specific prospective studies.[12,13]

Preventive analgesia aims to minimize postoperative pain and analgesic requirements by reducing peripheral and central sensitization arising from noxious perioperative inputs.[14] In the rib cartilage graft procedure, intercostal spaces are widely exposed during the harvest of the rib cartilage, making it easy to perform ICNB before the cartilage is dissected. Additionally, catheters can be simply placed into each subchondral space before wound closure. The purpose of this study was to identify the efficacy of preventive donor site wound analgesia using ICNB and catheter-based infusion in rib cartilage graft for auricular reconstruction in children with microtia.

Methods

The current study was a prospective, randomized, controlled trial including a series of consecutive congenital microtia patients undergoing rib cartilage graft for auricular reconstruction at a single center from November 2014 to January 2016. The study was approved by the authorized institutional review board of our institution, and signed informed consent was obtained from all patients before enrollment.

Inclusion criteria were (i) children less than 18 years of age, (ii) those with a treatment plan including cartilage harvest from three ribs (the 6th, 7th, and 8th) for auricular reconstruction, and (iii) no history of previous surgery under general anesthesia. Exclusion criteria were (i) the harvest of cartilage from an additional (9th) rib, (ii) an allergy to local analgesics or morphine, and (iii) the inability to express pain scores because of comorbidities such as mental retardation.

Patients recruited in the study were randomly allocated to one of two groups. All patients were provided with IV analgesics according to the hospital's standard of postoperative care, and 0.5 mg/kg IV ketorolac was administrated twice a day until the first postoperative day. Additional ketorolac or morphine was given according to pain scores (visual analogue scale (VAS) score >4) during the entire hospital stay. In the study group, the surgeon injected 0.08 ml/kg 0.5% bupivacaine into each of the three exposed intercostal spaces under direct vision before harvesting the rib cartilage.[3] A 10-cc syringe was connected to a 23-gauge butterfly needle to check and maintain the penetration depth during injection (Figure 1). The needle was angled 15° cephalad, and the penetration depth was 5 mm, which was marked by a sterile tape on the needle to achieve a consistent depth of injection (Figure 1).[15] Injections proceeded after a surgeon confirmed that neither blood nor air was aspirated. Injection sites were lateral to the costochondral junction of the 6th, 7th, and 8th ribs. Three epidural catheters were placed within perichondrial envelopes, which were created by cartilage harvest. Catheters were placed before wound closure and were secured with a sterile tape to the skin (Figure 2).