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Original Contribution

Ultrasound-guided versus conventional injection for caudal block in children: A prospective randomized clinical study

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ABSTRACT

Study objective: The aim of this study was to compare the efficacies of ultrasound guided sacral hiatus injection and conventional sacral canal injection performed for caudal block in children.
Design: Randomized controlled clinical trial.
Setting: Operating rooms of university hospital of Erzurum, Turkey.
Patients: One hundred-thirty four children, American Society of Anesthesiologists I-II, between the ages of 5 and 12, scheduled for elective phimosis and circumcision surgery.
Interventions: Patients assigned to two groups for ultrasound guided caudal block (Group U, $n = 68$) or conventional caudal block (Group C, $n = 66$). Caudal solution was prepared as 0.125% levobupivacaine plus 10 mcg/kg morphine (total volume: 0.5 ml/kg), and was administered to both groups.
Measurements: The block performing time, the block success rate, the number of needle puncture, the success at first puncture and the complications were recorded.
Main results: The block performing time and the success rate of block were similar between Group U and Group C (109.96 ± 49.73 s vs 103.17 ± 45.12 s, and 97% vs 93%, respectively $p > 0.05$). The first puncture success rate was higher in Group U than in Group C (80% vs 63%, respectively $p = 0.026$). No significant difference was observed between the groups with regard to the number of needle punctures ($p = 0.060$). The rates of vascular puncture and subcutaneus bulging were higher in Group C than in Group U (8/66 vs 1/68, and 8/66 vs 0/68, respectively $p < 0.05$).
Conclusions: Despite the limitations in central neuroaxial anesthesia we recommend the use of ultrasound since it reduces the complications and increases the success rate of first puncture in pediatric caudal injection.

1. Introduction

Regional anesthetic techniques reduce the post-operative morbidity, provide early mobilization and reduce opioid analgesic requirements. Caudal epidural block has been widely used regional anesthesia method, especially in pediatric surgery, to provide intraoperative and postoperative analgesia by affecting the region between T10 and S5 dermatomes in surgeries below the umbilical level [1–5].

In conventional single-shot caudal block, the needle is inserted through the skin with a 60–80 degrees angle, until the sacrococcygeal ligament is passed through. Then the angle of the needle is decreased to 20–30 degrees and inserted further for an additional 2–3 mm, entering into the sacral canal [6]. There is a risk of dural or vascular puncture when the needle is passing through sacral canal. Other complications are the soft tissue bulging, intraosseous injections and systemic toxicity [7,8]. Nonetheless, it is currently unknown if the use of ultrasound improves the success of caudal blocks in children.

Many anatomical variations have been reported for sacral hiatus and sacral cornua. Therefore, the success rate of the classic caudal epidural anesthesia method in pediatric patients has been reported to be about 75% [9].With the usage of ultrasonography in regional anesthesia, many advantages have been reported. Ultrasonography is helpful for visualization of the sacral hiatus, sacrococcygeal ligament, duramater, epidural space and the distribution of the local anesthetic agent within the

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epidural space. Therefore, this significantly increases the block success [10].

The primary aim of this study was compare the success rate of ultrasound guided sacral hiatus injection and conventional sacral canal injection. Secondary objectives are; block performing time, number of needle puncture, success at first puncture and complication rate.

2. Materials and methods

The study included a total of 140 ASA I-II children aged between 5 and 12 years old who underwent elective phimosis and circumcision surgery after the ethical committee approval. The study was registered with a clinical trials registry (ClinicalTrials.gov. identifier NCT03337191). Children with severe systemic disease, previous neurological or spinal disorder, coagulation anomaly, allergy against local anesthetics, local infection at block site or with a history of premature birth were excluded from the study.

After exclusion eligible patients for this study were analyzed and are presented in a Consolidated Standards of Reporting Trials (CONSORT) flow diagram (Fig. 1).

The patients taken into the operation room underwent routine monitorization electrocardiogram (ECG), peripheral oxygen saturation (SpO2) and non-invasive blood pressure measurements, and then the basal levels were recorded. No sedative agent was administered for pre-medication. The patients were assigned to two groups as the conventional caudal block (Group C) and the ultrasound-guided caudal block (Group U) according to the randomization list by a computerized program. Anesthesia induction was performed via a face mask with 7–8% sevoflurane, 50% nitrous oxide and 50% oxygen until the patient was unconscious. Following loss of consciousness, vascular access was administered, and the patient was placed in the lateral position and caudal block was performed. Ventilation was provided via a face mask with sevoflurane, 50% nitrous oxide and 50% oxygen in order to provide spontaneous respiration and continuation of anesthesia. Nitrous oxide was stopped 10 min after the beginning of the surgery. Concentration of sevoflurane was reduced every 5 min to 6%, 4% and 2% following the caudal block. All conventional and US guided caudal blocks were performed by experienced clinicians H.A.A. and A.A.

Caudal block was performed in Group C by conventional method. The sacral cornus and the sacral hiatus were palpated. After sterilization of the region, a 20–22 gauge caudal needle (Epican® Paed caudal B·Braun Melsungen AG) was inserted into the skin with a 60–80 degree angle and until the sacrococcygeal ligament was passed with a "pop" feeling (puncture of the sacrococcygeal ligament). Then, the angle of the needle was reduced to 20–30 degrees and inserted further for an additional 2–3 mm, entering into the sacral canal. After confirming the absence of any blood or cerebrospinal fluid in the aspiration, the caudal solution calculated as 0.5 ml/kg was injected with hemodynamic and ECG monitoring. In the case of the needle touching the bony tissue, blood aspiration or bulging into the subcutaneous tissue, the angle of the needle was changed and the intervention was repeated.

Caudal block was performed by ultrasound guided in Group U. After sterilization of the region and USG with sterile plastic cover and gel, the sacral hiatus was visualized at the level of the sacral cornus at the out of

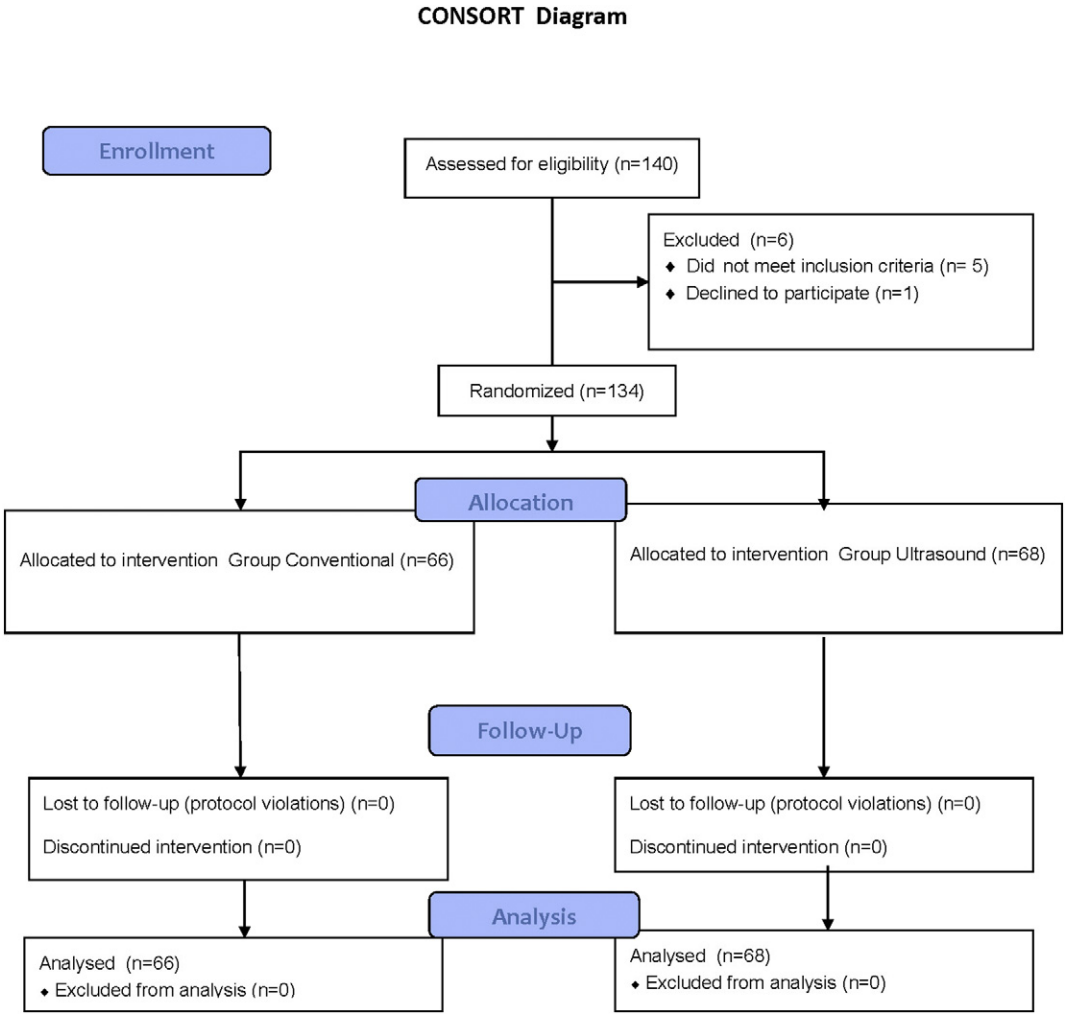

Fig. 1. CONSORT flow diagram of study.