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Dexamethasone as a ropivacaine adjuvant for ultrasound-guided interscalene brachial plexus block: A randomized, double-blinded clinical trial☆,☆☆

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ABSTRACT

Study objective: The purpose of this study was to evaluate the effect of intravenous or perineural dexamethasone added to ropivacaine on the duration of ultrasound-guided interscalene brachial plexus blocks (BPB).
Design: Randomized clinical trial.
Setting, patients and interventions: Sixty ASA physical status I–II patients with elective shoulder arthroscopic surgeries under interscalene brachial plexus blocks were randomly allocated to receive 20 ml of 0.75% ropivacaine with 1 ml of isotonic saline (C group, $n = 20$), 20 ml of 0.75% ropivacaine with 1 ml (4 mg) of perineural dexamethasone (Dpn group, $n = 20$), or 20 ml of 0.75% ropivacaine with 1 ml of isotonic saline and intravenous 4 mg dexamethasone (IV) (Div group, $n = 20$). A nerve stimulation technique with ultrasound was used in all patients.
Measurements: The onset time and duration of sensory blocks were assessed. Secondary outcomes were pain scores (VAS) and postoperative vomiting and nausea (PONV).
Main results: The duration of the motor and sensory block was extended in group Dpn compared with group Div and group C ($P < 0.05$). In addition, within 24 h, group Dpn presented lower levels of VAS and lower incidence of PONV as compared with the other groups. Moreover, there was a significant reduction on onset time between group Dpn and the other groups.
Conclusions: Perineural 4 mg dexamethasone was more effective than intravenous in extending the duration of ropivacaine in ultrasound-guided interscalene BPB. Moreover, Dpn has significant effects on onset time, PONV, and VAS.

1. Introduction

Arthroscopic subacromial decompression can cause significant postoperative pain after shoulder surgeries [1]. Brachial plexus block offers an excellent but limited duration of analgesia in this type of surgery. Continuous peripheral nerve blocks have been used to provide extended analgesia. However, these techniques have generally failed to gain popularity due to the need for technical proficiency and complications, such as catheter migration, anesthetic leakage, and pump malfunction [2].

To increase the duration of local anesthetic action, epinephrine, bicarbonate, corticosteroids, alpha-2 agonist, and opioids have been used [3]. Among these agents, epinephrine is the most commonly agent added to local anesthetic formulations. Dexamethasone added to local anesthetics appears to prolong single-injection interscalene block [4]. The analgesic effects of spinal and systemic corticosteroids combined with local anesthetics have proven to be effective in humans, whereas dexamethasone microspheres have increased block duration [5].

Previous studies [4,6,7] have demonstrated a longer duration of analgesic effect when intravenous dexamethasone was added to local anesthesia for interscalene, supraclavicular or infraclavicular plexus block. However, these results were not found in another study [8].

The objective of this study was to evaluate the effects of intravenous and perineural dexamethasone added to ropivacaine on the duration of ultrasound-guided interscalene brachial plexus blocks (BPB) in patients undergoing arthroscopic shoulder surgery.

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2. Methods

This prospective, randomized, double-blind study was conducted after obtaining institutional ethics committee approval. Written informed consent was obtained from American Society of Anesthesiologist (ASA) Grade I and II patients aged 18 years or older who were scheduled to undergo elective shoulder arthroscopic surgery under Interscalene BPB plus general anesthesia. Additionally, the investigation was approved by Plataforma Brasil http://aplicacao.saude.gov.br/plataformabrasil/login.jsf and registered at www.ensaioclinicos.gov.br (RBR-86mhm2). The Ethics Committee institution responsible was Hospital Infantil Joana de Gusmão (HIJG). No patient received premedication.

The exclusion criteria encompassed the following: refusal to regional anesthesia, infection at the site, anatomical abnormality at the site, history of allergic reaction to study drugs, systemic use of corticosteroid for two weeks or longer, drug abuse, peripheral neuropathy, head injury, psychiatric disorder, coagulation disorder, severe pulmonary, cardiac, renal, or endocrine disorder, pregnancy, and failure to achieve adequate block within 30 min of administration or shoulder pain soon after extubation of the endotracheal tube. None of the patients had inadequate block.

Patients were randomly assigned to the control group (C group, $n = 20$), the intravenous dexamethasone group (Div group, $n = 20$), or the perineural dexamethasone group (Dpn group, $n = 20$) shortly before going to the operating room. Anesthetist, nurse, surgeon, and the patient were blinded. Another anesthetist evaluated the postoperative variables. All three groups were blocked with 20 ml of 0.75% ropivacaine, according to the study group. Group C was administered 1 ml of perineural normal saline. Group Div was administered 1 ml of normal saline plus 4 mg of intravenous dexamethasone. Group Dpn was administered 1 ml of 4 mg perineural dexamethasone, with a total amount of 21 ml in each group.

After arrival at the operating room, all patients were monitored using electrocardiogram, non-invasive blood pressure, and pulse oximetry. Interscalene brachial plexus blocks were performed with the patient in the supine position. After intravenous injection of 50 mcg of fentanyl, a 22-gauge, 50 mm short-beveled needle (Stimuplex®, B/Braun, Melsungen, Germany), nerve stimulator (Stimuplex® Dig RC, B/Braun, Melsungen, Germany), and ultrasound (GE LOGIQ e, General Electric®, USA) were used to examine the nerve. At first, motor response was sought by stimulating with a 0.8 to 1.0 mA current intensity and a frequency of 1 Hz. When the proper twitch was elicited (hand and arm movements), stimulating intensity was gradually decreased to <0.5 mA. Once the proper twitch was maintained with a current <0.5 mA, 1 ml of local anesthetics was injected. After the injection stopped the twitch, the position of the needle was considered to be acceptable, and the remaining 20 ml was injected.

A blinded observer recorded the time used to perform the block, measured from localization of the individual nerves to completion of local injection of anesthetics. The degree of sensory block was assessed using pinpricks in each nerve distribution and was graded according to a two-grade scale (0 = no block, 1 = loss of pinprick sensation). The degree of sensory block was evaluated every 1 min after drug administration for 20 min. Onset time was defined as the time interval between the end of local anesthetic injection and the loss of pinprick sensation, and a successful block was defined as grade 1 sensory block. The duration of the sensory nerve block was considered to be the time interval between a successful block and the complete recovery of the arm senses. The duration of the motor nerve block was considered to be the time interval between a successful block and the complete recovery of all movements of the arm. A resident doctor in anesthesiology evaluated postoperative variables every hour in the first six-hour period, and every 3 h in the first 24-hour period and every 6 h in the first 48-hour period. Motor and sensory block duration was converted from hours into minutes after measurement.

After successful block, all patients were submitted to general anesthesia by Total Intravenous Anaesthesia Target Control Infusion (TIVA-TCI). Anesthesia was induced with 1% propofol and 50 μg/ml remifentanil simultaneously administered by two separate pumps of a continuous computer-assisted TCI system (Infusomat® Space, B. Braun Melsungen, Germany). Before the induction of anesthesia, patients' weight and height, age, sex, and target of effect-site concentration of propofol and remifentanil were entered into the TCI system. The initial effect-site target of propofol was set at 4 μg/ml, and the initial effect-site target of remifentanil was 5 ng/ml, titrated against vital signs. We used Marsh and Minto three compartment pharmacokinetic models for propofol and remifentanil, respectively. After hypnosis (lack of eyelid reflex), rocuronium (0.5 mg/kg) was administered IV to achieve muscle relaxation for endotracheal intubation.

Adverse events included hypotension (a 20% decrease in blood pressure), bradycardia (HR < 50 beats/min) or hypoxemia (SpO2 < 90%). Atropine 0.5 mg or ephedrine 10 mg was administered intravenously.

After extubation, all patients were transferred to the recovery room for at least 1 h. Recovery room discharge criteria were stable vital parameters, absence of nausea and vomiting, and no further request for analgesics. On patient's request, parecoxib 40 mg was administered intravenously. Patients were instructed not to endure unnecessary pain after surgery, and to order analgesics as soon as the pain started. Morphine 0.1 $mg \cdot kg^{-1}$ was used to pain rescue medication.

The duration of the sensory block was the primary outcome. Assuming that the expected mean difference is 400 min and 500 is the maximum standard deviation, the minimum sample size required for a 0.8 statistical power and alpha value of 0.05 was calculated to be 18 per group. Twenty patients were recruited for each group.

The data were expressed as mean ± standard deviation or number (%). Age, height, weight, duration of surgery, time to perform the block, onset time and duration of sensory block were compared among the 3 groups by using one-way ANOVA and Tukey post-hoc tests. Sex, ASA physical status, PONV, postoperative opioid need were compared using the chi-square test and Fisher's exact test. Statistical analysis was performed using IBM SPSS 20.0 (SPSS Inc., Chicago, IL, USA). *P*-values < 0.05 were regarded as statically significant.

3. Results

There were no significant differences between the three groups with regard to demographic data (Table 1). The onset time of the sensory block showed a significant difference between control and Dpn groups (Table 2).

The duration of motor and sensory block was extended in group Div and group Dpn as compared to group C ($P < 0.05$), and there was a significant difference between group Div and group Dpn (Table 2). There was no significant difference in the quality of the block between the groups. No failed block was reported in either group. Duration of surgery was similar for all three groups.

Table 1
Demographic data and surgical characteristics.*

Variable	C group ($n = 20$)	Div group ($n = 20$)	Dpn group ($n = 20$)
Age (years)	52.05 ± 13.7	52.1 ± 12.3	53.2 ± 9.8
Sex (M/F)	11/9	14/6	12/8
Height (m)	1.66 ± 0.69	1.63 ± 0.73	1.64 ± 0.91
Weight (kg)	67.4 ± 11.5	65.3 ± 4.2	63.2 ± 5.1
ASA physical status (I/II)	6/14	8/12	9/11
Duration of surgery (min)	77.9 ± 89.4	72.2 ± 68.6	62.4 ± 48.4

Values are mean ± SD or number of patients. There are no significant differences between the groups. C group: control group, Div group: dexamethasone IV group, Dpn group: dexamethasone perineural.

* $P < 0.05$.