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Research Article

Intraoperative lidocaine infusion attenuates tourniquet induced hypertension in patients undergoing anterior cruciate ligament reconstruction under general anesthesia

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KEYWORDS

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Abstract *Objective:* This randomized, double blind, controlled study was designed to test whether the intraoperative use of intravenous lidocaine bolus followed by infusion would attenuate the tourniquet induced hypertension (TIH) in patients undergoing anterior cruciate ligament reconstruction (ACLR) under general anesthesia.
Methods: 76 patients were randomly allocated into two equal groups. Lidocaine group (group L), in which patients received lidocaine 2% 1 mg/kg IV bolus after induction of anesthesia followed by lidocaine infusion (2 mg/kg/h) and placebo group (group P), in which patients received equal volumes of saline. Heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded before induction of anesthesia, before tourniquet inflation (baseline value), every 15 min after tourniquet inflation, and after tourniquet deflation. The number of patients who developed TIH was recorded and total amount of propofol and fentanyl used intraoperative was recorded.
Results: SBP, DBP and HR were significantly less after tourniquet inflation in group L compared to group P in most of the time periods after tourniquet inflation (p value < 0.05), the number of patients developed TIH was significantly less in group L compared to group P (26% in group L compared to 52.6% in group P) (p value 0.019), and the total amount of propofol and fentanyl used intraoperative was significantly less in group L compared to group P (p value 0.000).
Conclusion: Intraoperative use of lidocaine bolus (1 mg/kg), followed by infusion (2 mg/kg/h), started 10 min before tourniquet inflation attenuated the TIH in patients undergoing anterior cruciate ligament reconstruction under general anesthesia.

1. Introduction

Arterial tourniquet is used in limb surgeries to provide a bloodless field and improve the surgical conditions. However,

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tourniquet inflation is associated with some consequences that may be relatively benign in healthy individuals, but could be hazardous in patients with impaired cardiac conditions [1]. Tourniquet inflation is associated with an increased sympathetic outflow, an increase in arterial blood pressure and severe pain [2–4].

The tourniquet induced hypertension (TIH) is usually delayed 30–60 min after tourniquet inflation [5], and it is difficult to treat even with adequate analgesia and good level of anesthesia [6,7]. Although the proper mechanism of (TIH) is still unclear [7], the autonomic nervous system is probably involved and plasma catecholamine levels are increased [2]. Also, stimulation of N-methyl-D-Aspartate (NMDA) receptors by noxious stimuli from the extremities is another possible cause leading to TIH [8,9]. There are several studies done using different analgesics and NMDA receptor antagonists to find an effective drug to attenuate (TIH) [6–8,5].

Intravenous lidocaine is known as having anti-inflammatory [10,11], analgesic [10], anti-hyperalgesic [12] properties and is used for attenuating stress response to laryngoscopy and intubation [13]. To our knowledge, no previous studies tested the effect of intraoperative lidocaine infusion on TIH.

We designed this randomized, double blind, placebo controlled study to test whether the intraoperative use of intravenous lidocaine infusion would attenuate the TIH in patients undergoing anterior cruciate ligament reconstruction under general anesthesia as a primary outcome.

2. Materials and methods

After obtaining ethical committee approval, written informed consents were taken from 76 patients, American Society of Anesthesiology (ASA) physical status I or II, their age range between 18 and 50 years, who were scheduled for anterior cruciate ligament reconstruction under general anesthesia with the use of pneumatic tourniquet.

The study was carried out at Saad Specialist Hospital, Alkhobar, Saudi Arabia, during the period from January 2014 to June 2015. Exclusion criteria included patients with sickle cell disease, peripheral vascular disease, hypertension, history of DVT, cardiac, liver or kidney diseases, allergy to amide local anesthetics and seizure disorder. Patients weighing more than 100 kg and patients in whom tourniquet time was less than 60 min were also excluded.

Patients were randomly allocated into two equal groups (37 patients each) by using the closed envelope technique. The study drugs were prepared by an anesthesia technician unaware of the study medications; as follows:

- Lidocaine group (group L): patients received lidocaine 2% 1 mg/kg IV bolus after induction of anesthesia followed by lidocaine infusion (2 mg/kg/h) diluted in 50 ml syringe with a maximum of 200 mg/h. The tourniquet was inflated 10 min after the start of lidocaine infusion. The lidocaine infusion stopped at the time of tourniquet deflation.
- Placebo group (group P): equal volumes of saline.

Anesthesiologists, surgeons and patients were all blinded to the treatment allocation. The lidocaine and placebo syringes were identical and labeled as test medication. Anesthesiologist who gave anesthesia was instructed not to use local anesthetics.

Depending on previous studies [5,7], the sample size was estimated to be 38 patients per group, to give a power of 80% at the level of 0.05 to detect 6.5% difference in the percentage increase of baseline arterial blood pressure after 60 min of tourniquet inflation.

All patients were pre-medicated with midazolam 0.03 mg/kg intravenously 5 min before induction of anesthesia. In the operating room intravenous infusion of Ringer's lactate 10 ml/kg started and monitors were attached to the patient [ECG, pulse oximeter, non-invasive blood pressure, capnography, temperature probe and bispectral index (BIS)]. Anesthesia was induced using fentanyl 2 μg/kg IV, propofol 2 mg/kg IV and cisatracurium 0.15 mg/kg IV to facilitate tracheal intubation. Mechanical ventilation was adjusted to maintain end tidal CO_2 between 35 and 40 mmHg. Anesthesia was maintained by using propofol infusion (5–10 mg/kg/h), starting with (10 mg/kg/h) and then adjusted to maintain the BIS between 40 and 60. Additional doses of fentanyl (50–100 μg) were given if there were signs of inadequate analgesia (BP and HR within 20% of pre-induction values). Cisatracurium boluses of 0.03 mg/kg were guided by peripheral nerve stimulator to maintain muscle relaxation.

If the BP or HR increased >30% of the baseline value before tourniquet inflation, labetalol boluses of 5 mg were given to control the hemodynamic changes.

The pneumatic tourniquet (20 cm width) was applied over cotton layer to the upper thigh (operation side), the limb was elevated 45 degrees for 5 min, exsanguination was done using crepe bandage and the tourniquet was inflated to 300 mmHg. The tourniquet was deflated at the end of the operation and all anesthetics were discontinued.

Patients were extubated after reversal of neuromuscular blockade using neostigmine 0.05 mg/kg and atropine 0.02 mg/kg IV and shifted to the post-anesthesia care unit (PACU). The following parameters were recorded by an anesthesiologist unaware of study drugs:

1. Hemodynamic including HR, SBP and DBP (measured every 5 min) were recorded at the following time: before induction of anesthesia, before tourniquet inflation (baseline value), every 15 min after tourniquet inflation, and 15 min after tourniquet deflation.
2. The number of patients who developed TIH which was defined by an increase in arterial blood pressure >30% of the baseline value (number of patients received labetalol).
3. Total dose of fentanyl needed intraoperative.
4. Total dose of propofol used intraoperatively.
5. Tourniquet time.
6. Duration of operation.

2.1. The statistical analysis

Data were statistically described in terms of mean ± standard deviation (±SD), or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using Student's *t* test for independent samples while comparing variables over time was done using repeated measure analysis of variance with