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Research Article

Dexmedetomidine versus fentanyl in anesthesia of cochlear implantation in pediatric patients

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KEYWORDS

Cochlear implantation;
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Abstract *Background:* Anesthesia for cochlear implantation in pediatrics mandates deliberate hypotension to provide a better surgical field. Dexmedetomidine is α_2 adrenoceptor agonist that provides adequate sedation with high cardiovascular stability. We aimed to compare it with fentanyl as an anesthetic adjuvant.

Methods: 52 pediatric patients (ASA I or II), undergoing cochlear implantation were randomized into dexmedetomidine (D) group and fentanyl (F) group ($n = 26$ for each). Anesthesia was induced by I.V. dexmedetomidine in (D) group at a bolus dose of 0.4 μg/kg slowly infused over 10 min, then continuous infusion by a rate of 0.4 μg/kg/h until the end of surgery. In (F) group; anesthesia was induced by I.V. fentanyl at a dose of 1 μg/kg over 10 min, then continuous infusion by a rate of 1 μg/kg/h. This is followed by I.V. propofol and atracurium for both groups. Maintenance was done without additional muscle relaxant to allow monitoring of the facial nerve. Both groups were compared as regards the quality of the surgical field, intraoperative hemodynamics, recovery and discharge time, postoperative pain using objective pain score and the need for rescue analgesics and anti-emetics in postanesthesia care unit (PACU).

Results: Dexmedetomidine group showed a decreased heart rate and mean arterial pressure than fentanyl group. These parameters were significantly decreased compared to the baseline throughout the procedure in D group. The quality of the surgical field was significantly better in D group than in F group. Postoperative pain and complications were not different between the two groups. Recovery and discharge time was significantly shorter for the patients in D group than in F group ($p < 0.05$).

Conclusion: Dexmedetomidine infusion in cochlear implantation in pediatric patients was better in inducing deliberate hypotension and providing better quality scale of surgical field compared to fentanyl infusion. It allowed rapid recovery from anesthesia and reduced need for pain medication in the PACU.

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1. Introduction

Surgery for cochlear implantation is a great advance in otology for patients with irreversible hearing loss and deaf-mutism but it carries a great challenge to the anesthesiologist [1].

Anesthetic management includes bloodless surgical field to facilitate microsurgery, efficient airway management, careful head positioning to avoid venous obstruction and congestion, limited use of muscle relaxants to facilitate monitoring of the facial nerve by peripheral nerve stimulator, smooth recovery and adequate post-operative care without nausea and vomiting [2].

Controlled hypotension can be achieved by a combination of physical techniques and pharmacologic agents: inhalational anesthetics, opioids, vasodilators, beta blockers, magnesium sulfate and α_2 adrenergic agonists [3,4].

Dexmedetomidine is an α_2 adrenergic agonist with a sedative and analgesic effect. It does not cause respiratory depression even at supramaximal plasma levels [5]. It suppresses sympathetic activity and decreases airway and circulatory responses during intubation and extubation [6]. Previous reports recommended its use instead of fentanyl to augment anesthesia [7,8].

According to the available data, no study had been published to compare fentanyl and dexmedetomidine in pediatrics undergoing cochlear implantation.

1.1. Aim of work

The main objective was to compare fentanyl with dexmedetomidine as regards their efficacy in inducing deliberate hypotension and providing better quality of the surgical field during cochlear implantation. The effect of both drugs on postoperative pain and recovery time was also compared.

2. Patients and methods

This study was a prospective, randomized, blind study that conducted at Kasr El-Ainy hospital, Cairo University, from April 2012 to March 2014 after approval of ethical committee. Informed consents were obtained from parents or guardians of all children.

Fifty-two pediatric patients of ASA physical status I or II, aged below 8 years and scheduled for elective cochlear implantation, were enrolled in this study. Patients with known allergy to fentanyl or dexmedetomidine were excluded from the study. Also, patients with fever, upper respiratory tract infection, coagulopathy, prolonged QT interval and ventricular arrhythmia were excluded. Also, patients with congenital abnormalities were excluded. Randomization was accomplished by using computerized randomization tables.

All patients were preoperatively assessed by history, physical examination and routine laboratory investigations (CBC, PT, PTT, INR, urea, creatinine, SGPT, SGOT, albumin, bilirubin and serum electrolytes). Cardiological consultation and pre-operative ECG were done. Careful assessment of the airway was done. Careful search for renal, endocrine abnormalities, goiter and hypothyroidism was done.

Solid food was not allowed 6 h before surgery but clear fluids were given for up to 2 h pre-operatively. Children were randomized into dexmedetomidine (D) group and fentanyl (F) group ($n = 26$ for each). Preparation of dexmedetomidine (Precedex; Abbott Laboratories, North Chicago, Illinois, USA) (vial = 2 ml) 100 μg/ml and fentanyl ampoule 100 μg/2 ml was done. Each drug was diluted with 48 ml of 0.9% NaCl in 50 ml syringe to get a concentration of 4 μg/ml in dexmedetomidine group and 2 μg /ml in fentanyl group.

Demographic data were recorded including age, sex and weight.

On arrival to the operating room; an intravenous catheter was inserted. Monitors were applied: precordial stethoscope, noninvasive automatic blood pressure, pulse oximeter and electrocardiograph. Peripheral nerve stimulator was used to assess recovery from muscle relaxant and to monitor the facial nerve intra-operatively. Premedication with 0.15 mg/kg I.V. dexamethasone was done to prevent postoperative nausea and vomiting. Induction of anesthesia was done by I.V. dexmedetomidine in (D) group at a bolus dose of 0.4 μg /kg slowly infused over 10 min, then continuous infusion by a rate of 0.4 μg/kg/h. until the end of surgery. In (F) group; fentanyl was given at a dose of 1 μg/kg over 10 min, then continuous infusion by a rate of 1 μg/kg/h until the end of surgery. This is followed by propofol 2 mg/kg for both groups. Then, I.V. atracurium at a dose of 0.5 mg per kg was given to facilitate intubation. When T1 is 0%, the patient was intubated by a proper sized cuffed endotracheal tube. Additional doses of atracurium were not administered to allow intraoperative monitoring of the facial nerve.

Anesthesia was maintained using a mixture of O_2 and air in a ratio of 1:1 mixture with 2% sevoflurane. Controlled ventilation at a tidal volume of 6 ml/kg was initiated to maintain normocapnia (35–40 mmHg) by adjusting the respiratory rate and guided by the end tidal CO_2 monitoring. Body core temperature was measured by oropharyngeal temperature probe and maintained between 36° and 37 °C using heated mattress and warm intravenous fluids at room temperature. Anesthesia was maintained with continuous infusion of the tested drugs. The target blood pressure was a decrease in blood pressure to get the mean blood pressure (MAP = 50–60 mmHg). If the MAP increased above the target, a bolus dose of either dexmedetomidine or fentanyl similar to the induction dose was added. Bradycardia was treated with 0.02 mg/kg I.V. atropine if the HR was 20% lower than the baseline value. Fluids were given at 10 ml/kg/h in the form of dextrose 5% and normal saline at a ratio of 1:1. At the end of the procedure, the patient was extubated under deep anesthesia to avoid coughing (which may cause dislodgement of the electrode array of the implant) and transferred to the recovery room.

2.1. Intra-operative data recorded

1. Heart rate (HR) and mean arterial blood pressure (MAP). These data were recorded before induction (baseline), 1 min after induction, 1 min after intubation then every 15 min till the end of the operation.
2. Total dose of dexmedetomidine and fentanyl.
3. Total time of the operation.
4. Quality scale:

The surgeon who was blinded of the selected hypotensive agent was asked to assess the quality of the surgical field according to the quality scale proposed by Fromme and colleagues [9]: