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Comparatative Study Between Dexmedetomidine And Fentanyl For Analgesia And Prevention Of Emergence Agitation In Children Undergoing Cochlear Implantation

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Abstract

Aim of the work: The main objective will to compare fentanyl with Dexmedetomidine as regards;
1. Their efficacy 2. Provide better quality of surgical field during cochlear implantation. in including deliberate hypotension.
3. The effect of both drugs on postoperative pain.
4. Recovery time.
5. Emergence agitation**..**

Patient and Methods:
The study was conducted after approval of the Ethical committee of Sohag university Hospital and obtaining informed written consent from the parents of the patients.
50 pediatric patients (ASA I or II), undergoing cochlear implantation were randomized into dexmedetomidine (D) group and fentanyl (F) group. Anesthesia was induced by I.V. dexmedetomidine in (D) group at a bolus dose of 2 micg/kg slowly infused over 10 min, then continuous infusion by a rate of 0.7 micg/kg/h until the end of surgery. In (F) group; anesthesia was induced by I.V. fentanyl at a dose of 1 micg/kg over 10 min, then continuous infusion by a rate of .0.1 mg/kg/h. This is followed by I.V. propofol and atracurium for both groups. 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 post anesthesia care unit (PACU).
.Results: Dexmedetomidine group showed a slight decrease in heart rate than fentanyl group. These parameters were significantly decreased compared to the baseline throughout the procedure in D group. Modified Aldrete Score is better with D group compared to F group .
There was significant difference between both group as regard objective pain score.
There was a significant difference between two groups, as the time for recovery was more rapid in D (group) than in F (group) the data is significant.
Conclusion : Dexmedetomidine infusion in cochlear implantation in pediatric patients was better in inducing deliberate hypotension. It allowed rapid recovery from anesthesia and reduced need for pain medication in the PACU.

Introduction:

Surgery of cochlear implantation is a great advance in otology for patient with deaf mutism but it carries a great challenge to the anesthesiologist (15).

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 relaxant to facilitate monitoring of the facial nerve by peripheral nerve stimulator, smooth recovery and adequate postoperative care without nausea and vomiting (13).

Controlled hypotension can be achieved by a combination of pharmacologic agents; inhalational anesthetic, opioid, vasodilator, beta blockers, magnesium sulfate and alpha 2 adrenergic agonists. Physical techniques; in placing the operated area higher than the heart, postural maneuvers have reduced blood pressure in this area and decreased venous pressure (4, 16).

Dexmedetomidine is an alpha 2 adrenergic agonists with a sedative and analgesic effect. It doesn't cause respiratory depression even at supramaximal plasma level (8). It suppresses sympathetic activity and decrease air way and circulatory response during intubation and extubation (5).

Fentanyl is potent synthetic opoid analgesic with rapid onset and short duration of action. It is a strong agonist at the mu opiod receptor.

Analgesia and emergence agitation: recovering from anesthesia often results in pain, elevating catecholamine concentrations. At the same time, anesthesia residuals compromise breathing. Therefore, α2-adrenoceptor agonists may prove beneficial in the postoperative period because of their sympatholytic and analgesic effects without respiratory depression.

Aim of work:

The main objective was to compare fentanyl with Dexmedetomidine as regards;

1. Their efficacy in including deliberate hypotension.
2. Provide better quality of surgical field during cochlearimplantation.
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Patient and methods:/material and methods:

The study was conducted after approval of the Ethical committee of Sohag university Hospital and obtaining informed written consent from the parents of the patients.

Inclusion criteria

Fifty patients of ASA physical status I or II, aged 6 months to 8 years and scheduled for elective cochlear implantation, were enrolled in this study.

Exclusion criteria:

Patients that were excluded from the study will include children with:

Patients with known allergy to fentanyl or dexmedetomidine.

Patients with fever.

Coagulopathy.

prolonged QT interval and ventricular arrhythmia.

Patients with congenital heart diseases.

Randomization was accomplish by using computerized randomization tables.

All patients were preoperatively assessed by history, physical examination and routine laboratory investigations (CBC, PT, PTT, INR, urea, creatinine, and SGPT, SGOT, albumin, bilirubin and serum electrolytes). Cardio logical consultation and pre-operative ECG will be done. Careful assessment of the airway will be done.

Solid food wont be allowed 6 h before surgery but clear fluids will be 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 (vial = 2 ml) 100micg/ml and fentanyl ampoule 100micg/2 ml will done. Each

drug will be diluted with 48 ml of 0.9% NaCl in 50 ml syringe to get a concentration of 4 mcg/ml in Dexmedetomidine group and 2micg /ml in fentanyl group.

Methods of the study:

On arrival to the operating room; an intravenous catheter was inserted.

Monitors were applied:, noninvasive automatic blood pressure, and pulse oximeter,capnography and electrocardiograph.

Induction of anesthesia was done by I.V. Dexmedetomidine (D) group at a bolus dose of 2 mcg /kg slowly infused over10 min, then continuous infusion by a rate of 0.7 mcg/kg/h. until the end of surgery. In (F) group; Fentanyl will be given at a dose of 1mcg/kg over 10 min, then continuous infusion by a rate of1 mcg/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 will be given to facilitate intubation.

The patient was intubated by a proper sized cuffed endotracheal tube. Anesthesia was maintained using a mixture of O2 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 CO2 monitoring.

Anesthesia was maintained with continuous infusion of the Dexmedetomidine or Fantanyl..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 will be added. Bradycardia will be treated with 0.02 mg/kg I.V. atropine if the HR was 20% lower than the baseline value. Fluids will be 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 will be extubated under deep anesthesia to avoid coughing (which may cause dislodgement of the electrode array of the implant) and transferred to the recovery room.

Data collection:

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.

Total dose of dexmedetomidine and fentanyl.

Objective Pain Scale (OPS**)** Need for more analgesia.

Diclofenac suppository (12.5 or 25 mg) was given if OPS were P4. It was given according to the nearest dose guided by body weight (2 mg/kg)

Quality scale: the surgeon who was blinded of the selected hypotensive agent was asked to assess the quality of the surgical field .

Both recovery time and discharge time were recorded for all patients.

Recovery time was defined as the period of time from discontinuation of sevoflurane till achieving a modified Aldrete recovery score of at least 9. Discharge time was defined as the time from the end of the procedure until the child fulfilled the discharge criteria from PACU.

Postoperative nausea and vomiting were monitored for 24 h. Intravenous ondansetron (0.1 mg per kg) was given if nausea and vomiting had occurred. Number of patients who suffered from apnea was recorded. The anesthetist who was recording the intra-operative and postoperative data did not share in preparing or giving the selected agent

Statistical Analysis:

All the parameters were recorded , tabulated ,analysed & statistically compared between two groups to identify any significant differences .

Data was analysed using STATA intercooled version 9.2. Quantitative data was analysed using student t-test to compare means of two groups. Mann-Whitney test was used to compare data when data wasn't normally distributed. Qualitative data was compared using Chi square or fisher exact test. Figures were produced by excel sheet. P value was considered significant if it was less than 0.05.

Results:

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 postanesthesia care unit (PACU).dexmedetomidine was better for analgesia and decrease incidence of emergence agitation and decrease postoperative nausea and vomiting .

The study included 50 pt. who were anaesthetized for cochlea implantation surgery classified into 2 groups :The 1st group D group using Dexmedetomidine (25 patient)
The 2nd group F group using Fentanyl (25 patient)

- There was statistically insignificant difference between both groups as regard MAS.
- There was a significant difference between two groups, as the time for recovery was more rapid in D (group) than in F (group) the data is significant. Table(1)
- As regard OPS:comparison of groups in which patient presented without pain found that : There was a statistically significant difference between both groups in patient presented without pain attime interval (1/2 , 1 and 2 hours) There was statistically insignificant differences between both groups in patient presented without pain at time interval (from 4 upto 24 hours).
- In patient presented with mild pain : There was statistically significant difference between both groups presented with mild pain at time interval (1/2&1 hours).There was statistically in significant differences between both groups for patient with mild pain at time interval (2 upto 24 hour).
- In patient presented with moderate pain :There is a statistically significant difference between both groups at1/2 & 1 hours on patient with moderate pain.
- In patient presented with severe pain : There is no statistical significant differences between both groups for patient with severe pain at time interval (1/2 hour up to 24 hour).
- As regard use of additional use of tested drug there was insignificant difference.
- There was statistically significant difference between both groups as regard need for other analgesics.
- There was statistically insignificant difference between both groups as regard quality of surgical field.
- There was a statistically insignificant difference between both groups as regard duration of surgery. In D group duration was 155.24±28.79 minutes, while in F group was162.2±31.16 minutes
- There was significant difference (p value<0.001) decrase in recovery time in D group (11.24 minutes) than F group (13.920 minutes).
- There was statistically significant difference (p value<0.05) decrase in discharge time in D group (24.4 minutes) than F group (41.6 minutes).
- There was statistically significant difference between both groups as regard postoperative agitation and vomiting .

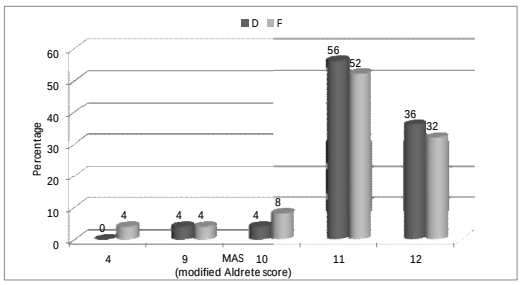
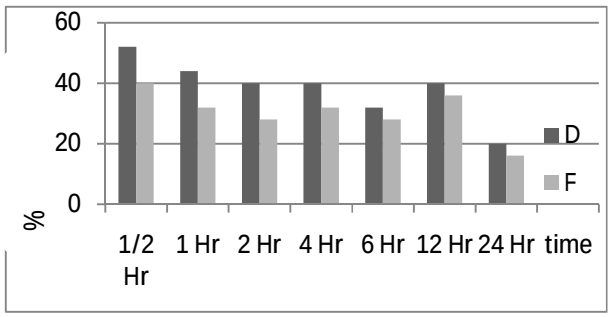
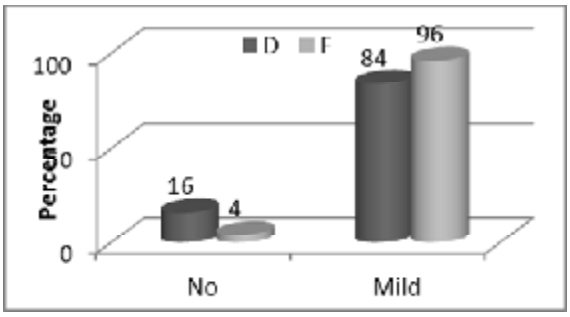


Figure (1) MAS between both groups



(2) Comparison between D group and F group as regard objective pain score



Figure(3)Quality of surgical field

Discussion:

Surgery of cochlear implantation is a great advance in otology for patient with deaf mutism but it carries a great challenge to the anesthesiologist (Pedersen et al. 2000). 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 relaxant to facilitate monitoring of the facial nerve by peripheral nerve stimulator, smooth recovery and adequate postoperative care without nausea and vomiting (Morgan et al. 2006).

Fentanyl is potent synthetic opoid analgesic with rapid onset and short duration of action. It is a strong agonist at the mu opiod receptor. Analgesia and emergence agitation: recovering from anesthesia often results in pain, elevating catecholamine concentrations. At the same time, anesthesia residuals

compromise breathing. Therefore, α2-adrenoceptor agonists may prove beneficial in the postoperative period because of their sympatholytic and analgesic effects without respiratory depression (Guler et al. 2005).

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.

Mean age of our study group was 4.81±2.25 years in Dexmedetomidine group and 3.88±0.86 in Fentanyl group. Dexmedetomidine group included 52.3% females and 47.6% males, on the other hand Fentanyl group included 48% females and 52% males. Mean of body weight was 17.57±4.92 in D group and 15.76±2.18 in F group. Mean duration of surgery was 155.24±28.79 in Dexmedetomidine group and 162.2±31.16 in Fentanyl group. In study of El Saied et al. (2016) mean age of D group was 5.91 ±1.62 and 6.17± 1.67 in F group, D group included 38.5% males and 61.5% females, F group included 42.3% males and 57.7% females. Mean duration of surgery was 121.53±25.6 in D group and 117.88± 26.4 in F group (El Saied et al. 2016).

Dexmedetomidine is a potent a2 adrenergic agonist with a distribution half-life of 8 min and a terminal half-life of 3.5 h. Its short half-life provides easy titration, quick recovery and less adverse events related to prolonged sedation. It provides adequate sedation with high cardiovascular and respiratory stability (Nelson et al. 2003). a2-adrenoceptors exist on the dorsal horn neurons of the spinal cord and can release endogenous opiate compounds. Thus, a2-adrenoceptor agonists may be used in pain management and may decrease intra-operative opioid requirements, similar to clonidine (Xu et al. 2000).

The protocol of the doses of tested drug is controversial

In many studies dexmedetomidine is given for sedative, amnestic, and analgesic properties in a bolus dose of < 0.5 μg/kg in pediatric patient to avoid bradycardia giving further infusion dose with titrated response with a maximum dose of 2 μg/kg/hr. At these doses in children Dexmedetomidine acts as an effective sedative and analgesic agent without any significant hemodynamic effects (Hall et al. 2000, Schnabel et al. 2013).

As regard hemodynamics in our study, we found that mean HR and Mean blood pressure decreased gradually after inducton up to 180 minutes without significant difference in both groups with better quality surgical field, this was in agreement with El Saied et al, 2016 as they found that dexmedetomidine showed a significant reduction in intra-operative HR and mean artrial pressre (MAP) more than fentanyl. ***Kim, et al, 2015*** Was in agreement of our study . Mason et al. (2006) were the first who studied the sedative effect of dexmedetomidine on pediatric patients for radiological imaging studies. They reported that dexmedetomidine produced a reduction of HR and MAP which was clinically acceptable for the pediatric age group. These findings coincide with the results of the present study. On the other hand, Koroglu et al. (2005) noticed that dexmedetomidine produced a reduction of HR only in comparison with propofol in children undergoing MRI study. Tanskanen et al. (2006) reported that dexmedetomidine was an excellent

anesthetic adjuvant because of the perioperative hemodynamic stability and the faster tracheal intubation that obtained in comparison with fentanyl in patients undergoing brain surgery. Also, Feld et al. (2006) compared dexmedetomidine with fentanyl in bariatric surgery. They reported that dexmedetomidine decreased sympathovagal balance and heart rate intra-operatively more than fentanyl.

Ali and El Ghoneimy. (2010) had compared dexmedetomidine with fentanyl in pediatric patients undergoing extracorporeal shock wave lithotripsy and reported that the MAP and HR were significantly decreased compared to the baseline throughout the procedure in both groups, these results are consistent with the present study. Turgut et al. (2008) reported that MAP values were significantly higher in dexmedetomidine group than in fentanyl group only after intubation, while they were significantly lower in dexmedetomidine group than in fentanyl group before and after extubation during lumbar laminectomy surgery. There was no statistically significant difference in HR between groups in their study (Turgut et al. 2008).

Dikmen et al. (2010) found that infusion of dexmedetomidine was effective in inducing consistent and sustained controlled hypotension, and achieved clear surgical field during middle ear surgery with no need for additional use of a potent hypotensive agent in low-flow anesthesia. Dexmedetomidine also reduced isoflurane and fentanyl requirements for deliberate hypotension and attenuated cardiovascular responses perioperatively (Dikmen et al. 2010).

As regards modified aldrate score (MAS), we found that it was high 11 in 56% of Dexmedetomidine group and 52% of Fentanyl group without significant differences . MAS was 12 in 36% of Dexmedetomidine group and 32% in Fentanyl group without significant difference, In agreement with our study El Saied et al , 2016 found that there was no statistically significant difference between both groups regarding modified Aldrete score.

Regarding postoperative OPS we found that it was significantly lower in Dexmedetomidine group than Fentanyl group in all times up to 24 hrs after surgery, only 12 patients in D group need post-operative analgesia compared to 20 patient in fentanyl group with significant P value (<0.001)

As regard mean recovery time We found that mean recovery time was shorter and highly significant in dexmedetomidine group than fentanyl group as regard 11.240±0.5228 minutes in Dexmedetomidine group and 13.920 ± 3.3407 minutes in Fentanyl group.

Discharge time also show significant difference in dexmedetomidine group than fentanyl group as regard 24.4 ± 12.47minutes in dexmedetomidine group and 41.6±19.31 minu

In our study incidence of agitation with fentanyl was mild in 48% and 32% of patients presented with moderate agitation .

Our study suggest that intraoperative continuous dexmedetomidine infusion (0.7 mg kg/hr) until extubation was effective in reducing the incidence of emergence agitation after cochlea implant surgery without delay of extubation or increasing incidence of other complications. Furthermore, intraoperative use of dexmedetomidine produced more stable haemodynamic changes during extubation and enhanced patient-reported global quality of recovery at 24 h after surgery.

In our study incidence of nausea and vomiting was significantly less in dexmedetomidine group than fentanyl group as regard non of our patients in dexmedetomidine suffered from nausea nor vomiting while in fentanyl group 8 patient suufer from nausea and 10 patient presented with vomiting .

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 postanesthesia care unit (PACU).dexmedetomidine was better for analgesia and decrease incidence of emergence agitation and decrease postoperative nausea and vomiting .

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