Attenuating the hormonal response to rigid bronchoscopy; comparison between iv fentanyl, dexmedetomidine or lidocaine

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Abstract

Hormonal stress response due to manipulation of the upper and lower respiratory tracts occurring during rigid bronchoscopy represents a potentially great hazard to safeanesthesia.There were many attempts to attenuate these adverse effects.Dexmedetomidine is highly selective, short-acting central alpha 2 agonist. It has increasingly gained popularity among anesthesiologists as adjuvant to general and regional anesthesia techniques. This study was conducted to compare the efficacy of administrating fentanyl, dexmedetomidine or lidocaine on control of hormonal changes in response to rigid bronchoscopy in pediatric patients. Ninety ASA I-II children aged 2-12 year were randomly assigned to 3 groups: fentanyl (F), dexmedetomidine (D) and lidocaine (Z). cortisol, ACTH and vasopressinlevels were measured and recorded. Results revealed that patients in the D group showed less elevation of ACTH levels in in response to the insertion of the rigid bronchoscope compared with the other groups, cortisol levels increased significantly after bronchoscopy in the lidocaine group, meanwhile, changes in vasopressin levels were not significant between the groups We concluded that dexmedetomidine can be used safely and effectively to attenuate the hormonal responses to rigid bronchoscopy in pediatric patients.

Introduction

Laryngoscopy and intubation have been shown to induce marked hormonal changes due to a sympatho-adrenal response to stimulation of the upper respiratory tract leading to marked rise in heart rate and in arterial blood pressure. Bronchoscopy entails more manipulation of the upper and lower respiratory tracts, takes a significantly longer time and would be expected to produce a longer and possibly more severe hormonal stress response.(1)(2)(3) These hormonal responses are of short duration and are usually well tolerated. However, unwanted effects may occur as dysrhythmias and a rise in myocardial oxygen consumption. Myocardial ischemia may result and may be especially worrying in those patients with pre-existing hypertension and ischemic heart disease, and in the elderly with accompanying lung disease.(4)(5)(6) There have been many attempts to attenuate these adverse effects. They include topical anesthesia, systemic lidocaine, Alpha and beta blockers, nitroprusside, hydralazine, midazolam, deeper inhalational techniques and different doses of fentanyl but many of these drugs have adverse and long lasting effects, and the use of some of these agents may require invasive monitoring, which is not always appropriate and some of these agents shows variable response(7)(8)(9,10)Fentanyl is a short acting synthetic opioid agonist 75-125 times more potent than morphine. It has a rapid onset but has a distinct time lag between the peak plasma fentanyl concentration and peak slowing on the EEG of around 3- 7 minutes. This reflects the lag between achievement of a drug concentration in the plasma

and the clinical effect. (11) Dexmedetomidine is a relatively new, highly selective, short-acting central alpha 2 agonist. Activation of α2-receptors leads to dose dependent sedation and anxiolysis, analgesia. (12,13) Dexmedetomidine has increasingly gained popularity among anesthesiologists and intensive care physicians abroad as adjuvant to general and regional anesthetic techniques and as a sedative. Its administration potentiates the effect of other sedative and hypnotic agents while causing minimal respiratory depression. It also reduces the sympathetic response thus minimizing changes in blood pressure and heart rate during critical moments such as laryngoscopy and intubation. (14)(15) Intravenous (IV) lidocaine which is an aminoamide local anesthetic has been popular for its role in attenuating stress response to endotracheal intubation probably because of its theoretical advantages of suppressing cough reflex (16,17), preventing increases in intracranial pressure (18), attenuating circulatory responses (19), and its antiarrhythmic properties. (20) This study was conducted to compare the efficacy of systemic administration of either fentanyl, dexmedetomidine or lidocaine on control of hormonal responses to rigid bronchoscopy in pediatric patients.

Patients 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. Ninety ASA I-II children aged 2-12 year undergoing elective rigid bronchoscopy for removal of suspected airway foreign body were enrolled in this study. Patients excluded from the study were children with congenital disease, cerebral disease, cardiovascular disease, hepatic disease, renal disease, muscular disease, predicted difficulty in laryngoscopy and intubation, those requiring prompt interventions for a life-threatening situation (acutely compromised airway with SpO2 values below 70%) and patients scheduled for additional interventions or surgery subsequent to the bronchoscopy. The fasting time before anesthesia induction was at least six hours for solid foods and two hours for clear liquids. On arrival in the operating theatre, patients were randomly (using sealed envelopes) assigned to 3 groups fentanyl (F), dexmedetomidine (D) and lidocaine (Z), vascular access was obtained. Anesthesia monitor was used for monitoring ECG, heart rate (HR), peripheral oxygen saturation (SpO2), systolic (SAP), diastolic (DAP) and mean (MAP) arterial pressures.all patients received atropine 0.01 mg/kg and dexamethasone (0.1 mg/kg) IV to decrease secretions and prevent tracheal and laryngeal edema. Before induction, all children were preoxygenated and a 10 mg/kg crystalloid bolus was given. Group F (n = 30) received 2 mcg/kg fentanyl citrate, group D (n = 30) received 1 mcg/Kg dexmedetomidine while group Z (n = 30) received 1.5 mg/kg lidocaine 2% and all these drugs were diluted with normal saline to make 20 ml volume and administered slowly IV over 5 minutes. Induction of anesthesia was conducted using 2 mg/kg propofol and 1.5 mg/kg succinylcholine administered intravenously. The bronchoscope was inserted 30 seconds after induction and the Patients were manually ventilated with a ‘T’ piece connected to the side arm of the rigid bronchoscope. The fresh gas flow was adjusted to 10 l/min and in case of major air leakage, an oxygen flush valve was used for adequate filling of the reservoir bag and the airway pressure limit was adjusted to `20-30

cmH_2O without desaturation of SpO_2 below 90%. All patients received 2% sevoflurane in 100% oxygen for maintenance of anesthesia. Blood samples to measure plasma concentrations of stress hormones including vasopressin, cortisol and ACTH were withdrawn immediately after induction and before instrumentation of the airway and 5 minutes after insertion of the bronchoscope. At the end of the procedure endotracheal intubation was performed with manually controlled ventilation and anesthesia was discontinued and tracheal and oral secretions were suctioned as needed, and the patients were turned to the lateral decubitus position for recovery. When patients begin to demonstrate emergence from anesthesia by displaying a regular respiratory pattern, facial grimacing, or purposeful movement the patient was extubated. As regard to statistical analysis**;** data are presented as mean ± SD or number (%), SPSS version 16 was used for data analysis, analysis of variants (ANOVA) was utilized for comparison of continuous data between the study groups. Chi squared test was used for comparison of categorical data. Repeated measures were compared with repeated measured ANOVA. P value less than 0.05 was considered significant

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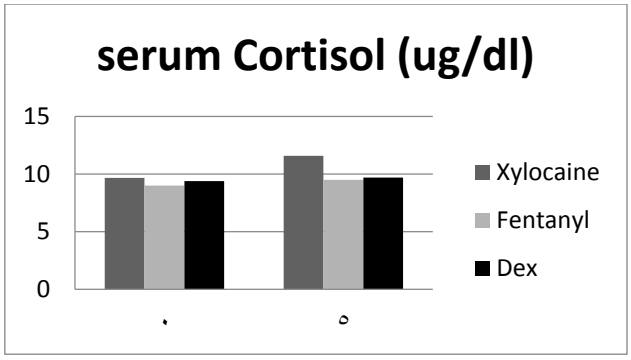
Results

Demographic data of the patients in the groups were comparable for age, weight, Hight and sex ratio with no significant statistical difference as shown in table (1)
We found that cortisol levels measured 5 minutes after insertion of the bronchoscope were significantly higher in the lidocaine group as shown in graph (1)

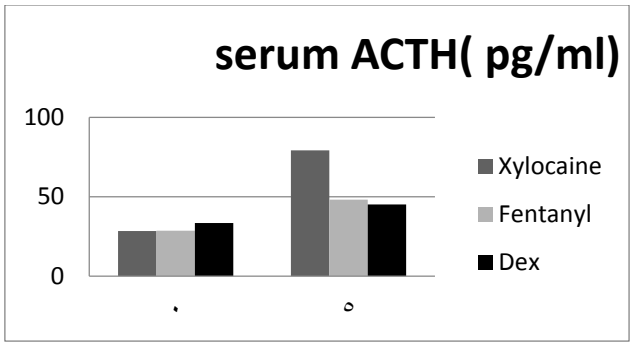
Variable	Lidocaine (*n* = 30)	fentanyl (*n* = 30)	dexmedetomidine (*n* = 30)	P VALUE
Age (years)	6.83±3.41	6.80±3.18	7.10±3.08	0.925
Sex M	15 (50%)	16 (53.3%)	15 (50%)	0.96
Sex F	15 (50%)	14 (46.7%)	15 (50%)	
Weight (kg)	24.41±10.28	23.60±9.25	24.10±8.75	0.945
Hight (cm)	115.80±21.27	117.15±19.20	119.46±19.20	0.772

Table (1): demographic data



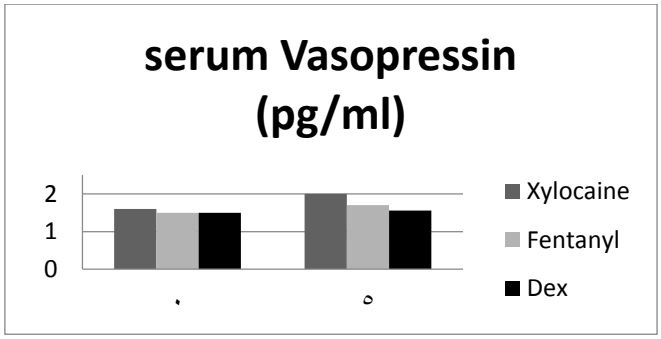
Graph (1): mean values for serum cortisol levels

In this study, the ACTH levels measured in serum 5 minutes after starting the bronchoscopy were significantly lower in the dexmedetomidine group than in the other groups as shown in graph (2).



Graph (2): mean values for serum ACTH levels

There was no statistically significant difference between the groups in the levels of serum vasopressin levels measured before and after bronchoscope insertion as in graph (3).



Graph (3): mean values for serum vasopressin

DISCUSSION

In our study serum cortisol levels increased in all the groups from the base line measures when it is measured 5 minutes after insertion of the bronchoscope. this rise was the least in the dexmedetomidine group,but it was not statistically significant when compared to the fentanyl group meanwhile it was statistically significant when compared tothe lidocaine group with p value 0.001.ACTH levels increased when measured 5 minutes after insertion of the bronchoscopewith statistically significant less increase in the dexmedetomidine group (p value 0.001). Vasopressin levels increased when measured 5 minutes after insertion of the bronchoscope but with nostatistically significant difference between the groups (p value 0.349).

Jiang W et al, 2016 compared the effects of dexmedetomidine and propofol on stress response in thirty patients of ASA I-II, 60-75 years of age, scheduled for open esophagectomy under total intravenous anesthesia and they concluded that plasma norepinephrine (NE), epinephrine, cortisol and ACTH levels in both groups increased significantly at T1 (prior to anesthesia) and T2 (2 hr after starting surgery) but NE, epinephrine level were significantly higher in propofol group.(21)**Tang Cet al, 2015** investigated the effect of intranasal dexmedetomidine on stress hormones, inflammatory markers, and postoperative analgesia after functional endoscopic sinus surgery (FESS) through randomly allocating Sixty patients of either sex with the American Society Anesthesiologistsphysical status I-II, aged between18 and 60 years undergoing FESS to receive either intranasal dexmedetomidine (undiluted 1.5 µg/kg) or intranasal saline (same volume) 1 h before surgery and found that plasma epinephrine, norepinephrine, ACTH and blood glucose levels were significantly lower in dexmedetomidine group.(22)**Joseph D et al, 2014** studied the role of different anesthetic techniques in altering the stress response during cardiac surgery in children where 48 children undergoing surgical repair of congenital heart disease were randomized to receive low-dose fentanyl (10 mcg/kg), high-dose fentanyl (25mcg/kg; high), or low-dose fentanyl plus dexmedetomidine (as a 1 mcg/kg loading dose followed by infusion at 0.5mcg/kg/hr until separation from cardiopulmonary bypass) and they concluded that Subjects in the low-dose fentanyl plus placebo group had significantly higher levels of adrenocorticotropic hormone, cortisol, glucose, lactate, and epinephrine during the study period. the lowest levels of stress markers were seen in the high-dose fentanyl plus placebo group.(23)**Venn R et al, 2001** studied the effects of dexmedetomidine on adrenocortical function and the cardiovascular, endocrine and inflammatory responses in twenty patients aged 18 year or older after complex major abdominal or pelvic surgery and who were expected to require 8 h post- operative sedation and ventilation in ICU where they were allocated randomly to receive either an infusion of dexmedetomidine 0.2-2.5 µg/kg/hr or propofol 1-3 mg/kg/hr and found that there were no differences in cortisol, ACTH, prolactin and glucose concentrations between the two groups.(24)**Ahmed A H et al, 2018** studied the use of dexmedetomidine 1mcg/kg versus magnesium sulphate 30mg/kg or lidocaine 1.5mg/kg for blunting stress response to direct

laryngoscopy and endotracheal intubation in 56 ASA physical status I or II patients aged between 20-40 years scheduled for abdominal surgery and observed that there was a statistically significant less rise in the serum cortisol and serum glucose levels from the baseline measurements in the dexmedetomidine group.(25)**Ashraf M et al, 2015** Compared the use of either dexmedetomidine (0.1µg/kg) , lidocaine (1mg/kg) or a combination of both (0.1µmg/kg + 1mg/kg) in attenuation of cardiovascular and catecholamine responses to tracheal extubation and anesthesia emergence in 60 hypertensive ASA II–III patients aged between 25 and 68 years and he found that catecholamine concentrations increased significantly after extubation in the three groups, with no significant difference between them.(26)

Conclusion

Adding dexmedetomidine to general anesthesia can effectively reduse the hormonal stress response to the process of rigid bronchoscopy.

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