Dexmedetomidine as an Anaesthetic Adjuvant in ENT Surgeries

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Abstract

Context: Dexmedetomidine is an alpha 2 receptor agonist with sympatholytic, analgesic and sedative effects. This study was designed to study the anaesthetic sparing effect of dexmedetomidine and to compare the efficacy of dexmedetomidine with fentanyl. *Aims:* 1) to study the effect of dexmedetomidine and compare dexmedetomidine with fentanyl in patients undergoing ENT surgeries. *Methods and Material:* After approval from institutional ethical committee a prospective randomized controlled study was conducted in forty ASA class 1 and 2 patients posted for ENT surgeries. Patients were randomly divided into two groups. Dexmedetomidine group received a bolus dose of 1mcg/kg body weight over ten minutes followed by infusion at the rate of 0.4mcg/kg/minute. Fentanyl group patients received 2mcg/kg fentanyl five minutes before the induction. Haemodynamic parameters were measured at specific end points. The anaesthetic and analgesic requirement was noted. *Statistical analysis used:* Data was analysed using computer statistical software system openepi. The unpaired t-test was used for intergroup comparisons except where specified. Probability values $p < 0.05$ were considered significant and $p < 0.001$ were considered highly significant. *Results:* It was noted that there was no significant difference haemodynamic parameters and quality of surgical field. The average sevoflurane during the first hour of surgery was significantly lower in group D. The incidence of post-operative nausea and vomiting was significantly lower in group F. *Conclusions:* Dexmedetomidine used in the dose of 1mcg/kg IV bolus followed by 0.4mcg/kg/hour provides effective and well tolerated alternative to fentanyl in reducing the requirement of analgesic and anaesthetic agents.

Keywords: Dexmedetomidine; Fentanyl; Anaesthetic Sparing Effect; Hypotensive Anaesthesia.

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Introduction

Dexmedetomidine is an alpha 2 receptor agonist, which produces analgesia, hypnosis, sedation, anxiolytics and reduces the requirement of anaesthetic agents [1]. Dexmedetomidine has been used as a sole sedative for non-invasive procedures and as an adjunct for invasive procedures. It has been suggested that dexmedetomidine influences core components of an anaesthetic regimen, such as analgesia, hypnosis and memory function and has the ability to reduce both anaesthetic and analgesic requirements in the perioperative period. The purpose of this study was to use intravenous dexmedetomidine as an anaesthetic adjuvant and compare dexmedetomidine with fentanyl.

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Materials and Methods

After approval from institutional ethical committee of government medical college Surat this study was conducted in government medical college, New Civil Hospital Surat. Patients posted in ENT operative list were included in this study. Forty ASA class I and II patients were enrolled into the study. They were divided into two groups by computer generated table of random numbers. Dexmedetomidine group (group D) and fentanyl group (group F). Patients in dexmedetomidine group received dexmedetomidine intravenous bolus dose 1 microgram per kg body weight diluted in hundred ml of normal saline over 10 minutes just before induction of anaesthesia followed by dexmedetomidine infusion at the rate of 0.4mcg/kg/hr delivered through a syringe infusion pump. 100mcg of dexmedetomidine was diluted in 50 ml of normal saline to obtain a concentration of 2mcg/ml. Patients in fentanyl group received 2mcg/kg fentanyl IV, 5 minutes before induction followed by saline placebo infusion. The primary aims of the study was

1. To study the effect of dexmedetomidine and compare dexmedetomidine with fentanyl in reduction of requirement of inhalational anaesthetic agent in patients undergoing ENT surgeries.

2. To study and compare the haemodynamic effects of dexmedetomidine with fentanyl. The secondary aims of the study were

    1. To study the analgesic sparing effects of dexmedetomidine.

    2. To evaluate the influence of dexmedetomidine in the incidence of post-operative nausea and vomiting and compare the same with fentanyl.

    3. To review the effect of dexmedetomidine and fentanyl in quality of surgical field.

Patients with the following conditions were excluded from the study a) history of allergy to alpha agonist or sulpha drugs b) pregnant and lactating mothers and morbidly obese patients c) heart block d) presence of clinically significant neurologic, cardiac, renal, hepatic, gastrointestinal endocrinal diseases Informed consent was taken from all patients. Patients received inj Midazolam 0.02mg/kg IV just before shifting the patient to the operation theatre. On arrival to operation theatre, routine monitoring (ECG, pulse oximetry, NIBP) were started. After obtaining baseline measurement of heart rate and blood pressure patients dexmedetomidine group received a bolus dose of 1mcg/kg body weight in 100ml normal saline over ten minutes, patients in group F received saline. In fentanyl group patients received 2mcg/kg fentanyl diluted in 10 ml NS five minutes before the induction of anaesthesia and patients in group D received 10 ml normal saline. In dexmedetomidine group patients received dexmedetomidine infusion at the rate of 0.4mcg/kg/hr. throughout the surgery through syringe infusion pump which contained dexmedetomidine 2mcg/ml. In fentanyl group patients received normal saline infusion; the rate of infusion was decided presuming that it was dexmedetomidine infusion. Patients were monitored and the parameters were noted by an anaesthesiologist blinded to the study. Patients were induced with propofol IV and rocuronium 0.9mg/kg IV. The dose of propofol required was noted. Patients were maintained on sevoflurane and O_2 and N_2O and vecuronium. Hemodynamic values were recorded at specific end-points after bolus dose, 1 minute after induction, 1 minute after intubation, 3minutes after tracheal intubation, 5 minutes after tracheal intubation, at skin incision, 5 and 10 minutes after skin incision and subsequently at 10 minute intervals. As agent monitors were not available sevoflurane vaporizer dial settings were recorded every 10 minutes. Systolic blood pressure was maintained within ±20% of baseline values by adjusting the inspired sevoflurane concentration. Hypotension was defined as systolic blood pressure value <20% of baseline value or systolic blood pressure <80 whichever is lower on two consecutive readings within two to three minutes, not responding to decrease in sevoflurane concentration were given 200ml fluid bolus. It was decided that if hypotension persists ephedrine 5-10mg would be given and if hypotension was not responding to the above measures then infusion of the study medication would be stopped. As all patients required hypotensive field in this study therefore hypertension was defined as systolic arterial pressure > 20% of baseline value or systolic blood pressure greater than 110 mm of hg whichever is lower on two consecutive readings within two to three minutes. Hypertension not responding to increase in sevoflurane concentration was treated with fentanyl 1 microgram/kg IV. Tachycardia in this study was defined as heart rate >20% baseline or heart rate >100/minute for more than 2 minutes. Tachycardia despite of increase in inspired sevoflurane concentration was treated with fentanyl 1microgram/kg IV. Bradycardia (defined as heart rate <20% of baseline value on two consecutive readings within 2-3 minutes or heart rate <50 whichever is lower) was treated with atropine 0.6mg IV bolus. The need for the following rescue measures was recorded: Increase in sevoflurane concentration,

ephedrine, atropine, fentanyl, stopping of study medication. Infusion of study medication was discontinued after the completion of the wound closure. After removal of the laryngeal pack, sevoflurane was discontinued. Residual neuromuscular block was reversed with adequate dose of neostigmine and glycopyrolate and tracheal extubation was performed. Patients were observed in post anaesthesia recovery room for adverse effects during post-operative period. The patients were assessed for pain at thirty minutes and one hour using VRS score. Patients were asked to rate pain on a scale of zero to ten where zero stands for no pain and ten stands for worst pain imaginable. When VRS was greater than four patients, were treated with inj diclofenac sodium 75mg IV. Number of patients who developed nausea and vomiting in the first hour and the need for rescue antiemetic therapy was recorded. Patients were observed for other complications like shivering, arrhythmias. Surgeons were asked to grade the quality of surgical field as per their impression into 1) Excellent 2) Good 3) Poor.

Data was analysed using computer statistical software system openepi (open source epidemiological statistics for public health). All data was presented as mean and standard deviation (SD), except where specified. The unpaired t-test was used for intergroup comparisons except where specified. Probability values p<0.05 were considered significant
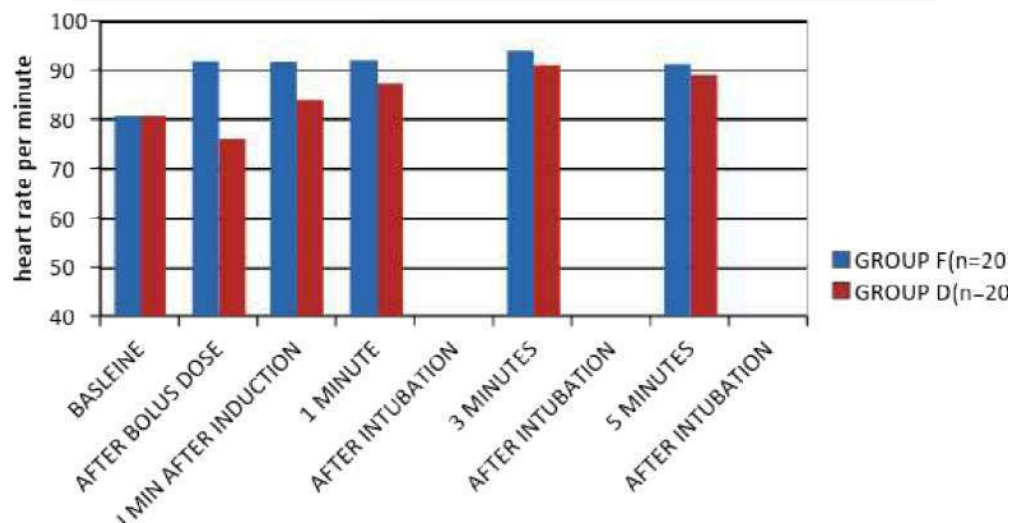
and p<0.001 were considered highly significant.

Results

There was no significant difference in age, sex, weight, gender, duration of surgery between the two groups. It was observed that mean propofol requirement in group D and group F were 2.14(±0.25) mg/kg and 2.87(±0.326) mg/kg respectively. The difference between the two groups was not statistically significant (p>0.05). It was observed that there was no significant difference between heart rate, systolic blood pressure and diastolic blood pressure after induction and following intubation. (p<0.05) (Figure 1, 2, 3) Table 1. Haemodynamic parameters were noted at incision, 5 minutes after incision and subsequently at 10 minute intervals throughout the surgery. It was noted that there was no clinically significant difference in heart rate, systolic arterial pressure and diastolic arterial pressure between the two groups (Figure 4, 5, 6). The average sevoflurane during the first hour of surgery in group F was 1.946 (±0.44) and group D was 1.473 (±0.76). The difference was statistically significant (p<0.05). 7 patients in group F and 1 patient in group D required supplemental dose of fentanyl and the difference between the two groups were statistically significant (p<0.05). It was observed that in group D, 2 patients developed hypertension

Table 1: Demographic Profile and duration of surgery

	Demographic profile and Duration of surgery		
	Group F(n=20)	Group D(n=20)	P value
Mean age (years)	26(±5.695)	23.45(±7.45)	>0.05
Mean weight (kg)	47.25(±5.25)	48.f(±3.284)	>0.05
Sex, m/f	8/12	12/8	
Mean duration (mins)	75.5(30.34)	95(39.80)	>0.05

Fig. 1: Mean heart rate during induction of anaesthesia
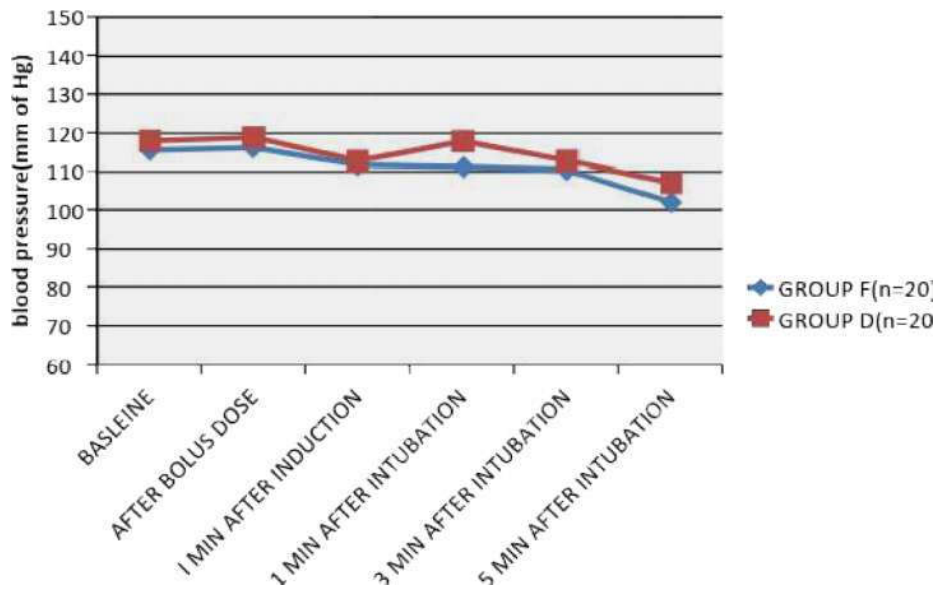
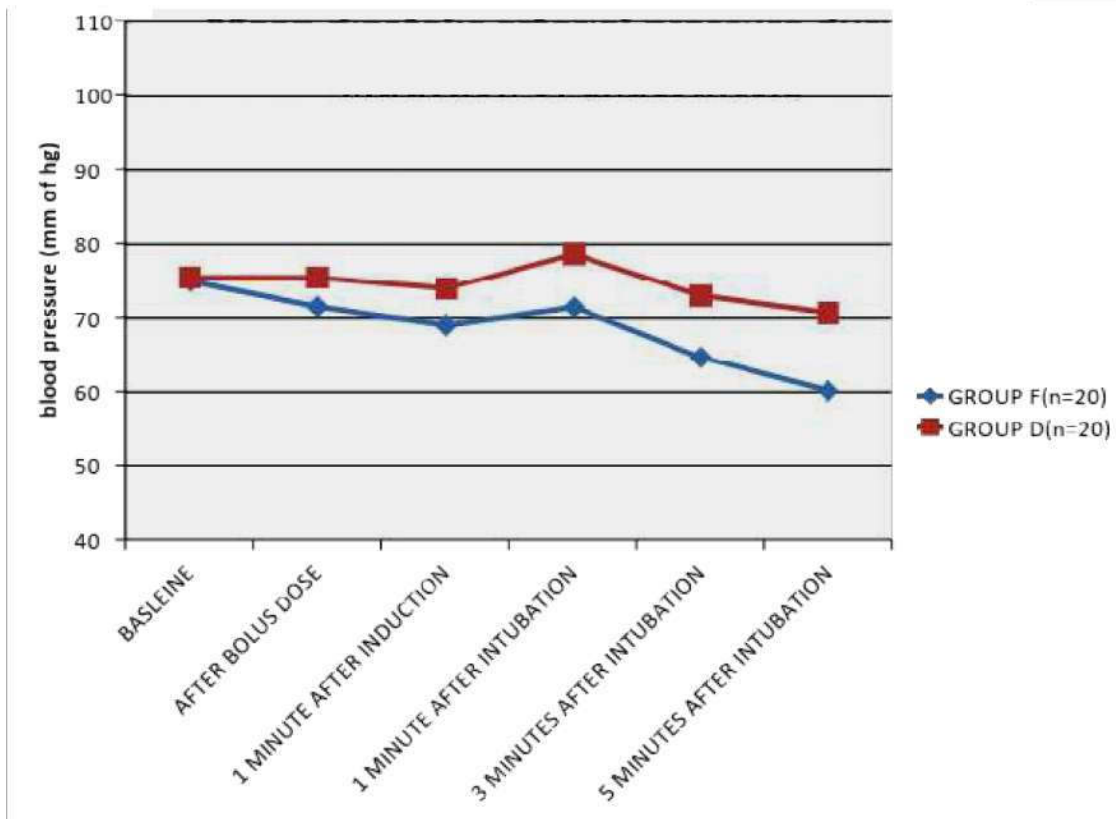**Fig. 2:** Mean systolic blood pressure during induction of anaesthesia

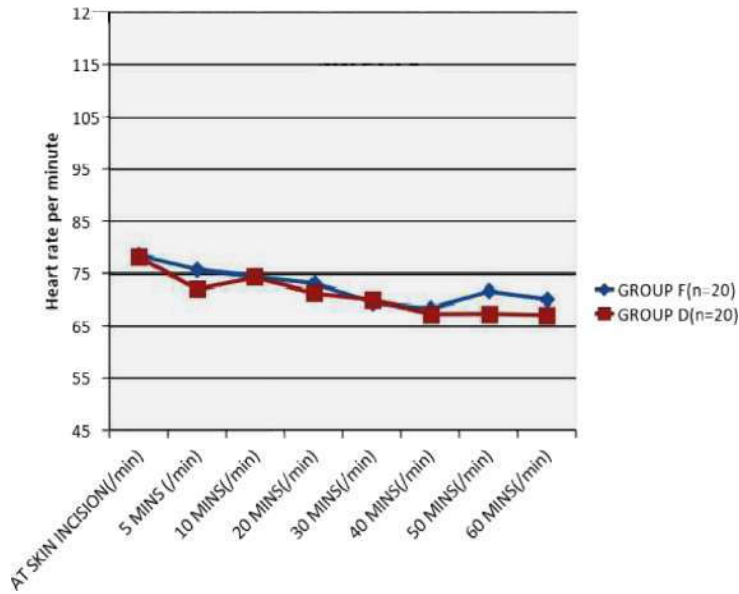**Fig. 3**: Mean diastolic blood pressure during induction of anaesthesia

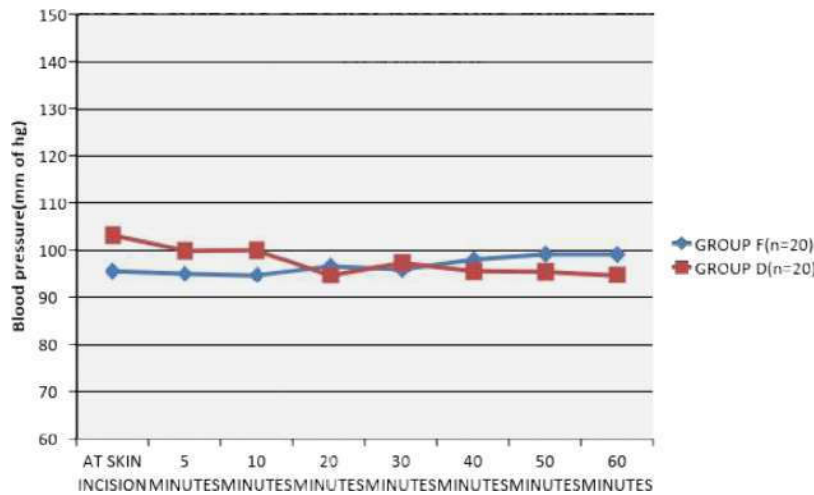**Fig. 4**: Mean heart rate during the first hour of surgery

Fig. 5: Mean systolic blood pressure during the first hour of surgery
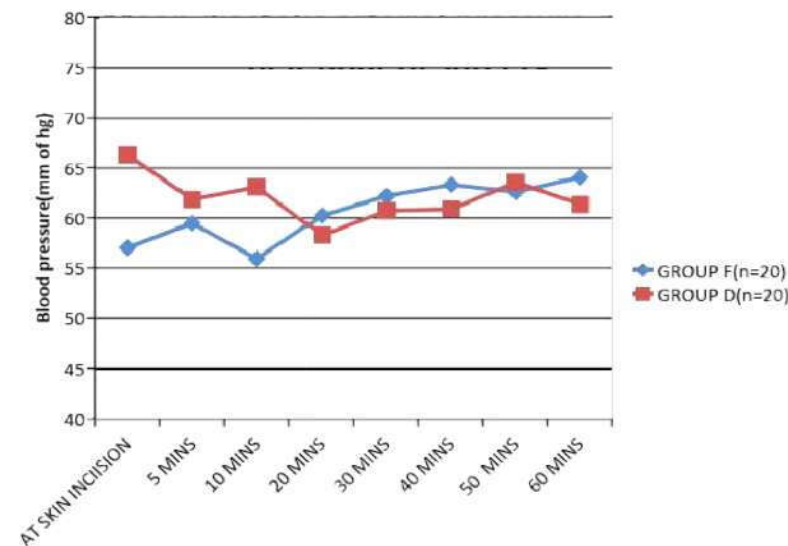

Fig. 6: Mean diastolic blood pressure during the first hour of surgery

and in group F, 4 patients developed hypertension, however the difference was not statistically significant (p<0.05). There was no significant difference in the incidence of tachycardia and bradycardia between the two groups. None of the patients developed hypotension, shivering or arrhythmia. VRS was assessed at 30 minutes and 1 hour. The mean VRS score at half an hour in group D was 1.4 (±1.729) and group F was 3.2 (±0.489) and the difference was statistically highly significant (p<0.01). The mean VRS score at thirty to sixty minutes was 1.4 (±1.729) in group F and 1.7 (±1.729) in group D the difference was statistically insignificant (p>0.05). There was significant difference between the analgesic requirement at 30 minutes between the two groups, 7 patients in group F and only one patient in group D required analgesic supplement. Between 30 to 60 minutes 1 patient in group F and 2 patients in group D required analgesic and the difference was statistically insignificant (p>0.05). 1 patient in group D and 7 patients in group F developed nausea therefore required antiemetic. The difference between the two groups was statistically significant (p<0.05). There was no significant difference in the quality of surgical filed between both the groups (Figure 7). Tab 2.

Discussion

Perioperative stress associated with surgery and anesthesia leads to stimulation of sympathetic nervous system causing an increase in arterial blood pressure and heart rate. In ENT surgeries even minimal bleeding can make the surgeons work difficult by obscuring the operative filed. Complications have been reported in ENT surgeries under GA resulting from impaired visibility due to excessive bleeding. High dose of potent inhaled anaesthetics have been used in the past to improve
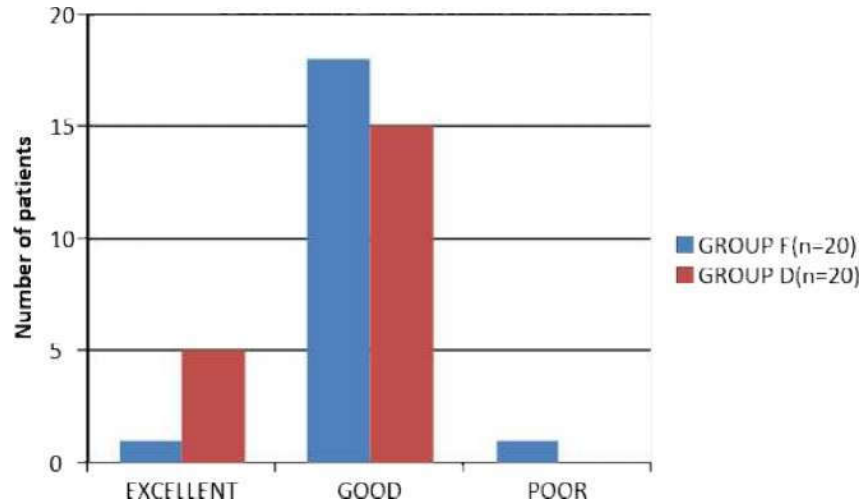
Fig. 7: Quality of surgical field.

Table 2: Complications

	Group F(n=20)	Group D(n=20)	P value
Hypertension	4	2	0.675
Hypotension	0	0	
Tachycardia	5	1	0.1843
Bradycardia	1	2	0.99
Shivering	0	0	
Arrythmia	0	0	

quality of anaesthesia but there was always the risk of delayed recovery from anaesthesia. Various agents like magnesium sulphate, vasodilators like sodium nitroprusside, nitroglycerine have been used to achieve controlled hypotensive anaesthesia. Dexmedetomidine is a highly selective alpha 2 receptor agonist with sedative, analgesic and anaesthetic sparing effect. This study was designed to study the anaesthetic sparing effect of dexmedetomidine and to compare the efficacy of dexmedetomidine with fentanyl in terms of quality of surgical field, haemodynamic stability and to assess any possible side effects. It was decided to give dexmedetomidine bolus dose of 1mcg/kg/hr. over ten minutes in this study as a higher rate of infusion has a tendency to produce hypertension due to action on the alpha 2B receptors on the vascular smooth muscles cells [1]. In most of the studies conducted before dexmedetomidine was used in the dose of 0.2 to 0.8mcg/kg/hr. IV infusion [4,5 and 6] but the incidence of complications like hypotension was more with 0.8mcg/kg/hr. [9]. Therefore dexmedetomidine infusion at the rate of 0.4mcg/kg/hr. was used to provide haemodynamic stability with minimum adverse reactions. Patients in fentanyl group received fentanyl at the dose of 2mcg/kg/hour diluted in 10 ml NS 5 minutes prior to induction. Fentanyl at the dose of 1.5-5mcg/kg/hr given 3 to 5 minutes before induction blunts haemodynamic response to tracheal intubation [3]. Fentanyl is also known to reduce the inhalational anaesthetic requirement. Fentanyl is a potent opioid analgesic, which has been used as an anaesthetic adjuvant over the years. Therefore it was decided to compare dexmedetomidine with fentanyl.

Dexmedetomidine produces sedation; amnesia decreases the requirement of inhaled anaesthetic agents. The dose of propofol required for induction of anaesthesia was noted to assess whether dexmedetomidine has any superior effect over fentanyl regarding effect on induction dose of propofol. There was no significant difference between doses of propofol required for induction between the two groups. The mean heart rate, systolic arterial pressure and diastolic arterial pressure were comparable between the two groups. There was no significant difference in mean pulse rate, systolic arterial pressure and diastolic arterial pressure between the two groups after bolus dose, 1 minute after induction, 1, 3 and 5 minutes after induction. In

this study the haemodynamic parameters were maintained between 20% of baseline by varying the inhaled sevoflurane concentration. It was observed that the mean of average sevoflurane requirement in the first hour of surgery was significantly lower in dexmedetomidine group compared to fentanyl group

Dexmedetomidine provides analgesia through its action at the central and peripheral sites. Alpha-2-Adrenergic receptors located at nerve endings may have a role in the analgesic effect of the drug by preventing norepinephrine release [1]. Dexmedetomidine acts on the alpha 2 receptors in the spinal cord and reduces the transmission of nociceptive signals to brain centers. Dexmedetomidine also inhibits the release of substance P from the dorsal cord of the spinal cord, leading to primary analgesic effects [1,2]. The requirement of supplemental dose of fentanyl was significantly lower in patients in dexmedetomidine group. We also observed that dexmedetomidine provides better post-operative pain relief and reduces the requirement of analgesics in the immediate post-operative.

Dexmedetomidine acts on central presynaptic alpha 2 receptors in the ventrolateral medulla, especially in the nucleus tractussolitarius and decreases the central sympathetic outflow [1]. The basic effects of alpha 2 agonists on the cardiovascular system are decreased heart rate; decreased systemic vascular resistance; and indirectly decreased myocardial cardiac output, and systemic blood pressure. Fentanyl is a potent opioid analgesic which is known to produce hemodynamic stability. The hemodynamic effects of dexmedetomidine were comparable with fentanyl. The quality of the surgical field was also comparable in both the groups. Although hypotension has been described in patients receiving dexmedetomidine, this exaggerated physiological effect is seen only after loading dose or in patients with pre-existing hypovolemic [2]. In this study dexmedetomidine was used at a low dose of 0.4mcg/kg/min, at this dose dexmedetomidine does not produce significant bradycardia or hypotension. The limitations of this study were that invasive blood pressure monitoring, BIS monitor and agent monitors were not used, the availability of these monitors would provide more accurate results.

Conclusion

Dexmedetomidine used in the dose of 1mcg/kg IV bolus followed by 0.4mcg/kg/hour produces effective and well tolerated alternative to fentanyl to reduce the requirement of analgesic and anaesthetic agents.

It attenuates laryngoscopic reflex and provides intraoperative haemodynamic stability. The quality of surgical field is acceptable without any significant side effects in patients undergoing ENT Surgeries.

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