International Journal of Medical and Health Research
ISSN: 2454-9142
www.medicalsciencejournal.com
Volume 2; Issue 1; January 2016; Page No. 01-04

Original research article: Performance of functional endoscopic sinus surgery with using isoflurane anesthesia

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Abstract
Background: An important requirement during functional endoscopic sinus surgery is to maintain a clear operative field to improve visualization during surgery and to minimize complications.
Aims: To evaluate Performance of functional endoscopic sinus surgery with isoflurane anesthesia.
Methodology: 40 patients of either sex in the age group between 20-45 years with ASA grade I or II physical status who underwent functional endoscopic sinus surgery (FESS) under general Anaesthesia were provided hypotensive Anaesthesia (Group I) with isoflurane to facilitate bloodless operative field. The MAP was maintained between 55-60 mmHg. Another group of similar 40 patients were provided normotensive Anaesthesia and acted as control (Group II).
Results: The mean duration (min.) of surgical procedure was lesser ($p< 0.05$) in group I that is 94.9 min as compared to 133.2 in group II. Similarly mean blood loss (ml) was considerably lower in group I (140 vs 255) than group II. Four patients of group II required blood transfusion whereas only one in group I. Surgical postponement was lesser in group I that is 2 as compared to 8 in group II. The mean inspired isoflurane concentration required to induce hypotension was 3.8%. In group I intraoperative heart rate was lower ($p< 0.05$) and MAP was significantly lower ($p< 0.01$) compared to group II patients. No patients of group I had any postoperative complication due to intraoperative hypotension

Keywords: Sinus surgery Endoscopic, Anaesthesia technique, Hypotensive Anaesthesia, isoflurane.

1. Introduction

The aim of functional endoscopic sinus surgery (FESS) is to restore the drainage and aeration of the par anasal sinuses, while maintaining the natural mucociliary clearance mechanism and seeking to preserve the normal anatomic structures [1, 2]. However, this surgery can lead to complications such as orbital cellulitis, rhino-oral fistulas and damage to the optic nerve [2, 4]. It is important to have a clear surgical field to minimize the complications. Patients commonly seek advice on recurring symptoms of rhinorrhoea, nasal congestion, and intermittent facial pain with postnasal drip. Over the past decade surgical management of rhino sinusitis has completely changed. Introduction of telescopes into routine outpatient practice and their intraoperative use to guide and focus attention on the middle meatus and osteomeatal complex has caused a revolution in rhinology. The ability to see the site of disease within the nose and paranasal sinuses [4]. clearly has allowed surgeons to develop more meticulous and thorough surgical techniques to remove diseased tissue and leave the nose functionally stable. In addition, these advances in optics have facilitated a more detailed assessment and understanding of postoperative results. Enthusiasm for functional endoscopic sinus surgery (FESS), engendered by a plethora of reports of short term success, has been justified more recently by the publication of long term postoperative results which show a continued trend towards subjective improvement of symptoms in most patients [5]. As FESS is a delicate and time consuming procedure, it is performed routinely under general Anaesthesia. So anaesthesiologists have to plan the technique in such a way that will facilitate the operating team for achieving a bloodless field for better visualisation of the intranasal structures and minimise intraoperative bleeding. Because very little bleeding can obstruct the view of the operating endoscope. Hence comes the role of hypotensive Anaesthesia. Many pharmacological agents, [6-8]. Including isoflurane as a combination, are in use for inducing intraoperative hypotension but the hypotensive effect of only isoflurane is not really utilised thoroughly. It is easy to administer and control its concentration, does not require infusion pump and can be quickly washed out from body by hyperventilation. As isoflurane induces hypotension slower than the other pharmacological agents like Na-nitroprusside, continuous intra-arterial blood pressure monitoring is not mandatory. It causes least arrhythmia in presence of exogenous adrenaline which is routinely infiltrated into the operative field for creating a bloodless field.

2. Material and methods

This study was conducted AMC MET Medical college, Sheth L.G. Hospital Ahmedabad, Gujarat from January 2008-december 2009.80 adult patients of either sex, belonging to ASA grade I or II who had undergone FESS procedure were taken up for the study. After a thorough preoperative check-up, patients were explained about the procedure and advised to practice mouth breathing.

Exclusion Criteria: Patients with uncontrolled hypertension, coronary artery disease, autonomic disturbances, and heavy smoker and on anticoagulation therapy were excluded from the study. All the patients were investigated in the preoperative period for Hb%, TLC, DLC, platelet count, PT, PTT, blood

sugar, blood urea, serum creatinine, urine for albumin and sugar, chest X-ray and 12 lead EKG. Two doses of anxiolytic; diazepam 0.2mgkg^{-1}; one the night before and another 2 hours prior to surgery were administered orally. Intramuscular premedication comprised of pethidine 1.5 mgkg^{-1} and metoclopramide 10 mg was administered one hour prior to induction of Anaesthesia. All the patients were induced with fentanyl 1mgkg^{-1} plus diprivan 3mgkg^{-1} along with 66% N_2O in O_2, 0.4% isoflurane and intubated with the help of atracurium 0.5mgkg^{-1}. Before intubation lungs were manually ventilated by bag & mask technique. After intubation ventilation was carried out with the help of Ohmeda® ventilator attached with the closed circuit system fitted with circle absorber to maintain normocarbia. Supplemental analgesia was provided with 0.5mgkg^{-1} of fentanyl every 30 minutes. At this point patients were randomly divided into two groups of 30 each. GroupI (n=30) patients received maximum concentration of isoflurane to maintain a mean arterial blood pressure (MAP) between 55-60 mm Hg guided by NIBP monitoring. Whereas group II (n=30) patients received only 0.4% isoflurane and preoperative blood pressure was maintained throughout the procedure. Patients were positioned at 20^0 head up tilt just before the procedure started. Patients of both the groups received IV fluids; Ringer lactate solution 4mlkg^{-1}hr^{-1}. Further neuromuscular block was maintained with intermittent boluses of atracurium; 1/4 th of the intubating dose at 30 minutes interval. Blood loss more than 20% of the estimated blood volume of the patient was replaced by whole blood. At the end of the endoscopic procedure, residual neuromuscular paralysis was reversed with 0.05mgkg^{-1} of neostigmine along with 0.02 mgkg^{-1} atropine and trachea was extubated on the table. Monitoring consisted of continuous EKG (lead II and V_5) with HR, NIBP for systolic, diastolic and mean pressures (MAP), inspired and end-tidal concentration of isoflurane (FiI so & ETI so), SpO_2, $ETCO_2$, FiO_2. These parameters were monitored by the in-built monitor of the Ohmeda® Anaesthesia work station. Blood loss was monitored directly from the collection into a calibrated bottle entrapped in line with the suction from the operative field. Depth of neuromuscular block was monitored through train-of-four (TOF) study by DBS Myotest® monitor. Recording of the haemodynamic parameters were done at pre induction, post induction, every 5 minutes in the intraoperative period and after extubation. But for statistical analysis HR and MAP were considered at pre induction, post induction, post incision (5 minutes after intra mucosal infiltration of 2% xylocaine with 1:200,000 of adrenaline), and average intraop. And immediate postoperative period only Stastas tical analysis:

Results were systematically analysed by t' test to find out the significance between the groups and in the groups at different periods of study. A 'p' value less than 0.05 was considered as statistically significant. urea, serum creatinine, urine for albumin and sugar, chest X-ray and 12 lead EKG. Two doses of anxiolytic; diazepam 0.2mgkg^{-1}; one the night before and another 2 hours prior to surgery were administered orally. Intramuscular premedication comprised of pethidine 1.5 mgkg^{-1} and metoclopramide 10 mg was administered one hour prior to induction of Anaesthesia. All the patients were induced with fentanyl 1mgkg^{-1} plus diprivan 3mgkg^{-1} along with 66% N_2O in O_2, 0.4% isoflurane and intubated with the help of atra curium 0.5mgkg^{-1}. Before intubation lungs were manually ventilated by bag & mask technique. After intubation ventilation was carried out with the help of Ohmeda® ventilator attached with the closed circuit system fitted with circle absorber to maintain normocarbia. Supplemental analgesia was provided with 0.5mgkg^{-1} of fentanyl every 30 minutes. At this point patients were randomly divided into two groups of 30 each. Group I (n=30) patients received maximum concentration of isoflurane to maintain a mean arterial blood pressure (MAP) between 55-60 mm Hg guided by NIBP monitoring. Whereas group II (n=30) patients received only 0.4% isoflurane and preoperative blood pressure was maintained throughout the procedure. Patients were positioned at 20^0 head up tilt just before the procedure started. Patients of both the groups received IV fluids; Ringer lactate solution 4mlkg^{-1}hr^{-1}. Further neuromuscular block was maintained with intermittent boluses of atracurium; 1/4 th of the intubating dose at 30 minutes interval. Blood loss more than 20% of the estimated blood volume of the patient was replaced by whole blood. At the end of the endoscopic procedure, residual neuromuscular paralysis was reversed with 0.05mgkg^{-1} of neostigmine along with 0.02 mgkg^{-1} atropine and trachea was extubated on the table. Monitoring consisted of continuous EKG (lead II and V_5) with HR, NIBP for systolic, diastolic and mean pressures (MAP), inspired and end-tidal concentration of isoflurane (FiIso & ETIso), SpO_2, $ETCO_2$, FiO_2. These parameters were monitored by the in-built monitor of the Ohmeda® Anaesthesia work station. Blood loss was monitored directly from the collection into a calibrated bottle entrapped in line with the suction from the operative field. Depth of neuromuscular block was monitored through train-of-four (TOF) study by DBS Myotest® monitor. Recording of the haemodynamic parameters were done at preinduction, postinduction, every 5 minutes in the intraoperative period and after extubation. But for statistical analysis HR and MAP were considered at preinduction, postinduction, postincision (5 minutes after intra mucosal infiltration of 2% xylocaine with 1:200,000 of adrenaline), and average intraop. And immediate postoperative period only Stastastical analysis:

Results were systematically analysed by't' test to find out the significance between the groups and in the groups at different periods of study. A 'p' value less than 0.05 was considered as statistically significant.

3. Result

The age of the patients were between 20-45 years in group I and in group II. (Table 1)The male patients were predominant in numbers in this series. (Table 2) The body weight and the duration of symptoms were similar in both the groups (Table 3, 4).

Table 1: Age wise distribution of participants

Group	Age range(Year)	Mean Age(year)
Group 1(Study Group)	20-45 yr	35.2±5.2
Group 2(Control Group)	20-45 yr	36.3±6.1

Table 2: sex wise distribution of participants

Group	Male	Female
Group 1(Study Group)	35	05
Group 2(Control Group)	36	04

Table 3: Body weight (kg) of all participants

Group	Body weight(kg)
Group 1(Study Group)	65.5
Group 2(Control Group)	69.6

Table 4: Distribution of participants according to duration of symptoms

Group	Duration of symptoms(Month)
Group 1(Study Group)	6.7
Group 2(Control Group)	7.1

Table 5: Distribution of participants according to differential diagnosis

Diagnosis	Group 1(Study Group) (n=40)	Group 2(Control Group)(n=40)
Allergic rhinosinusitis	22	18
Maxillary sinusitis	10	12
Ethmoidal sinusitis	08	10

Main preoperative diagnosis (Table 5) was allergic rhino sinusitis followed by maxillary sinusitis and ethmoidal polyps Mean HR in both the groups were comparable at pre induction and post induction periods. There was rise ($p< 0.05$) in heart rate in group II patients after incision compared

To group I patients. There was significant ($p< 0.01$) drop in HR in group I patients compared to group II (Table 6) in the whole intraoperative period. Mean HR in group II patients were higher ($p< 0.05$) than group I patients in the immediate postoperative period also.

Table 6: Hemodynamic status of participants during intraoperative period

Parameter	Group 1(Study Group) (n=40)	Group 2(Control Group)(n=40)	P-value
Heart Rate			
Preinduction	83.8±12.2	84.5±11.2	>0.05
Postinduction	69.2±15.5	70.1±16.7	>0.05
Postincision	73.5±25.2	92.2±22.7	<0.05
Average-Intraoperative	36.3±6.1	87.2±11.2	<0.05
Average-Postoperative	36.3±6.1	96.2±28.2	<0.05
Mean arterial blood pressure(MAP)(mmhg)			
Preinduction	109.2±25.5	106.2±27	>0.05
Postinduction	85.2±33.2	87.29±35.6	>0.05
Postincision	60.2±22.5	109.2±23.5	<0.05
Average-Intraoperative	54.2±11.5	107±29.1	<0.05
Average-Postoperative	99.5±21.5	107±31.2	<0.05

MAP dropped significantly ($p< 0.01$) in group I patients from post incision period and maintained so throughout the whole intraoperative period compared to group II patients (Table 7). The mean isoflurane (FiIso) requirement was 3.8%) in group I compared to 0.4% in group II (Table 7).

Table 7: Comparision of various intraoperative events of both Group

Events	Group 1 (Study Group) (n=40)	Group 2 (Control Group) (n=40)
Duration of surgery(min)	94.9	133.2
Blood loss(ml)	140	255
Surgical postponement	02	08
Isoflourane requirements	3.8	0.4
Blood transfusion	01	04

The mean blood loss in both the groups were similar although the range of loss was quite different. The maximum blood loss in group II patients were higher than group I patients hence 4 patients in group II required blood transfusion. Surgical postponement was higher in group II compared to group I. The postponement was due to repeated bleeding and complexity of the pathological condition. The duration of surgery was higher in group II patients ($p< 0.05$) compared to group I (Table 7).
There was no neurological or renal complications in the postoperative period in any patients of group I.

4. Discussion

Isoflurane-based inhalational anesthetic technique can be practiced wherever a general anesthetic is given. However, there is always a need to explore newer techniques and drugs to try and achieve better results and conditions for surgeries like FESS. In a study by Tirelli *et al*., mean arterial pressure of 60–70 mmHg was aimed for in FESS. A concentration of 1–2% of isoflurane was used in the isoflurane group for the maintenance, which is almost similar to our study. In the TIVA group, hypotensive anesthesia was achieved using propofol and remifentanil [6]. Rate of propofol used was 35–45 ml hr^{-1} whereas in our study, we used the infusion rate based on the patient's body weight and hemodynamic response. Other factors which influence the propofol dosage requirement include age, weight, preexisting medical condition, type of surgical procedure and concomitant medical therapy [7].
There was no significant difference between the two groups in terms of heart rate measured at different time intervals. The absence of tachycardia suggests that both the groups experienced adequate depth of anesthesia and analgesia because of the concomitant use of fentanyl. None of the
Patients had intraoperative awareness which was enquired in postoperative follow-up. There was no significant difference in
The intraoperative blood loss between two groups. The reduced blood loss in both the groups reflects effective controlled hypotension by both the techniques. Nair *et al.* described that patients on beta-blockers undergoing FESS had better surgical field with the heart rate less than 60 beats min^{-1}.[8,9] We achieved acceptable surgical conditions even though the heart rate in both the groups of our study was more than 60 beats min^{-1}. Mandal observed less bleeding with hypotensive anesthesia using isoflurane in FESS as compared to normotensive anesthesia provided by isoflurane. There were no postoperative complications due to intraoperative hypotension [10]. Both sodium nitroprusside and isoflurane have self-tuning adaptive control during hypotension. [10] As isoflurane does not increase right to left shunt, gas exchange is not hampered in the lungs during induced hypotension, hence there is no chance of developing hypoxic state [11]. This is one of the major advantages of isoflurane-induced hypotension. The magnitude

and duration of metabolic and endocrine response during induced hypotension by isoflurane, sodium nitroprusside or trimetaphan camsylate were similar for middle ear surgery as concluded by Newton MC *et al.* [12]. These indicate that isoflurane is as safe as any other currently available hypotensive agent.

5. Conclusion

From my study conclusion is that Controlled hypotension can be achieved equally and effectively by both isoflurane-based inhalational anesthetic technique. The method of its administration is simple hence can be routinely practiced without any extra arrangement of intra-arterial line or infusion pump.

6. References

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