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A Prospective Observational Study Comparing total Intravenous Anaesthesia (TIVA) and Inhalational Anaesthesia for Controlled Hypotension in Radical Reconstructive Surgeries of Oral Cancers

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Abstract
Context: *Controlled hypotension in oromaxillofacial surgeries provides better visualization of surgical field and decreased blood loss. The aim of the study was to know whether TIVA using propofol was superior to inhalational anaesthesia for controlled hypotension*
Aims: *The aim of the study was to know whether TIVA was superior to inhalational anaesthesia for controlled hypotension*
Settings and Design: *Prospective observational study for six months in major operation theatre complex of a tertiaty cancer centre.*
Methods and Material: *132 ASA physical status I and II adult patients (Inhalational group, n = 66; TIVA group, n = 66) were analysed. Mean arterial blood pressure (MAP) and mean heart rate (HR) at different time intervals, time taken for fall in MAP to the desired level, intra operative blood loss, operative field conditions based on Fromm and Boezaart scale and requirement of supplemental Nitroglycerine(NTG) infusion for MAP control were compared.*
Statistical Analysis Used: *Comparison of qualitative variables was done using Chi square test and comparison of quantitative variables was done using Student's t - Test. Result was considered statistically significant when p-value was <0.05.*
Results: *Significantly more number of patients in the inhalational group required supplemental hypotensive drug (NTG) infusion for controlled hypotension than in the TIVA group (p = 0.000). There was no significant difference between the two groups with regard to time taken for decreasing MAP to 70 mm Hg (p=0.722), total intraoperative blood loss (p=0.215) and surgical field conditions (p=0.803).*
Conclusions: *Controlled hypotension was obtained in TIVA group with significantly lesser use of supplemental hypotensive drug. Hence TIVA proved to be better than inhalational anaesthesia for controlled hypotension intraoperatively. However, with regard to total intraoperative blood loss & surgical field conditions, both groups were comparable.*

Introduction

Controlled hypotension can be defined as the reduction of systolic blood pressure to 80-90 mm Hg, a reduction of mean arterial pressure (MAP) to 50-65 mm Hg or a 30% reduction of baseline MAP.[1] It is indicated in endoscopic sinus or middle ear microsurgery, oromaxillofacial surgery, neurosurgery, major orthopaedic surgery, prostatectomy, cardiovascular and liver transplant surgery.

Controlled hypotension during radical reconst-ructive oral surgeries reduces intraoperative blood loss to a great extent. This in turn reduces the requirement of blood transfusion and thereby it's associated hazards like impaired immunity which can trigger tumor recurrence. Additionally, it provides a bloodless and clear field for the surgeon and helps to minimize complications. Major contraindications of induced hypotension are increased intracranial pressure in patients with cerebral disease, severe coronary artery disease and hypertension combined with arteriosclerosis of cerebral vessels. Careful assessment and selection of patients, appropriate choice of drugs and invasive beat-by-beat monitoring, are essential for safe practice of induced hypotension.

The chief concern while providing controlled hypotension in radical reconstructive surgeries is flap perfusion and thereby flap survival. Towards the end of surgery, it is important to have normal blood pressure for better haemostasis. Hence it is advisable to provide moderate controlled hypotension during the procedure and increase BP to baseline level towards the end of surgery.

Inhalational anaesthesia and Total Intravenous Anaesthesia (TIVA) are two methods of general anaesthesia used for elective head and neck oncosurgeries. The effect of TIVA and inhalational anaesthesia on controlled hypotension was compared in patients with oral cancers undergoing radical reconstructive surgeries under general anaesthesia.

Subjects and Methods

This was a prospective observational study for six months. After obtaining permission from Institutional Review Board, 132 patients (66 each under Inhalational anaesthesia group and TIVA group) were studied. Informed written consent was obtained from all. Confidentiality of patients was maintained. The study patients were kept fasted as per American Society of Anaesthesio-logists (ASA) guidelines and premedicated with oral Alprazolam 0.5 mg and Pantoprazole 40 mg two hours prior to induction of anaesthesia. In the operating room, intravenous access was obtained. Preinduction monitors - pulseoximetry (SpO_2), non-invasive blood pressure (NIBP), electrocardi-ogram (ECG) were attached and baseline values recorded. The patients were given additional pre-medication with inj.Midazolam 0.02 mg/kg, inj.Glycopyrrolate 0.2 mg and inj. Fentanyl 2 µg/kg. After preoxygenation patients were induced with IV Propofol 2mg/kg. Nasotracheal intubation was facilitated byInjVecuronium 0.1mg/kg.Inj. Lignocaine 2% (preservative free) 1.5mg/kg was administered 90 seconds prior to intubation. Post induction monitors $EtCO_2$, end tidal Isoflurane agent analyzer and temperature probe were attached. Fentanyl infusion at 2 µg/kg/h was started following intubation.

Patients receiving TIVA were maintained with Propofol infusion at 100-125 µg/kg/min. titrated to effect. The infusion rates were adjusted to maintain an adequate depth of anaesthesia as judged by clinical signs and hemodynamic response to surgical stimuli and to achieve a target MAP between 60-70 mmHg. However, the maximum rate of Propofol infusion was kept less than 125 µg/kg/min. These patients were ventilated with 50% Oxygen in air.

Patients in inhalational group received Isoflurane for maintenance of anaesthesia. The concentration of Isoflurane was adjusted with agent analyzer (end tidal concentration between 0.6-1.4%) according to clinical signs and hemodynamic response to surgical stimuli and to achieve an MAP between 60-70 mmHg. These patients were also ventilated with 50% Oxygen in air. End tidal CO_2 was maintained between 30-35mmHg in both groups.

During the perioperative period, all patients received IV Crystalloids at 4 ml/kg/h. Neuromuscular blockade was achieved with intermittent boluses of Vecuronium 0.02 mg/kg. Normothermia was maintained using warming blankets. Intraoperative blood loss was recorded in all patients.

Visibility of the operative field during surgery was assessed by operating surgeon. For evaluation of visibility of the operating field, the quality scale proposed by Fromm and Boezaart was used [2]. The scale is as follows.

Grade 0: No bleeding.

Grade1: Slight bleeding- no suctioning required.

Grade 2: Slight bleeding- Occasional suctioning required. Surgical field not threatened.

Grade 3: Slight bleeding- Frequent suctioning required. Bleeding threatens surgical field a few seconds after suction is removed.

Grade 4: Moderate bleeding-Frequent suctioning required. Bleeding threatens surgical field directly after suction is removed

Grade5: Severe bleeding. Constant suctioning required. Bleeding appears faster that can be removed by suction. Surgical field severely threatened and surgery impossible.

Prior to completion of surgery the following actions were taken

- Ondansetron 0.08 mg/kg I.V. was given to all patients.
- Propofol infusion was stopped at the completion of skin closure in patients who received TIVA
- Fentanyl infusion was stopped 30 minutes before completion of surgery in all patients because of longer context sensitivity half-life when compared to Propofol.
- After stopping Fentanyl infusion, all the patients received Inj. Morphine 0.05 mg/kg IV to avoid awareness.
- Isoflurane was stopped at the completion of skin closure in patients who received inhalational anaesthesia.

The residual neuromuscular blockade was reversed with Neostigmine 0.05 mg/kg and Glycopyrrolate 0.01 mg/kg.

Even after attaining adequate depth of anaesthesia based on clinical signs and hemodynamic response to surgical stimuli or after giving maximum dose of Propofol or Isoflurane, if there was reduced visibility of surgical field due to ongoing bleeding and MAP is not reduced to the desired level of 60-70 mm Hg, NTG infusion was started at a dose of 0.5-10 µg/kg/min. The infusion rate was titrated to achieve the target MAP. If the visibility of the surgical field was not reduced, no intervention was made for further reduction in MAP. If the MAP fell below 60mm Hg, a 6mg bolus of I.V. Ephedrine was administered and anaesthetic agent was titrated down.

In all patients, the following parameters were recorded intraoperatively

- MAP and mean HR were recorded at 5 minutes interval for the initial 30 minutes and thereafter at 10 minutes interval till the end of surgery.
- Mean HR was recorded at 10 minutes interval till the end of surgery.
- Total intraoperative blood loss.
- Visibility of the operating field during surgery.
- Whether supplemental NTG infusion was required for MAP control. If so, the time since induction of anaesthesia at which NTG infusion was started
- Awareness during surgery.

Inclusion criteria

American Society of Anaesthesiologists (ASA) 1 and 2 patients of either sex between 18 to 60 years of age scheduled for elective radical reconstructive surgeries of oral cancers.

Exclusion criteria

- Bleeding disorders
- Patients on anticoagulant therapy.
- Patients on antihypertensives.
- Coronary artery disease, renal disease, hepatic disease.

- Known allergy to study drugs.
- Post radiation therapy
- Recurrent surgery for the same disease

Observations were recorded both graphically and numerically. The data was entered in Microsoft Excel software. Statistical Packages for the Social Sciences (SPSS) was used for statistical analysis. Comparison of qualitative variables was done using Chi square test and comparison of quantitative variables was done using Students t Test. Result was considered statistically significant when p-value was <0.05.

Results

There was no significant difference in age, gender and weight distribution between the two groups. (The p-values were 0.425, 0.465 and 0.983 respectively.)

There was no significant difference in baseline MAP and HR between the two groups. The p-values were 0.325 and 0.281 respectively.

MAP and HR were recorded for the entire duration of surgery in both groups at fixed time intervals. For comparison of MAP and HR, values up to 200 minutes were taken in both groups as most of the surgeries got over around this period. This was done to ensure comparable and sufficient sample size in both groups.

Figure 1 shows the comparison of average MAP during the intraoperative period in both groups at fixed intervals from the start of surgery.

In both the groups, the average MAP followed the same trend with slight increase towards the end of surgery. Towards the end of surgery there was significant difference in MAP between both groups (p<0.004) with inhalational group showing increased MAP when compared to TIVA group.

Figure 2 shows the comparison of average HR in both groups during the intraoperative period

In both the groups, the average MAP followed the same trend with slight increase towards the end of surgery. Towards the end of surgery there was significant difference in MAP between both groups (p<0.004) with inhalational group showing increased MAP when compared to TIVA group.

Figure 2 shows the comparison of average HR in both groups during the intraoperative period

In both the groups, the average HR followed the same trend. But there was significant difference in Heart Rate between the two groups with inhalational group having higher HR between the initial 50-110 minutes. After initial reduction, HR remained almost steady in both groups.

Other parameters compared between the two groups during surgery were

- Time taken for fall in MAP to 70 mm Hg
- Requirement of NTG infusion
- Total intraoperative blood loss
- Fromm and Boezaart scale

Need for supplemental NTG infusion was significantly more in the inhalational group than in the TIVA group (Figure 3). In the inhalational group, out of the 66 patients, 60 required supplemental NTG infusion. In the TIVA group, out of the 66, only 19 required NTG infusion. (P-value=0.000)

In inhalational group, NTG infusion was started at a mean of 15 minutes from induction of anaesthesia. In TIVA group, the mean time was 11.6 minutes. The difference was not statistically significant. (p=0.132)

The mean time from induction for decreasing MAP to 70 mm Hg was 28 minutes in the inhalational group. It was slightly lower i.e. 27 minutes in the TIVA group. The difference is not statistically significant (p=0.722).(figure 4)

Total intraoperative blood loss during surgery was comparable in both groups. The mean blood loss was 385 ml in the inhalational group and 373.6 in the TIVA group. (Figure 5)

Fromm and Boezaart (F&B) scale grades visibility of the surgical field. It can be seen that F&B scale is comparable across the two groups (p=0.803) (figure 6).

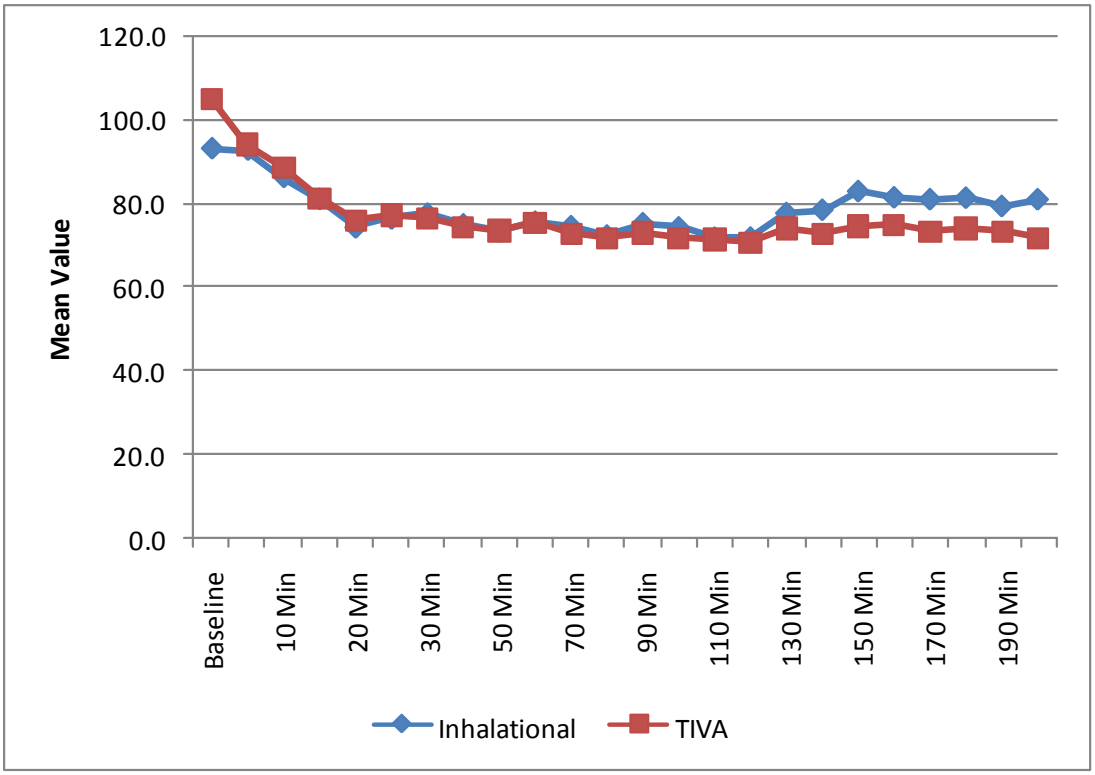

Figure 1 Comparison of MAP

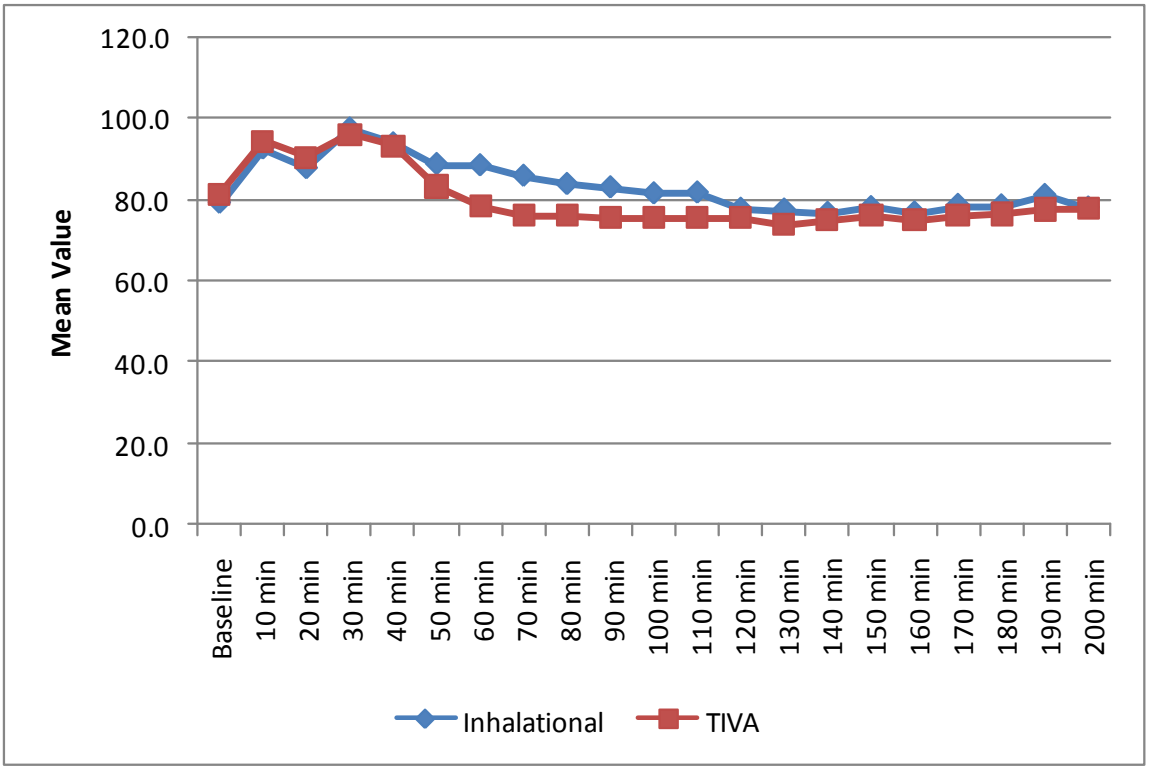

Figure 2 Comparison of HR

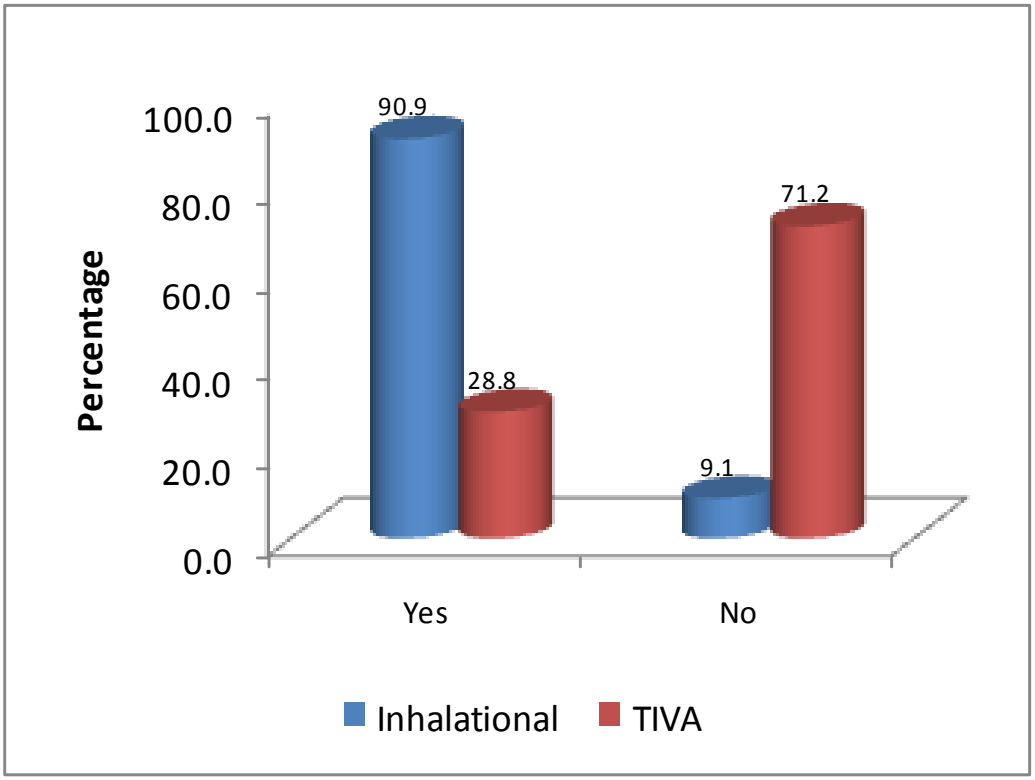

Figure 3. Comparison of need for supplemental NTG infusion

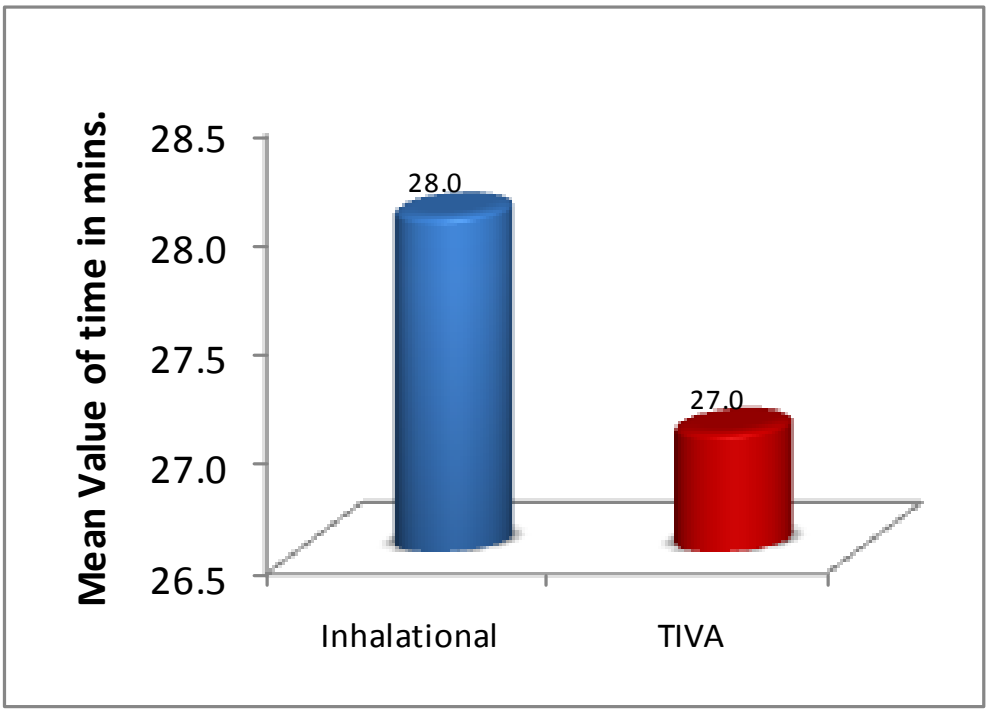

Figure 4 Comparison of time in minutes from induction of anaesthesia for decreasing MAP to 70 mm Hg

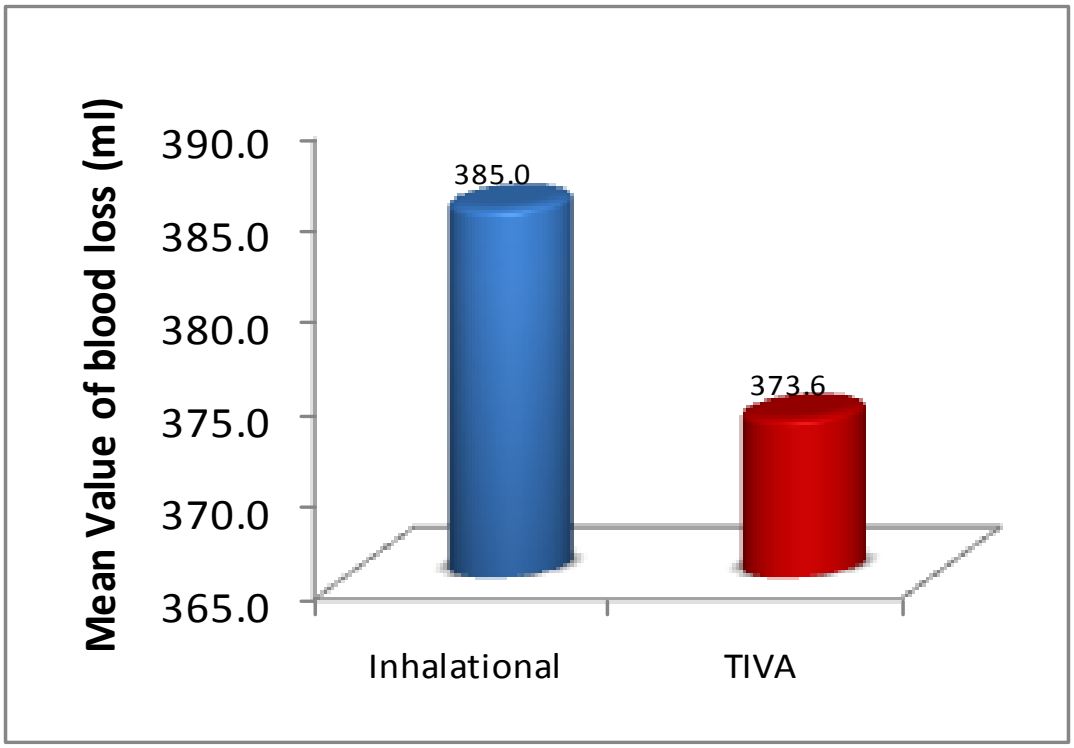

Figure 5. Comparison of blood loss based on group

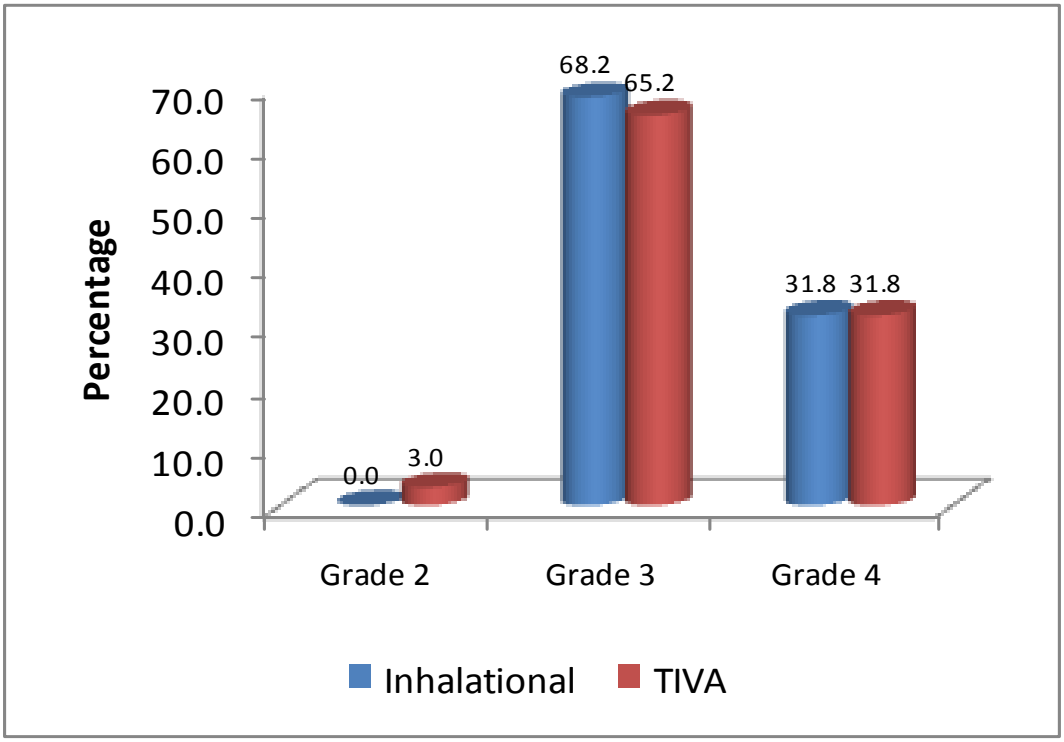

Figure 6. Comparison of F & B Scale

Discussion

Analysis of demographic data showed no significant difference in age, gender and weight distribution between the two groups. (P values were 0.425, 0.465 and 0.983 respectively.) The base line values of MAP and HR were also comparable between the two groups. (p values were 0.325 and 0.281 respectively.)

The trends in MAP and HR were compared during the surgery. The p values for MAP and HR was

estimated for each time interval during the surgery. There was no significant difference in the MAP trends during surgery between the two groups. In both groups MAP showed slight increase towards the end of surgery (after 140 minutes.). This might be due to the following reason: After surgical resection, as haemostasis and closure starts, the BP is gradually brought back to the preoperative state. So both groups showed an increase in MAP trend towards the end of surgery. There was significant difference in MAP between both groups towards the end of surgery, ($p<0.004$) with inhalational group showing increased MAP compared to TIVA group.(after 140 mins) (figure 1). This coincides with the results of the study by Ozkose, Zerrin, et al.[3] where Heart Rate (HR) and Mean Arterial Pressure (MAP) decreased significantly after induction of anaesthesia in the TIVA group, compared to the two other groups (inhalational anaesthesia using Sevoflurane and Isoflurane.) ($P<0.05$ for both comparisons).

In both groups, average Heart Rate (HR) followed the same trend. After initial reduction, heart rate remained almost steady in both groups. But there was significant difference in heart rate between the two groups with inhalational group having higher heart rate during initial maintenance period (50-110 mins.). Increased heart rate in the inhalational group when compared to TIVA group was also noticed by Ozkose, Zerrin, et al [3], Grundmann et.al. [4], Adams, H. A. et al. [5]. Activation of sympathetic nervous system may explain the increase in heart rate during Isoflurane anaesthesia. Higher sympathetic outflow during balanced anaesthesia is confirmed by Ledowski, Thomas, et al. [6]. This effect is, however, more pronounced during transient than during steady state condition. Isoflurane also inhibits vagal activity in a dose dependent manner. Propofol causes bradycardia due to depression of cardiac conduction system. The patients in inhalational group showed a slightly higher heart rate during initial maintenance phase where Isoflurane was used. Heart rate did not show significant difference during the later steady maintenance phase.

The need for supplemental NTG infusion for reducing MAP was significantly more in the inhalational group compared to the TIVA group. This can be due to the hypotensive effect of Propofol used as infusion in the TIVA group. Propofol decreases heart rate and cardiac output whereas Isoflurane increases heart rate and does not significantly alter cardiac output. Lower cardiac output caused by decrease in heart rate with Propofol might be responsible for this. Upton, Richard N., et al.[7] had shown that the arterial concentration of Propofol after IV administration was inversely related to cardiac output. The hypotensive effect of Propofol could have reduced MAP to required level so that NTG infusion was not required. It was noted that better control over MAP was achieved in the TIVA group. This coincides with the studies by Ozkose, Zerrin, et al.[3], Sudheer, P. S. et al[8]. In the study by Sudheer, P. S. et al[8], the cardiac index decreased to a significantly greater extent in the TIVA group (reduced by 25.9% compared to baseline) than in the inhalational group (12.9% decrease) following turning the patient prone ($p < 0.001$).

The mean time to achieve target BP was 28 minutes and 27 minutes in inhalational group and TIVA group respectively. There was no significant difference between the two groups.

The results of our study deviated from the results obtained by Gravel, Normand R., et al [9], where more patients in the inhalational group (8/15) presented bradycardia in the induction period (T:2/15) ($P = 0.05$). The inhalational agent used in this study was Sevoflurane as compared to Isoflurane in our study. This difference could have been the reason for bradycardia.

It is observed from our study that grade 2 bleeding is 3% in TIVA group compared to 0% in the inhalational group. Grade 3 bleeding is 3% higher in the inhalational group (68.2%inhalational vs. 65.2% TIVA) as compared with the TIVA group. This observation correlates with the study done by

Wormald, Peter J., et al.[10] where the surgical score was significantly better in the TIVA group. The intraoperative blood loss observed in our study is slightly more in the inhalational group, though not significant. None of the patients in both group showed significant tachycardia. Absence of tachycardia suggests that both groups had adequate depth of anaesthesia and analgesia due to concomitant use of Fentanyl. There was no significant bradycardia in both groups.

There was no intra operative hemodynamic instability (heart rate or MAP <80% or >120% of baseline value) in both groups.

There were no postoperative complications due to intraoperative hypotension. None of the patients had postoperative nausea and vomiting. This could be due to prophylactic administration of Ondansetron and avoidance of N_2O in both groups.

Conclusions

-Better control over MAP was possible using TIVA than using inhalational anaesthesia in patients with oral cancer undergoing radical reconstructive surgeries. Controlled hypotension was attained in TIVA with significantly lesser use of supplemental NTG.

-Average MAP and HR in both groups followed the same trend for most part of the procedure. Towards the end of surgery, i.e., after 140 minutes. The MAP showed significantly higher value in the inhalational group.

-TIVA is preferred to inhalational anaesthesia by theatre personnel as it does not cause theatre pollution. There is increased pericuff leakage of inhalational anaesthetic agents in oral surgeries as the oral cavity is kept open. Also, the surgeons work on the oral cavity which makes them prone for increased exposure to inhalational agents.

Limitations of the Study

-Target controlled infusion was not provided due to non-availability of TCI pumps. Hence infusion rates could not be adaptively varied.

-Fentanyl infusion had to be stopped half an hour prior to surgery. Remifentanyl, which has a shorter $t_{1/2}$ compared to Fentanyl, would have been a better substitute for the study. This couldn't be used due to non-availability of the drug.

-Depth of anaesthesia was not monitored using BIS due to limited availability of leads and the cost incurred.

Key messages: Better control over mean arterial pressure was possible using TIVA than using inhalational anaesthesia. Controlled hypotension was attained in TIVA with significantly lesser use of supplemental NTG.TIVA is preferred to inhalational anaesthesia by theatre personnel as it does not cause theatre pollution

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References

1. Degoute CS. Controlled hypotension. Drugs. 2007 May 1;67(7):1053-76.
2. Boezaart AP, van der Merwe J, Coetzee A. Comparison of sodium nitroprusside-and esmolol-induced controlled hypotension for functional endoscopic sinus surgery. Canadian Journal of Anesthesia/Journal canadiend' anesthésie. 1995 May 1;42(5): 373-6.
3. Ozkose Z, Ercan B, Ünal Y, Yardim S, Kaymaz M, Dogulu F, Pasaoglu A. Inhalation versus total intravenous anesthesia for lumbar disc herniation: comparison of hemodynamic effects, recovery characteristics, and cost. Journal of neurosurgical anesthesiology. 2001 Oct 1;13(4):296-302.
4. Grundmann U, Uth M, Eichner A, Wilhelm W, Larsen R. Total intravenous anaesthesia with Propofol and Remifentanil in paediatric patients: a

comparison with a Desflurane-nitrous oxide inhalation anaesthesia. Acta anaesthesiologica scandinavica. 1998 Aug 1;42(7):845-50.

5. Adams HA, Schmitz CS, Baltes-Götz B. Endocrine stress reaction, hemodynamics and recovery in total intravenous and inhalation anesthesia. Propofol versus isoflurane. Der Anaesthesist. 1994 Nov;43(11):730-7.
6. Ledowski T, Bein B, Hanss R, Paris A, Fudickar W, Scholz J, Tonner PH. Neuroendocrine stress response and heart rate variability: a comparison of total intravenous versus balanced anesthesia. Anesthesia & Analgesia. 2005 Dec 1; 101(6):1700-5.
7. Upton RN, Ludbrook GL, Grant C, Martinez AM. Cardiac output is a determinant of the initial concentrations of Propofol after short-infusion administer-ation. Anesthesia & Analgesia. 1999 Sep 1; 89(3):545.
8. Sudheer PS, Logan SW, Ateleanu B, Hall JE. Haemodynamic effects of the prone position: a comparison of propofol total intravenous and inhalation anaesthesia. Anaesthesia. 2006 Feb 1; 61(2):138-41.
9. Gravel NR, Searle NR, Taillefer J, Carrier M, Roy M, Gagnon L. Comparison of the hemodynamic effects of sevoflurane anesthesia induction and maintenance vs. TIVA in CABG surgery. Canadian Journal of Anesthesia. 1999 Mar 1; 46(3):240-6.
10. Wormald PJ, Van Renen G, Perks J, Jones JA, Langton-Hewer CD. The effect of the total intravenous anesthesia compared with inhalational anesthesia on the surgical field during endoscopic sinus surgery. American journal of rhinology. 2005 Sep 1; 19(5):514-20.
11. Milne, S. E., G. N. C. Kenny, and S. Schraag. "Propofol sparing effect of remifentanil using closed-loop anaesthesia †." British journal of anaesthesia 90.5 (2003): 623-629.
12. Vasudeva Upadhyaya K.S " TIVA is the anaesthesia of choice for day care surgeries -Pro" RACE 2016 : 191-197.
13. Roberts, F. L., et al. "Induction and maintenance of propofol anaesthesia." Anaesthesia 43.s1 (1988): 14-17.
14. Madhuri S. Kurdi" TIVA is the anaesthesia of choice for day care surgeries -Con" RACE 2016 : 199-202.
15. Kam, P. C. A., and D. Cardone. "Propofol infusion syndrome." Anaesthesia 62.7 (2007): 690-701.
16. Ankichetty, Saravanan P., et al. "Comparison of total intravenous anesthesia using propofol and inhalational anesthesia using isoflurane for controlled hypotension in functional endoscopic sinus surgery." Journal of Anaesthesiology Clinical Pharmacology 27.3 (2011): 328.
17. Tirelli, G., et al. "Total intravenous anaesthesia in endoscopic sinus-nasal surgery." Acta otorhinolaryngologica italica 24 (2004): 137-144.
18. Beule, Achim G., et al. "Propofol versus sevoflurane: bleeding in endoscopic sinus surgery." Otolaryngology--Head and Neck Surgery 136.1 (2007): 45-50.
19. Yoo, Hyung-Seok, et al. "Comparison of surgical condition in endoscopic sinus surgery using remifentanil combined with propofol, sevoflurane, or desflurane." Korean journal of anesthesiology 59.6 (2010): 377-382.
20. Haghbin, Mohammad Ali, Hossein Hakimzadeh, and Mohammad Shabani. "Evaluating the efficacy of remifentanil-propofol versus isoflurane in reducing blood loss with considering depth of anesthesia during endoscopic sinus surgery." (2013).
21. Pavlin, Janet D., et al. "Propofol versus isoflurane for endoscopic sinus surgery."

American journal of otolaryngology 20.2 (1999): 96-101.

22. Ozkose, Zerrin, et al. "Inhalation versus total intravenous anesthesia for lumbar disc herniation: comparison of hemodynamic effects, recovery characteristics, and cost." Journal of neurosurgical anesthesiology 13.4 (2001): 296-302.
23. Sudheer, P. S., et al. "Haemodynamic effects of the prone position: a comparison of propofol total intravenous and inhalation anaesthesia."Anaesthesia 61.2 (2006): 138-141.
24. Grundmann, U., et al. "Total intravenous anaesthesia with propofol and remifentanil in paediatric patients: a comparison with a desflurane-nitrous oxide inhalation anaesthesia." Acta anaesthesiologica scandinavica 42.7 (1998): 845-850.
25. Gravel, Normand R., et al. "Comparison of the hemodynamic effects of sevoflurane anesthesia induction and maintenancevs TIVA in CABG surgery." Canadian Journal of Anesthesia 46.3 (1999): 240-246.
26. Adams, H. A., C. S. Schmitz, and B. Baltes-Götz. "[Endocrine stress reaction, hemodynamics and recovery in total intravenous and inhalation anesthesia. Propofol versus isoflurane]." Der Anaesthesist 43.11 (1994): 730-737.