CHAPTER VI
DISCUSSION
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The present work was conducted to study induction characteristics of sevoflurane alone, and in combination with nitrous oxide and compared it with propofol induction in adults undergoing elective surgery in the Department of Anaesthesiology, Pt. B.D. Sharma PGIMS, Rohtak. A total of one hundred and fifty patients of age between 20-40 years were taken and divided into three groups of fifty each. In group I, patients were induced with sevoflurane 8% in oxygen in group II, patients were induced with sevoflurane (8%) with 63% N₂O in O₂ and in group III, induction was carried out with propofol.

DEMOGRAPHIC PROFILE

Mean age in all the three groups was comparable when analysed statistically (p >0.05). In this study, patients in group I and II were induced with vital capacity breath technique and for this technique patient cooperation is absolute necessity. For this reason young age group patients where more patient cooperation is expected were included in this study. Likewise no statistical difference was found as regards to weight of the patients in all the three groups.
Male predominance was seen in all the three groups, which can be attributed to the type of surgical procedures (hydrocele, varicocele, hernia) as shown in Table IV. However the male female ratio among the three groups was comparable.

**Anaesthesia technique**

No premedication was used as performance of the vital capacity breath could be altered by its use and dose requirement of propofol can also be affected by its use.

Gaseous induction in adults has largely fallen into disuse. This is because, intravenous induction has proved rapid and reliable though not necessarily ideal. All intravenous anaesthetic agents have drawbacks which are related to the particular agent used; though common to all is danger of loss of control of airway. Volatile agents available till how, except halothane, are not suitable for gaseous induction as they are irritant to the airways. Halothane has high blood gas solubility therefore there is delayed induction of anaesthesia which may frustrate the anaesthesiologist. Sevoflurane is suitable for inhalational induction because of its low blood gas solubility (0.69) and its non irritant effect on airways even in high concentration.

Single breath induction or vital capacity rapid inhalational induction (VCRII) was demonstrated by Ruffle et al in 200 patients, who were instructed to take a vital capacity breath of 4% halothane in O$_2$ and to hold it in lungs for
30-90 seconds until loss of consciousness. The VCRII technique was found to have certain advantages over conventional inhalational and intravenous induction of anaesthesia, like prompt induction without a prolonged excitatory phase and smooth recovery. Yurino and Kimura used this technique with sevoflurane for induction of anaesthesia with 7.5% sevoflurane in N$_2$O and oxygen. A single breath technique was made akin to that of intravenous bolus injection and they demonstrated that it is associated with fewer adverse airway events.

In this study in group I and group II, the circuit was primed with the desired anaesthetic gas mixture (i.e. 8% sevoflurane in oxygen in group I and 8% sevoflurane in 63% nitrous oxide and oxygen in group II) by allowing it to run through bain's circuit with reservoir bag collapsed for thirty seconds. Since our institution does not have anaesthetic gas analyser, vaporiser setting was taken as a guide of delivered concentration. To make sure that desired concentration of sevoflurane is delivered to the patient, priming of circuit was carried out using 8 litre min$^{-1}$ of anaesthetic gas mixture for 30 seconds with reservoir bag collapsed.

In group III, propofol (1% solution) mixed with 2ml of 1% lignocaine was given at the rate of 0.5 ml/sec, till various endpoints of induction were achieved. Injection lignocaine 2ml of 1% solution (preservative free) was given in group I and II also just before induction to make the study comparable. Loss of eyelash
reflex, dropping of 20ml weighted syringe and jaw relaxation were taken as induction end points. Since loss of eyelash reflex is the most commonly used end point, and dropping of 20 ml syringe is considered most sensitive and jaw relaxation is required for LMA insertion, so we included all the three events as end points of induction in this study.

**INDUCTION CHARACTERISTICS**

**Time of dropping of weighted syringe:**

In our study mean time of dropping of weighted syringe was significantly less in propofol group (29.38±2.68 seconds) as compared to sevoflurane groups. Among sevoflurane groups time taken to achieve this end point was more in patients induced with sevoflurane in oxygen (58.30±10.88 seconds) as compared to patients induced with sevoflurane in nitrous oxide and oxygen (54.88±10.68 seconds), though not significant (Group I > Group II Group III).

A similar study conducted by Thwaites et al compared induction characteristics of sevoflurane with propofol in 102 patients in two groups of 51 each and considered dropping of weighted syringe as end point. They also found that induction with propofol is rapid than with sevoflurane which is similar to our observations. But in their study they observed that the time to achieve dropping of weighted syringe was more than that observed in our study (57±11 vs 29.38±2.68 seconds). It may be because of slower rate of injection of 1% propofol used by them (16-18 ml min⁻¹). Time to achieve this end point in patients
induced with sevoflurane and nitrous oxide in O₂ was more in their study than that observed in our study (84±24 vs 54.88±10.68 seconds). It may be because they used tidal breath technique for induction whereas we used vital capacity breath technique which is known to enhance induction.

Our results are in contrast to those observed by Dashfield et al. In their study, they observed that time of dropping of weighted syringe was significantly longer in propofol group (92 sec) than in sevoflurane group (75 sec). It may be because they used slower rate of propofol injection (20 ml min⁻¹). Further in their study, time to achieve this end point in sevoflurane group was longer than observed in our study (75 sec vs 54.48 sec). These conflicting results may be due to our patient population being younger (average age 28 years vs 40 years) and moreover we did not administer injection fentanyl. Both the above factors are known to affect performance of vital capacity breath.

Again in their study the time to achieve this end point in propofol group was significantly longer than observed in our study (29.50 sec). This may be explained on the basis that we used different rate of propofol injection (0.5 ml/sec vs 20 ml min⁻¹).

**Loss of eyelash reflex**

In our study, the time to achieve loss of eyelash reflex was longest in patients induced with 8% sevoflurane in oxygen (group I) followed by those induced by combination of sevoflurane in N₂O and O₂ (group II) and was least
in patients induced with propofol (group III) (Group I > Group II > Group III).

In a study by Hall et al time to achieve loss of eyelash reflex in patients induced with 8% sevoflurane in O₂ was 71±37 seconds and in patients induced with 8% sevoflurane in N₂O and O₂ was 61±24 seconds which is comparable to the results of our study. Although they also observed that time to abolish eyelash reflex was least in the propofol group than in sevoflurane groups, but this time in their study was much more as compared to ours (60±25 vs 32.48±2.48 seconds). This may be attributed to the different method adopted for propofol administration. In this study by Hall et al patients were given a precalculated dose of propofol 3 mg kg⁻¹ over 30 seconds followed by 20 mg incremental doses till cessation of finger tapping (synonymous with dropping of weighted syringe in our study) was achieved. Administering incremental doses, assessing the effect and followed by another incremental dose if need be must have consumed more time than that of our methodology where 5 mg/sec propofol was continued to be administered till the end point was achieved. After this propofol infusion at rate of 12 mg kg⁻¹ hr⁻¹, which is much slower as compared to our study, was started. Authors however do not clarify whether the infusion was started just after cessation of finger tapping or after the loss of eye lash reflex which takes more time.

Our results are also similar to study by Smith et al in respect that they also observed the shorter time for loss of eyelash reflex in propofol group in
comparison to sevoflurane 5% with N₂O 60% in oxygen group which was 60 seconds (range 30-85). This time was more than what has been observed in our study which is probably because of lower fixed dose (2 mg kg⁻¹) used by them followed by inhalational anaesthetics. Probably because of this reason the variation in induction time was also observed to be large in their propofol group.

Further time to achieve loss of eyelash reflex with sevoflurane 8% in oxygen and combination of sevoflurane and N₂O in oxygen was less in our study as compared to study by Smith et al. This is because the patients in their study were induced with 5% sevoflurane in N₂O and O₂. Moreover in our study patients were induced using single vital capacity breath whereas in their study they employed tidal breath technique.

Our results are in contrary to study by Sivalingam et al. They observed longer time to achieve loss of eyelash reflex with propofol (46.4 seconds) than with sevoflurane in N₂O and O₂ (34.6 seconds). It maybe explained on the basis that they administered propofol 2.5 mg kg⁻¹ over 45 seconds followed by incremental doses of propofol if required and patients induced with sevoflurane and N₂O in O₂ were instructed to take extra vital capacity breath if required, thus probably further shortening the induction time.
Our results are in contrast to study by Dashfield et al.\textsuperscript{52} They observed longer time to achieve loss of eyelash reflex in propofol group (92 sec) than in sevoflurane group (54 sec). It may be explained on the basis that they used different rate of propofol injection (20 ml min\textsuperscript{-1}).

Further they achieved loss of eyelash reflex earlier in sevoflurane group as compared to ours (54±18 vs 66.16±11.45 sec) and later in propofol group as compared to ours (92±30 vs 32.48±2.48 sec). These conflicting results may be explained by the fact that eyelash reflex is not known to be definite end point. Moreover in propofol group, they used different rate of injection (20 ml min\textsuperscript{-1}).

Our results are in contrary to study by Molloy et al.\textsuperscript{54} They observed longer time to achieve loss of eyelash reflex with propofol (44 sec) than with sevoflurane in N\textsubscript{2}O and O\textsubscript{2} (25 sec). It may be explained on the basis that they administered propofol at a different rate (2.5 mg kg\textsuperscript{-1} over 30 seconds) followed by incremental doses if required and in sevoflurane group, patients were encouraged to take vital capacity breaths and allowed to continue doing so as compared to regular breathing followed by vital capacity breath in our study.

**Time of jaw relaxation**

The mean time of jaw relaxation was least in propofol group; it was higher in sevoflurane + N\textsubscript{2}O in comparison to propofol group but was maximum in patients induced with sevoflurane and oxygen (Group I > Group II Group III).
The observations in our study are similar to study by Hall et al. But time to achieve this end point was shorter in propofol group (35.44±2.70 seconds) in our study than observed by Hall et al (109±25 seconds).\textsuperscript{49} It may again be because the rate of propofol administration was slower (12 mg kg\textsuperscript{-1} hr\textsuperscript{-1}) following initial dose of 3 mg kg\textsuperscript{-1} over 30 seconds. Moreover number of patients in their study was also small.

**Breath holding**

Number of patients who had episodes of breath holding was 8 in sevoflurane in O\textsubscript{2} group, 15 in sevoflurane in N\textsubscript{2}O and O\textsubscript{2} group and 24 in propofol group.

The more incidence of breath holding in propofol group as observed in our study is supported by Thwaites et al who observed that 65\% of patients in propofol group had episodes of breath holding.\textsuperscript{50}

Breath holding episode were also observed in study by Hall et al and were significantly more when induction was achieved with sevoflurane (3 out of 25) or combination of sevoflurane with N\textsubscript{2}O (3 out of 25) as compared to induction with propofol (1 out of 25).\textsuperscript{49} But in another study by Smith et al, no episode of breathholding was observed in patients induced with sevoflurane whereas only one patient had apnoea in propofol group.\textsuperscript{46} Since the patients population in above studies was smaller than our study, to know the true incidence larger sample are required to be studied.
Movements

In our study, number of patients in whom movement was observed on LMA insertion was less in patients induced with combination of sevoflurane and N₂O in oxygen (2 out of 50) than patients induced with propofol (15 out of 50) or with 8% sevoflurane in oxygen (10 out of 50).

Our results are similar to study by Hall et al. In their study, 7 patients out of 25 showed movements on LMA insertion in propofol group.⁴⁹ While only 4 patients out of 25 induced with 8% sevoflurane in O₂ and only 3 patients out of 25 induced with 8% sevoflurane in N₂O and O₂ showed movements.

In study by Sivalingam et al, 18 patients out of 25 showed movements on LMA insertion in propofol group which is higher in comparison to our study.⁵³ This may be because they have induced patients using precalculated dose of 2.5 mg kg⁻¹ over 45 seconds. Ten patients out of 25 showed movements on insertion of LMA in sevoflurane in N₂O and O₂.

In another study by Molloy et al they observed equal incidence of movements in both sevoflurane (28 out of 44) and propofol (30 out of 44) group of patients during insertion of LMA in comparison to 2 out of 50 patients in sevoflurane group and 15 out of 50 patients in propofol group in our study.⁵⁴ These conflicting results may be explained on the basis that they may have attempted LMA insertion earlier in sevoflurane group i.e. 1 minute after loss of eyelash reflex (85 sec) whereas in propofol group, they administered lower dose
Other complications

No patient in our study had cough, laryngospasm, bronchospasm or excessive salivation during induction and during insertion of LMA. Other studies by Smith et al, Thwaites, and Yurino and Kimura observed no incidence of above complications during induction. In a study by Hall et al, incidence of cough was more when the patients were induced with propofol than with sevoflurane.46,50,45 In another study by Sivalingam laryngospasm was observed during insertion when the patients were induced with propofol or with sevoflurane. However, the incidence was low and severity of laryngospasm was mild.53 In a separate study by Molloy et al, eleven patients out of 44 in propofol group and ten patients out of 44 experienced coughing and laryngospasm during insertion of LMA.54 In our study above complications were not observed because of stringent exclusion criteria in choosing our patient population.

Physiological parameters

**Pulse:** In this study, we observed an increase in pulse rate in all the patients after induction which further increased after insertion of LMA. After that it decreased and dropped to baseline in sevoflurane groups but never dropped to baseline in propofol group.

Our results are similar to those observed by Hall et al who observed an increase in pulse rate in all the groups.49 However, they observed a smaller
increase in propofol group whereas in our study it was equal rise in all groups. In their study they observed that it did not drop to baseline, probably because they observed this for three minutes only.

Our results are contrary to Smith et al who did not observe much difference in HR after propofol. This may be because of the lower dose of propofol used by them.

Our results are similar to those observed by Sivalingam et al. They found that there was increase in pulse rate in both sevoflurane and propofol group that nearly dropped to baseline in both the groups.

**Blood pressure**

In our study we observed a fall in systolic as well as diastolic blood pressure in all the groups after induction which transiently increased after LMA insertion. Thereafter again it decreased till five minutes after LMA insertion. Fall in diastolic pressure was more in sevoflurane group as compared to propofol.

Our results are similar to the study by Sivalingam et al as they observed fall in blood pressure in both the groups. Our results are also comparable to those observed in a study by Hall et al.49

Our results are also similar to study by Smith et al who observed fall in blood pressure in all the groups. They also observed transient increase in blood pressure after intubation which decreased to pre intubation level within 2 minutes.
Changes in oxygen saturation

In our study, oxygen saturation in sevoflurane in O\textsubscript{2} group and sevoflurane in N\textsubscript{2}O in oxygen group increased after induction, but it decreased in propofol group after induction although not clinically significant. There were no incidence of fall in oxygen saturation below 96% in any group.

In all the groups, the oxygen saturation increased after insertion of LMA, it increased to 100% at 5 minutes in all the groups.

Our results are similar to those observed by Thwaites et al and those by Sivalingam et al\textsuperscript{50,53} They observed that oxygen saturation never dropped below 96% in separate studies.

Our results are also in accord with those observed by Hall et al. None of their patient had fall in oxygen saturation below 96%.\textsuperscript{49} However the difference in their and our study was that our patients were inhaling room air even then our patient did not have episodes of desaturation.

Our results are also similar to those observed by Yurino and Kimura.\textsuperscript{44} They also observed that oxygen saturation increased slightly after the application of anaesthetic mask.

Patient satisfaction

The patients in sevoflurane group found the smell of sevoflurane pleasant except the two in sevoflurane in oxygen group who found the smell unpleasant.
Patients in all the groups were willing to undergo the same procedure again except the same two patients in sevoflurane in O₂ group who did not like the induction procedure.

Our results are comparable to those of Yurino and Kimura, who observed that patient experience was pleasant in every patient and all of them would accept the inhalational technique again.⁴³

Our results are contrary to those observed by Thwaites et al. In this study 7 patients out of 51 described induction by sevoflurane as unpleasant and significantly more patients (24%) were unwilling to receive the sevoflurane induction again.⁵⁰ This may be attributed to tidal breath technique of induction whereas in our study we employed vital capacity breath for induction.