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ORIGINAL ARTICLE

Comparison of hemodynamic stability and recovery profile with sevoflurane as inhalational agent versus propofol as total intravenous anesthesia during laparoscopic surgeries

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ABSTRACT

Background and Aim: Propofol and sevoflurane, both meet the criteria of rapid smooth induction, hemodynamic stability, rapid recovery with minimal side effects. The present study investigated the hemodynamic stability and recovery profile while maintaining anesthesia with sevoflurane as inhalational agent versus propofol as total intravenous anesthesia during laparoscopic surgeries.

Methodology: This was a prospective study conducted for one year at our hospital. Using convenient sampling technique, a total of 50 adult patients of American Society of Anesthesiologists (ASA) physical status I or II, aged between 18-60 years, of either sex, who were scheduled for elective day care surgeries of less than 2-hour duration under general anesthesia were selected for the study after informed consent. All the patients were randomly allocated into one of the two groups using computer generated random number table. Group-S received induction with propofol and maintenance with sevoflurane, while Group-P was induced and maintained with propofol only. Hemodynamic and recovery profiles were then compared.

The differences between two groups were analyzed using unpaired t-test while categorical variables were analyzed using chi-square test. All the statistical tests were performed in Epi Info 3.5.1 software by CDC, USA.[6] $p < 0.05$was considered as statistically significant while $p < 0.01$ was considered as statistically highly significant.

Results: The baseline demographic analysis showed that the two groups did not differ significantly in age, weight, sex, ASA grade and operative times. During the course of surgery, heart rate was significantly low in Group-P at 45 to 60 min than in Group-S. Systolic and diastolic blood pressures were significantly low during maintenance of anesthesia with propofol as compared to sevoflurane. Group-S showed significantly shorter time for spontaneous eye opening and recalling names and recognizing surroundings. Post-operative nausea and vomiting was significantly low in Group-P.

Conclusion: The present study concludes that patients in both groups were hemodynamically stable. Sevoflurane has the added advantage of providing rapid emergence and recovery of cognitive function. Hence it can be considered as a useful alternative to propofol for maintenance of anesthesia.

Key words: Anesthesia; Day care surgery; Laparoscopic surgery; Propofol; Sevoflurane

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INTRODUCTION

Daycare surgery is a planned surgery wherein the patients, requiring early recovery and discharge, are admitted for short stay for surgery on a non-resident basis.[1] It is one of the most common surgical procedures performed worldwide and widely used now a days for laparoscopic appendectomy, lap cholecystectomy, laphernioplasty, other urology surgeries and gynecological surgeries like diagnostic laparoscopy for infertility, hysteroscopy, embryo transfer etc. Current practices for establishing an anesthetic state consists of initial administration of an intravenous sedative-hypnotic as an induction agent followed by inhalational agents for maintenance of anesthesia. However, one common problem encountered during such practice is the phase of transition from the induction to maintenance. This has promoted the rediscovery of single agent anesthesia, which avoids problems associated with transition phase.

An ideal day-care anesthetic agent should have rapid smooth induction and provide rapid recovery with minimal intra-operative and post-operative side effects.[2] These are the characteristics desirable for early hospital discharge. It is nearly improbable that a single anesthetic agent completely satisfies all these requirements, how ever pharmacological developments over the past decades have brought us considerably closer.

By virtue of its kinetic properties, propofol has become the preferred intravenous (IV) anesthetic agent for day-care surgeries.[3] Propofol allows for rapid induction of anesthesia, adequate maintenance and rapid recovery with minimal post-operative nausea vomiting (PONV). Sevoflurane, a newer volatile halogenated inhalational anesthetic agent with relatively low blood solubility also provides both rapid induction and recovery time.[4] The non-pungent odor of the drug makes it agreeable for most patients especially during an inhalational induction of anesthesia. Sevoflurane has been successfully used as an alternative to propofol in various daycare procedures.[5]

As the recovery characteristics of propofol are comparable with many newer inhalational agents, we conducted a study to determine if sevoflurane offered advantages in terms of hemodynamic stability, recovery profile and emergence times as compared to conventional intravenous propofol induced anesthesia.

METHODOLOGY

Study setting and duration:

This study was conducted in department of Anesthesiology within the premises of Sterling Hospital, Ahmedabad from January 2011 till December 2011.

Study design and study population:

This was a prospective study designed to compare the hemodynamic and recovery profile of patients administered with propofol versus sevoflurane for general anesthesia. Appropriate ethical clearance was obtained from Hospital Ethics Committee. Each patient was included in the study only after informed consent.

Using convenient sampling technique, a total of 50 adult patients of American Society of Anesthesiologists (ASA) physical status I or II, aged between 18-60 y, of either sex, who were scheduled for elective daycare laparoscopic surgeries of less than 2-h duration under general anesthesia were selected for the study after informed consent. Patients, who provided consent to be included in the study or patients with corelated cardiovascular, pulmonary, renal disease or history of hypersensitivity to halogenated anesthetic agents, were excluded from the study. All the patients were randomly allocated into one of the two groups using computer generated random number table. Hence each group contained a total of 25 patients.

Anesthesia technique:

Pre-anesthetic checkup was performed the day before and on the day of surgery. Basic routine investigations like hemoglobin, renal function tests, serum electrolytes, random blood sugar, electrocardiogram (ECG) and chest x-ray PA view were done and recorded. In the operating room, all standard monitors like non-invasive blood pressure (NIBP), pulse-oximetry (SpO_2), electrocardiogram (ECG) and capnography ($EtCO_2$) were attached and vital parameters of the patient recorded. All the patients in both groups were pre-medicated with glycopyrrolate 4 μg/kg iv, fentanyl 1 μg/kg and lidocaine 1.5 mg/kg iv. In both groups, after pre-oxygenation with 100% O_2 for three minutes, anesthesia was induced using propofol 2 mg/kg iv. This was followed by endotracheal intubation facilitated using succinylcholine 2 mg/kg iv. Intubation was confirmed with $EtCO_2$ and inj vecuronium 0.05 mg/kg iv was given after return of respiration. In both groups patients were put on circle absorber system (ventilator) with IPPV mode with

tidal volume 7 ml/kg, respiratory rate 16/min with PEEP 5 cmH_2O. In Both groups intra operative non-opioid analgesia was given in the form of diclofenac and inj paracetamol to all the patients.

In Group-S, anesthesia was maintained using sevoflurane (1-2%), nitrous oxide (50%) and oxygen (50%) with intermittent injection of vecuronium. In Group-P, anesthesia was maintained with propofol (100-120 μg/kg/min), nitrous oxide (50%) and oxygen (50%) with injection of vecuronium intermittently.

At the end of the surgery, in both groups sevoflurane and propofol were discontinued, especially when deflation of pneumoperitoneum and closure started and onset of spontaneous respiration. Neuromuscular blockade was reversed with neostigmine 50 μg/kg and inj glycopyrrolate 8 μg/kg iv. Extubation of trachea was done when patients were adequately recovered from the effects of neuromuscular blockade with regular breathing pattern and were able to respond to verbal commands. Time of extubation and the times at which patients were able to state their name were recorded.

Measurement tools:

The heart rate, non-invasive blood pressure, oxygen saturation (SpO_2) and end tidal CO_2 ($EtCO_2$) were recorded pre-operatively, every minute from induction and intubation for 5 min, at 15 min intervals during surgery and after extubation at 5, 10, 15 and 30 min. Emergence was assessed at 15 sec intervals after discontinuation of the volatile anesthetic. Times since discontinuation of anesthetic agent were recorded. The time at which the patients opened their eyes and responded to verbal command were recorded. Anesthesia time and operative time were also recorded. Postoperative follow up for complications like nausea, vomiting and general discomfort was done for 24 h.

Data analysis:

Qualitative data were expressed as percentages and proportions. Quantitative data were expressed as mean and standard deviation. The differences between two groups with respect to continuous variables were analyzed using unpaired t-test while categorical variables were analyzed using chi-square test. All the statistical tests were performed in Epi Info 3.5.1 software by CDC, USA.[6] $p < 0.05$ was considered as statistically significant while $p < 0.01$ was considered as statistically highly significant.

RESULTS

A total of 50 patients aged 18-60 years belonging to ASA grade I-II were included in the study in two equal random groups. The baseline demographic analysis showed that the two groups did not differ significantly in age, weight and sex. Both the groups were comparable with respect to ASA grade and operative time (the difference was non-significant) (Table 1).

Table 1: Baseline characteristics of the patients

Characteristic		Group-S N=25	Group-P N=25	p	Inference*
Age (Mean ± SD) (y)		41.1 ± 12.2	38.1 ± 12.7	0.39	NS
Weight (Mean ± SD) (kg)		52.9 ± 13.9	58.4 ± 14.1	0.55	NS
Sex	Male	9	12	0.38	NS
	Female	16	13		
ASA grade	Grade I	10	10	1.0	NS
	Grade II	20	20		
Operative time (min)		72.0 ± 15.4	75.6 ± 16.0	0.49	NS

**NS = non-significant*

Table 2: Comparative heart rates (Mean ± SD) at various intervals

Time (in min)	Group-S N=25	Group-P N=25	P value	Inference*
Pre-op baseline	73.2 ± 2.9	75.2 ± 3.5	0.07	NS
Intubation	78.6 ± 4.8	80.5 ± 4.1	0.13	NS
Post-intubation 5 m	76.1 ± 1.3	75.3 ± 4.0	0.11	NS
Insufflation 10 m	83.8 ± 4.9	81.9 ± 2.5	0.09	NS
15 m	73.4 ± 3.9	72.3 ± 3.7	0.12	NS
30 m	69.4 ± 2.5	69.5 ± 3.4	0.18	NS
45 m	72.0 ± 3.5	67.0 ± 3.3	0.02	S
60 m	72.2 ± 5.4	65.8 ± 3.8	0.01	S
75 m	69.7 ± 4.3	67.0 ± 3.7	0.15	NS
90 m	68.8 ± 3.8	67.1 ± 2.7	0.11	NS
105 m	67.8 ± 3.5	68.0 ± 2.4	0.21	NS
120 m/END	71.6 ± 3.2	68.7 ± 3.5	0.20	NS
Post-op 5 m	89.6 ± 7.9	82.8 ± 5.4	0.01	S
Post-op 10 m	87.2 ± 6.3	83.4 ± 5.0	0.01	S
Post-op 15 m	86.0 ± 5.3	82.8 ± 5.4	0.02	S
Post-op 30 m	84.24 ± 5.79	80.72 ± 5.47	0.16	NS

**S = significant, NS = non-significant*

Table 3: Mean systolic and diastolic non-invasive blood pressure (mmHg) at various intervals

Time (in min)	Systolic blood pressure		p value	Diastolic blood pressure		p value
	Group-S N=25	Group-P N=25		Group-S N=25	Group-P N=25	
Pre-op baseline	125.6 ± 8.4	123.2 ± 8.5	0.11	72.0 ± 5.4	71.3 ± 7.0	0.12
Intubation	137.6 ± 12.1	146.3 ± 15.4	0.06	78.2 ± 7.2	77.0 ± 8.1	0.22
Post-intubation 5 m	107.8 ± 7.7	106.4 ± 13.6	0.12	68.9 ± 5.2	60.4 ± 4.9	0.06
Insufflation 10 m	142.3 ± 8.0	138.1 ± 8.0	0.06	80.3 ± 5.1	73.6 ± 6.5	0.01
15 m	134.6 ± 5.8	126.8 ± 7.7	0.01	78.9 ± 4.6	71.0 ± 4.6	0.01
30 m	135.0 ± 14.0	121.1 ± 6.9	0.02	78.3 ± 4.2	71.6 ± 3.9	0.02
45 m	133.4 ± 14.1	113.4 ± 9.3	0.01	76.8 ± 4.4	68.5 ± 4.4	0.00
60 m	130.0 ± 5.4	109.3 ± 7.2	0.03	75.3 ± 4.3	67.5 ± 4.4	0.01
75 m	130.5 ± 4.9	116.2 ± 8.9	0.01	78.5 ± 4.9	64.8 ± 3.6	0.00
90 m	132.0 ± 3.5	115.0 ± 6.8	0.01	78.3 ± 2.6	65.6 ± 4.2	0.00
105 m	133.6 ± 4.3	113.0 ± 6.7	0.00	78.4 ± 4.7	65.3 ± 1.6	0.01
120 m/END	131.0 ± 4.2	116.0 ± 5.3	0.01	85.0 ± 1.4	64.0 ± 4.0	0.00
Post-op 5 m	143.4 ± 6.5	150.2 ± 6.6	0.23	87.0 ± 5.0	87.2 ± 5.9	1.10
Post-op 10 m	134.3 ± 4.3	134.0 ± 6.3	1.01	81.1 ± 5.8	78.2 ± 6.9	0.11
Post-op 15 m	130.5 ± 3.9	129.8 ± 6.8	0.25	78.8 ± 4.8	77.7 ± 4.6	0.19
Post-op 30 m	127.1 ± 4.3	121.9 ± 13.3	0.06	77.2 ± 4.2	78.3 ± 5.9	0.16

There was no significant difference in heart rates between the two groups during intra-operative intervals, except at 45 and 60 min. Post-operatively, the heart rate was significantly higher in Group-S at 5, 10 and 15 min intervals (Table 2).

The systolic blood pressure was significantly low in Group-P from 15 min after insufflation till the end of surgery. Similarly, the diastolic blood pressure was significantly low in Group-P from 10 min of insufflation till the end of surgery.

There was no significant difference in systolic and diastolic blood pressure between the two groups during induction as well as post-operatively (Table 3).

The end tidal CO_2 levels between the two groups did not differ significantly during induction and intubation. However, it was significantly higher in Group-S from 10 min of insufflation till 60 min (Table 4).

Propofol group showed significant delay in spontaneous eye opening compared to sevoflurane group. Propofol also showed significant delay in recalling name and recognizing surroundings compared to sevoflurane group (Table 5). But the time to seat upright and walk without support, showed no significant difference in both groups. Post-operative nausea and vomiting was significantly low in Group P, while no significant difference was found in visual analog scale of pain between the two groups (Table 5).

DISCUSSION

Laparoscopic procedures are rapidly increasing in daycare procedures because of reduced hospital stay and health cost.[7] Rapid emergence and post-operative recovery as well as hemodynamic stability are important requisites of modern day anesthesia.[8] Generally both propofol and sevoflurane meet these criteria. Propofol is the preferred intravenous agent in day care surgeries as it has smooth induction and rapid recovery with some antiemetic properties.[9] Sevoflurane is nowadays widely used in anesthesia because of its relative lack of airway irritation and myocardial depressant effect.[10] Sevoflurane has a low blood gas partition coefficient of 0.69 which contributes to rapid induction and emergence than other volatile agents.[11]

The present study investigated the hemodynamic and recovery profile of propofol versus sevoflurane in day care surgeries. In our study, the mean age was 41.1 years and mean weight 52.9 kg. In a similar study conducted by Sahu DK et al.[1] the mean age was 40.9 years and mean weight 57.1 kg. Shah A et al.[12] reported in their study that mean age of the ASA grade I-II patients was 35.5 years while mean weight was 52.8 kg.

The mean age and weight in a study conducted by Singh SK et al.[3] was 38.7 years and 56.6 kg respectively. Thus there was no wide variation in mean age and weight across different studies.

Reduction in pulse rate was noticed in both the groups post induction as patients were induced with propofol. During the course of surgery, heart rate

Table 4: Mean end tidal CO_2 ($EtCO_2$) (mmHg) levels at various intervals

Time (in min)	Group-S N=25	Group-P N=25	p value	Inference*
Intubation	32.7 ± 1.3	33.3 ± 1.8	0.18	NS
Post-intubation 5 m	28.9 ± 1.0	30.3 ± 1.4	0.27	NS
Insufflation 10 m	37.7 ± 1.7	33.4 ± 2.0	0.01	S
15 m	35.4 ± 1.6	32.9 ± 1.5	0.03	S
30 m	34.2 ± 1.6	32.1 ± 1.5	0.02	S
45 m	34.8 ± 2.0	32.0 ± 1.7	0.01	S
60 m	33.6 ± 1.6	30.5 ± 1.5	0.01	S
75 m	31.4 ± 1.1	30.8 ± 2.9	0.22	NS
90 m	31.0 ± 1.2	30.2 ± 2.8	0.13	NS
105 m	30.8 ± 1.0	30.0 ± 3.3	0.06	NS
120 m/ END	30.0 ± 1.4	28.5 ± 4.9	0.02	S

**S = significant, NS = non=significant*

Table 5: Recovery characteristics and post-operative complication in both groups. Data expressed as Mean ± SD

Profile	Group-S N=25	Group-P N=25	*p*	Inference*
Recovery profile (emergence)				
Open eyes (min)	3.4± 1.2	8.0± 0.7	0.00	S
Orientation (min)	5.8 ± 1.5	11.4 ± 0.1	0.00	S
Seat (h)	3.6 ± 1.1	3.4 ± 0.7	0.15	NS
Walk (h)	6.4 ± 1.4	6.7 ± 0.8	0.09	NS
Complications				
PONV (0-4 hours) (N)	20	11	0.00	S
PONV (4-48 hours) (N)	16	0	0.00	S
Pain VAS	4.5± 0.6	4.8± 0.6	0.11	NS

**S = significant, NS = non-significant*

was significantly low in Group-P at 45 to 60 min than in Group-S. This could be due to maintenance of anesthesia in Group-P with propofol. Juckenhöfel S et al.[13]and Yao XH[14]et al. observed a significant decrease in mean heart rate during maintenance of anesthesia with propofol but not with sevoflurane.

In the present study, systolic and diastolic blood pressures were significantly low during maintenance of anesthesia with propofol as compared to sevoflurane. Similar findings were reported by several studies conducted by Orhon ZN et al.[15], Joo HS et al.[16], and Shah A et al.[12], where blood pressure significantly decreased intra-operatively with propofol, although patients remained hemodynamically stable. Samantaray A et al.[17]observed that the intraoperative hemodynamic parameters like heart rate and blood pressure were within acceptable range in both the groups during his study on spine surgery. Frink et al.[18] found that compared to baseline values, sevoflurane anesthesia decreased systolic and diastolic arterial blood pressures 3-5 min before surgical incision.

The patients in our study belonging to sevoflurane group showed significantly shorter time for spontaneous eye opening and recalling names and recognizing surroundings, as compared to propofol group. Similar findings were reported by Wandel C et al.[19] Our findings also concurred with studies done by Yao XH et al.[14] and Singh SK[3] which reported emergence and recovery were significantly faster in sevoflurane group than propofol group. Contrary to our findings, Gupta et al.[20] reported no significant difference in eye opening time between the sevoflurane and propofol group whereas Larsen et al.[21] reported better recovery characteristics in propofol group.

Post-operative nausea/vomiting still affects the time to discharge of patients after anesthesia. Out study reported significantly low PONV in propofol group. This could be due the intrinsic anti-emetic properties of propofol. Many studies[22-26] reported similar findings.

CONCLUSION

The present study concludes that patients in both group were hemodynamically stable, though there were slight variations in heart rate, blood pressure and EtCO2 in both groups. Sevoflurane has the added advantage of providing rapid emergence and recovery of cognitive function. Hence it can be considered as a useful alternative to propofol for maintenance of anesthesia. However, it is advisable to administer anti-emetic prophylaxis when sevoflurane is to be used to maintain anesthesia.

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Authors'contribution:
JS: Concept, study design, manuscript writing
NV: Data collection and analysis, study conduction

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