IBOM MEDICAL JOURNAL
Vol.19 No.2 | April - June 2026 | Pages 294-299
www.ibommedicaljournal.org

Recovery profile and discharge following day case laparoscopic gynaecological surgeries: use of sevoflurane anaesthesia vs propofol

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Abstract

Context: Rapid emergence and early recovery from anaesthesia with minimal complications are desirable. Both propofol and sevoflurane meet the above needs and are established as agents of choice in laparoscopic surgeries for induction and maintenance of anaesthesia. This study compared postoperative recovery and discharge profiles of sevoflurane with propofol in patients undergoing laparoscopic gynaecological surgeries under general anaesthesia.
Materials and Methods: In this prospective randomized clinical trial 60 patients, aged 18-65 years with ASA grade I and II scheduled for elective laparoscopic gynaecological surgeries under general anaesthesia were randomly allocated into two groups (Groups S and P, as sevoflurane and propofol groups respectively). Both groups were pre-treated with IV fentanyl 2µg/kg and then induced with IV propofol 2.5 mg/kg. In Group S, anaesthesia was maintained with sevoflurane inhalation 2.0 to 2.5% while in Group P, anaesthesia was maintained with propofol infusion (75-125 µg/kg/min), and 100% O2 at 4L/min.
Results: The age, weight and BMI between the two groups were comparable. The mean recovery time in group S was 6 minutes compared to 17 minutes in group P (p=0.007). The discharge time were also significantly in favour of group S which was 50 minutes compared to the 93 minutes of group P (p=0.001). The incidence of Post-operative nausea and vomiting (PONV), laryngospasm were comparable between the groups.
Conclusion: Sevoflurane is superior to propofol for maintenance of anaesthesia in day case laparoscopic gynaecological surgeries owing to its favourable recovery from anaesthesia and home readiness features. However, both groups were found to be comparable in terms of PONV, laryngospasm.

Key words: Day case, laparoscopic surgery, sevoflurane, propofol

Introduction

In contemporary practice, there is an established principle of ambulating the surgical patient as early as possible. This idea has gone a step further by discharging the post-operative patient home as soon as the critical period is overcome or when the immediate post-operative nursing needs have been met. This has led to the concept of day case surgery[1] which has been defined by the Royal College of Surgeons as "when the surgical patient is admitted for investigation or operation on a planned non-resident basis," this would nonetheless require facilities for recovery.[2]
Minor surgeries have been performed regularly in hospital surgical outpatient units as well as Accident

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DOI: 10.61386/imj.v19i2.1054

and Emergency Departments for years. However, over the past three decades, day surgery rates have steadily increased in many countries across the world.[2] Daycare surgeries are on the increase in Nigeria across all surgical specialties, and laparoscopic gynaecological procedures such as bilateral clip sterilization and dye test are standard day case procedures in Nigeria.[3]

Laparoscopic surgery is one of the most common day case surgical procedures performed with rapidly increasing numbers. General anaesthesia which is routinely utilized is provided by use of an intravenous sedative-hypnotic as an induction agent followed by inhalational agents for maintenance of anaesthesia.[4] Non-pungent and rapidly acting volatile anaesthetic agents are increasingly being used for induction and maintenance of general anaesthesia in day care surgeries. However, early recovery and the risk of postoperative nausea and vomiting (PONV) depend on the anaesthetic technique used.[4] Guidelines for safe discharge from ambulatory surgical facility include stable vital signs, return to baseline orientation, ambulation without dizziness, minimal pain or post operative nausea and vomiting (PONV), and minimal bleeding at the surgical site.[5]

Propofol, an ultrashort-acting hypnotic agent, remains one of the most widely used for the induction of anaesthesia, it may also be used for maintenance of general anaesthesia in day-case surgeries because of its rapid onset, short duration of action, favorable induction characteristics, reduced incidence of PONV, high patient satisfaction, and few postoperative side effects.[5] However, its association with airway obstruction and apnea may be risky, especially in geriatric patients. Elderly patients require smaller boluses of this drug due to its lower initial distribution volume.[6]

Sevoflurane (fluorinated methyl isopropyl ether) is a non-pungent inhalational anaesthetic used widely as a paediatric or outpatient anaesthetic due to its excellent hemodynamic stability and low blood solubility, which allows rapid induction and emergence from general anaesthesia, as well as control of the depth of anaesthesia.[7] However, when sevoflurane is used alone it is associated with a high incidence of emergence agitation in some patients, because of its rapid removal of residual anaesthetics due to its low blood solubility.[7]

A rapid recovery and an uneventful discharge is most desired during day-case procedures and this is largely dependent on anaesthetic agents used. This study compared post-operative recovery and discharged profile with the use of propofol and sevoflurane for day-case procedures

Materials and Methods

Study location

This study was conducted at Aminu Kano Teaching Hospital, in Kano, North-western Nigeria.

Study Design

This was a double-blind randomized prospective study.

Study Population

A total of 60 patients were recruited, inclusion criteria were patient aged between 18 to 65 years undergoing laparoscopic gynaecological day case surgery that had given informed consent, patients that belongs to American society of Anaesthesiology physical status I and II and Patients whose surgery is amenable to either of the study drugs.

Those excluded from the study were patients with a known hypersensitivity to propofol, sevoflurane, egg ,soya beans, patients with body mass index >35 kg, known history of obstructive sleep apnoea (OSA) and patients living far (more than 30 min drive) from the day surgery centre.

Sample size determination

The formula for determining sample size for comparative studies was used.[8] the formula is:

$n = 2(Z\alpha + Z\beta)^2 \pi(1-\pi) / \Delta 2$

Where, n = minimum sample size for each of the compared groups

$Z\alpha$ = standard normal deviation set at 95% confidence level = 1.96

$Z\beta$ =standard normal deviation for the power of test to detect difference between intravenous Propofol and sevoflurane at 80% power, corresponding to 0.84

π = arithmetic average of the two proportions = (p2+p1)/2

Δ = arithmetic difference between the two proportions = (P2 – P1)

To calculate the sample size for each group therefore,

P1 = proportion of patients with PONV during 24hrs after administering sevoflurane 60.0% = 0.60 (based on previously published study by Khare A, et al.[9])

P2 = proportion of patients with PONV during 24hrs after administering propofol 17.0% = 0.17
(Based on previously published study by Khare A, et al.[9]) Therefore, $\pi = (0.60+0.17)/2 = 0.385$
$\Delta = 0.60 - 0.17 = 0.430$
$n = 2(1.96+0.84)^2 \times 0.385(1.0-0.385)$

$(0.43)^2$
$n = 2 \times 7.84 \times 0.82 \times 0.18 / 0.1849$
= 20.07 i.e approximately 20 patients per each group.

Allowing for 10% attrition has increased the sample size to 22 in each of the groups. The total sample size for the 2 groups was therefore 44 patients. However, to account for non-response, loss to follow-up and increase precision, the sample size was increased to 30 in each group with total of 60 patients.

Study procedure

After obtaining the approval from hospital ethical committee and written informed consent from the patient, patients were reviewed on the day of surgery, history and physical examination were carried out. Basic investigations [full blood count with differentials, urea, electrolytes and creatinine, Fasting Blood Sugar (FBS) as well as urinalysis] were checked. Patients were fasted overnight based on American Society of Anaesthesiologist fasting guidelines and informed consent signed by each participant.

On arrival to the theater, study participants were randomly allocated (by the closed envelope technique) into two groups (and assigned by research assistant who took no further part in the study); S and P, in which anaesthesia was maintained using either sevoflurane in group S or propofol in P group. All patient were positioned supine on the operating table and connected to a multiparameter monitor (DASH 4000 GE Medical System.

Information Technologies, Wisconsin, USA) to obtain baseline vital signs Noninvasive blood pressure, mean arterial pressure, heart rate, respiratory rate, oxygen saturation (NIBP, MAP, HR, RR, SpO2). An intravenous access was obtained with size 18G cannula. All patients were premedicated with glycopyrrolate 0.2mg and fentanyl 2µg/kg intravenously. After preoxygenation with 100% O2 for 3 mins, patients were induced with propofol (2.5mg/kg) intravenously in both groups and then test ventilated to ensure ability to ventilate. Atracurium 0.5mg/kg was given to all patients who were manually ventilated for 3 mins until relaxation, then they were intubated using appropriate sized cuffed endotracheal tube (ETT). The HR, SBP, DBP, MAP and SpO2 were recorded at 5mins interval throughout the procedure. All patients were given intermittent positive pressure ventilation (IPPV) using closed circuit anaesthesia machine with tidal volume of 7ml/kg and frequency of 12cycle/min. In Group S, anaesthesia was maintained with sevoflurane 2.0-2.5% via a TEC IV Drager vapor 2000 vaporizer titrated in 100% oxygen at 6L/min. While in Group P, anaesthesia was maintained with IV propofol infusion via SK 500I B-Braun infusion pump with 100% oxygen supplementation at 6L/min, propofol infusion was at the rate of 75-125 µg/kg/min using automatic infusion pump in Group P. Atracurium 0.1mg/kg top-ups were administered every 25 mins.

Sevoflurane and propofol were discontinued at the end of surgery to facilitate rapid emergence from anaesthesia and 100% O2 was continued for 5 mins after the end of surgery. Neuromuscular blockade was reversed with IV neostigmine (2.5 mg) in glycopyrrolate (0.4 mg). Gentle pharyngeal suction and tracheal extubation was done after adequate recovery from the effects of neuromuscular blockade.

The time of discontinuing sevoflurane or propofol infusion was recorded. The patient's response to simple verbal commands was assessed. Aldrete recovery score was employed to assess the overall recovery of the patient, parameters assessed include patient activity, respiration, circulation, consciousness level and oxygen saturation. With a maximum score of 10, the score of greater than or equal to 9 passed for the post anaesthesia care unit (PACU)

Apnoea and postoperative need for airway intervention, re-intubation and other complications (e.g. laryngospasm, desaturation, agitation and PONV) were recorded. Patients with nausea or vomiting were given IV ondansetron 4 mg and their post-operative antiemetic needs were recorded. Intravenous fluid was available for administration if vomiting is significant or there was evidence of dehydration.

Additional analgesic requirement of IV paracetamol 1g and IM diclofenac 75 mg were given to any patient that complained of pain postoperatively.

The recovery time was the time taken from

discontinuation of propofol or sevoflurane to the time taken to attain an Aldrete score of ≥ 9, while discharge time was the time taken from discontinuation of propofol or sevoflurane to the time of discharge. This was determined using the Post Anaesthesia Discharge Scoring System (PADSS). Parameters assessed include vital signs (pulse rate and blood pressure), ambulation, nausea and vomiting, presence of pain, occurrence of surgical bleeding. With a maximum of 10 points, a score of ≥ 9 was taken as the time to home readiness. Postoperative instructions were given in case they require medical assistance overnight, this include phone-in by the patient and follow up phone calls were encouraged because of the possibility of severe pain or PONV. The take home drugs were prescribed by the anaesthetist and this included an antiemetic (tabs metoclopramide 10mg 12hourly) and an analgesic (tabs diclofenac 50mg 12hourly and tabs paracetamol 1g 8hourly) to ensure patient comfort at home and to prevent unanticipated admission.

Data Analysis

Data obtained were analysed using Statistical Package for the Social Sciences (SPSS) version 20.0 Quantitative data were summarized as means and standard deviation for normally distributed data and median and range for non-normally distributed data. Qualitative variables were summarized as frequencies and percentages. All data were presented in tables, charts and graphs. Test of association for qualitative data was done using the Chi-squared test, and for the quantitative data using the students t-test. Level of statistical significance was set at p-value of <0.05.

Results

Patient demographic characteristics is shown on table I. There was no significant difference between patients in groups S and P in terms of age (p= 0.916), weight (p= 0.765) and BMI (p= 0.117). Table II shows the frequency distribution of the procedure in the 2 study groups. Majority of the patients in both groups, 27 (90.0%) had laparoscopy and dye test. One patient (2%) in group P had hysteroscopy and adhesiolysis, two patients (3%) in group S had laparoscopic BTL and one and two patients (5%) in groups S and P respectively had laparoscopy alone Recovery and discharge times are represented in table III. The average recovery time of patients in group S was six minutes (6±3) compared to 17 minutes (17±20) in group P. This was statistically significant (p=0.007). Similarly, the average discharge time in group S was 50 minutes (50±23),which was significantly lower than 93 minutes (93±39) recorded in group P (p <0.001). Table IV shows the postoperative complications (PONV and laryngospasm) in the 2 study groups. Five patients (17%) in group S and 1(3%) patient in group P had PONV. Also 3(10%) in group S and 2(7%) patients in group P had laryngospasm. The two groups were comparable in terms of the postoperative complications studied as p-value in both groups were greater than 0.05

Table I: Demographic characteristics of Respondents

Parameters	Groups (Mean ± SD)		P-value
	S	P	
Age	30.4 ± 8.0	30.6 ± 6.5	0.916
Weight	62.4 ± 13.1	61.6 ± 8.8	0.765
Height	1.6 ± 0.0	1.6 ± 0.1	0.002
BMI	25.0 ± 5.2	23.3 ± 2.8	0.117

Table II: Frequency distribution for the nature of surgery

Groups		Nature of Surgery				Total
		Laparoscopic and Dye Test n(%)	Hysteroscopy and Adhesiolysis n(%)	Laparoscopic BTL n(%)	Laparoscopy n(%)	N(%)
Group	S	27 (45.0)	0 (0.0)	2 (3.3)	1 (1.7)	30 (50)
Group	P	27 (45.0)	1 (1.7)	0 (0.0)	2 (3.3)	30 (50)
Total		54 (90.0)	1 (1.7)	2 (3.3)	3 (5.0)	60 (100)

Table III: Recovery and discharge time in the two groups

Parameter	Group S	Group P	P-Value	95% CI
	Mean±SD		.	.
Recovery time (min)	6±3	17±20	0.007*	-3.0 - -17.8
Discharge time (min)	50±23	93±39	<0.001*	-27.6 - -60.3

Table IV: Post-operative complications

.	Group 1	Group 2	Total	p-value
Post-operative complications	n(%)	n(%)		
PONV	5(8.3)	1(1.7)	6(10.0)	0.090
LARYNGOSPASM	3(5.0)	2(3.3)	5(8.3)	0.647

Discussion

The results obtained from this study showed that patients maintained on sevoflurane had a significantly shorter average recovery time of 6 minutes as against 17 minutes in those maintained on propofol (p=0.007). Furthermore, patients maintained with sevoflurane had significantly shorter average discharge time of 50 minutes compared to 93 minutes in the propofol group (p<0.001). These findings agree with a similar study by Khare et al[9] where they reported that the mean time for all recovery parameters was significantly shorter in their sevoflurane group (9.30 ± 2.78 minutes) compared to the propofol group (11.93±2.73 minutes), p value (0.0004).

The findings of Ajay Kumar and colleagues[10] reaffirm our result of a faster emergence from sevoflurane when compared to propofol. They observed that the time to phase II recovery was significantly shorter with sevoflurane than with propofol. However, contrary to the findings of this study, the time to achieve phase I recovery in their study was similar in both sevoflurane and propofol groups. This is probably due to the use of sevoflurane as the sole agent for both induction and maintenance in their sevoflurane group. The adoption of intravenous induction with propofol in our study for both groups (prior to maintenance with the respective study agents) shortened the exposure time of patients in group S and the consequent rapid recovery observed even in the phase I.

In this study, patients was randomized to receive either sevoflurane or propofol (parallel design). However, in the Uezeno et al study[11] each of their patients had anaesthesia twice and received both sevoflurane and propofol in a predetermined sequential order but after several months interval (crossover study). Uezeno et al[11] found faster recovery from anaesthesia with sevoflurane compared to propofol. This is similar to finding of this present study. Our observations and theirs were still similar despite the design of our study being parallel and theirs crossover. Contrary to the report of this present study, Singh et al[12] found that recovery timings after sevoflurane anaesthesia was comparable with that after propofol anaesthesia (p > 0.05). The MAC of sevoflurane that produced adequate anaesthesia depth in their study (1-2%) was lower than the 2-2.5% in this study, the mean propofol consumption in their study and this study was however not reported.

In this study, patients maintained with sevoflurane had significantly shorter average discharge time of 50 minutes compared to 93 minutes in the propofol group (p<0.001).

The Post Anaesthesia Discharge Scoring System (PADSS) is a simple cumulative index often used to measures patients' home readiness and is based on five major criteria namely vital signs, activity, nausea and vomiting, pain and surgical site bleeding.[13] A maximum score of 10 may be achieved. Patients with a score of 9 or greater and have a responsible adult escort are considered fit for discharge Delays in discharge are typically related to persistent symptoms such as pain, PONV, dizziness, unsteady gait or, frequently, the lack of an escort. Excessive pain post operatively is a common surgery related cause of delayed discharge. PONV was seen in only a few patients in this study.

The incidence of PONV recorded in our study was five times higher in the sevoflurane group (17%) than in the propofol group (3%). This difference however, failed to reach statistical significance. Propofol possesses an intrinsic antiemetic effect and its use has been associated with lower incidence of PONV when compared to inhalational agents. The use of propofol as induction agent in both groups may have masked the real incidence of PONV in the sevoflurane group. Moreover, the population and procedure (females and gynaecological laparoscopy) in this study may have increased the incidence of PONV in both groups to an extent that it masked the antiemetic benefit of propofol use in especially the propofol group, as was seen in the study by Koivuranta et al[14] where women had three times the risk of PONV compared to men. Singh et al[10] reported that the incidence of PONV was significantly lower in propofol group (p <0.05). No single patient in the propofol group compared to nine in the sevoflurane group had vomiting and required rescue antiemetic. Their observation demonstrates the strong intrinsic antiemetic effect of propofol.

In this study, the incidence of laryngospasm recorded in the two study groups was similar. Chavan et al[15] on the contrary, did not encounter laryngospasm in any of the patients in both groups. The airway device used by Chavan and coworkers[15] was a supraglottic airway device (LMA) rather than the endotracheal tube used in our study, with the cuff of LMA lying superior to the laryngeal inlet, it causes less irritation of the vocal cord when compared with ETT.

Conclusion

Sevoflurane has been shown to be superior to propofol for maintenance of anaesthesia in day case laparoscopic gynaecological surgeries owing to its favourable recovery characteristics and home readiness features. However, both agents produce similar and comparable postoperative complications such as PONV and laryngospasm.

Conflict of Interest: We declare no conflict of interest

Authors' contributions: All authors contributed to this research.

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