Comparison of the Impact of Propofol and Sevoflurane on Early Postoperative Recovery in Living Donors After Laparoscopic Donor Nephrectomy: A Prospective Randomized Controlled Study

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Abstract

Background: Enhancing postoperative recovery of the donor is important to encourage living kidney donation. We investigated the effects of anesthetic agents (intravenous [IV] propofol versus inhaled [IH] sevoflurane) on the quality of early recovery of healthy living kidney donors after hand-assisted laparoscopic nephrectomy (HALN) under analgesic intrathecal morphine injection.

Methods: This single-center, prospective randomized controlled study enrolled 80 living donors undergoing HALN from October 2019 to June 2020 at Seoul St. Mary's hospital. Donors were randomly assigned to the IV propofol group or IH sevoflurane group. To measure the quality of recovery, we used the Korean version of the Quality of Recovery-40 questionnaire (QoR-40K) on postoperative day (POD) 1, and ambulation (success rate, number of footsteps) 6–12 hours after surgery and on POD 1. The pain score for the wound site, IV opioid requirement, postoperative complications including incidence of nausea/vomiting, length of in-hospital stay were also assessed.

Results: The global QoR-40K score and all subscale scores (physical comfort, emotional state, physical independence, psychological support, and pain) were significantly higher in the IV propofol group than in the IH sevoflurane group. The numbers of footsteps at all timepoints were also higher in the IV propofol group. The donors in the IV propofol group had a lower incidence of nausea/vomiting, and a shorter hospitalization period.

Conclusions: Total IV anesthesia with propofol led to better early postoperative recovery than that associated with IH sevoflurane.

Trial registration: Clinical Research Information Service, Republic of Korea (approval number: KCT0004351) on October 18, 2019.

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Background

Kidney transplantation (KT) is beneficial in terms of quality of life, and also lowers morbidity and mortality rates relative to dialysis in patients with end-stage renal disease (1, 2). According to the annual report of the Korean Network for Organ Sharing (2018), the requirement for KT has been increasing: 22,620 patients were on the waiting list in 2018, which was almost double that in 2011 (3). One of the best solutions to satisfy the increasing need for KT is living kidney donation. However, the rate of KT has only increased by 3.25% (4). Given the lack of organ donors, it is important to improve the experience of the living donor and minimize the disincentives related to the procedure, such as postoperative pain/discomfort, prolonged hospital stay and time off work (5).

The anesthetic agent is a clinically modifiable factor that could impact the quality of postoperative patient recovery in various surgical settings. Among intravenous (IV) and inhalational (IH) anesthetics,

propofol and sevoflurane have been widely used without fatal complications. However, these two drugs have different clinical features; IV propofol is associated with a lower incidence of postoperative nausea and vomiting (PONV) (6), a better sense of well-being (7) and less postoperative pain (8, 9) while IH sevoflurane has hemodynamic stability and organ-protective effects, including a cardioprotective effect (10).

Because good early postoperative recovery is crucial to shorten the hospital stay, allow performance of activities of daily living, improve satisfaction and reduce financial losses, improving the quality of recovery would lead to a more favourable experience of healthy living donors (11, 12). The quality of recovery can be assessed based on Quality of Recovery-40 questionnaire (QoR-40) scores and postoperative ambulation. The QoR-40 is a validated self-rated questionnaire widely utilised to evaluate the quality of postoperative recovery, in terms of pain and physical and emotional status (11). The QoR-40K, which is the Korean version of the QoR-40, has shown acceptable validity, reliability and feasibility (13). Early postoperative ambulation reflects the degree of recovery after surgery. Also, many studies have suggested the importance of early ambulation for preventing postoperative complications (14–18). However, there are no universally accepted instruments that use the level of ambulation to assess postoperative recovery. Thus, we used the ambulation success rate and number of footsteps to evaluate the quality of functional recovery in this study.

To our knowledge, there have been few studies on the effect of anesthetics on the early postoperative recovery of healthy living donors. Therefore, this study aimed to investigate the effects of anesthetics (i.e. IV propofol and IH sevoflurane) on the quality of early recovery based on the QoR-40K scores and ambulation outcomes of healthy living donors undergoing hand-assisted laparoscopic nephrectomy (HALN).

Methods

Ethical considerations

This single-centre, prospective randomized controlled study was conducted at Seoul St. Mary's Hospital. Ethical approval was obtained from the Institutional Review Board and Ethics Committee of Seoul St. Mary's Hospital (approval number: KC19MESI0573) on October 7, 2019. The trial was performed according to the Declaration of Helsinki. The protocol was prospectively registered at a publicly accessible clinical trial database recognized by the International Committee of Medical Journal Editors (Clinical Research Information Service, Republic of Korea; approval number: KCT0004351) on October 18, 2019. Written informed consent was obtained from all patients registered in the trial between October 2019 and June 2020. Our study complies with the Consolidated Standards of Reporting Trials (CONSORT) guidelines (CONSORT Checklist); a CONSORT flow chart is presented in Figure 1. The summary of our study protocol is presented in Supplemental file 1.

Study population

Adult donors (aged≥19 years) with an American Society of Anesthesiologists physical status (ASA-PS) I or II, who were suited for KT according to clinical practice guidelines (19) and were undergoing elective HALN at our hospital, were recruited to the study. We excluded patients who refused to participate or met the following exclusion criteria: emergency case, age<19 years, ASA-PS III or IV, intra-operative haemodynamic instability (massive haemorrhage, requirement for fluid resuscitation with colloid solution, blood product transfusion and/or an infusion of strong inotropic drugs), or not appropriate for intrathecal intervention (bleeding diathesis, neurologic dysfunction, history of lumbar spine surgery, recent systemic or local infection or drug allergy).

Among the 84 living donors registered in this trial, 4 were excluded based on the exclusion criteria: 2 had a history of spinal surgery and 2 refused to participate. Consequently, 80 living donors were included in the final analysis.

Randomization

Living donors were randomly classified into two groups: an IV propofol group (*n*=40) and an IH sevoflurane group (*n*=40). We used sealed opaque envelopes to randomly assign the living donors to the groups. The envelopes were divided into groups of 10 and each group contained equal numbers of IV propofol and IH sevoflurane group allocations. Then a colleague not otherwise involved in this study randomly shuffled the envelopes within the group and stacked. When a participating donor entered the preoperative holding area, the uppermost envelope was opened by the attending anesthesiologist and the patient was offered the anesthetic management described therein.

The attending anesthesiologist and nurses were aware of the group allocations, but were not involved in patient care. The patients, surgical team, physicians, post-anesthetic care unit and ward nurses, and all researchers were blinded to the group allocation.

Surgery and anesthesia

An experienced urologic surgeon (Y.H.P.) performed HALN, which was comprehensively described in a previous article (20). Patients were offered balanced anesthesia by the experienced attending anesthesiologist. Induction of anesthesia was achieved using 1–2 mg kg^{-1} propofol (Fresenius Kabi, Bad Homburg, Germany) and 0.6 mg kg^{-1} rocuronium (Merck Sharp & Dohme Corp., Kenilworth, NJ, USA). Anesthesia in the IV propofol group was maintained by infusing propofol and remifentanil (Hanlim Pharm. Co., Ltd., Seoul, Republic of Korea) according to the effect-site concentration using a target-controlled infusion pump (Orchestra® Workstation; Fresenius Kabi). Schneider's and Minto's pharmacokinetic models were used for propofol and remifentanil, respectively. Anesthesia in the IH sevoflurane group was maintained using sevoflurane (Hana Pharm.) combined with medical air/oxygen. In both groups, anesthetic agents were titrated to maintain the bispectral index (BIS) at 40–60.

Pain management

The participants all received intrathecal morphine (ITM) injection and intravenous patient-controlled analgesia (IV-PCA) for postoperative analgesia. Informed consent for ITM was acquired on the day before the surgery. The ITM injection was administered before the induction of general anesthesia without any sedative. The intrathecal space was approached through the L3-4 interspace. Once free flow of cerebrospinal fluid had been observed, a single bolus of 0.2 mg (0.2 ml) morphine sulphate (BCWorld Pharm. Co., Ltd., Seoul, Republic of Korea) mixed with 0.9% saline (1 ml) to a total volume of 1.2 ml was injected slowly.

All living donors were provided with the IV-PCA device (AutoMed 3200; Acemedical, Seoul, Republic of Korea) containing 1,000 μg of fentanyl (Dai Han Pharm.) and 0.3 mg of ramosetron (Boryung Co., Ltd., Seoul, Republic of Korea) in a total volume 100 ml. The IV-PCA device was programmed as follows: no basal infusion, 1 ml bolus injection, and a lockout time of 10 min. If the numeric rating scale (NRS) pain score was ≥7 despite ITM and IV-PCA, a rescue IV opioid was administered on approval by the attending physician in the post-anesthesia care unit (PACU) or ward.

Quality of early postoperative recovery outcomes

The quality of early postoperative recovery was evaluated with the QoR-40K questionnaire, which consists of the following five subscales: physical comfort (12 items), emotional state (9 items), physical independence (5 items), psychological support (7 items) and pain (7 items). All items are rated on a 5-point Likert scale, where scores range from 1 (“none of the time”) to 5 (“all of the time”) for positive questions; the anchor points are reversed for negative questions. The total score ranges from 40 to 200 and is calculated by summing the scores for all items. Better-quality recovery corresponds to a higher score (11). In this study, donors were asked to complete the QoR-40K questionnaire on postoperative day (POD) 1.

We assessed functional recovery using the objective measurements of ambulation success rate and number of footsteps. Donors were advised to attempt sitting, standing and walking only after at least 6 hours postoperatively, and only under the guidance of an attending physician. Ambulation was assessed at 6–12 hours after surgery and on POD 1. Successful ambulation was defined as walking more than 10 steps without any adverse event (nausea, vomiting or pain) or physical support from the attending physician. Ambulation at the former and latter time points was classed as successful early and late ambulation, respectively. The number of footsteps was counted using the EI-AN900 activity tracker (Samsung Electronics, Suwon, Republic of Korea).

Postoperative complications

A NRS was used to evaluate the intensity of postoperative pain at the wound site. Pain severity was measured at 6 hours and 24 hours after surgery, and during every nursing shift as a part of standard patient care. For each measurement, donors were asked to report the intensity of pain at rest and while coughing. We collected all pain scores during the initial 24 hours after surgery, and the highest NRS

scores at rest and during coughing were analysed. The total IV-PCA use and number of rescue IV opioids used during the first 24 hours after surgery were also documented.

Other complications occurred on POD 1 were recorded, including nausea/vomiting, headache, shivering, respiratory depression and pruritus. The adverse events related to the surgery were graded using the Clavien–Dindo classification, which is used to evaluate the severity of postoperative complications after many surgeries (21). The length of hospital stay after surgery was compared between donors in the IV propofol and IH sevoflurane groups.

Clinical variables

The preoperative findings included demographic and laboratory variables. The intraoperative findings included hemodynamic variables and total surgical duration. Laboratory variables measured on POD 1.

Statistical analysis

The required sample size was determined based on an unpublished retrospective pilot study conducted at Seoul St. Mary's Hospital and including 20 patients. The number of patients needed in each group for a statistical power of 0.8 at a significance level of 5% was 36, when the standard deviation (SD) and the mean difference between groups were 30 and 20, respectively. We enrolled 40 subjects in each group assuming a drop rate of 10%.

We used the Shapiro–Wilk test to verify the normality of the data distribution. Normally distributed data were compared using an unpaired *t*-test, while non-normally distributed were analysed with the Mann–Whitney *U* test. Categorical data were analysed using Pearson's χ^2 test or Fisher's exact test, as appropriate. Data are presented as mean ± SD, median and interquartile range or number (%), as appropriate. All tests were two-sided and a p-value<0.05 was considered significant. All statistical analyses were performed using SPSS for Windows (ver. 24.0; IBM Corp., Armonk, NY, USA) and MedCalc for Windows software (ver. 11.0; MedCalc Software, Ostend, Belgium).

Results

Pre- and intraoperative living donor characteristics

The study population consisted of 32 (40%) male and 48 (60%) female subjects, with a mean age of 47 ± 13 years and a mean body mass index (BMI) of 23.9 ± 3.4 kg/m^2. All living donors were in a clinically acceptable condition (ASA-PS I or II) with controlled comorbidities: two donors had a history of hypertension, but no other systemic diseases were present in the study population.

The pre- and intraoperative donor characteristics were similar between the two groups (Table 1).

QoR-40K scores and ambulation

The global and subscale scores (i.e. physical comfort, emotional state, psychological support, physical independence and pain) were significantly higher in the IV propofol group than in the IH sevoflurane group (Table 2).

The success rate of early ambulation was marginally higher in the IV propofol group; however, all of the donors could ambulate on POD 1 (Table 3). The numbers of footsteps during the early and late postoperative periods, and the total footsteps on POD 1, were significantly higher in the IV propofol group than in the IH sevoflurane group.

Clinical and laboratory variables during the initial 24 hours postoperatively

Nausea and vomiting was the only clinical variable that was significantly different between the two groups (Table 4). Donors in the IV propofol group had a lower incidence of nausea and vomiting than those in the IH sevoflurane group. Pain at the wound site, total IV-PCA use, rescue IV opioid use and other clinical variables (headache, shivering and pruritus) were similar between the groups. There were no cases of post-dural puncture headache or respiratory depression.

No significant differences were noted in laboratory variables between the groups on POD 1 (Table 5).

Surgical complications and length of hospital stay

All donors were classified as Clavien–Dindo grade 1 and discharge was uneventful in all cases. The length of hospital stay after surgery was significantly shorter in the IV propofol group than in the IH sevoflurane group (3 [3–4] days in the IV propofol group versus 4 [3–5] days in the IH sevoflurane group; p=0.013).

Discussion

The main finding of our study was that the global QoR-40K score was significantly higher in donors receiving IV propofol than in those receiving IH sevoflurane; this tendency was also observed for the physical comfort, emotional state, physical independence, psychological support and pain subscale scores. The numbers of footsteps during early and late ambulation, and the total number (which we took to reflect physical capability) were also higher in the IV propofol group than in the IH sevoflurane group.

The better recovery outcomes (higher QoR-40K score and physical capability) observed in the IV propofol group could be explained by the difference in characteristics between the two anesthetic agents. Firstly, propofol has anxiolytic effects and produces a general sense of well-being, or even euphoria, after general anesthesia (7, 22, 23). The anxiolytic effect is related to potentiation of $GABA_A$ receptors and inhibition of the serotonergic system, while the euphoric mood is associated with the stimulation of dopaminergic neurons in the ventral tegmental area (22, 24). These effects of propofol on patient mood may have contributed to the higher scores on the emotional subscales of the QoR-40K. Secondly, many previous studies demonstrated that propofol has analgesic and anti-nociceptive effects (22). The

analgesic effect of sevoflurane is also widely known, but which agent provides superior postoperative analgesic effects remains controversial, with equivocal results among studies (8, 9). In the present trial, a higher pain score on the QoR-40K, indicating less pain, was observed in the IV propofol group. However, as the pain subscale of the QoR-40K subsumes extra-surgical pain, such as muscle pain, headache and backache, it is unclear if the IV propofol actually provided better postoperative analgesia at the wound site. In this trial, the highest NRS pain score for the wound site was slightly, but non-significantly, lower in the IV propofol group, both during coughing and at rest. Thirdly, propofol significantly reduces PONV compared with inhalational anesthetics (25). The anti-emetic effect of propofol is associated with inhibition of the 5-hydroxy-tryptamine-3 (5-HT) receptors in the serotonergic system, dopaminergic (D2) receptors in the chemoreceptor trigger zone, and the limbic system (22, 26). PONV is not only covered by a separate item in the QoR-40K questionnaire, but also affects the overall sense of physical comfort (27). This was consistent with our findings of a significantly lower incidence of PONV and higher physical comfort scores in the IV propofol group. Fourthly, sevoflurane leads to greater decrease of bronchial mucus transport relative to propofol. Impaired bronchociliary clearance may have resulted in the retention of secretions, which can cause discomfort while breathing after surgery, as well as a higher risk of pulmonary complications (28). Lastly, a modulatory effect on surgical stress of propofol, as well as anti-inflammatory effects, have been demonstrated, reflected in a decrease of pro-inflammatory cytokines (i.e. tumour necrosis factor-α and interleukin [IL]-6) and increase in anti-inflammatory cytokines (i.e. IL-10) (29–31). It is well known that surgical injury triggers the systemic inflammatory response (SIR), where an excessive SIR is assumed to contribute to delayed recovery after surgery and postoperative complications (32, 33). SIR may have played a role in the better recovery of our donors who received IV propofol.

However, some recent studies reported no difference in the effects of propofol and sevoflurane on postoperative recovery outcomes, namely the QoR-40 scores, postoperative pain, length of PACU stay, and complications including PONV (34–36). Possible explanations for this discrepancy between our results and those of previous studies include different study population characteristics, surgical aetiologies and analgesic regimens. The donors in our study were healthier; most had no comorbidities, except for two with controlled hypertension. Although other studies enrolled patients with ASA-PS of I or II, comorbidities were not investigated and the patients were undergoing surgery due to their illness. Differences in underlying health conditions among study populations could confound comparison of postoperative recovery. Additionally, the pain threshold tends to be lower in healthy living donors than patients undergoing a similar surgical procedure for health reasons, which could also have affected the results (37). We used ITM as the analgesic in this study, which offers superior analgesia compared with IV opioid, IV-PCA and continuous wound infusion, for example (38). Better pain control, and subsequently reduced IV opioid consumption and PONV incidence, may facilitate ambulation, improve physical capability and prevent severe wound pain, thus resulting in a shorter hospitalization period (39, 40).

Several limitations of this study should be discussed. Firstly, the specific mechanisms underlying the differences in recovery were not determined. Secondly, we calculated the sample size required to detect group differences in the QoR-40K scores, rather than in subscale scores or other clinical variables. Thirdly, as this study was performed in healthy donors undergoing HALN in the setting of ITM, the results may

not be generalizable to other patient populations, surgeries, or analgesic strategies. Lastly, no long-term follow-up was performed.

Conclusions

The choice of anesthetic drug may affect the quality of early postoperative recovery in healthy living donors undergoing HALN. IV propofol seems to be a better option with respect to postoperative recovery than IH sevoflurane under appropriate analgesia, such as ITM.

Abbreviations

KT, kidney transplantation; IV, intravenous; IH, inhalational; PONV, postoperative nausea and vomiting; QoR-40, Quality of Recovery-40; QoR-40K, the Korean version of the QoR-40; CONSORT, Consolidated Standards of Reporting Trials; HALN, hand-assisted laparoscopic nephrectomy; ASA-PS, American Society of Anesthesiologists physical status; BIS, bispectral index; ITM, intrathecal morphine; IV-PCA, intravenous patient-controlled analgesia; NRS, numerical rating scale; PACU, post-anesthetic care unit; POD, postoperative day; SD, standard deviation; BMI, body mass index; 5-HT, 5-hydroxy-tryptamine-3; IL, interleukin; SIR, systemic inflammatory response

Declarations

Ethical approval and consent to participate

This single-centre, prospective randomized controlled study was conducted at Seoul St. Mary's Hospital. Ethical approval was obtained from the Institutional Review Board and Ethics Committee of Seoul St. Mary's Hospital (approval number: KC19MESI0573) on October 7, 2019. The trial was performed according to the Declaration of Helsinki. The protocol was prospectively registered at a publicly accessible clinical trial database recognized by the International Committee of Medical Journal Editors (Clinical Research Information Service, Republic of Korea; approval number: KCT0004351) on October 18, 2019. Written informed consent was obtained from all patients registered in the trial between October 2019 and June 2020. Our study complies with the Consolidated Standards of Reporting Trials (CONSORT) guidelines (CONSORT Checklist); a CONSORT flow chart is presented in Figure 1. The summary of our study protocol is presented in Supplemental file 1.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analyzed during this study are available from the corresponding author on reasonable request.

Competing interests

No author has any conflict of interest regarding the publication of this article.

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Author's contributions

M.S.C. were responsible for the study concept and design. S.H. and M.S.C. wrote the manuscript. S.H, J.P., S.L., Y.H.P., J.W.S., H.M.L., Y.S.K., Y.E.M., S.H.H. and M.S.C. participated in the collection and interpretation of the data. All authors approved the final version of the manuscript.

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Tables

Table 1. Comparison of pre- and intraoperative clinical findings between the IV propofol and IH sevoflurane groups

Group	**IV propofol**	**IH sevoflurane**	***p***
n	**40**	**40**	
Preoperative findings			
Gender (male)	18 (45.0%)	14 (35.0%)	0.361
Age (years)	50 (40 - 58)	49 (36 - 56)	0.371
Height (cm)	162.5 (156.0 - 170.0)	166.5 (162.0 - 171.5)	0.167
Weight (kg)	64.0 (54.3 - 71.5)	64.5 (58.0 - 68.8)	0.795
Body mass index (kg/m2)	24.5 (21.1 - 26.5)	23.4 (21.6 - 25.5)	0.7
ASA physical status			>0.999
Status 1	32 (80.0%)	32 (80.0%)	
Status 2	8 (20.0%)	8 (20.0%)	
Comorbidity			
Hypertension	2 (5.0%)	0 (0.0%)	0.494
Vital sign			
Systolic blood pressure (mmHg)	120 (111 - 132)	120 (111 - 130)	0.742
Diastolic blood pressure (mmHg)	79 (71 - 80)	76 (69 - 80)	0.13
Heart rate (beats/min)	76 (71 - 85)	76 (68 - 82)	0.623
Laboratory variables			
WBC count (x 109/L)	5.6 (4.8 - 6.7)	5.3 (4.3 - 6.2)	0.163
Hemoglobin (g/dL)	13.9 (12.8 - 15.1)	13.9 (12.6 - 15.1)	0.715
Platelet count (x 109/L)	244.5 (213.5 - 282.3)	234.0 (215.5 - 280.8)	0.832
Creatinine (mg/dL)	0.77 (0.66 - 0.86)	0.75 (0.66 - 0.94)	0.647
Albumin (g/dL)	4.5 (4.3 - 4.7)	4.4 (4.3 - 4.6)	0.603
Sodium (mEq/L)	142 (141 - 144)	142 (141 - 143)	0.476
Potassium (mEq/L)	4.2 (4.0 - 4.4)	4.2 (4.1 - 4.3)	0.658
Chloride (mEq/L)	105 (103 - 106)	104 (103 - 106)	0.733
International normalized ratio	0.98 (0.95 - 1.02)	0.98 (0.96 - 1.04)	0.612
aPTT (sec)	27.2 (26.3 - 28.2)	26.9 (26.0 - 28.2)	0.56

Intraoperative findings			
Total surgical duration (min)	138 (125 - 154)	145 (126 - 160)	0.289
Average of vital signs			
Systolic blood pressure (mmHg)	118 (106 - 124)	114 (108 - 123)	0.476
Diastolic blood pressure (mmHg)	76 (71 - 83)	74 (67 - 79)	0.167
Heart rate (beats/min)	66 (61 - 74)	66 (61 - 76)	0.836
Hypotension event†	0 (0.0%)	2 (5.0%)	0.494
Total remifentanil infusion (mg)	0.5 (0.4 - 0.7)	0.5 (0.3 - 0.7)	0.154
Total amount (mL) of			
Fluid input	500 (400 - 765)	576 (400 - 750)	0.379
Urine output	185 (100 - 200)	200 (100 - 300)	0.115
Hemorrhage	50 (50 - 100)	100 (50 - 100)	0.229

Abbreviations: IV, intravenous; IH, inhalational; aPTT, activated partial thrombin time
Hypotension event† was defined as systolic blood pressure < 90 mmHg over 5 min.
NOTE: Values are expressed as mean (standard deviation) and number (proportion).

Table 2. Comparison of scores in the QoR-40K questionnaire on POD 1 between the IV propofol and IH sevoflurane groups

Group	**IV propofol**	**IH sevoflurane**	***p***
n	**40**	**40**	
Global QoR-40K score (point)	169 (162 - 179)	142 (131 - 154)	<0.001
Sub-dimension score (point)			
Physical comfort	51 (47 - 54)	44 (38 - 47)	<0.001
Emotional state	41 (38 - 43)	36 (32 - 38)	<0.001
Psychological support	32 (29 - 35)	28 (25 - 30)	<0.001
Physical independence	17 (13 - 20)	10 (8 - 13)	<0.001
Pain	31 (28 - 33)	27 (24 - 29)	<0.001

Abbreviations: IV, intravenous; IH, inhalational; QoR-40K, Quality of Recovery-40 questionnaire; POD, postoperative day
NOTE: Values are expressed as median and interquartile.

Table 3. Comparison of postoperative ambulation between the IV propofol and IH sevoflurane groups.

Group	**IV propofol**	**IH sevoflurane**	***p***
n	**40**	**40**	
Successful ambulation			
Early ambulation	40 (100.0%)	35 (87.5%)	0.055
Late ambulation	40 (100.0%)	40 (100.0%)	-
Ambulation (foot-steps)			
Total ambulation	4449 (2179 - 5144)	1970 (639 - 3649)	0.001
Early ambulation	364 (137 - 516)	111 (22 - 398)	0.004
Late ambulation	4086 (1659 - 4533)	1730 (571 - 3253)	0.001

Abbreviations: IV, intravenous; IH, inhalational
Total ambulation was defined as sum of early and late ambulation.
Early ambulation was defined as steps on the day after surgery.
Late ambulation was defined as steps on postoperative day 1.
NOTE: Values are expressed as number (proportion) and median (interquartile).

Table 4. Comparison of clinical variables during 24 h postoperatively between the IV propofol and IH sevoflurane groups

Group	IV propofol	IH sevoflurane	*p*
n	**40**	**40**	
Peak NRS score on wound site			
at rest			0.606
mild pain (0 to 3 points)	31 (77.5%)	29 (72.5%)	
moderate pain (4 to 6 points)	9 (22.5%)	11 (27.5%)	
severe pain (7 to 10 points)	0 (0.0%)	0 (0.0%)	
at cough			0.612
mild pain (0 to 3 points)	8 (20.0%)	5 (12.5%)	
moderate pain (4 to 6 points)	18 (45.0%)	18 (45.0%)	
severe pain (7 to 10 points)	14 (35.0%)	17 (42.5%)	
Requirement of IV opioid			
Total amount of IV-PCA infusion (mL)	13.5 (9.3 - 23.8)	16.0 (7.0 - 37.3)	0.522
Rescue IV opioid	2 (5.0%)	3 (7.5%)	>0.999
Nausea/vomiting	12 (30.0%)	26 (65.0%)	0.002
Headache	3 (7.5%)	5 (12.5%)	0.712
Shivering	5 (12.5%)	10 (25.0%)	0.152
Respiration depression	0 (0.0%)	0 (0.0%)	-
Pruritus	11 (27.5%)	13 (32.5%)	0.626

Abbreviations: IV, intravenous; IH, inhalational; NRS, numeric rating scale; IV-PCA, intravenous patient-controlled analgesia
NOTE: Values are expressed as median (interquartile) and number (proportion).

Figures

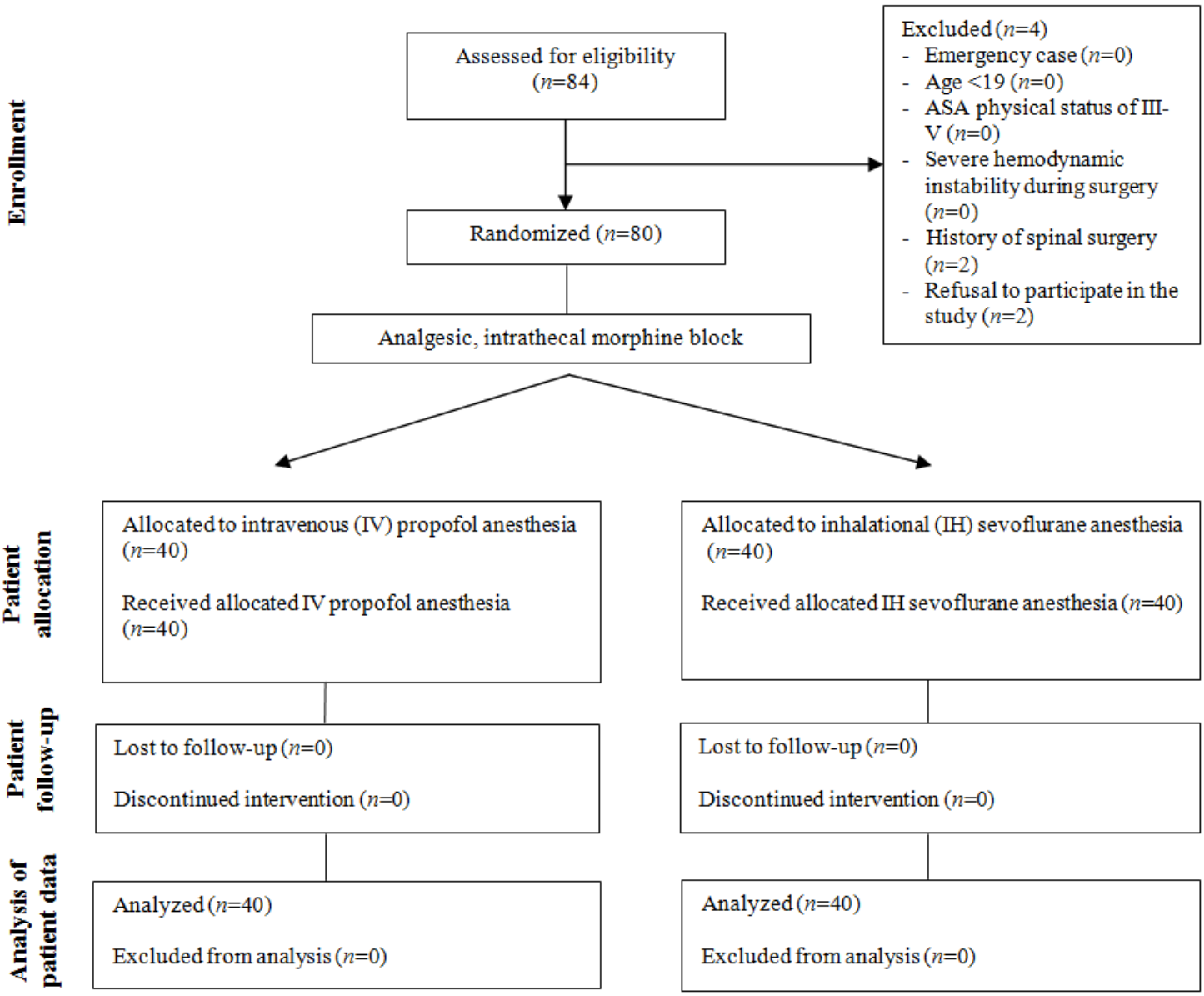

Figure 1

Consolidated Standards of Reporting Trials (CONSORT) flow chart.

Supplementary Files

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- Supplementalfile1.docx
- CONSORTChecklist.doc