BMC Women's Health

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# Comparative analysis of spinal anesthesia versus general anesthesia in single-port access laparoscopic adnexal surgery: a propensity score matching study

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## Abstract

This study evaluated the safety and efficacy of spinal anesthesia as an alternative to general anesthesia in single-port access (SPA) laparoscopic adnexal surgeries. 110 patients were recruited and, after propensity score matching, 63 (general anesthesia: 42, spinal anesthesia: 21) were analyzed. During surgery, the Trendelenburg position was limited to 15°, and CO2 pressure maintained at 8–12 mmHg. Postoperative pain and nausea/vomiting scores were assessed up to 48 h post-surgery. No significant differences in patient characteristics were noted between groups. Immediately postoperative, the spinal anesthesia group showed significantly lower pain scores (4.74 ± 1.48 in spinal anesthesia vs. 0.67 ± 0.66 in general anesthesia; $p < .001$) and nausea/vomiting scores ($p = .027$). Intraoperative hypotension occurred in both groups (28.6% in spinal anesthesia vs. 33.3% in general anesthesia; $p = .774$) and was managed with ephedrine. No other intraoperative or postoperative complications were noted. Conclusively, spinal anesthesia is a viable and safe option for SPA laparoscopic salpingo-oophorectomy, effectively reducing immediate postoperative pain and nausea/vomiting.

**Keywords** Adnexal disease, General anesthesia, Laparoscopy, Spinal anesthesia

## Introduction

In recent years, there has been a marked transition in the field of various surgical disciplines, including gynecology, with a strong inclination towards laparoscopy over the traditional laparotomy method [1, 2]. This shift in surgical practice is significant and reflects a broader trend in medical procedures. Laparoscopy, as opposed to open surgery, offers a notable advantage in terms of postoperative recovery, especially in reducing overall pain experienced by patients after surgery, as evidenced by clinical findings [1]. Moreover, the evolution and continuous enhancement of laparoscopic techniques and the tools used in these procedures have played a crucial role.

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These advancements have been instrumental in the rising acceptance of single-port access (SPA) laparoscopy within the realm of gynecology, as documented in various studies and reports [3, 4]. SPA laparoscopy, especially when applied to adnexal surgery, has shown considerable promise. Studies have shown that this approach leads to a reduction in postoperative pain for patients. However, it is important to note that while the reduction in pain is significant, patients may still experience moderate levels of residual pain post-procedure [5].

Laparoscopy, while advantageous in many respects, is not without its own set of challenges and complications. One of the notable issues associated with this surgical approach is the occurrence of upper abdominal and shoulder pain in patients. This discomfort is often attributed to the retention of carbon dioxide (CO2) within the abdominal cavity during the procedure, a necessary part of the laparoscopic process [6]. This aspect highlights a significant area of patient discomfort that needs to be managed effectively in laparoscopic surgeries.

In terms of anesthesia, general anesthesia is the preferred choice in the majority of laparoscopic procedures. The primary reason for this preference is the level of control general anesthesia offers over respiratory parameters, especially during the creation of pneumoperitoneum, which is a critical phase in laparoscopy [7]. This control is essential for the successful execution of laparoscopic surgeries. However, the use of general anesthesia is not without its drawbacks. It carries inherent risks and potential complications, such as the possibility of airway damage resulting from intubation. Moreover, patients undergoing procedures under general anesthesia often face extended postoperative recovery periods. In addition to these concerns, there is the issue of postoperative nausea and vomiting (PONV), a common side effect that patients experience due to the inhalation of anesthetic gases [8–10]. These challenges associated with general anesthesia highlight the need for careful consideration and management of anesthesia in laparoscopic surgical procedures.

Efforts to address these limitations have resulted in the successful application of spinal anesthesia in laparoscopic procedures. Previous investigations have elucidated the safety and efficacy of spinal anesthesia in laparoscopic cholecystectomy, demonstrating significant reductions in postoperative pain and PONV [11]. However, it is important to note that the majority of these studies have been predominantly concentrated on the field of general surgery. This focus has left a gap in the research regarding the application of spinal anesthesia in gynecological laparoscopic procedures.

This study aimed to compare the surgical outcomes of laparoscopic adnexectomy under spinal anesthesia and general anesthesia, along with assessing the feasibility and practicality of spinal anesthesia in laparoscopic adnexal surgery in gynecology.

## Materials and methods

This study was approved by the Institutional Review Board of Yonsei University Wonju Severance Christian Hospital (approval code C318120), which also waived the requirement for written informed consent. This study was conducted in accordance with the principles of the Declaration of Helsinki.

The investigation included 110 patients who underwent SPA laparoscopic adnexal surgery in January 2016 to December 2018, including bilateral and unilateral salpingo-oophorectomies under spinal anesthesia or general anesthesia.

The inclusion criteria for patients were as follows: (1) age 19–65 years; (2) diagnosis of an adnexal cystic mass; and (3) American Society of Anesthesiologists physical status I–II. The exclusion criteria were: (1) hysterectomy or myomectomy; (2) previous history of gynecological malignancy; (3) evidence of gynecological malignancy on ultrasonography, abdominopelvic computed tomography, magnetic resonance imaging, or tumor marker analysis; (4) clinically predicted severe infiltrative endometriosis; and (5) absolute or relative contraindications for spinal anesthesia.

### Anaesthetic management

To ensure consistency in the preoperative phase, all patients participating in the study followed a standardized pre-anesthetic medication regimen. This regimen involved administering intramuscular midazolam to each patient, with the dosage set at 2.5 mg. As part of the preoperative assessment, vital signs of the patients were meticulously documented. These vital signs included measurements of systolic and diastolic blood pressure, heart rate, respiratory rate, and pulse oximetry, providing a comprehensive overview of each patient's preoperative physiological state.

For those in the spinal anesthesia group, the procedure began with the patient being positioned in the left lateral decubitus position. This was followed by a precise puncture into the subarachnoid space at the L3–L4 intervertebral level. After achieving access to this space, a dose of 2–3 mL of hyperbaric 0.5% bupivacaine was administered. This administration was carried out using a 25G Quincke spinal needle (Spinocan®, B. Braun Medical Inc, Bethlehem, PA, USA). Following the administration of the spinal anesthetic, patients were then repositioned into a supine posture, ensuring either a neutral or slightly head-down position of the head. To confirm the effective spread and adequacy of the anesthesia, the attending anesthesiologist checked for anesthesia at the T4–T6 level. In preparation for the surgical procedure, patients

in the spinal anesthesia group also received sedation through dexmedetomidine (Precedex premix injection, produced by Pfizer Ltd., NY, USA). This was administered as an initial loading dose of 1 mcg/kg over a span of 10 min, succeeded by a continuous maintenance infusion at a rate of 0.6 mcg/kg/hour.

In contrast, the general anesthesia group underwent a different protocol for anesthesia induction. This began with preoxygenation lasting 3–5 min, followed by the administration of 1.5–2.0 mg/kg of propofol and 0.6 mg/kg of rocuronium to facilitate anesthesia induction. Endotracheal intubation was then performed using a curved laryngoscope. Throughout the surgical procedure, anesthesia was maintained by using a combination of desflurane and remifentanil. Upon the completion of the surgery, neuromuscular blockade was reversed in the general anesthesia group patients with the administration of 0.2 mg/kg of pyridostigmine and glycopyrrolate at a dosage of 0.004 mg/kg. This detailed approach in both groups aimed to ensure optimal conditions for the surgical procedures and the safety and comfort of the patients.

### Surgical technique

During the surgical procedure, the patients were positioned in the lithotomy and the Trendelenburg position. The Trendelenburg position involved a specific inclination, which was carefully regulated to ensure it did not exceed a maximum angle of 15 degrees, as illustrated in Fig. 1 (A) of the study. This controlled positioning was a critical aspect of the procedure, ensuring optimal surgical access while maintaining patient safety. For the surgical access, a single-port channel system was employed. This system was introduced through an umbilical incision. The introduction of this system was facilitated using a unique combination of a surgical glove and Alexis wound protectors/retractors (Applied Medical, Rancho Santa Margarita, CA, USA). The use of this equipment, as depicted in Fig. 1 (B), was integral to the procedure, enabling effective access while minimizing tissue trauma.

Following the establishment of the surgical access, the planned laparoscopic SPA surgery was executed. A key aspect of the procedure involved the maintenance of pneumoperitoneum, which was consistently regulated within a pressure range of 8–12 mmHg using CO2. Post-surgery, patient care continued in the recovery room, where patients were observed and monitored for a duration of 30 min. During this postoperative period, the administration of patient-controlled analgesia (PCA) was an option available to patients, based on their individual preferences.

### Postoperative management

Postoperatively, pain intensity was assessed using a visual analog scale (VAS) score from 0 to 10, and the severity of PONV was quantified using an emesis score ranging from 0 to 3 at 0, 2, 6, 12, 24, and 48 h postoperatively. Aceclofenac (100 mg) was administered every 12 h for pain management. In cases of uncontrolled pain, defined as a VAS score of > 5, additional IV tramadol HCl (50 mg) was administered. Metoclopramide (10 mg) was

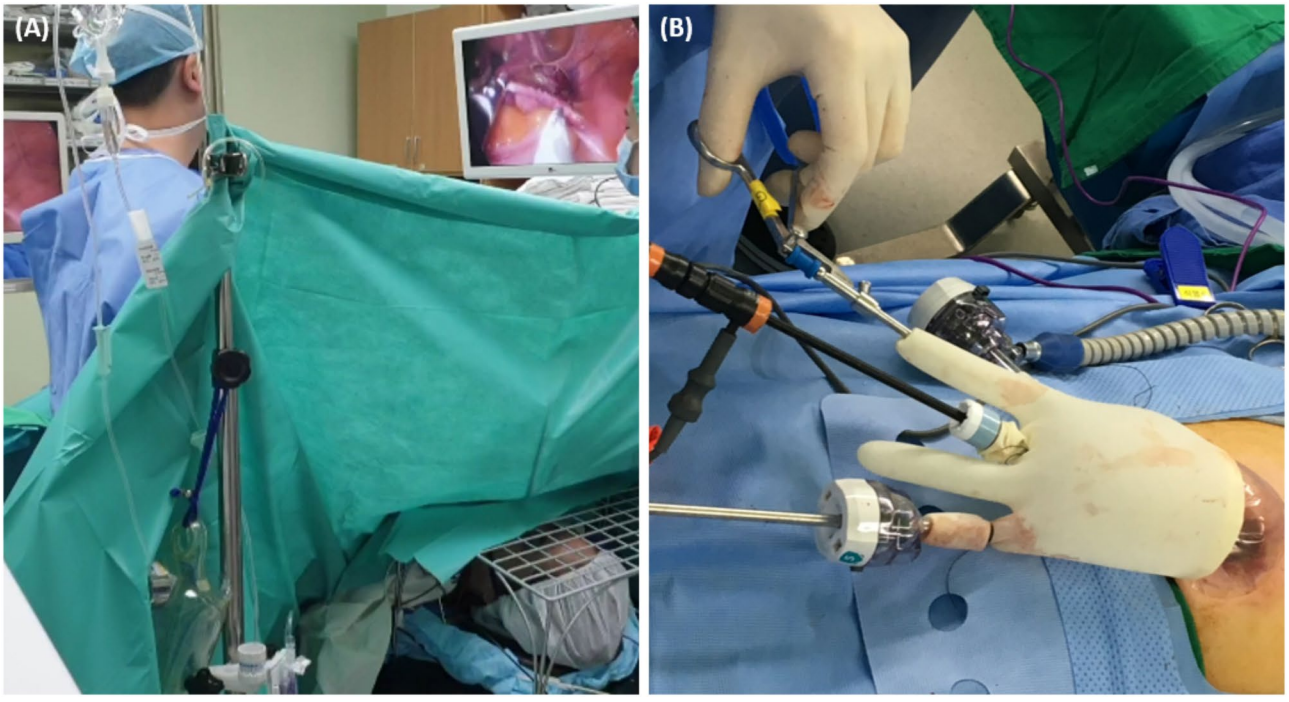


**Fig. 1** Laparoscopic surgery with spinal anesthesia (**A**) and single-port access procedure (**B**)

administered every 8 h to manage emesis, with additional administration of ramosetron hydrochloride (0.3 mg in cases of uncontrolled emesis). The cumulative quantities of administered analgesics and antiemetics were recorded in electronic health records.

The operative time was the interval between skin incision and skin closure, and the pneumoperitoneum time was the duration from gas insufflation to gas desufflation. The change in hemoglobin level was calculated as the difference between the preoperative and postoperative hemoglobin levels on Day 1. The length of the hospital stay was the interval from the operative day to the day of discharge. Intraoperative and postoperative complications occurring within 30 days of surgery were meticulously documented. Patients had follow-up exams at 1 week and 1 month post-surgery.

### Statistical analysis

Continuous data are expressed as mean ± standard deviation (SD), while categorical data are presented as absolute numbers or percentages. The frequency distributions were compared using the $\chi 2$ test, whereas the means or medians were compared using the Student's t-test or the Mann–Whitney U-test, as appropriate. All *p*-values were two-tailed, and statistical significance was set at $p < .05$.

Statistical analyses were conducted using SAS (version 9.4; SAS Institute Inc., Cary, NC, USA), SPSS (version 24; IBM, Armonk, NY, USA), and the ggplot package in R (version 3.6.2; R Foundation for Statistical Computing, Vienna, Austria). Propensity scores were estimated to facilitate the matching of the spinal anesthesia and general anesthesia groups in terms of age, body mass index, preoperatively measured ovarian tumor size, and total operation time [12]. Following the propensity score matching (PSM) analysis, a linear mixed model was employed to analyze the pain scale over time, contingent on the method of anesthesia.

## Results

In total, 110 patients underwent bilateral or unilateral salpingo-oophorectomy, with 89 and 21 receiving general anesthesia and spinal anesthesia, respectively. Preoperative evaluation revealed significant differences in adnexal mass size and histological diagnosis between the two anesthesia groups. However, after rigorous PSM analysis, these initial disparities were effectively mitigated, yielding no significant differences between the two anesthesia groups (Table 1). Before matching, the propensity scores ranged from 0.15 to 0.85 for the general anesthesia group and from 0.25 to 0.75 for the spinal anesthesia group, indicating some initial imbalance in the covariates related to the likelihood of receiving spinal anesthesia. After matching, we successfully paired 42 patients from the general anesthesia group with 21 patients from the spinal anesthesia group, using nearest neighbor matching with a caliper width of 0.1 standard deviations of the propensity score distribution.

Surgical outcomes after PSM analysis are shown in Table 2. No statistically significant differences were observed between the two anesthesia methods in the total operation time, time spent in the operating room or pneumoperitoneum time. However, a significant difference was evident in the use of PCA, with a higher percentage in the general anesthesia (54.8%) vs. spinal anesthesia (23.8%) group ($p < .001$). Immediate postoperative antiemetic use also demonstrated a substantial

**Table 1** Patient characteristics before and after a propensity score matching

| | Before PSM | | | | | After PSM | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Patient characteristics** | **General anesthesia (*N* = 89)** | | **Spinal anesthesia (*N* = 21)** | | ***p*-value** | **General anesthesia (*N* = 42)** | | **Spinal anesthesia (*N* = 21)** | | ***p*-value** |
| Age, years | 52.8 ± 10.5 | | 53 ± 9.35 | | 0.943 | 52.5 ± 11.3 | | 53 ± 9.35 | | 0.862 |
| Body mass index, kg/m$^2$ | 24.34 ± 4.37 | | 24.8 ± 3.6 | | 0.650 | 24.38 ± 4.39 | | 24.8 ± 3.6 | | 0.701 |
| Tumor size, cm | 6.95 ± 3.89 | | 5.66 ± 2.23 | | 0.049 | 5.87 ± 2.55 | | 5.66 ± 2.23 | | 0.747 |
| Pathologic diagnosis | | | | | | | | | | |
| Serous | 15 | (16.9) | 8 | (38.1) | 0.037 | 7 | (16.7) | 8 | (38.1) | 0.006 |
| Mucinous | 16 | (18.0) | 2 | (9.5) | | 4 | (9.5) | 2 | (9.5) | |
| Endometrioma | 13 | (14.6) | 6 | (28.6) | | 3 | (7.1) | 6 | (28.6) | |
| Teratoma | 11 | (12.4) | 1 | (4.8) | | 7 | (16.7) | 1 | (4.8) | |
| Other | 34 | (38.2) | 3 | (14.3) | | 21 | (50.0) | 3 | (14.3) | |
| CA125, U/mL | 21.21 ± 45.2 | | 17.2 ± 15.48 | | 0.547 | 23.71 ± 61.35 | | 17.2 ± 15.48 | | 0.581 |
| Previous abdominal operation | | | | | | | | | | |
| 0 | 39 | (43.8) | 10 | (47.6) | 0.939 | 16 | (38.1) | 10 | (47.6) | 0.893 |
| 1 | 23 | (25.8) | 6 | (28.6) | | 12 | (28.6) | 6 | (28.6) | |
| 2 | 23 | (25.8) | 4 | (19.1) | | 11 | (26.2) | 4 | (19.1) | |
| ≥ 3 | 4 | (4.5) | 1 | (4.8) | | 3 | (7.1) | 1 | (4.8) | |

Values are presented as mean ± SD or n (%). PSM, propensity score matching; SD, standard deviation

**Table 2** Comparison of surgical outcomes after propensity score matching

| Surgical outcomes | General anesthesia (*N* = 42) | | Spinal anesthesia (*N* = 21) | | *p*-value |
|---|---|---|---|---|---|
| Total operation time, minutes | 41.98 ± 20.13 | | 41.05 ± 12.9 | | 0.827 |
| Time spent in the operating room | 60.45 ± 15.2 | | 58.75 ± 13.8 | | 0.734 |
| Pneumoperitoneum time, minutes | 27.29 ± 19.33 | | 28.71 ± 12.2 | | 0.725 |
| PCA use | 23 | (54.8) | 5 | (23.8) | < 0.001 |
| Opioid dosage, mg | 25.0 ± 29.73 | | 23.81 ± 40.68 | | 0.895 |
| Immediate post-op antiemetic use | 27 | (64.3) | 0 | (0.0) | 0.0017 |
| Additional antiemetic use | 0 | (0.0) | 1 | (4.8) | 0.3333 |
| Intraoperative hypotension (lower than 90/60 mm Hg) | 12 | (28.6) | 7 | (33.3) | 0.7741 |
| Intraoperative ephedrine use | 12 | (28.6) | 6 | (28.6) | > 0.99 |
| Hb change, g/dL | 1.26 ± 1.27 | | 1.07 ± 0.65 | | 0.4287 |
| Gas out time, hours | 32.31 ± 8.81 | | 27.62 ± 10.31 | | 0.0647 |
| Ambulation time, hours | 17.36 ± 2.74 | | 17.38 ± 2.29 | | 0.9728 |
| Total hospital time, days | 2.71 ± 1.11 | | 2.29 ± 0.56 | | 0.0462 |

Values are presented as mean ± SD or n (%). †PCA, patient-controlled analgesia; Hb, hemoglobin; SD, standard deviation

disparity, with 64.3% of patients in the general anesthesia group requiring antiemetics compared to none in the spinal anesthesia group ($p$ = .002). Although infrequent, additional antiemetic use was more prevalent in the spinal anesthesia group (4.8%) than in the general anesthesia group (0.0%) ($p$ = .333). Other parameters, including intraoperative hypotension, ephedrine use, hemoglobin change, gas out time, ambulation time, and total hospital days, did not exhibit significant differences between the two groups, except for the total hospital days, where the spinal anesthesia group had a significantly shorter hospital stay (2.29 ± 0.56 days) than the general anesthesia group (2.71 ± 1.11 days) ($p$ = .046).

The immediate postoperative pain levels exhibited a notable disparity, with the spinal anesthesia group reporting significantly lower pain scores (0.67 ± 0.66) than the general anesthesia group (4.74 ± 1.48) ($p$ < .001). Conversely, 6 h following surgery, the spinal anesthesia group reported significantly higher pain levels (2.83 ± 0.79) than the general anesthesia group (3.67 ± 1.74) ($p$ = .048). Notably, postoperative pain assessments at the 2-, 12-, 24-, and 48-hour intervals showed no significant intergroup differences. Decreased PCA utilization was observed in the spinal anesthesia group (23.8%) compared to that in the general anesthesia group (54.8%) ($p$ < .001), although the total opioid consumption was not statistically significant (spinal anesthesia: 23.81 ± 40.68 vs. general anesthesia: 25.0 ± 29.73; $p$ = .895). Figure 2 illustrates the temporal evolution of postoperative pain in both cohorts.

Immediate PONV incidence was significantly more pronounced in the general anesthesia cohort ($p$ = .027), further substantiated by the significantly lower postoperative use of antiemetics in the spinal anesthesia group (0.0%) than in the general anesthesia group (64.3%) ($p$ = .002). However, the two anesthesia groups had similar PONV prevalence rates at 2, 6, 12, 24, and 48 h postoperatively. The spinal anesthesia group evacuated gas faster, but the difference was not statistically significant. Notably, the length of hospitalization was significantly lower in the spinal anesthesia cohort (2.29 ± 0.56 days) than in the general anesthesia group (2.71 ± 1.11 days) ($p$ = .046). These findings are summarized in Table 3.

## Discussion

This study underscores the feasibility and safety of spinal anesthesia as an alternative anesthetic approach for SPA laparoscopic salpingo-oophorectomy compared to the conventional practice of general anesthesia. Our findings demonstrated a significant reduction in immediate postoperative pain and PONV.

Laparoscopic procedures are commonly performed under general anesthesia. However, intravenous and inhalation agents employed under general anesthesia, such as propofol and desflurane, have been established as recognized PONV risk factors [13]. These agents can induce emesis by stimulating the vestibular nuclei, area postrema, and vagal afferent fibers originating from the gastrointestinal tract, subsequently eliciting an emetic reflex. Moreover, volatile agents can potentiate the central and peripheral effects of serotonin type 3 receptor antagonists, causing emesis or nausea [14].

To overcome the drawbacks of general anesthesia, spinal anesthesia in laparoscopic surgery has been investigated. A notable meta-analysis of eight randomized controlled trials (723 patients) disclosed that patients subjected to spinal anesthesia during laparoscopic cholecystectomy exhibited lower postoperative pain and PONV (odds ratio: 0.38, 95% confidence interval: 0.19–0.76; $p$ = .006) compared to their general anesthesia counterparts [15].

However, in gynecologic laparoscopy, there have been challenges in introducing spinal anesthesia compared to the field of general surgery. This difference is mainly due to the specific operational requirements of gynecological

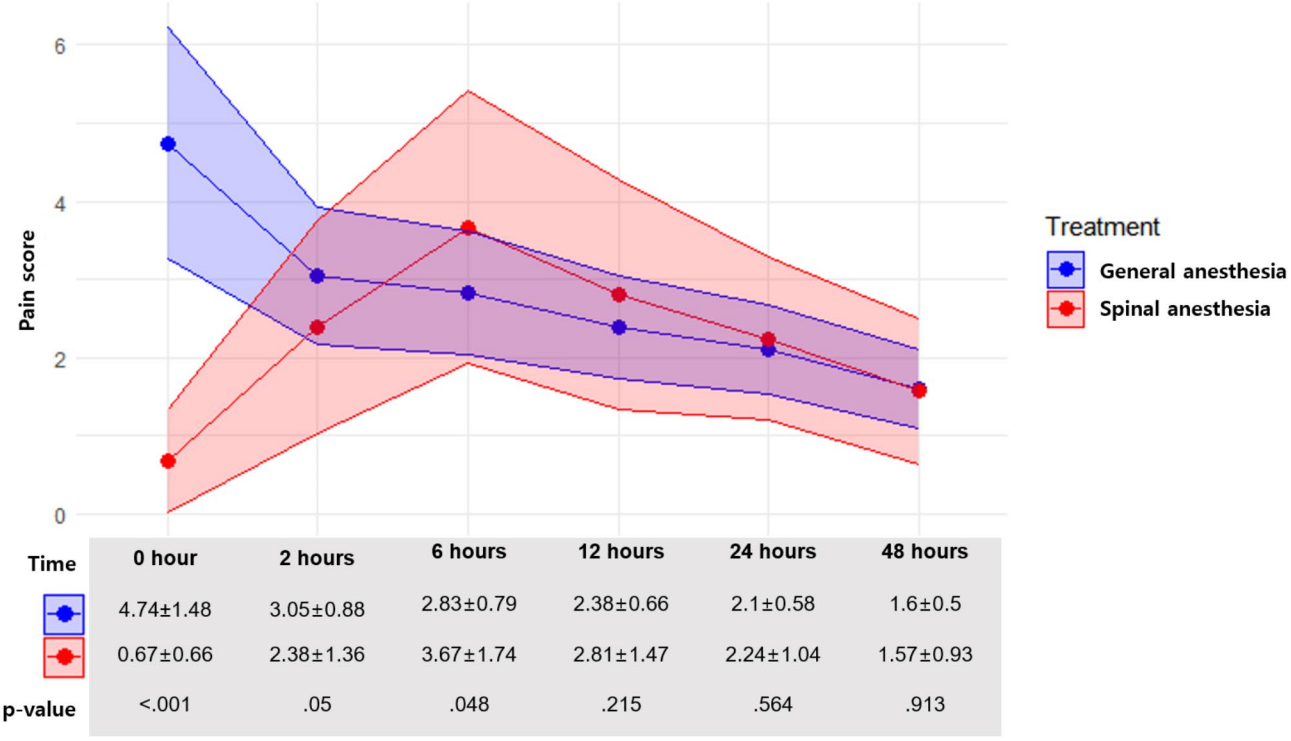


**Fig. 2** Trend of postoperative pain according to anesthesia method

**Table 3** Comparison of postoperative nausea/vomiting after propensity score matching

| PONV (Emesis score, 0–3) | | General anesthesia (*N* = 42) | | Spinal anesthesia (*N* = 21) | | *p*-value |
|---|---|---|---|---|---|---|
| 0 h | 0 | 27 | (64.3) | 19 | (90.5) | 0.027 |
| | 1 | 15 | (35.7) | 2 | (9.5) | |
| | 2 | 0 | (0.0) | 0 | (0.0) | |
| | 3 | 0 | (0.0) | 0 | (0.0) | |
| 2 h | 0 | 42 | (100.0) | 20 | (95.2) | 0.333 |
| | 1 | 0 | (0.0) | 1 | (4.8) | |
| | 2 | 0 | (0.0) | 0 | (0.0) | |
| | 3 | 0 | (0.0) | 0 | (0.0) | |
| 6 h | 0 | 42 | (100.0) | 19 | (90.5) | 0.108 |
| | 1 | 0 | (0.0) | 1 | (4.8) | |
| | 2 | 0 | (0.0) | 1 | (4.8) | |
| | 3 | 0 | (0.0) | 0 | (0.0) | |
| 12 h | 0 | 42 | (100.0) | 20 | (95.2) | 0.333 |
| | 1 | 0 | (0.0) | 1 | (4.8) | |
| | 2 | 0 | (0.0) | 0 | (0.0) | |
| | 3 | 0 | (0.0) | 0 | (0.0) | |
| 24 h | 0 | 42 | (100.0) | 20 | (95.2) | 0.333 |
| | 1 | 0 | (0.0) | 1 | (4.8) | |
| | 2 | 0 | (0.0) | 0 | (0.0) | |
| | 3 | 0 | (0.0) | 0 | (0.0) | |
| 48 h | 0 | 42 | (100.0) | 20 | (95.2) | 0.333 |
| | 1 | 0 | (0.0) | 0 | (0.0) | |
| | 2 | 0 | (0.0) | 0 | (0.0) | |
| | 3 | 0 | (0.0) | 1 | (4.8) | |

PONV, postoperative nausea/vomiting

laparoscopy, requiring the Trendelenburg position. In this position, elevated upper abdominal pressure may lead to pronounced shoulder pain and nausea during the procedure compared to the head-up position [16].

In the present study, innovative strategies were implemented in the spinal anesthesia group to mitigate the challenges posed by the Trendelenburg position. These included imposing a restriction on the Trendelenburg inclination to less than 15° and maintaining CO2 pressure within 8–12 mmHg. No instances of shoulder pain or nausea were reported in the spinal anesthesia group, and the sedation protocol ensured that anxiety did not emerge. However, in gynecological surgery, the limitation of the Trendelenburg angle to 15° may hinder the convenience of surgical procedures, highlighting the need to carefully select appropriate surgical candidates who can be easily managed under the restricted Trendelenburg angle.

In laparoscopy, $CO_2$ insufflation is indispensable. Nevertheless, $CO_2$ retention within the abdominal cavity can trigger adverse consequences, including phrenic nerve stimulation and referred pain at the C4 dermatome. Concurrently, $CO_2$ retention between the liver and right diaphragm may precipitate upper abdominal discomfort [6]. Disparities in pneumoperitoneal pressure can discernibly influence postoperative pain [17]. Strict regulation of $CO_2$ pressure within 8–12 mmHg was maintained in both groups to prevent unwarranted effects.

In this study, the impact of spinal anesthesia on immediate postoperative pain was found to be significant. This notable reduction in pain shortly after surgery is likely due to the continued effects of the spinal anesthesia. In contrast, while a higher number of patients in the general anesthesia group resorted to PCA for pain management, the levels of postoperative pain, with the exception of the assessment conducted at 6 h post-surgery, did not show any significant differences when compared to the spinal anesthesia group. This observation suggests that while immediate postoperative pain management might be more effective under spinal anesthesia, the long-term pain levels post-surgery appear to be similar between the two groups.

Additionally, the study highlighted a considerable advantage of spinal anesthesia in the context of immediate PONV. It was observed that in the immediate postoperative period, spinal anesthesia significantly reduced the incidence of PONV. This benefit was especially pronounced when considering that none of the patients in the spinal anesthesia group required supplementary antiemetic interventions. This finding stands in stark contrast to the general anesthesia group, where a significant portion, precisely 35.7%, of the patients needed additional measures to manage PONV. The observed difference in hospital stay between the spinal anesthesia and general anesthesia groups can be attributed to the reduced incidence of PONV in the spinal anesthesia group, which facilitated earlier discharge and contributed to the shorter hospitalization duration.

Similar findings were documented by Asgari et al., who compared postoperative pain following gynecologic laparoscopy under general anesthesia, spinal anesthesia, and spinal anesthesia supplemented with subdiaphragmatic lidocaine. Both spinal anesthesia and spinal anesthesia with subdiaphragmatic lidocaine substantially alleviated postoperative pain at the 2-hour mark, in contrast to general anesthesia [16]. The comparison between these different anesthesia methods provides critical insights, particularly highlighting the enhanced efficacy of spinal anesthesia, with or without the addition of local lidocaine, in managing postoperative pain effectively, especially in the early hours following gynecologic laparoscopy.

Khetarpal et al. conducted a comprehensive review of the efficacy and safety of regional anesthesia modalities, including spinal anesthesia, paravertebral block, continuous epidural anesthesia, and combined spinal-epidural anesthesia, in patients with chronic obstructive pulmonary disease (COPD) [18]. The review confirmed the safety profile of regional anesthesia in patients with COPD and corroborated its utility in mitigating postoperative pulmonary complications. Notably, in this study, spinal anesthesia was judiciously employed in a patient with intubation challenges due to dental concerns. This unique circumstance has prompted the use of spinal anesthesia instead of general anesthesia, ultimately yielding safe and uncomplicated surgical outcomes.

Previous investigations have identified various adverse events associated with spinal anesthesia, including abdominal discomfort, anxiety, shoulder pain, nausea/vomiting, and hypotension during the perioperative phase, along with postoperative sequelae such as headache, urinary retention, and persistent nausea/vomiting [19–21]. In this study, intraoperative hypotension was observed in 28.6% of patients in the general anesthesia group and 33.3% in the spinal anesthesia group. This finding highlights the importance of detailed monitoring and analysis of blood pressure and heart rate trends during surgery to better understand the hemodynamic effects associated with spinal anesthesia and dexmedetomidine use. In both cohorts, ephedrine managed these instances of hypotension, and further intervention was unnecessary. Importantly, no patient in the spinal anesthesia group who underwent concomitant sedation with dexmedetomidine reported abdominal discomfort, shoulder pain, or anxiety during the surgical procedure.

Contrary to the findings of previous studies that reported a significantly higher incidence of urinary retention after spinal anesthesia compared with general

anesthesia (odds ratio: 4.95, 95% confidence interval: 1.24–19.71; $p$=.02) [14, 22], no patient in either cohort needed Foley catheter reinsertion due to urinary retention in the present study. This favorable outcome could be attributed to the standardized protocol of Foley catheter insertion before surgery, coupled with its removal on the first postoperative day for all patients, mitigating the incidence of postoperative urinary retention.

The study, while offering valuable insights, had certain limitations that need to be acknowledged. One of the primary limitations of this retrospective study is its observational nature, which inherently relies on pre-existing data rather than randomized patient selection. The dependence on the preferences of the operator and patient for determining the anesthesia type may introduce potential bias, reflecting the constraints of retrospective data collection. Another limitation was the relatively small size of the sample in the spinal anesthesia cohort. A larger sample size could have provided more robust and generalizable results. Furthermore, the study was limited to a specific patient population, as it exclusively included patients undergoing adnexal surgery. This narrow focus may limit the applicability of the study's findings to other types of surgeries or patient groups. Additionally, the use of PCA within the study was primarily dependent on the preference of the patients, which could introduce variability in postoperative pain management and its outcomes. Specifically, the spinal anesthesia group received dexmedetomidine as part of their postoperative analgesia regimen, whereas the general anesthesia group did not receive any standardized postoperative analgesics. This difference in analgesic protocol could potentially influence the observed outcomes, particularly the pain scores reported postoperatively.

Despite these limitations, the study also had several notable strengths. To the best of our knowledge, this study represents one of the first investigations to explore the safety profile of spinal anesthesia specifically in SPA laparoscopy within the field of gynecology, with a focus on unique methodologies such as its combination with dexmedetomidine. This exploration into a relatively uncharted area adds significant value to the existing body of medical knowledge. Another merit of the study was the evident reduction in intraoperative complications associated with the use of spinal anesthesia in SPA laparoscopy. These complications include factors such as pain, nausea/vomiting, and anxiety, which were observed to be lower in cases where spinal anesthesia was used compared to those where general anesthesia was applied. Moreover, the study employed PSM analysis. This statistical approach was utilized to minimize potential sources of selection bias and confounding variables. By doing so, the study aimed to ensure a more accurate comparison between the spinal anesthesia and general anesthesia groups, thereby enhancing the reliability and validity of its findings. This methodological strength is a significant aspect of the study, adding to its overall merit and the relevance of its conclusions.

In summary, spinal anesthesia has emerged as a viable and secure alternative to general anesthesia for SPA laparoscopic salpingo-oophorectomies. The use of spinal anesthesia during SPA laparoscopic adnexal surgery can lead to an immediate reduction of postoperative pain and PONV. Further investigations are warranted to ascertain the broader applicability of spinal anesthesia across a diverse spectrum of gynecological surgeries.

#### Author contributions

Conceptualization, K.J.E. and S.H.L.; methodology, S.H.L.; software, J.H.A.; validation, J.H.A. and S.H.L.; formal analysis, J.H.A.; investigation, K.J.E.; resources, S.H.L.; data curation, J.S.P. and S.H.P.; writing—original draft preparation, K.J.E.; writing—review and editing, J.H.A. and Y.S.C.; visualization, J.H.A.; supervision, K.J.H.; project administration, S.H.L. All authors have read and agreed to the published version of the manuscript.

#### Funding

This research received no external funding.

#### Data availability

No datasets were generated or analysed during the current study.

## Declarations

#### Ethics approval and consent to participate

This study was approved by the Institutional Review Board of Yonsei University Wonju Severance Christian Hospital (approval code C318120). Patient consent was waived due to the retrospective nature of the study, where only pre-existing data was used. This study was conducted in accordance with the principles of the Declaration of Helsinki.

#### Consent for publication

N/A.

#### Competing interests

The authors declare no competing interests.

Received: 16 March 2024 / Accepted: 12 February 2025
Published online: 24 February 2025

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