INTRODUCTION

In the last two decades, the prevalence of endoscopic surgeries has widely spread in the field of gynecology. The advantages of laparoscopic surgery are cosmetic beauty, shorter postoperative recovery time, less postoperative pain, shorter hospital stays, and decreased blood loss. Operative laparoscopy offers the benefit of a faster return to normal activity. In addition to the other benefits of laparoscopic surgeries, adhesions are less likely to form with laparoscopic surgeries than with laparotomies. For pain relief after surgery, epidural anesthesia and patient-controlled analgesia (PCA) have been used after conventional laparotomies. However, after laparoscopic surgery these procedures were not used because of decreased postoperative pain. Postoperative pain in laparoscopic surgery is...
believed to be lighter than laparotomy. If we can reduce postoperative pain after laparoscopic surgery, these methods will lead to increased patient satisfaction.

Various types of pain are experienced in laparoscopic surgery such as pain in the trocar wound, pain of the wound in the abdominal cavity, peritoneal irritation, and pain in the pneumoperitoneum. Local infiltration anesthesia has been used for pain relief after laparoscopic surgery. Several studies on local anesthesia for pain control after laparoscopic surgery have been conducted. However, the results of pain relief with local anesthesia are still controversial. Meta-analysis on the intraperitoneal administration of local infiltration anesthesia published by Marks et al in 2012 was effective for 6 hours postoperatively, and no significant difference was observed 24 hours postoperatively, although the administration route of local infiltration anesthesia was different between this study and Marks et al. Wheatley and Fiddes reported that they could reduce pain by administering local infiltration anesthesia directly to the fallopian tube during sterilization surgery. In addition, Ke et al reported that patients desiring infertility and undergoing sterilization surgery were able to reduce postoperative pain by injecting local infiltration anesthesia into the port wounds preoperatively. Pellico and Ceyhan reported that postoperative pain was reduced by administrating local infiltration anesthesia both intraperitoneally and directly to the port wound. Parsanezhad et al reported that locally infiltrating anesthetics intraperitoneally administered when performing diagnostic laparoscopy for unexplained infertility can effectively relieve pain. Jimenez et al reported that the combination of local infiltration anesthesia to the port wound site preoperatively and intraperitoneal administration postoperatively reduced postoperative pain and opioid usage. In contrast, several studies demonstrated that administration of local infiltration anesthesia to the port wound did not reduce postoperative pain.

In Japan, facilities expecting the analgesic effect after laparoscopic surgery and administering local infiltration anesthesia to the wound have already been found; however, studies on local anesthetics are limited in Japan. In this study, we conducted a randomized control study of local anesthesia in gynecological laparoscopic surgery to analyze effects of local infiltration anesthesia on postoperative pain. We also investigated the effects of anesthesia in various kinds of laparoscopic surgeries in the field of gynecology.

2 | MATERIALS AND METHODS

2.1 | Patients and selection

Patients who underwent laparoscopic surgeries due to gynecologic benign diseases or endometrial cancer in the early stage in Kawasaki Medical School Hospital and Okayama Ofuku Clinic from June 2015 to January 2017 were enrolled in this study. All patients aged ≥18 years and had no allergies to local anesthesia; all agreed to participate in this study. As a result, patients who used epidural anesthesia in addition to general anesthesia, those who underwent laparotomy were not included in the study. This study was approved by the ethical review board of Kawasaki Medical School (No.2082). A clinical trial registration (number: UMIN000022412) was also obtained. Written informed consent was obtained from all patients enrolled in the study.

2.2 | Study protocol

We conducted a randomized controlled trial on the local infiltration anesthesia after a laparoscopic surgery in this study. The enrolled patients were divided into intervention and control groups using the envelope method. Patients in the intervention group were injected with 2 mL of 0.5% levobupivacaine (POPCSAIN®; Maruishi Pharmaceutical Co., Ltd., Osaka city, Japan) using a 25G needle per 1 cm of wound into the muscular fasciae at the end of the laparoscopic surgery. Patients in the control group were injected with 2 mL of saline. The pain evaluation after laparoscopic surgery was performed using a Visual Analogue Scale (VAS) at 1 hour and 2 hours postoperatively. VAS exhibits the strongest pain as 10 and the weakest pain as 0. The primary outcome is the dosage of analgesic consumption within 12 hours postoperatively because it can be measured objectively and we avoided to disturb the rest of the patient. Secondary outcomes are the VAS scores 1 or 2 hours postoperatively and analgesic use or nonuse. We also examined the adverse effects of local infiltration anesthesia, such as local bleeding, allergic reaction, and damage to the organs.

Laparoscopic surgeries were performed under general anesthesia without an epidural or PCA. The location of trocars in total laparoscopic hysterectomy (TLH) or TLH with pelvic lymph node dissection (PLD), ovarian cystectomy, and salpingo-oophorectomy (SO) was one trocar (12 mm) from the umbilicus and three trocars (5 mm) at the right, left, and middle of the lower abdomen. The location of trocars in myomectomy was one trocar (12 mm) at the left lower abdomen and three trocars (5 mm) at the right lower abdomen, umbilicus, and beside the umbilicus. When patients had postoperative pain, intravenous acetaminophen, intravenous pentazocine, or anal dicylofenac was administered.

We analyzed the effects of local anesthesia in the subgroups of laparoscopic surgeries. Gynecological laparoscopic surgeries were divided into four groups depending on the degree of operative invasion: laparoscopic surgery of the ovary and fallopian tube (Group 1), laparoscopic myomectomy (LM; Group 2), laparoscopically assisted vaginal hysterectomy (LAVH; Group 3), and TLH or TLH+PLD (Group 4).

2.3 | Statistical analysis

The Student’s t test was performed for the analysis of analgesic consumption within 12 hours postoperatively, VAS in 1 and 2 hours postoperatively, and the number of days of hospitalization. The chi-squared test was performed for analgesic use or nonuse. Statistical analysis was performed using the JMP version 9 program (SAS Institute Inc., Cary, NC, USA). Statistical significance was
considered if $P < 0.05$. The values were represented as mean ± standard deviation.

3 | RESULTS

A total of 322 patients were enrolled in this study and were divided into the intervention (147 patients) and control (147 patients) groups. Two patients dropped out of the study: one was shifted to an open surgery and the other was treated with epidural anesthesia in the intervention group (Figure 1). No serious complications were observed in either group. As shown in Table 1, differences in age, BMI, parity, operation time, and blood loss were not significant between the intervention and control groups. Table 2 demonstrates the operative methods of both groups. No significant difference was observed in the operative methods between the two groups. As shown in Table 3, no significant difference on the outcome of local anesthesia was found between the two groups. No adverse effects were also found in either group.

As shown in Tables 4 and 5, the difference on the effects of local anesthesia was not significant between Group 1 and Group 2. Table 6 demonstrates that local anesthesia has no positive effects in Group 3. Table 7A demonstrates the effects of local anesthesia in Group 4. The dosage of analgesic consumption within 12 hours postoperatively in the intervention group was significantly smaller.
than that in the control group \((P = 0.003)\). The difference on analgesic use or nonuse within 12 hours postoperatively was also significant between the two groups \((P = 0.003)\) in Group 4. The VAS score at 1 hour and 2 hours postoperatively in the intervention group was lower than that in the control group in Group 4, but not significant. The time to initial use of analgesics in Group 4 in the control group was significantly shorter than that in the intervention group \((p = 0.003)\). We divided Group 4 into TLH and TLH+PLD. Tables 7B and 7C demonstrate the effects of local anesthesia on patients who underwent TLH and TLH+PLD, respectively.

### TABLE 3  Results of all laparoscopic surgeries in this study

|                          | Intervention group \((N = 147)\) | Control group \((N = 147)\) | \(P\) value |
|--------------------------|-----------------------------------|-----------------------------|-------------|
| Analgesic consumption within 12 h after surgery (time) | 1.6 ± 1.0 | 1.6 ± 1.0 | 0.481 |
| Analgesic use or nonuse within 12 h after the surgery (use/overall) | 124/147 | 123/147 | 0.873 |
| VAS in 1 h after surgery | 4.5 ± 3.2 | 4.3 ± 3.1 | 0.340 |
| VAS in 2 h after surgery | 2.8 ± 3.2 | 2.6 ± 2.7 | 0.230 |
| Hospitalization (days) | 3.6 ± 1.1 | 3.6 ± 1.2 | 0.451 |
| Time to initial use of analgesic (min) | 152.3 ± 246.9 | 160.5 ± 248.8 | 0.389 |

### TABLE 4  Results of surgeries of the ovary or the fallopian tube (Group 1)

|                          | Invention group \((N = 54)\) | Control group \((N = 54)\) | \(P\) value |
|--------------------------|-------------------------------|-----------------------------|-------------|
| Analgesic consumption within 12 h after surgery (time) | 1.2 ± 0.8 | 1.1 ± 1.0 | 0.494 |
| Analgesic use or nonuse within 12 h after surgery (use/overall) | 41/54 | 35/54 | 0.206 |
| VAS in 1 h after surgery | 3.7 ± 2.4 | 4.1 ± 2.6 | 0.201 |
| VAS in 2 h after surgery | 2.1 ± 2.2 | 2.1 ± 2.2 | 0.498 |
| Hospitalization (days) | 3.3 ± 1.4 | 3.0 ± 1.1 | 0.085 |
| Time to initial use of analgesic (min) | 215.3 ± 292.3 | 288.4 ± 323.5 | 0.111 |

### TABLE 5  Results of surgeries of laparoscopic myomectomy (Group 2)

|                          | Invention group \((N = 49)\) | Control group \((N = 35)\) | \(P\) value |
|--------------------------|-------------------------------|-----------------------------|-------------|
| Analgesic consumption within 12 h after surgery (time) | 1.7 ± 0.9 | 1.5 ± 0.9 | 0.135 |
| Analgesic use or nonuse within 12 h after surgery (use/overall) | 44/49 | 29/35 | 0.223 |
| VAS in 1 h after surgery | 4.2 ± 3.4 | 2.8 ± 2.7 | 0.026 |
| VAS in 2 h after surgery | 2.3 ± 2.5 | 1.8 ± 2.1 | 0.184 |
| Hospitalization (days) | 3.7 ± 0.9 | 3.5 ± 1.4 | 0.167 |
| Time to initial use of analgesic (min) | 100.5 ± 190.3 | 145.4 ± 228.1 | 0.164 |

### TABLE 6  Results of laparoscopically assisted vaginal hysterectomy (Group 3)

|                          | Invention group \((N = 34)\) | Control group \((N = 43)\) | \(P\) value |
|--------------------------|-------------------------------|-----------------------------|-------------|
| Analgesic consumption within 12 h after surgery (time) | 2.5 ± 0.9 | 2.3 ± 0.9 | 0.127 |
| Analgesic use or nonuse within 12 h after surgery (use/overall) | 33/34 | 43/43 | 0.257 |
| VAS in 1 h after surgery | 6.3 ± 3.3 | 5.4 ± 3.3 | 0.121 |
| VAS in 2 h after surgery | 4.4 ± 5.0 | 2.9 ± 3.1 | 0.047 |
| Hospitalization (days) | 3.8 ± 0.6 | 4.0 ± 0.8 | 0.147 |
| Time to initial use of analgesic (min) | 45.4 ± 60.4 | 35.0 ± 21.1 | 0.146 |
addition, we analyzed the time to initial usage of analgesics for the four groups in the control group. The time to initial use of analgesics in Group 1, Group 2, Group 3 and Group 4 in the control group were 288.4 ± 323.5 minutes, 145.4 ± 228.1 minutes, 35.0 ± 21.1 minutes, and 94.7 ± 72.4 minutes, respectively. The time to initial use of analgesics in Group 2 was significantly shorter than that in Group 1 (P = 0.012), and that in Group 4 was also significantly shorter than that in Group 1 (P = 0.012). The difference in the time to initial use of analgesics was not significant between Groups 3 and 4.

### DISCUSSION

In this study, we investigated the effectiveness of local anesthesia in reducing postoperative pain in gynecological laparoscopic surgery. The difference on the outcomes of local anesthesia was not significant between the intervention and control groups in all gynecological laparoscopic surgeries in the study. The effect on pain relief of local anesthesia is controversial in gynecological laparoscopic surgery. Recently, a meta-analysis on local infiltration anesthesia demonstrated that it was effective 6 hours postoperatively, but not 24 hours postoperatively. This meta-analysis was conducted mainly on patients who underwent adnexal surgeries, who generally had low surgical stress. We divided gynecological laparoscopic surgeries into four groups depending on the degree of operative invasion. The results of the meta-analysis were different from those of this study, because the latter was conducted on patients who underwent ovarian or fallopian tube surgeries. The reason for the discrepancy was unknown; however, one possible reason is that it was difficult to make a significant difference between the intervention and control group because laparoscopic surgery in the ovary or fallopian tube might be less invasive and induce less pain.

Although local anesthesia did not affect VAS on postoperative pain, the dosage of analgesic consumption and the frequency of analgesic use within 12 h after surgery were significantly lower in the intervention group than in the control group.
analgesic use within 12 hours postoperatively in Group 4 in the intervention group were significantly lower than those in the control group. The time to initial use of analgesic in Group 4 in the intervention group was significantly longer than that in the control group. These data indicate that Group 1 experienced significantly less pain than Groups 3 and 4 had. In general, surgical stress is considered to be highest in Group 4 and minimally invasive in Group 1.

The results of our study demonstrate that local infiltration anesthesia might be more effective in reducing postoperative pain in more invasive laparoscopic surgeries such as HT and oncological surgery (Group 4). Although the reason is uncertain, local anesthesia might possibly reduce the pain in the skin and fascia of the port wound site, which may lead reduced analgesic consumption and number of analgesic users. Further investigations would be needed to demonstrate the mechanism of pain relief of local infiltration anesthesia in more invasive laparoscopic surgeries.

The dosage of analgesics used by the patients in the intervention group was significantly lower than that in the control group in laparoscopic hysterectomy and laparoscopic oncological surgeries; however, the difference in VAS between 1 and 2 hours postoperatively was not significant. This might be due to the fact that patients were treated with analgesic whenever they felt pain in this study. Patients may possibly use an analgesic 1 hour and 2 hours postoperatively. The difference in the number of days of hospitalization was not significant between the two groups in the laparoscopic hysterectomy/oncological surgery. Because hospitalization days for laparoscopic surgery have already become shorter, making it shorter than they are at the current condition is difficult.

After a meta-analysis report in 2012, several studies on local infiltration anesthesia have been conducted. The bupivacaine infiltration to the trocar wound after a laparoscopic surgery did not reduce the pain score significantly compared with the non-administered group. The administration of peritoneal ropivacaine nebulization was effective to reduce postoperative pain. Studies on pain control by local infiltration anesthesia were still controversial. Further investigations will be necessary to reveal the effects of local anesthesia in gynecological surgeries.

In conclusion, the local infiltration anesthesia can effectively reduce postoperative pain after laparoscopic hysterectomy and laparoscopic oncological surgery. In addition to a conventional analgesic, using local infiltration anesthesia may improve the patient’s quality of life.

A meta-analysis demonstrated effectiveness of local anesthesia on minimally invasive surgery, however, this study could not confirm the effect of local infiltration anesthesia on minimally invasive surgery. Further investigations would be necessary to clarify the usefulness of local anesthesia in laparoscopic surgeries.

ACKNOWLEDGEMENTS

This work was supported, in part, by the clinical research grant of the Society of Obstetrics and Gynecology in Chugoku and Shikoku Regions. The authors declare to have no potential conflicts of interest. The contribution of each author is as follows: study construction (MH, MS, and KS), data sampling (MH, TM, YM, TO, YH, RS, TN, and MS), statistical analysis (MH, YH, MS, and KS), data analysis (MH, MS, and KS), and manuscript production (MH, MS, and KS).

DISCLOSURES

Conflict of interests: Mika Sugihara, Takahito Miyake, Yasunari Miyagi, Takashi Oda, Yukiko Hazama, Rikiya Sano, Takafumi Nakamura, Mitsuru Shiota, and Koichiro Shimoya, declare to have no conflict of interest. Human rights statements and informed consent: This article does not contain any studies with human and animal subjects performed by the any of the authors. Animal studies: All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the 1964 Helsinki Declaration and its later amendments. Informed consent was obtained from all patients for being included in the study. The protocol for the research project including human subjects has been approved by a suitably constituted Ethics Committee.

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REFERENCES

1. Berek JS, Novak E, Berek DL. Berek & Novak’s Gynecology. 15th ed. Jonathan S. Berek; editorial assistant & design, Deborah L. Berek; illustrations by Timothy C. Hengst, George Barile, eds. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins; 2012. xix, 1539 pp.
2. Hsien CF, Wang CL, Long CY, et al. Factors associated with types and intensity of postoperative pain following gynecological laparoscopic surgery: a cross-sectional study. Biomed Res Int. 2017:2017:2470397.
3. Marks JL, Ata B, Tulandi T. Systematic review and metaanalysis of intraperitoneal instillation of local anesthetics for reduction of pain after gynecologic laparoscopy. J Minim Invasive Gynecol. 2012;19(5):545-553.
4. Wheatley SA, Millar JM, Jadad AR. Reduction of pain after laparoscopic sterilisation with local bupivacaine: a randomised, parallel, double-blind trial. Br J Obstet Gynaecol. 1994;101(5):443-446.
5. Fiddes TM, Williams HW, Herbison GP. Evaluation of post-operative analgesia following laparoscopic application of Filshie clips. Br J Obstet Gynaecol. 1996;103(11):1143-1147.
6. Ke RW, Porteria SG, Lincoln SR. A randomized blinded trial of preemptive local anesthesia in laparoscopy. Prim Care Update Ob Gyns. 1998;5(4):197-198.
7. Pellicano M, Zullo F, Di Carlo C, Zupi E, Nappi C. Postoperative pain control after microlaparoscopy in patients with infertility: a prospective randomized study. Fertil Steril. 1998;70(2):289-292.
8. Ceyhan T, Teksoz E, Gungor S, Goktolga U, Pabuccu R. Effect of bupivacaine after operative laparoscopic gynecologic procedures. J Minim Invasive Gynecol. 2005;12(4):326-329.
9. Parsanezhad ME, Lahsaei M, Alborzi S, Vafaei H, Schmidt EH. Comparative, double-blind, randomized, placebo-controlled trial of intraperitoneal bupivacaine and lidocaine for pain control after diagnostic laparoscopy. J Am Assoc Gynecol Laparosc. 2003;10(3):311-315.

10. Jimenez Cruz J, Dieboldier H, Dogan A, et al. Combination of preemptive port-site and intraoperative intraperitoneal ropivacaine for reduction of postoperative pain: a prospective cohort study. Eur J Obstet Gynecol Reprod Biol. 2014;179:11-16.

11. Fong SY, Pavy TJ, Yeo ST, Paech MJ, Gurrin LC. Assessment of wound infiltration with bupivacaine in women undergoing day-case gynecological laparoscopy. Reg Anesth Pain Med. 2001;26(2):131-136.

12. Ghezzi F, Cromi A, Bergamini V, et al. Preemptive port site local anesthesia in gynecologic laparoscopy: a randomized, controlled trial. J Minim Invasive Gynecol. 2005;12(3):210-215.

13. Tam T, Harkins G, Wegrzyniak L, Ehrgood S, Kunselman A, Davies M. Infiltration of bupivacaine local anesthetic to trocar insertion sites after laparoscopy: a randomized, double-blind, stratified, and controlled trial. J Minim Invasive Gynecol. 2014;21(6):1015-1021.

14. Shibuya F, Taketani T, Fujimura T, Sueoka K, Tamura H, Sugino N. The analysis of pain relief effect of local anesthesia infiltration in laparoscopic surgery. Obstet Gynecol Pract. 2017;66(5):663-666.

15. Somaini M, Brambillasca P, Ingelmo PM, et al. Effects of peritoneal ropivacaine nebulization for pain control after laparoscopic gynecologic surgery. J Minim Invasive Gynecol. 2014;21(5):863-869.

How to cite this article: Sugihara M, Miyake T, Miyagi Y, et al. Does local infiltration anesthesia on laparoscopic surgical wounds reduce postoperative pain? Randomized control study. Reprod Med Biol. 2018;17:474–480. https://doi.org/10.1002/rmb2.12224