Evaluation of Usefulness of Epidural Anesthesia in Gynecologic Laparoscopic Surgery in Comparison to General Anesthesia

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Abstract

This study was designed to evaluate the usefulness and advantages of epidural anesthesia in gynecologic laparoscopic surgery in comparison to general anesthesia. It included 40 patients undergoing laparoscopic surgery who were randomly administered epidural anesthesia (group A, n = 20) or general anesthesia (group B, n = 20). The operation was performed under 6 mmHg pneumoperitoneum and in the 20^o Trendelenburg (Tr) position. Respiratory function tests using a spirometer and blood gas analysis were performed during the intra- or perioperative period. Pain status including abdominal and shoulder pain was evaluated with visual analog scale scoring. The number of postoperative recovery days needed to resume daily activities was obtained by a questionnaire. Respiratory rate, minute volume, $PaCO_2$, vital capacity (VC), and forced expiratory volume in 1 s (FEV1) % were virtually constant throughout the study period in group A, whereas VC was decreased immediately after operation in group B ($P<0.05$). Minute volume immediately after operation was significantly increased in group B compared with group A ($P<0.01$), suggesting shallow respiration in women under general anesthesia. Observed pain scores on abdominal pain and shoulder pain were very low during operation in group A. Pain scores immediately and 3 hours after operation were also minimal in group A, whereas abdominal pain scores at these points were significantly higher in group B than those in group A (both $P<0.01$). The number of days required for a half reduction in wound pain, trotting, and full recuperation for group A were less than those for group B ($P<0.05$). It could be concluded that epidural anesthesia, when used in gynecologic laparoscopic surgery, has advantages over general anesthesia in terms of analgesic effects, postoperative respiratory function, and return to normal daily activities.

Introduction

An advantage of laparoscopic surgery is the reduction of surgical trauma, resulting in less pain and less impairment of postoperative respiratory function compared to open surgery,[1]. In open surgery, epidural anesthesia has been shown to relieve postoperative pain, improve diaphragmatic function, and reduce the probability of hypoxemia, with a consequent reduction of postoperative respiratory morbidity compared with general anesthesia,[2]. However, the advantages of epidural anesthesia observed in open surgery cannot be translated to laparoscopic surgery due to particular maneuvers inherent in

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laparoscopic surgery, which include pneumoperitoneum and the Trendelenburg position, known factors affecting cardiovascular and respiratory function, [(3)]. In gynecologic laparoscopy, some studies reported that epidural anesthesia provided smoother postanesthetic recovery and a lower rate of complications than general anesthesia in laparoscopic tubal sterilization, [(4)]. ***Ciofolo et al.***, [(5)] ***showed*** that laparoscopy for gamete intrafallopian transfer performed under epidural anesthesia was not associated with ventilatory depression. These studies imply that epidural anesthesia may be the alternative to general anesthesia in laparoscopy, at least for simple procedure, and short duration operations.

This study evaluates usefulness of epidural anesthesia in gynecologic laparoscopic surgery, focusing on the respirocirculatory functions during and after operation. We also compared pain status including shoulder pain, abdominal pain and postoperative recovery in comparison to general anesthesia.

Patients and methods

After approval of the study protocol and informed consent, a total of 40 ASA status I,II women scheduled for gynecologic laparoscopic surgery were randomized into two groups; group (A) (n=20 patients) prepared for epidural anesthesia and group (B) (n=20 patients) prepared for general anesthesia. Respiratory function tests using a mobile spirometer were performed in the horizontal supine (Su) position at rest and in the 20^{o} head-down Trendelenburg position 15 min later. On the morning of operation, all patients were premedicated with an intramuscular injection of atropine sulfate (0.5 mg) and midazolam (0.05 mg/kg) 30 min before surgery. In the operation room, an epidural catheter was inserted in group (A) via the L1–L2 or L2–L3 interspace using the loss of resistance technique and advanced 5 cm cephalad. The position of the catheter was tested with 3ml of xylocaine with adrenaline 5 µg/ml (1/200.000) to exclude subarachnoid or intravascular insertion. Then, 10–15 ml of 0.5% bupivacaine was injected initially. Subsequently, additional doses of bupivacaine were given when needed. We called this point AnSu (Anesthesia in Supine position). In group B, general anesthesia was induced with thiopental (5 mg/kg) after vecuronium (0.1 mg/kg i.v.) was administered to facilitate tracheal intubation. Anesthesia was maintained with 100% O2 and isoflurane (1-2% MAC).

Ventilation was adjusted to maintain the end-tidal CO_2 between 32 and 40 mmHg. Fifteen minutes later, patients in both groups were placed in the 20° head-down Trendelenburg position (AnTr). Then, the operation was started. We maintained pneumoperitoneal pressure at 6 mmHg so as not to interfere with both spontaneous ventilation and operative procedures. The time points of 10 and 30 min after the start of pneumoperitoneum were abbreviated TrPn10 (Trendelenburg pneumoperitoneum at 10 minutes) and TrPn30 (Trendelenburg pneumoperitoneum at 30 minutes) respectively. The time points in a recovery room and 3hours after operation were abbreviated Re and 3H respectively. Respiratory function tests were performed at Su, Tr, AnSu, AnTr, TrPn10, TrPn30, Re, and 3H in group A and at Su, Tr, Re, and 3H in group B. Visual analog scale (VAS) scoring was performed at AnSu, AnTr, TrPn10, TrPn30, Re, and 3H in group A and at Re and 3H in group B.

The following parameters were used for evaluation of respiratory functions: respiratory rate, minute volume, VC, FEV1%, and $PaCO_2$. All parameters were measured using a mobile spirometer. All patients received a chest x-ray examination 24 hours postoperatively for early detection of respiratory complications. It has been reported that intraoperative VAS scoring is affected by emotional experiences that cannot be assessed objectively, [6]. To eliminate emotional factors as much as possible, patients were asked to assess pain with a focus on abdominal pain and shoulder pain. In both groups, VAS using a 10-cm scale was measured. The early recovery stage was evaluated using a questionnaire that asked for the time to first flatus and more than half of usual food intake. The late recovery stage was evaluated using a questionnaire that asked for the number of postoperative days needed for complete relief of shoulder pain, wound pain relief by half, complete relief of wound pain, trotting, and full recuperation (i.e., resumption of daily activities equivalent to the preoperative status). The questionnaires were given to patients before operation and were collected from the patients within 2 week after operation.

All values are expressed as mean ± standard deviation. For statistical analysis of respiratory functions and pain scores along the time course for each group, we used one way analysis of variance (ANOVA). For statistical analysis to compare respiratory functions and pain scores between group A and group B, we used Student's t-test if the interaction was negative. For statistical analysis of variables on the questionnaire, we used Student's t-test. P<0.05 was considered statistically significant.

Results

Characteristics of the subjects are shown in (Table 1). There were no statistical differences in age, body mass index, anesthesia time, and operation time between group A and group B. Blood loss was small in both groups. In all patients in group A, epidural anesthesia reached a level higher than Th8. They displayed no abnormal findings on postoperative chest x-ray photography and were discharged uneventfully on postoperative day 0 or 1.

(Table 2) shows the results of respiratory function tests. Respiratory function tests were not feasible in group B during operation. All mean values of respiratory parameters were within the normal range during the operative and perioperative study period for both groups. Regarding time course variation for each parameter, only VC showed variation in group B, with a significant decrease in Re compared to Tr (P<0.05). In group A, all parameters were virtually constant throughout the perisurgical period. Between group comparisons for each parameter demonstrated that a significant difference was observed only in minute volume at Re, with the value being higher for group B than for group A (P < 0.01). Neither blood pressure nor pulse rate showed significant variation for both groups (data not shown).

(Table 3) shows pain scores for group A during and after operation and those for group B after operation. Abdominal pain scores for group A were maximum at TrPn30 (0.9 ± 1.1). Shoulder pain scores reached the maximum at TrPn30 (1.4 ± 1.6). Abdominal pain scores were significantly lower for group A than those for group B at Re and 3H (P<0.0 l).

The parameters for postoperative recovery status are shown in (Table 4, Fig.2). Group A required fewer days than group B for a half reduction in wound pain, trotting, and full recuperation (P<0.05).

Discussion

This study explored the usefulness of epidural anesthesia in laparoscopic gynecologic surgery. Analysis of pain scoring showed that epidural anesthesia satisfactorily relieved intra-operative abdominal and shoulder pain. The respire-circulatory status as evaluated by the parameters of VC, FEV, and $PaCO_2$ was substantially stable during operation, with 6 mmHg pneumoperitoneum and the Trendelenburg position. Few data are available about the influence of the Trendelenburg position on respiratory functions. ***Scott & Slawson***, [7] detected no significant change in minute volume, $PaCO_2$ and pH of blood during gynecologic open surgery under epidural anesthesia at the horizontal and 30° Trendelenburg position. ***Ciofolo et al.***, [5] reported that respiratory functions during gamete intrafallopian transfer using laparoscopy and epidural anesthesia demonstrated that ventilatory parameters were not different in the 20° Trendelenburg position compared to the horizontal supine position. Our study further elucidated that the 20° Trendelenburg position did not affect respiratory functions even with the use of 6 mmHg pneumoperitoneum for 30 min.

Galizia et al., [8], reported that pneumoperitoneum affects respirocirculatory functions. More precisely, pneumoperitoneum at 11–13mmHg was shown to increase pulmonary capillary wedge pressure, central venous pressure, and mean arterial pressure. Head down tilt further increases these pressures, [9]. In addition, ***Lister et al***, [10] reported that $PaCO_2$ increases with an increase in intraperitoneal insufflation pressure. Although these findings were observed under general anesthesia with mechanical ventilation, it is likely that impaired respirocirculatory function may occur under epidural anesthesia coupled with pneumoperitoneum. However, we found that respiratory functions were almost stable even after 30 min pneumoperitoneum in the Trendelenburg position. ***Gramatica et al.***, [11], has shown that laparoscopic surgery conducted under epidural anesthesia combined with pneumoperitoneum at 8 mmHg is frequently associated with dyspnea. Therefore, the low pressure may contribute to the observed stable respirocirculatory functions. Despite the low-pressure pneumoperitoneum, a significant decrease in VC in recovery room (Re) compared to Trendelenburg position was observed in group B. In addition, minute volume at Re was significantly increased in group B compared to group A. The increase in minute volume is suggested to reflect shallow respiration with increased flow in the dead space fraction. The decrease in VC and shallow respiration may be induced by pain stimulation because postoperative pain scores with general anesthesia were significantly higher than those with epidural anesthesia.

Similar postoperative impairment of lung function is well-known in open surgery under general anesthesia, (12). No data are available concerning the appropriate levels of epidural anesthesia in gynecologic laparoscopic surgery. In laparoscopic cholecystectomy, a good analgesic effect was obtained with epidural anesthesia up to the level of Th7 with concurrent general anesthesia, (11).

Our data suggest that epidural anesthesia up to the level of Th8 provides enough analgesic for gynecologic laparoscopic surgery. An interesting finding in our study was that postoperative recovery, as evaluated by the number of days needed for a half reduction in wound pain, trotting, and full recuperation, was shorter for group A than for group B. In the postoperative period, mean abdominal pain scores for group B at Re and 3H were significantly higher than those for group A. A widely believed concept is that pain stimulates the release of pain causing noxious substances that in turn amplifies pain perceptions, (13). Given this, favorable postoperative pain control with epidural anesthesia can be explained, in part, by earlier postoperative pain relief in cases of epidural anesthesia versus general anesthesia.

In conclusion, epidural anesthesia is useful in laparoscopic surgery, providing sufficient pain control and good postoperative recovery compared to general anesthesia.

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Table (1): Demographic Data and Operation Time

	Group A	Group B
No.	20	20
Age (yr)	33.0 ± 3.4	32.0 ± 3.5
Body mass index (kg/m^2)	20.6 ± 1.9	20.8± 2.8
Anesthesia time, min (range)	149.0 ± 50.0 (135–235)	139.7 ± 39.6 (70–210)
Operation time, min (range)	72.6 ± 42.6(37–25)	68.7 ± 31.2 (42–135)

Table (2): Results of Respiratory Function Tests

	Group	Su	Tr	AnSu	AnTr	TrPn10	TrPn30	Re	3H
Respiratory rate (times/min)	A	13.1± 3.8	12.2±4.8	11.8 ± 3.7	11.5 ± 3.4	14.3 ± 4.5	13.5 ± 2.9	10.5 ± 4.7	12.6 ± 5.1
	B	14.0± 2.4	14.1±2.3	-	-	-	-	16.3 ± 5.3	15.7 ± 4.0
Minute volume (L/min)	A	3.4± 0.9	3.7±1.3	2.8 ± 0.9	3.3 ± 0.9	4.0 ± 1.2	3.8 ± 1.2	2.8 ± 0.7**	3.3 ± 0.7
	B	4.6± 0.9	4.9±1.1	-	-	-	-	5.4 ± 1.5	4.4 ± 1.1
$PaCO_2$ (mmHg)	A	38.8± 2.6	-	41.4 ± 5.3	41.4 ± 2.9	41.9 ± 3.8	41.7 ± 3.4	40.1 ± 3.3	38.4 ± 3.3
	B	40± 1.4	-	-	-	-	-	41.1 ± 4.2	40.4 ± 1.6
VC	A	108.9± 11.6	107.8± 17.9	98.4 ± 12.3	100.2± 11.4	95.8 ± 11.4	99.2 ± 19.2	99.3 ± 17.7	99.9 ± 16.7
	B	111.5± 14.6	116.5± 18.6	-	-	-	-	89.1 ± 22.2*	98.1 ± 28.2
FEV1%	A	78.2±8.5	78±6.5	72.6 ± 7.6	73.5 ± 7.5	74.3 ± 10.4	77.1 ± 8.3	75.5 ± 9.9	73.3 ± 9.7
	B	77.8±8.3	77.5± 10.1	-	-	-	-	77.6 ± 10.3	77.0 ± 8.2

Su, Supine; **Tr**, Trendelenburg position; **An**, anesthesia; **Pn**, pneumoperitoneum; **Re**, recovery room; **3H**, 3 h after operation

*P<0.05 vs Tr

**P<0.01 vs group B

Table 3. Pain Scores During and After Operation in Studied Groups

	Group	AnSu	AnTr	TrPn10	TrPn30	Re	3H
Abdominal pain (cm/10 cm)	A	-	-	0.4±1.1	0.9±1.1	0.5±1.0*	0.2±0.3*
	B	0.4±0.9	0.7±1.4			3.8±2.1	2.4±1.5
Shoulder pain (cm/10 cm)	A	-	-	1.2±1.5	1.4±1.6	0.6±0.9	0.2±0.4
	B	-	-			0.2±0.7	0.2±0.7

Data are presented as mean ± SD

An, anesthesia; **Su**, Supine; **Tr**, Trendelenburg position; **Pn**, pneumoperitoneum; **Re**, recovery room; **3H**, 3 h after operation.

*P<0.01 vs group B

Table 4. Comparison of time from operation to events between the epidural anesthesia group (A) and the general anesthesia group (B)

Event	Group A	Group B	P value
First flatus (h)	16.3±4.9	16.4±4.0	0.74
Food intake (>50% of usual (h)	22.4±4.4	27.3± 13.7	0.37
Discharge (d)	1	1	NA†
Shoulder pain, complete relief (d)	0.4±0.79	1.0±1.7	0.54
Wound pain, a half reduction (d)	0.86±0.9	2.3±1.5	0.038*
Wound pain, complete relief (d)	3.9±1.8	5.1±2.3	0.64
Trotting (d)	4.4±1.4	6.3±1.6	0.025*
Full recuperation (d)	4.7±1.5	6.6± 1.9	0.041*

* Significant values †:Not Applicable.

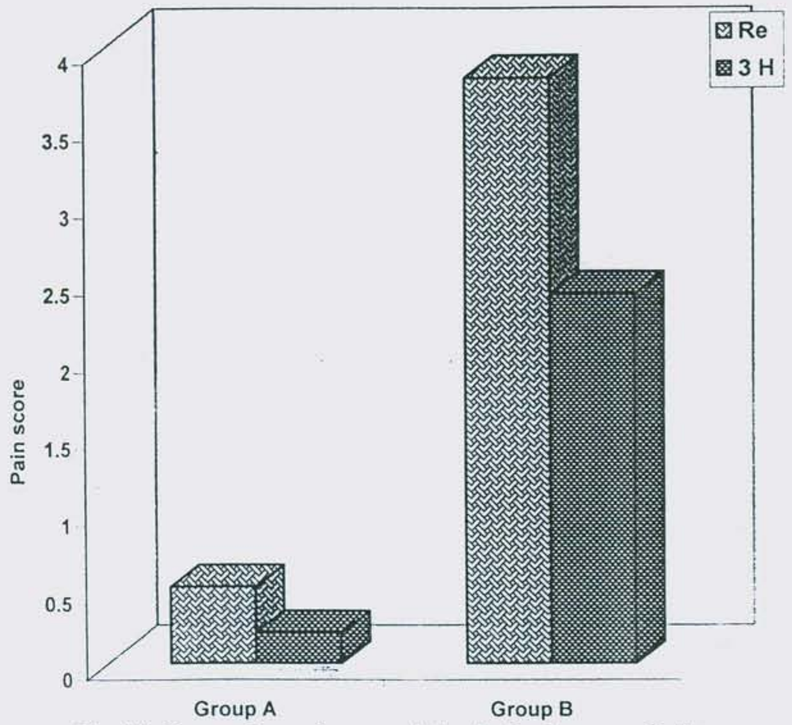

Fig. (1): Comparison of mean abdominal pain scores in the recovery (Re) and 3 hours (3H) postoperative periods in both groups

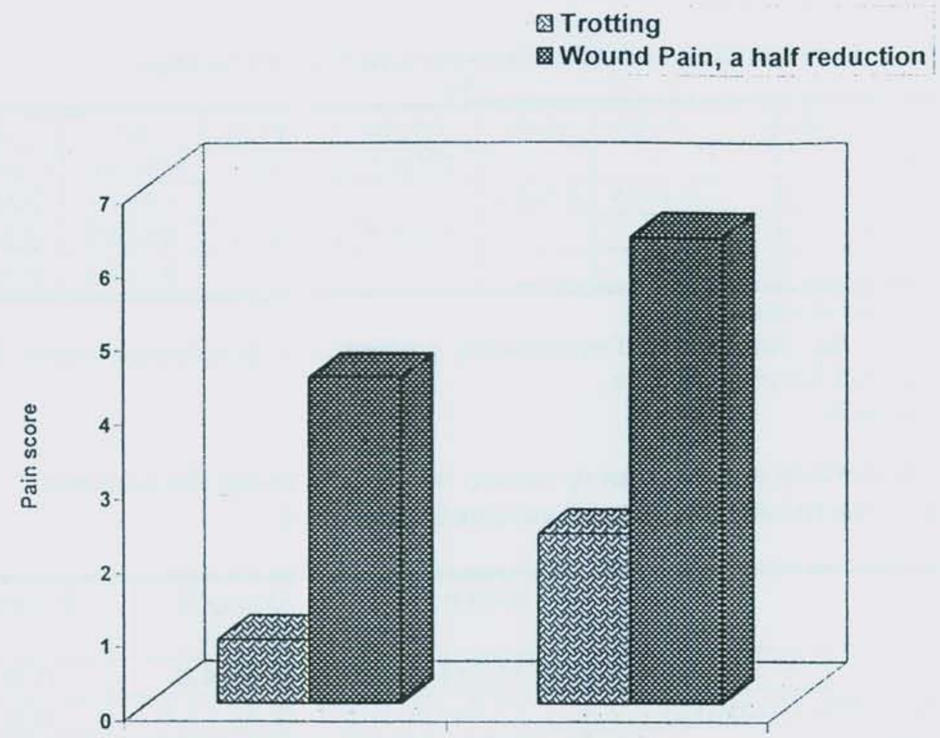

Fig. (2): Comparison of group A & B regarding trotting and wound pain (a half reduction)