Effectiveness of Intraperitoneal Bupivacaine in Reducing Postoperative Morphine Used among Total Abdominal Hysterectomy Patients at Phramongkutklao Hospital

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Objective: *To study the effectiveness of intraperitoneal bupivacaine in reducing 24-hour postoperative morphine used in women underwent total abdominal hysterectomy.*

Material and Method: *Sixty-two non-malignant gynecologic patients, aged 25 to 65 years, ASA class I-II, underwent elective total abdominal hysterectomy. On the operative day, patients were allocated simple random sampling. Blinded intraperitoneal solution was prepared and numbered for each patient. In total, 40 ml of 0.25% bupivacaine solution or normal saline was applied in the pelvic cavity after completed the operation. The abdominal muscle and subcutaneous fat were infiltrated with 0.25% bupivacaine 10 ml each layer. Intravenous morphine patient-controlled analgesia (PCA) was started in the recovery room. The assessment of total morphine used, sedative score, numerical rating score (NRS) for pain, postoperative nausea vomiting (PONV), pruritus, and the number of vomiting and antiemetic drugs used were recorded at 1, 2, 4, 8, 12, and 24 hours after intraperitoneal administration. Patients' satisfactory NRS was evaluated after PCA cessation. Repeated measure ANOVA was used to compare means between two groups. Baseline characteristics were calculated by descriptive statistics, i.e., mean, standard deviation, median, and range. A p-value less than 0.05 was considered statistically significant. Statistical package for the social sciences (SPSS) for Windows version 23 was used.*

Results: *There were no significant differences were found between the two groups in general patients' characteristics, intraoperative data, and anesthetic administration. Total morphine consumption at 24 hours after intraperitoneal administration was significantly less in the bupivacaine group than the saline group (25.03 vs. 16.13, p = 0.002). Lower pain score at 1 and 2 hours and significant difference in reduced morphine consumption were observed within the first 4 hours after intraperitoneal bupivacaine administration. Postoperative 24 hours satisfactory score, PONV, pruritic score, overall incidences of vomiting and antiemetic use were similar in both groups. Sedative scores were lower in the bupivacaine group except at 1 and 24 hours postintraperitoneal administration. No evidence of local anesthetic toxicity or operative complication was identified.*

Conclusion: *Administration of intraperitoneal and incisional 0.25% bupivacaine at the completion of total abdominal hysterectomy produced a significant reduction in 24-hour postoperative morphine used without adverse effect.*

Keyword: *Pain, Total abdominal hysterectomy, Bupivacaine, Intraperitoneal local anesthesia, Incisional local anesthesia*

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Total abdominal hysterectomy, the most common gynecologic operation performed[1], is associated with one to four days of moderate to severe postoperative pain[2]. Intravenous opioid is often used for postoperative pain relief. Although morphine is a commonly used opioid providing satisfactory analgesia, adverse effects such as sedation, pruritus, nausea, and vomiting can be found, especially when large amounts are used[3,4]. Multimodal analgesia can reduce these adverse effects[5-7]. Whenever local anesthesia has been administered in the peritoneal cavity during minimally invasive gynecologic procedures such as laparoscopic sterilization and laparoscopic diagnosis as part of the multimodal approach to postoperative pain management, they provided a statistically significant 24-hour morphine-sparing effect compared with placebo[8-15]. The rationale for this administration route is the peritoneum, which is exposed to block visceral nociceptive conduction, thereby providing an additional mechanism of analgesia[14-16]. Kaplan et al[9] showed the difference within-patient pain discrimination, i.e., patients treated with bupivacaine on laparoscopic Falope ring tubal ligation on one side of the tube, reported significantly less pain on the treated side, suggested that the action

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of topical local anesthetic was mediated by local peritoneal effects rather than by systemic absorption.

Total abdominal hysterectomy, a more invasive procedure and a more extensive skin incision, causes much pain[17]. Recent studies have suggested that pain after laparotomy was a composition of parietal pain defined as superficial pain located on the abdominal wall and visceral pain defined as deep, dull, more difficult to localize inside of the abdomen[12,17-22]. Local anesthesia, such as lidocaine and bupivacaine, had been infiltrated subcutaneously or applied intraperitoneally at the end of total abdominal hysterectomy without adverse effect, but in varied degrees of effectiveness. The failure to demonstrate beneficial effects after either an incisional or intraperitoneal administration of local anesthesia might be attributable to the hypothesis that nociceptive transmission needed to be blocked at both cutaneous and visceral sites[5,15,17,21-24].

The objective of the present study was to evaluate the effectiveness of intraperitoneal bupivacaine in decreasing postoperative morphine use among women underwent total abdominal hysterectomy, where parietal pain from the incision site was reduced by incisional bupivacaine infiltration.

Material and Method

After obtaining approval from the Ethics Committee and informed consent of subjects between July 2006 and February 2007, we performed a randomized double-blind placebo-controlled trial at Phramongkutklao Hospital, studying 66 non-malignant gynecologic patients, age 25 to 65 years, ASA class I-II, who underwent elective total abdominal hysterectomy with or without salpingo-oophorectomy and also other additional procedures such as appendectomy. Both Pfannenstiel and low midline incision were included. All patients had no history of asthma, morphine allergy or chronic use of morphine. They were also able to use the numerical rating score (NRS) and patient-controlled analgesia (PCA) device. Patients were excluded when total abdominal hysterectomy or endotracheal tube extubation could not be performed, as well as when the postoperative diagnosis confirmed malignant-gynecologic conditions or the research assessment was incomplete from either patient or PCA device problems. Four patients, two from each group, were excluded because of PCA device problems.

Patients were instructed to use the NRS for postoperative assessment and PCA device for postoperative pain relief on the day before surgery. On the operative day patients were allocated simple random sampling by random number table to receive intraperitoneal bupivacaine (bupivacaine group) or normal saline (control group). Blinded intraperitoneal solution was prepared and marked by number for each patient. Each patient received general anesthesia with routine monitoring including automated blood pressure monitoring, Electrocardiography (ECG), and pulse oximetry. The drugs for premedication, induction, maintenance, muscle relaxation, and reversal were at the discretion of anesthesiologist, although the intraoperative use of morphine was an exception. After completing the procedures, intraperitoneal solution 40 ml was administered to the pelvic cavity before peritoneal closure, and then 0.25% bupivacaine was infiltrated, 10 ml for each layer of muscle and subcutaneous tissue (Table 1).

After endotracheal tube extubation, patients were transferred to the recovery room and received intravenous morphine PCA (loading dose 3 mg, PCA dose 1 mg, lockout time 5 minutes) and monitored vital signs for one hour after transferred to the gynecologic ward. The assessment of total 24-hour morphine used, sedative score and NRS for pain (0 = no pain at all to 10 = the worst pain imaginable), postoperative nausea and vomiting (PONV), and pruritus (0 = no symptoms at all to 5 = the worst symptom imaginable), and number of vomiting and

Table 1. Details of the study

	Normal saline group	Bupivacaine group
1	NSS 40 ml intraperitoneal (pelvic cavity) before peritoneal closure	Bupivacaine 0.25% 40 ml intraperitoneal (pelvic cavity) before peritoneal closure
2	Incision local anesthesia, bupivacaine 0.25% 20 ml infiltrated to muscle and subcutaneous fat before each closure	Incision local anesthesia, bupivacaine 0.25% 20 ml infiltrated to muscle and subcutaneous fat before each closure
3	PCA at recovery room, loading dose 3 mg, PCA dose 1 mg, lockout time 5 minutes for 24 hours postoperation	PCA at recovery room, loading dose 3 mg, PCA dose 1 mg, lockout time 5 minutes for 24 hours postoperation

NSS = normal saline solution; PCA = patient-controlled analgesia

anti-emetic drugs were recorded at 1, 2, 4, 8, 12, and 24 hours after intraperitoneal solution administration. Any complaints during the assessment were also recorded. After 24 hours, PCA was removed and patients were asked to report their satisfaction using NRS (0 = not satisfied at all to 10 = completely satisfied).

Table 2. Baseline characteristics of non-malignant gynecologic patients

	Normal saline (n = 31)	Bupivacaine (n = 31)	*p*-value
Age (years)	44.84±4.52	45.87±4.25	0.359
Weight (kg)	55.67±6.61	55.89±7.86	0.906
Height (cm)	155.45±4.78	156.90±5.62	0.278
Laparotomy history			0.073
No	14 (45.16)	17 (54.84)	
Yes	21 (67.74)	10 (32.26)	
Chief complaint			0.856
Pelvic pain	4 (12.90)	3 (9.68)	
Menorrhagea	14 (45.16)	13 (41.94)	
Dysmenorrhea	2 (6.46)	1 (3.22)	
Pelvic mass	4 (12.90)	7 (22.58)	
Urinary symptoms	7 (22.58)	7 (22.58)	
Postoperative diagnosis			0.483
Myoma uteri	28 (90.32)	25 (80.65)	
Endometriosis	2 (6.46)	5 (16.13)	
Benign ovarian cyst	1 (3.22)	1 (3.22)	

Data were presented as mean ± SD or n (%)

Statistical analysis

To detect 35% reduction of postoperative morphine consumption at 0.05 level of significance (α) with the power of 80, a minimum of 28 patients were required in each group. A sample of this size (n = 31) had a power of 99 (1-tailed, α = 0.05). The data were analyzed using repeated measure ANOVA to compare means between the two groups. Baseline characteristics were calculated by descriptive statistics, i.e., mean, standard deviation, median and range. A *p*-value less than 0.05 was considered statistically significant. Statistical package for the social sciences (SPSS) for Windows version 23 was used.

Results

Sixty-two patients were included with no significant differences in age, weight, height, history of laparotomy, chief complaint, and postoperative diagnosis between the groups (Table 2). In addition, groups were comparable in type of operation, incision, degree of adhesion, estimate blood loss, operative time, anesthetic time, intraoperative fentanyl, and time from intraperitoneal administration to anesthesia stop (Table 3).

Total morphine consumption at 24 hours after intraperitoneal administration was significantly less in the bupivacaine group compared with the normal saline group (Fig. 1). Interval dose of morphine at each time

Table 3. Details of intraoperative data between the two groups

	Normal saline (n = 31)	Bupivacaine (n = 31)	*p*-value
Estimated blood loss (ml)	350 (100-1,500)	400 (100-1,500)	0.702
Operation time (minutes)	125 (85-245)	120 (75-325)	0.341
Anesthetic time (minutes)	167.10±41.42	159.19±51.67	0.509
Intraoperative fentanyl (mcg)	100 (50-300)	100 (50-200)	0.440
Time from intraperitoneal administration to anesthesia stop (minutes)	35 (25-60)	45 (15-60)	0.810
Surgical incision			0.520
Pfannenstiel	24 (77.42)	26 (83.37)	
Low midline	7 (22.58)	5 (16.13)	
Degree of adhesion			0.933
No	19 (61.29)	18 (58.06)	
Mild	8 (25.18)	8 (25.18)	
Moderate	4 (12.90)	5 (16.13)	
Operation			0.658
TAH	6 (19.36)	4 (12.90)	
TAH + appendectomy	4 (12.90)	2 (6.46)	
TAH + USO	3 (9.68)	5 (16.13)	
TAH + USO + appendectomy	1 (3.22)	0 (0.00)	
TAH + BSO	11 (35.48)	15 (48.38)	
TAH + BSO + appendectomy	6 (19.36)	5 (16.13)	

TAH = Total abdominal hysterectomy, USO = Unilateral salpingo-oophorectomy, BSO = Bilateral salpingo-oophorectomy
Data were presented as mean ± SD, median (range), or n (%)

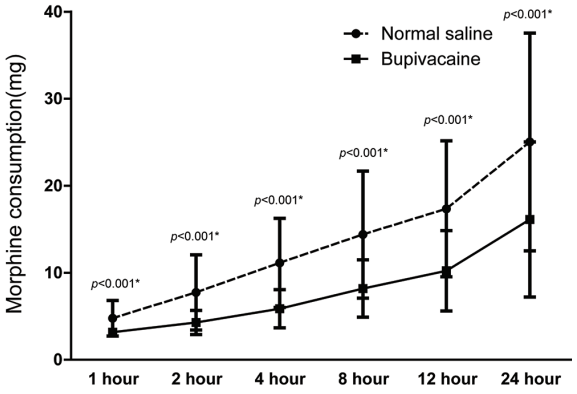

Fig. 1 Morphine consumption at each time interval postintraperitoneal administration, using repeated measure ANOVA to compare mean of the normal saline group with the bupivacaine group.

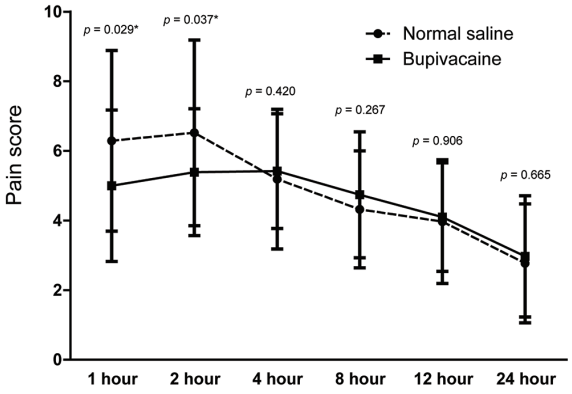

Fig. 2 Pain score at each time interval postintraperitoneal administration, using repeated measure ANOVA to compare means of the normal saline group with the bupivacaine group.

interval was significantly decreased in the bupivacaine group at 1, 2, 4, and 12 hours postintraperitoneal administration. Lower pain score in the bupivacaine group were reported more than in the normal saline group at 1 and 2 hours after intraperitoneal administration, but no difference thereafter (Fig. 2). The mean morphine consumption in five of the six periods of time (1, 2, 4, 12, 24 hours) were significantly lower in the bupivacaine group compared with the normal saline group (Fig. 3). Satisfactory scores at 24 hours were similar in both groups (Table 4).

PONV and pruritic scores were similar in both groups. The overall incidence of vomiting was 8 versus 5 and for the anti-emetic used was 5 versus 3 in the normal saline and bupivacaine groups, respectively.

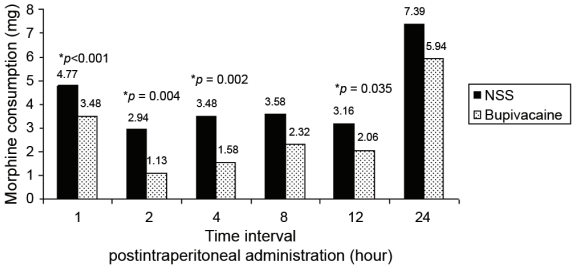

Fig. 3 Interval dose of morphine at each time interval postintraperitoneal administration. * $p<0.05$, significant difference.

One patient in the normal saline group was observed vomiting twice and required two doses of anti-emetic.

Table 4. Details of postoperative outcome between the two groups

	Normal saline (n = 31)	Bupivacaine (n = 31)	*p*-value
Morphine consumption (mg)			<0.001*
1 hour	4.77 (2.045)	3.16 (0.454)	
2 hours	7.74 (4.313)	4.29 (1.395)	
4 hours	11.13 (5.123)	5.87 (2.187)	
8 hours	14.39 (7.297)	8.19 (3.301)	
12 hours	17.35 (7.821)	10.23 (4.609)	
24 hours	25.03 (12.518)	16.13 (8.913)	
Pain score (NRS 0-10)			0.239
1 hour	6.29 (2.597)	5.00 (2.176)	
2 hours	6.52 (2.669)	5.39 (1.820)	
4 hours	5.19 (2.007)	5.42 (1.649)	
8 hours	4.32 (1.681)	4.74 (1.807)	
12 hours	3.97 (1.779)	4.10 (1.557)	
24 hours	2.77 (1.707)	2.97 (1.741)	
Satisfactory score (NRS 0-10)	9.00 (1.155)	9.06 (1.209)	

NRS = numerical rating score
Data were presented as mean (SD), * $p<0.05$, significant difference

The peak incidence of vomiting was between 8 and 12 hours postintraperitoneal administration. Sedative scores in the bupivacaine group were lower than in the normal saline group at all times recorded except at 1 and 24 hours postintraperitoneal administration (Table 5). Neither local anesthetic toxicity evidence nor complication from procedures was found.

Discussion

The present study revealed a significant reduction in 24-hour morphine consumption after intraperitoneal and incisional bupivacaine administration during total abdominal hysterectomy compared with incisional bupivacaine infiltration alone ($p<0.05$). The significant difference was attributed largely to reduced morphine consumption within the first 4 hours after intraperitoneal administration ($p<0.05$). This was associated with a significantly reduced pain score at 1- and 2-hour. These results were consistent with a recent study that reported intraperitoneal bupivacaine (100 mg) produced adequate analgesia for up to two hours postoperatively[16]. Ng et al[15] performed a randomized double-blind controlled trial, using 50 ml of bupivacaine 0.25% with epinephrine 5 microgram/ml or 50 ml of normal saline administered in the peritoneum and incision site, respectively. They found that a combination of incisional and intraperitoneal bupivacaine during total abdominal hysterectomy reduced 24-hour morphine consumption significantly compared with placebo in the first four postoperative hours. The effect duration was limited to approximately four hours and subsided subsequently. Gupta et al[25] demonstrated the infusion of levobupivacaine at 5 ml/hour (12.5 mg/hour) for 24 hours (total volume 300 ml) using a multihole catheter percutaneously, where the catheter tip was placed supravaginally after abdominal hysterectomy and found significant reduction in analgesic requirement during a 24-hour period of the infusion. These significant findings were similar to the present study.

In this study, a combination of two techniques was performed in the bupivacaine group. In the normal

Table 5. Adverse effects of post intraperitoneal administration outcomes

	Normal saline (n = 31)	Bupivacaine (n = 31)	*p*-value
PONV score (NRS 0-5)			0.996
at 1 hour	0.32±1.013	0.26±0.631	
2 hours	0.42±1.119	0.23±0.560	
4 hours	0.35±0.798	0.16±0.454	
8 hours	0.45±0.888	0.13±.0341	
12 hours	0.39±0.844	0.26±0.631	
24 hours	0.26±0.631	0.35±0.839	
Puritic score (NRS 0-5)			0.238
at 1 hour	0.03±0.180	0.03±0.180	
2 hours	0.03±0.180	0.00±0.000	
4 hours	0.10±0.301	0.00±0.000	
8 hours	0.06±0.250	0.06±0.359	
12 hours	0.19±0.477	0.03±0.180	
24 hours	0.23±0.805	0.06±0.250	
Sedative score			<0.001
at 1 hour	2 (0-3)	1 (0-2)	
2 hours	1 (0-2)	1 (0-2)	
4 hours	1 (0-2)	1 (0-2)	
8 hours	1 (0-2)	0 (0-2)	
12 hours	1 (0-2)	0 (0-2)	
24 hours	0 (0-1)	0 (0-2)	
Number of vomiting			
None	23 (74.19)	26 (83.87)	
One	7 (22.58)	5 (12.90)	
Two	1 (3.23)	0 (0.00)	
Number of anti-emetic used			0.544
None	26 (83.87)	28 (90.32)	
One	4 (12.90)	3 (9.68)	
Two	1 (3.23)	0 (0.00)	

PONV = postoperative nausea vomiting

Data were presented as mean ± SD, median (range), or n (%), repeated measure ANOVA, * $p<0.05$, significant difference

saline group, only incisional local anesthesia was performed to clearly identify the benefit of intraperitoneal technique by eliminating the parietal pain component. The result suggested that intraperitoneal local anesthesia could reduce the visceral component of postoperative pain.

The factors may influence anesthetic activity including dosage, method, and site of injection[26]. Our study used bupivacaine without the addition of a vasoconstrictor. Vasoconstrictors do not markedly alter the duration of action of bupivacaine, which is substantially absorbed by fat and then slowly released, contributing to their prolonged duration of action. The high lipid solubility may be responsible for the diminished effect of epinephrine[26]. However, we did not measure blood level of bupivacaine in this study.

In vitro, bupivacaine shows an intermediate onset time of five to eight minutes, but in vivo it is dependent. The onset of the conduction block in isolated nerves is primarily determined by the uncharged form of agent responsible for diffusion across the nerve sheath and nerve membrane[2,26,27]. Spielman et al[16] demonstrated that the peak concentration of bupivacaine was not evident from venous blood sample until 60 minutes after intraperitoneal administration, but did not demonstrate onset of the conduction block. Our study revealed that the time from intraperitoneal administration to anesthesia stop was 40 minutes (range 15 to 60) and reduced morphine consumption and pain score were seen at the first hour after administration. Onset of the conduction block may start around 40 minutes and as short as 15 minutes. Similarly, Kaplan et al[9] showed a beneficial effect of bupivacaine on laparoscopic Falope ring tubal ligation. This effect was seen immediately upon the patients' awakening from anesthesia (approximately 15 minutes after the procedure) and at 1 hour of recovery. In addition, one study showed differences within patient pain discrimination, i.e., patients treated on one side of the tube, reported significantly less pain on the treated side, suggested that the action of topical local anesthetic was mediated by local peritoneal effects rather than by systemic absorption. For further studies, dosage and different kinds of local anesthesia, including more rapid onset, longer duration action, and wider range of safety, may be used for more effectiveness.

Adequacy of postoperative pain control has a major influence on the patients' ability to resume their normal daily activities[2,3,7]. However, the extensive use of opioids, e.g., morphine, is associated with a variety of perioperative side effects such as respiratory depression, drowsiness and sedation, PONV, pruritus, urinary retention intestinal, ileus, and constipation that can delay hospital discharge. The benefit of reducing morphine consumption is thought to be related to improve recovery from surgery and anesthesia[3,4,6,28]. From recent studies, the clinical significance of morphine consumption comprised a 25 to 35% reduction[11,15,21,25,29] and our study detected a 35% reduction in 24 hours. The adverse effects were not significantly reduced, except for significantly reduced sedative score at 2, 4, 8, and 12 hours of the bupivacaine group compared with the normal saline group that may be associated with the morphine reduction. The 3-mg loading dose of PCA may be the reason no difference was observed in sedative score at the first hour. The fact that opioids produce a dose-dependent adverse effect[3,4,28] may explain the peak incidence of vomiting was between 8 to 12 hours. Moreover, PONV is caused by stimulation of the chemoreceptor trigger zone of the medulla, so patients' mobilization at that time may aggravate the effects[3,4,28]. However, less adverse effect was observed in the bupivacaine group. Our study failed to demonstrate any significant difference that might have been related to sample size and the categorical scoring system used was not sensitive enough.

No significant difference in 24-hours satisfactory score was observed between the two groups. The explanations were that the patient-controlled analgesic device allowed patients to administer opioids according to individual needed and provided superior pain relief compared with a single dose of opioids[3,4,7,30-32]. In addition, the difficulty of pain evaluation was one of the affected factors. Several studies have demonstrated that satisfaction was not related to pain scores[33-36]. Patient satisfaction is a multidimensional variable depending not only on the intensity of pain, but also on other factors such as age of patient, cultural background, expectations (influenced by previous pain experience), and the psychosocial aspect of care[35].

The present study showed no difference between groups regarding patient characteristics (Table 2) and the intraoperative data (Table 3) that might have influenced postoperative pain. However, we could not identify any correlation between the factors and postoperative pain. Increasing the sample size in a further study may clearly identify this correlation.

The present study used the PCA device only to compare postoperative opioids consumption

between groups, even though the PCA device is not available and may reduce opioids consumption postoperatively. We concluded that the combination of incisional and intraperitoneal bupivacaine administration is simple, available, and inexpensive, proved effective technique for post-total abdominal hysterectomy pain management without complications.

What is already known on this topic?

Local anesthesia, such as bupivacaine, have been infiltrated subcutaneously or applied intraperitoneally at the end of total abdominal hysterectomy without adverse effect, but in varied degrees of effectiveness.

What this study adds?

Intraperitoneal 0.25% bupivacaine at the end of total abdominal hysterectomy produced a significant reduction in 24-hour postoperative morphine used without adverse effect.

Potential conflicts of interest

None.

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ผลการให้บูพิวาเคนทางช่องท้อง ต่อการใช้ยาระงับปวดมอร์ฟีน ภายหลังการผ่าตัดมดลูกทางหน้าท้อง ณ โรงพยาบาลพระมงกุฎเกล้า

พนิดา จารุเวฬ, ศิริมาศ อิงคนารถ, สุธี พานิชกุล

วัตถุประสงค์: *เพื่อศึกษาผลการให้ bupivacaine ทางช่องท้อง ในการรักษาความปวดหลังการผ่าตัดมดลูกทางหน้าท้อง โดยวัดจากการลดปริมาณการใช้ยาระงับปวด morphine ใน 24 ชั่วโมง เมื่อลดความปวดจากผนังหน้าท้องโดยการให้ bupivacaine บริเวณแผลผ่าตัดหน้าท้อง*

วัสดุและวิธีการ: *ผู้ป่วยจำนวน 66 ราย ที่นัดมารับการผ่าตัดมดลูกทางหน้าท้อง ถูกแบ่งโดยวิธีสุ่ม แบบปกปิดสองทาง ให้ได้รับ bupivacaine 0.25% (กลุ่ม bupivacaine) หรือ น้ำเกลือ (กลุ่ม normal saline) ปริมาณ 40 มิลลิลิตร ทางช่องท้อง และตามด้วย bupivacaine 0.25% ปริมาณ 20 มิลลิลิตร บริเวณแผลผ่าตัดหน้าท้องในทั้งสองกลุ่มภายหลังการผ่าตัด จากนั้นทำการเก็บข้อมูลความปวด ปริมาณ morphine ที่ใช้ และผลข้างเคียงจาก morphine ในช่วง 24 ชั่วโมง หลังการให้ bupivacaine ทางช่องท้อง*

ผลการศึกษา: *ปริมาณ morphine ที่ใช้ใน 24 ชั่วโมง หลังการผ่าตัดในกลุ่มที่ได้รับ bupivacaine ทางช่องท้องน้อยกว่ากลุ่มที่ได้รับน้ำเกลืออย่างมีนัยสำคัญทางสถิติ (25.3 มิลลิกรัม และ 16.13 มิลลิกรัม, p-value = 0.002) ส่วนต่างของปริมาณ morphine ที่ใช้ส่วนใหญ่อยู่ในช่วง 4 ชั่วโมงแรก หลังการให้ bupivacaine ทางช่องท้อง คะแนนความปวดในกลุ่ม bupivacaine ต่ำกว่าในกลุ่ม normal saline ในชั่วโมงที่ 1 และ 2 หลังการให้ bupivacaine ทางช่องท้อง แต่ไม่มีความแตกต่างอย่างมีนัยสำคัญหลังจากนั้น ในการศึกษานี้ไม่มีภาวะแทรกซ้อนเกิดขึ้น*

สรุป: *การให้ bupivacaine 0.25% ทางช่องท้องร่วมกับบริเวณแผลผ่าตัดภายหลังการผ่าตัดมดลูกทางหน้าท้องสามารถลดการใช้ morphine ในการระงับปวดหลังการผ่าตัดได้อย่างมีนัยสำคัญโดยไม่มีผลข้างเคียง*