Thai Journal of Obstetrics and Gynaecology
January 2021, Vol. 29, No. 1, pp. 40-48

GYNAECOLOGY

Gabapentin for Acute Postoperative Pain Control in Total Abdominal Hysterectomy: A randomized controlled trial

Hathaipat Sukjariangporn, M.D.*,
Sittichoke Mahasukontachat, M.D.*

** Department of Obstetrics and Gynecology, Chonburi Hospital, Chonburi, Thailand*

ABSTRACT

Objectives: To evaluate the effect of gabapentin 300 mg in relieving acute postoperative pain in patients undergoing total abdominal hysterectomy at Chonburi Hospital.

Materials and Methods: A double-blind, randomized, controlled trial was performed on women scheduled for total abdominal hysterectomy at Chonburi Hospital from January 7, 2019 to April 26, 2019. All eligible participants were randomized by computer-generated with block of four into two groups to receive either 300 mg of gabapentin or placebo, orally two hours preoperative. Primary outcome was an additional opioid consumption. Secondary outcomes were time to first additional opioid requirement, pain score, sedative score, opioid-related adverse effects such as nausea/vomiting and pruritus, and gabapentin-related adverse effect as dizziness at 1, 2, 6, 10, 14, 18, 24 hours after surgery.

Results: The results were analyzed from 60 participants (gabapentin N=30, placebo N=30). Mean of total opioid consumption was lower in the gabapentin group compared with the placebo group (14.23 ± 9.78 mg vs 21.77 ± 12.71 mg, p = 0.012), especially during the first 4 hours. Time to first additional opioid requirement was longer in the gabapentin group. The average visual analogue scale and nausea/vomiting scores were lower in the gabapentin group. There was no difference between the means of pruritus and sedative scores. However, dizziness score was found to be higher in the gabapentin group in the first 6 hours.

Conclusion: Premedication with 300 mg of gabapentin orally 2 hours prior to elective total abdominal hysterectomy for patients with both benign and malignant conditions was effective for postoperative pain control with few adverse effects occurred.

Keywords: postoperative pain control, gabapentin, total abdominal hysterectomy.

Correspondence to: *Hathaipat Sukjariangporn, M.D., Department of Obstetrics and Gynecology Chonburi Hospital, 69 Sukhumvit Rd, Ban Suan, Chonburi 20000, Thailand. Email: suk.hathaipat@gmail.com*

Received: 31 July 2019, **Revised:** 23 September 2019, **Accepted:** 11 December 2019

การให้กาบาเพนตินเพื่อระงับอาการปวดเฉียบพลันหลังผ่าตัดมดลูกทางหน้าท้อง

หทัยภัทร สุขเจรียงพร, สิทธิโชค มหาสุคนธชาติ

บทคัดย่อ

วัตถุประสงค์: *เพื่อศึกษาผลของการให้กาบาเพนตินขนาด 300 มิลลิกรัม รับประทานก่อนการผ่าตัดมดลูกทางหน้าท้องที่โรงพยาบาลชลบุรี เพื่อดูประสิทธิภาพในการระงับปวดเฉียบพลันหลังผ่าตัด*

วัสดุและวิธีการ: *การศึกษานี้เป็นงานวิจัยศึกษาทางคลินิกแบบสุ่มและปิดบังข้อมูลสองฝ่าย โดยทำการศึกษาในหญิงที่มาเข้ารับการผ่าตัดมดลูกทางหน้าท้องที่โรงพยาบาลชลบุรีตั้งแต่วันที่ 7 มกราคม พ.ศ.2562 ถึง 26 เมษายน พ.ศ.2562 ผู้เข้าร่วมงานวิจัยจะได้รับการสุ่มโดยระบบคอมพิวเตอร์แบบบล็อกละ 4 เพื่อแบ่งเป็น 2 กลุ่ม เพื่อรับประทานยาก่อนผ่าตัด 2 ชั่วโมง โดยแบ่งเป็นยากาบาเพนตินขนาด 300 มิลลิกรัม หรือยาหลอก จุดประสงค์หลักคือการประเมินความเจ็บปวดหลังผ่าตัด โดยดูจากปริมาณยาโอปิออยด์ที่กดจากเครื่องควบคุมความปวดด้วยตนเอง จุดประสงค์รองได้แก่ ระยะเวลาที่กดโอปิออยด์เป็นครั้งแรก คะแนนความเจ็บปวด คะแนนความง่วงซึม ผลข้างเคียงจากยาโอปิออยด์ในเรื่องคลื่นไส้อาเจียนคัน และผลข้างเคียงจากกาบาเพนตินในเรื่องเวียนศีรษะ ซึ่งจะทำการบันทึกชั่วโมงที่ 1, 2, 6, 10, 14, 18, 24 หลังผ่าตัด*

ผลการศึกษา: *ทำการวิเคราะห์ผลการวิจัยจากผู้เข้าร่วมโครงการจำนวน 60 ราย แยกเป็นกลุ่มกาบาเพนติน 30 ราย และยาหลอก 30 ราย พบว่ากาบาเพนตินมีประสิทธิภาพในการช่วยควบคุมภาวะปวดหลังผ่าตัดได้ดีกว่าเมื่อดูจากปริมาณยาโอปิออยด์ที่ใช้เพิ่มใน 24 ชั่วโมงหลังผ่าตัด พบว่าในกลุ่มกาบาเพนตินใช้ 14.23 ± 9.78 มิลลิกรัม ต่อ 21.77 ± 12.71 มิลลิกรัมในกลุ่มยาหลอก โดยเฉพาะอย่างยิ่งใน 4 ชั่วโมงแรกหลังผ่าตัด กลุ่มยากาบาเพนตินมีการใช้ยาโอปิออยด์น้อยกว่าอย่างมีนัยสำคัญ นอกจากนี้ระยะเวลาที่เริ่มใช้โอปิออยด์เป็นครั้งแรกพบว่าในกลุ่มของกาบาเพนตินนั้นใช้เวลานานกว่า คะแนนความปวดและอาการคลื่นไส้อาเจียนพบน้อยกว่าในกลุ่มกาบาเพนติน แต่ไม่มีความแตกต่างในเรื่องอาการคันหรือง่วงซึม อย่างไรก็ตามผลข้างเคียงของยากาบาเพนตินเรื่องเวียนศีรษะพบว่ามีมากกว่าในกลุ่มที่ได้รับกาบาเพนติน*

สรุป: *การให้ยากาบาเพนตินขนาด 300 มิลลิกรัมก่อนการผ่าตัดมดลูกทางหน้าท้องอย่างน้อย 2 ชั่วโมงทั้งจากสาเหตุทั่วไปและสาเหตุมะเร็ง ให้ผลในการควบคุมภาวะปวดหลังผ่าตัดที่ดี และมีผลข้างเคียงน้อย*

คำสำคัญ: *การระงับปวดหลังผ่าตัด, กาบาเพนติน, การผ่าตัดมดลูกทางหน้าท้อง*

Introduction

Hysterectomy is one of the most common procedures in gynecology[1]. More than 300 patients undergo total abdominal hysterectomy at Chonburi hospital each year, including both benign and malignant conditions. However, postoperative pain remains one of the most complaints from patients. Adequate pain control allows early ambulation, improve bowel function and minimize postoperative complications such as fever, atelectasis and thrombophlebitis.

ERAS or Enhanced Recovery After Surgery was first described in the 1990s and the protocol was introduced in 2001 by groups of surgeons and anesthesiologists in Europe. Pain control is also a part of ERAS which aims to maintaining normal physiology in the perioperative period with optimizing patient outcomes without increasing postoperative complications or readmissions[1-5]. Opioid was known as the gold standard for moderate to severe pain management but undesired effects of nausea/vomiting and pruritus were observed widely. So, multimodal pain management has been introduced and studied over the past decades, hopefully to find the ideal analgesia agent which effectively pain relief and minimal adverse effects. Preemptive or preoperative analgesia were performed and showed effectiveness in decreasing postoperative pain.

Gabapentin is widely known as anticonvulsant agent that acts through voltage-dependent calcium channels. But in many recent studies, gabapentin was known for its effectiveness in postoperative pain control. Elimination of drug depends on creatinine clearance, in which varies with age, body weight, sex and serum creatinine[6].

According to the previous studies and articles, the administration of gabapentin ranges from 300 to 1,200 mg orally 2 hours preoperative results in good postoperative pain control with very few side effects. In detail, giving preoperative gabapentin was found decreasing in total opioid consumption, minimize opioid-related adverse effects such as nausea/vomiting and pruritus. However, dizziness should be aware as one of the adverse effects of gabapentin[7-14].

The main purpose of this study was to evaluate the effect of gabapentin 300 mg preoperatively in order to relieve postoperative pain in patients who undergo total abdominal hysterectomy at Chonburi hospital. We expected for better postoperative outcome and improve patient's quality of life.

Materials and Methods

A double-blind, randomized, controlled trial was performed after an approval by the Institutional Review Board of Chonburi Hospital (reference number 80/61/R/h1, issued on December 26, 2018). During the period of January 7, 2019 to April 26, 2019, 111 women were scheduled for elective total abdominal hysterectomy for both benign and malignant conditions. We provided the participants with general information about the study and obtained their informed consents.

The study included patients aged 30 to 70 years old, with creatinine clearance (CrCL) at least 60 mL/min (calculated using Cockcroft and Gault's formula), American Society of Anesthesiology (ASA) class I and II, who were able to use patient controlled analgesia (PCA) and had been scheduled for total abdominal hysterectomy under general anesthesia. Patients were excluded from the study if they had renal insufficiency with CrCL less than 60 mL/hr, if they were on hemodialysis or anticonvulsant drugs, if they had a known case of epilepsy, chronic opioid use, communication difficulties, hypersensitivity to gabapentin, or if they were pregnant or breastfeeding. Patients who sustained intraoperative complications, such as organ injury, or who had not received PCA post-operation were also excluded.

We calculated the sample size (N) using the following formula:

$$n_{trt} = \frac{(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta})2\,[\sigma_{trt}^2 + \frac{\sigma_{con}^2}{r}]}{\Delta^2}$$

$$\mathbf{r} = \frac{n_{con}}{n_{trt}}, \Delta = \mu_{trt} - \mu_{con}$$

The mean total opioid consumption was applied from Modak et al's study[7], alpha = 0.05 and type II error = 80%. Based on this formula, the sample size is 28, with 14 patients each group. In this study, a total of 60 patients will be conducted with 30 patients each group for more statistically accurate.

The participants were admitted at the hospital 1 day before surgery for preoperative preparations. Collected demographic data included age, body mass index (BMI), creatinine (Cr), CrCL, ASA, previous surgery and underlying diseases. All patients had fasted for 8 hours before surgery.

A computer-program generated a randomization in a block of four. In a blinded experiment, 63 participants received either 300 mg of gabapentin (N = 32) or an identical yellow placebo capsule (N = 31) with 50 mL of water 2 hours before surgery. After administration of the drug, falling precaution will be applied to all patients. In the operating room, vital signs and oxygen saturation were recorded. Anesthesia induction and muscle relaxant were established by using thiopental, atracurium, fentanyl, isoflurane and nitrous oxide. Residents or staff members at Chonburi Hospital performed the operations. Operative data such as incisions, operations, adhesions, operating and anesthetic time were recorded. Following the surgery, muscle relaxants were reversed using neostigmine and atropine by the anesthesiologist and the patients were transferred to recovery unit. Then, pain score, sedative score, additional opioid consumption and time to first opioid requirement were recorded by anesthesiologist. If no other immediate postoperative complications were observed, patients were transferred back to a gynecologic ward for routine postoperative care. Nurses recorded vital signs, pain score, nausea/vomiting score, pruritus score and dizziness score at 1, 2, 6, 10, 14, 18, 24 hours post-operation, while PCA kept record of additional opioid requirements.

We assessed postoperative pain by visual analog scale (VAS) and postoperative nausea/vomiting (PONV), pruritus and dizziness by severity score, and sedative score in the periods of 1, 2, 6, 10, 14, 18, 24 hours post-operation.

Patients were observed for 3 days and the data were collected by routine residents who were blinded for the study.

We used SPSS for Windows Version 22 to perform statistical analyses. The baseline characteristics were described in terms of frequency and percentage for categorical data. Mean, standard deviation and median were used for continuous data. Demographic parameters were analyzed by an independent t-test, while binary data was analyzed by chi-square test. Mann-Whitney U test was used to compare continuous variables. A p value of less than 0.05 was considered statistically significant.

Results

A total of 111 patients were scheduled for total abdominal hysterectomy at Chonburi Hospital from January 7, 2019 to April 26, 2019. Forty-nine patients were excluded from the study, in which 8 patients were excluded due to renal insufficiency (n = 3), age over 70 years old (n = 2), ASA physical status greater than class II (n = 3), and 41 patients declined to use PCA or participate in the study. The remaining 63 patients were randomized to gabapentin group (n = 32) and placebo group (n = 31). However, 2 patients in gabapentin group were excluded from the analysis due to bowel injury and did not receive postoperative PCA and 1 patient was excluded from the placebo group due to ureteral injury. Finally, two groups of 30 patients were included in the analysis (Fig. 1). Out of 30 patients in each group, 9 patients in the gabapentin group and 12 patients in the placebo group were diagnosed with malignant conditions.

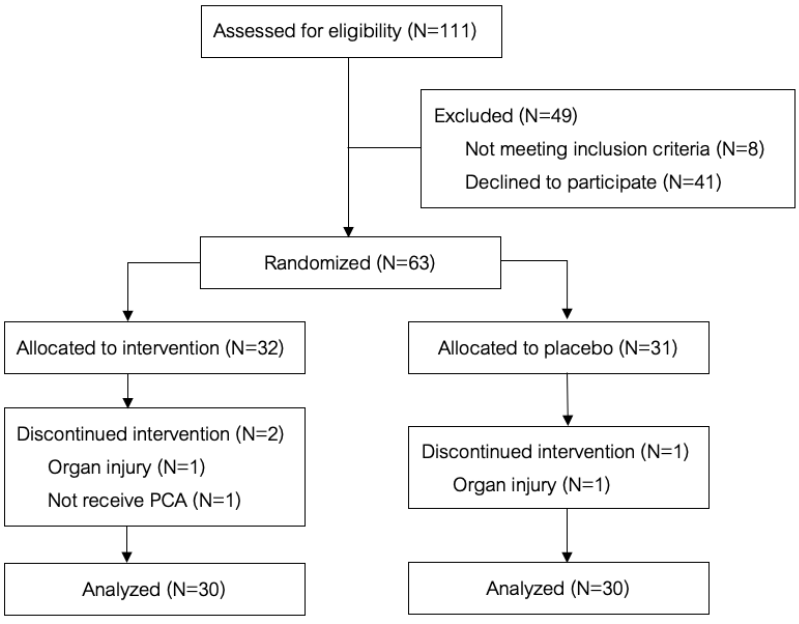

Fig. 1. The study flow chart.

According to baseline characteristics, there was no statistically significant difference between the two groups with respect to age, BMI, Cr, CrCL, previous surgery, and ASA physical status (Table 1). Only underlying diseases of hypertension and diabetes were significantly different. However, these findings could have less effect to the analysis. Further research is required to identify and evaluate the association between underlying diseases and postoperative pain and drug excretion.

Table 1. Baseline characteristics of the study population between gabapentin group and placebo group.

Characteristics	Gabapentin (N=30)	Placebo (N=30)	p value
Age (years) [a]	49.47 ± 10.81	48.57 ± 12.86	0.770
Body mass index (BMI) kg/m^2 [a]	24.67 ± 5.97	23.12 ± 4.50	0.260
Creatinine (mg/dL) [a]	0.66 ± 0.12	0.63 ± 0.16	0.383
Creatinine clearance (mL/hr) [a]	101.27 ± 13.22	106.24 ± 12.44	0.139
Underlying disease [b]			
Hypertension	6 (20%)	1 (3.33%)	0.044
Diabetes	7 (23.33%)	1 (3.33%)	0.023
Dyslipidemia	2 (6.67%)	2 (6.67%)	1.000
Other	2 (6.67%)	6 (20%)	0.129
Previous surgery [b]	16 (53.33%)	10 (33.33%)	0.118
ASA[b]			
Class I	16 (53.33%)	10 (33.33%)	0.118
Class II	14 (46.67%)	20 (66.67%)	0.118

[a] Data were expressed as mean ± standard deviation, [b] Data were expressed as number (%), ASA: American Society of Anesthesiology

There was no statistically significant difference between intraoperative data, including surgical incisions, operative type, adhesion, anesthesia and operation time, blood loss and time in PACU (Table 2).

Table 2. Baseline intraoperative data between gabapentin group and placebo group.

Characteristics	Gabapentin (N=30)	Placebo (N=30)	p value
Incisions [b]			
Pfannenstiel	11 (36.67%)	12 (40%)	0.791
Maylard	12 (40%)	11 (36.67%)	0.791
Low midline	7 (23.33%)	7 (23.33%)	1.000
Operation [b]			
TAH	9 (30%)	4 (13.33%)	0.117
TAH with SO/BSO	12 (40%)	14 (46.67%)	0.602
TAH with surgical staging	9 (30%)	12 (40%)	0.417
Adhesion [b]			
None	11 (36.67%)	14 (46.67%)	0.432
Filmy	12 (40%)	6 (20%)	0.091
Dense	7 (23.33%)	10 (33.33%)	0.390
Time of anesthesia (min) [a]	145.23 ± 27.76	145.97 ± 39.05	0.933
Time of operation (min) [a]	111.73 ± 25.35	113.43 ± 38.95	0.842
Blood loss (mL) mean [a]	355.67 ± 265.42	373.33 ± 356.40	0.828
Time in recovery room (min) [a]	64.67 ± 8.5	66.50 ±14.51	0.553

[a] Data were expressed as mean ± standard deviation, [b] Data were expressed as number (%)
TAH: Total abdominal hysterectomy, SO: salpingo-oophorectomy, BSO: bilateral salpingo-oophorectomy

Regarding additional opioid consumption during the fist 24 hours after surgery, total opioid consumption was lower in the gabapentin group, in which the mean was 14.23 ± 9.78 mg compared with the mean of the placebo group which was 21.77 ± 12.71 mg ($p = 0.012$). Additionally, gabapentin was very effective for postoperative pain relief, especially during the fist 4 hours (Fig. 2). Moreover, time to fist additional opioid requirement was longer in the gabapentin group, in which the mean was 345.00 ± 302.93 minutes compared with the mean of the placebo group which was 40.17 ± 24.36 minutes ($p < 0.001$).

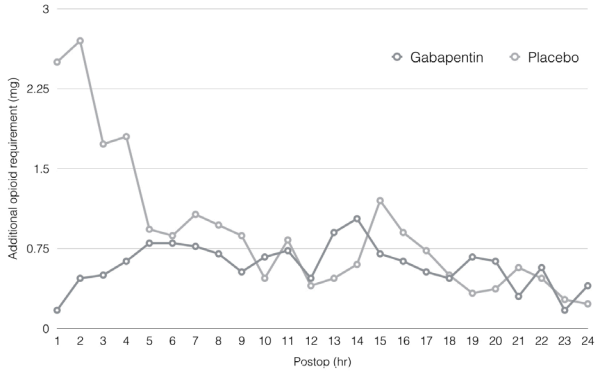

Fig. 2. Trend of change in additional opioid consumption.

The secondary outcomes were assessed at 1, 2, 6, 10, 14, 18 and 24 post-operative hours (Table 3, 4). Pain scores were assessed using VAS. The average VAS score was lower in the gabapentin group during the fist 6 hours as compared with the placebo group. An opioid-related adverse effect (nausea/vomiting score) was lower in gabapentin group during the fist 18 hours. Nonetheless, there was no difference between the means of pruritus and sedative scores. However, a gabapentin-related adverse effect as dizziness assessed by dizziness score was found to be higher in the gabapentin group in the fist 6 hours.

Table 3. VAS, Nausea/vomiting and pruritus score as in mean ± SD.

Postop (hr)	VAS score			Nausea/ vomiting score			Pruritus score		
	Gabapentin (N=30)	Placebo (N=30)	**p value**	Gabapentin (N=30)	Placebo (N=30)	**p value**	Gabapentin (N=30)	Placebo (N=30)	**p value**
1	0.73±1.84	3.87±3.37	<0.001	0.00±0.00	0.33±0.66	0.005	0.00±0.00	0.00±0.00	1.000
2	1.07±1.60	2.83±1.93	<0.001	0.00±0.00	0.77±0.86	<0.001	0.00±0.00	0.00±0.00	1.000
6	2.27±1.80	3.50±1.72	0.008	0.00±0.00	1.10±1.18	<0.001	0.00±0.00	0.07±0.25	0.154
10	2.40±1.90	2.77±1.43	0.276	0.07±0.37	0.63±0.89	0.001	0.00±0.00	0.10±0.31	0.078
14	2.13±1.68	2.40±1.38	0.459	0.00±0.00	0.53±0.82	0.021	0.00±0.00	0.07±0.37	0.317
18	1.77±1.52	2.47±1.70	0.177	0.00±0.00	0.27±0.64	0.078	0.00±0.00	0.00±0.00	1.000
24	1.47±1.31	2.00±1.58	0.186	0.00±0.00	0.10±0.31	1.000	0.00±0.00	0.00±0.00	1.000

Table 4. Sedative score and dizziness score as in mean ± SD.

Postop (hr)	Sedative score			Dizziness score		
	Gabapentin (N=30)	Placebo (N=30)	**p value**	Gabapentin (N=30)	Placebo (N=30)	**p value**
1	0.97±0.61	0.70±0.47	0.086	0.70±0.65	0.07±0.25	<0.001
2	0.57±0.68	0.23±0.43	0.041	0.47±0.73	0.00±0.00	<0.001
6	0.17±0.38	0.10±0.31	0.451	0.33±0.61	0.07±0.37	0.015
10	0.07±0.25	0.03±0.18	0.557	0.10±0.31	0.07±0.37	0.330
14	0.00±0.00	0.00±0.00	1.000	0.07±0.25	0.00±0.00	0.154
18	0.00±0.00	0.00±0.00	1.000	0.00±0.00	0.03±0.18	0.317
24	0.00±0.00	0.00±0.00	1.000	0.00±0.00	0.00±0.00	1.000

Discussion

According to the findings, the total additional opioid consumption in the first 24 hours was lower in gabapentin group compared with the placebo group (14.23 ± 9.78 vs. 21.77 ± 12.71, p = 0.012), which was consistent with previous studies[7-14]. In addition, VAS score and nausea/vomiting score were lower in the gabapentin group, but dizziness score was higher in the gabapentin group. However, sedative score and pruritus score were not different between the two

groups.

In a study conducted by Modak et al[7], 600 mg of gabapentin were given compared with placebo in 2 hours preoperatively, the average number of rescue analgesic dose requirements in the gabapentin group was lower with 5.17 ± 3.00 mg and 10.75 ± 3.20 mg in placebo during the initial 12 hours.

The systematic review conducted by Steinberg et al[8], indicated that administration of preoperative gabapentin resulted in better postoperative pain management and offered good satisfaction scores and decreased total narcotic requirement. Farzi et al revealed that prescribing 300 mg of gabapentin was effective in reducing postoperative pain and the average total opioid consumption in gabapentin group was lower than those in the placebo group (18.75 mg vs. 55.62 mg, p = 0.001). Frouzanford et al[10], conducted a study to compare 1,200 mg of gabapentin with placebo and the average morphine requirement in the gabapentin group was 1.2 ± 0.09 mg vs. 5.2 ± 2.8 mg (p = 0.001).

A meta-analysis conducted by Peng et al[11], illustrated that preoperative gabapentin was administered ranging from 600 mg to 1200 mg and resulted in a 35% reduction in total opioid consumption within the initial 24 hours following surgery (ratio of means 0.65, 95% CI 0.59 - 0.72). However, gabapentin was associated with an increase incidence of sedation and dizziness. Several previous studies concluded that giving higher gabapentin dose was correlated with higher dizziness score.

Nonetheless, several studies evaluated the effect of gabapentin on postoperative pain, few studies have been conducted in Thailand. To date, only one randomized controlled trial of 600 mg of gabapentin has been registered online in 2017 without results published. Therefore, this study was the first study initially evaluated the lowest dose of gabapentin and identified its effective dose of 300 mg of gabapentin on postoperative pain relief effect in Thai population. The main strengths of this study which have not been clarified in the previous studies included as follows: 1) this study included patients with both benign and malignant conditions for the analysis, and 2) all factors which possibly affect postoperative pain including incisions, adhesions, operative type were contained in the analysis.

However, the short-term follow-up was a limitation of this study. Further studies should be conducted to identify minimum dose of gabapentin which can effectively control pain without dizziness. Furthermore, time to first ambulation, total hospital stays and postoperative complications, including fever, ileus, infection rate, and readmission rate, should be evaluated.

Conclusion

Premedication with 300 mg of gabapentin orally 2 hours prior to elective total abdominal hysterectomy for patients with both benign and malignant conditions was effective for postoperative pain control with few adverse effects occurred.

References

1. Falcone T, Ridgeway B. Hysterectomy In: Berek JS, Novak E, eds. Berek & Novak's Gynecology. 16th ed. Philadephia: Lippincott Williams and Wilkins, 2019: 653-77.
2. Nelson G, Bakkum-Gamez J, Kalogera E, Glaser G, Altman A, Meyer LA, et al. Guidelines for perioperative care in gynecologic/oncology: Enhanced recovery after surgery (ERAS) Society recommendations-2019 update. Int J Gynecol Cancer 2019:ijgc-2019-000356.3.
3. Perioperative pathways: Enhanced Recovery After Surgery. Committee opinion No.750. American College of Obstetricians and Gynecologists. Obstet Gynecol 2018;132:e120-32.
4. Barber EL, Van Le L. Enhanced Recovery Pathways in Gynecology and Gynecologic Oncology. Obstet Gynecol Surv 2015;70:780-92.
5. Ljungqvist O, Scott M, Fearon KC. Enhanced recovery after surgery: A review enhanced recovery after surgery enhanced recovery after surgery. JAMA Surg 2017;152:292-8.6.
6. Gabapentin: FDA Approved labeling. 2011, reference ID 2911805.
7. Modak SD, Magar J, Kakad V. Pre-emptive gabapentin for postoperative pain relief in abdominal hysterectomy. Int J Res Med Sci 2016;4:3755-9.8.
8. Steinberg AC, Schimpf MO, White AB, Mathews C, Ellington DR, Jeppson P, et al. Preemptive analgesia for postoperative hysterectomy pain control: systematic

review and clinical practice guidelines. Am J Obstet Gynecol 2017;217:303-313.e306.
9. Farzi F, Naderi Nabi B, Mirmansouri A, Fakoor F, Atrkar Roshan Z, Biazar G, et al. Postoperative pain after abdominal hysterectomy: A randomized, double-blind, controlled trial comparing the effects of rramadol and gabapentin as premedication. Anesth Pain Med 2016;6:e32360-e.
10. Frouzanfard F, Fazel MR, Abolhasani A, Fakharian E, Mousavi G, Moravveji A. Effects of gabapentin on pain and opioid consumption after abdominal hysterectomy. Pain Res Manag 2013;18:94-6.
11. Peng PW, Wijeysundera DN, Li CC. Use of gabapentin for perioperative pain control - a meta-analysis. Pain Res Manag 2007;12:85-92.
12. Chang CY, Challa CK, Shah J, Eloy JD. Gabapentin in acute postoperative pain management. Biomed Res Int 2014;2014:631756.
13. Kumar A. Effect of single dose gabapentin on postoperative pain and opioid consumption following total abdominal hysterectomy: A dose fiding study. Surgery Curr Res 2013;3:80.
14. Schmidt PC, Ruchelli G, Mackey SC, Carroll IR. Perioperative gabapentinoids: choice of agent, dose, timing, and effects on chronic postsurgical pain. Anesthesiology 2013;119:1215-21.