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Comparison of the incidence of postoperative
nausea and vomiting between undergoing
open or robot-assisted thyroidectomy

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A Dissertation Submitted to The Graduate School of
Ajou University in Partial Fulfillment of the Requirements
for the Degree of Master of Medicine

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-ABSTRACT-

Comparison of the incidence of postoperative nausea and vomiting

Between women undergoing open or robot-assisted thyroidectomy

Background Open thyroidectomy is associated with a high incidence of postoperative nausea and vomiting (PONV) of up to 70 %. Use of the recently introduced robot-assisted endoscopic thyroidectomy using a gasless transaxillary approach has been increasing because of its several advantages over open thyroidectomy. This study compared the incidence of PONV in the women who underwent open or robot-assisted thyroidectomy.

Materials and methods This prospective, double-blinded study enrolled 170 women 20-60 years of age who were scheduled for conventional open thyroidectomy (Group O) or robot-assisted thyroidectomy (Group R). A standard anesthetic technique, including sevoflurane and air in oxygen, was used. During 0-24 postoperative periods, the presence and severity of PONV (nausea, retching/vomiting), severity of pain, need for rescue antiemetics and the incidence 'satisfied' patient were evaluated.

Results During 0-6 h postoperative periods, the incidence of PONV and mean pain score (40.0% vs. 51.8% and 4.2 vs. 4.8 in Group R and O, respectively) were not significantly different between groups. During 6-24 h postoperative periods, the incidence of PONV (18.8% vs. 44.7%), severe emesis (11.8% vs. 29.4%) and mean pain score (2.8 vs. 3.8) were significantly lower in Group R compared to Group O, respectively. Overall, the incidence of PONV (42.4% vs. 63.5%) and severe emesis (20.0% vs. 43.5%) were significantly lower in Group R compared to Group O. The incidence of 'satisfied' patient during 0-6 hr and 6-24 postoperative periods (55.3% vs. 28.2% and 82.4% vs. 58.8%) were significantly higher in Group R compared to Group O.

Conclusion Robotic thyroidectomy reduced the incidence and severity of PONV compared to open thyroidectomy during 0-24 postoperative periods.

Key Words Robotic·Open thyroidectomy, Postoperative nausea and vomiting

TABLE OF CONTENTS

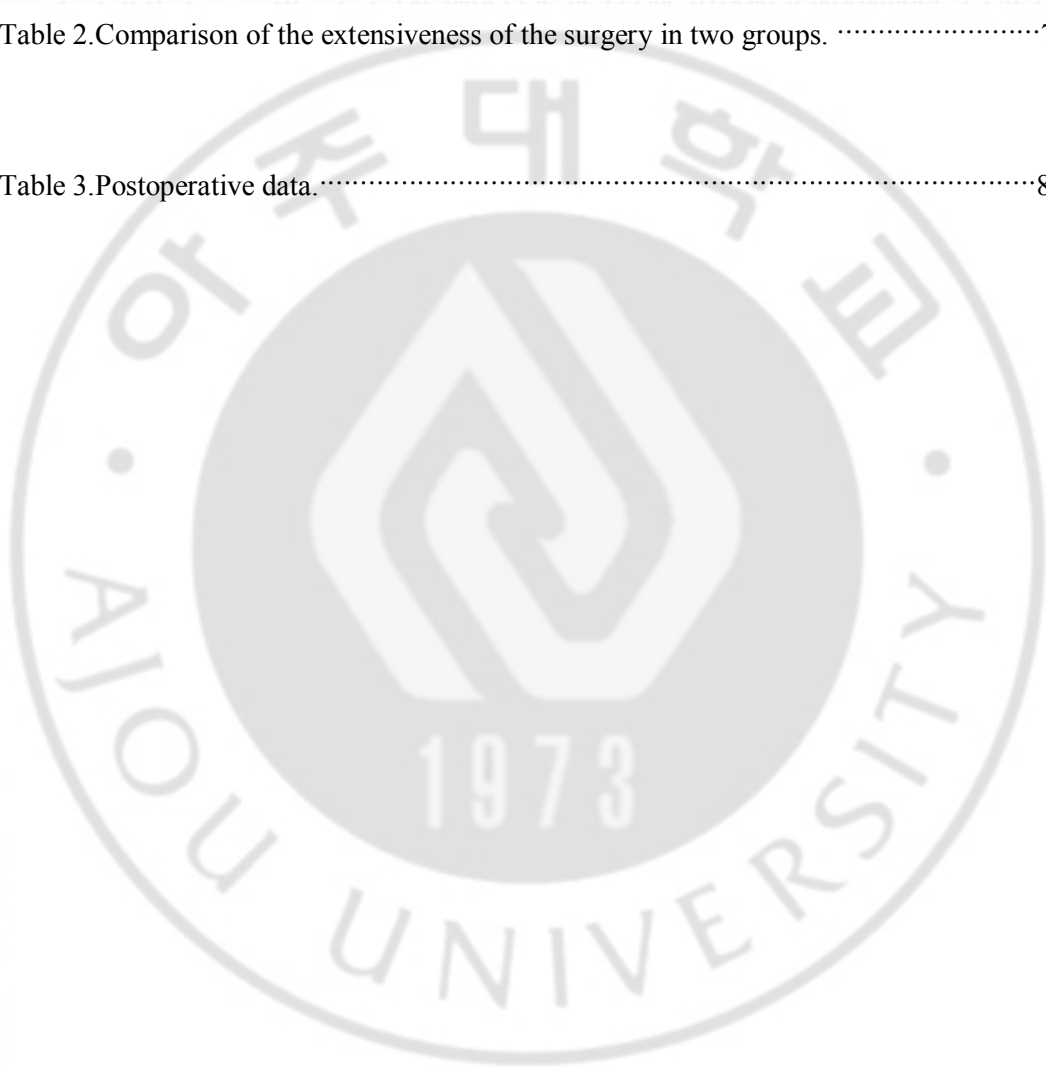
ABSTRACT	i
TABLE OF CONTENTS.....	ii
LIST OF TABLES	iii
I. INTRODUCTION	1
II. MATERIALS AND METHODS	2
A. MATERIALS.....	2
B. METHODS	2
C. STATISTICS	3
III. RESULTS	5
IV. DISCUSSION	10
V. CONCLUSION	13
REFERENCES	14
국문요약.....	17

LIST OF TABLES

Table 1. Demographic characteristics and anaesthesia data.6

Table 2. Comparison of the extensiveness of the surgery in two groups.7

Table 3. Postoperative data.8



I. INTRODUCTION

Postoperative nausea and vomiting (PONV) are main cause of discomforts after thyroid surgery and anesthesia and can predispose to aspiration of gastric contents, wound dehiscence, delayed discharge and higher medical costs. (Watcha and White, 1992; Kovac, 2000) Additionally, vomiting may increase the risk of postoperative bleeding, which may potentially cause airway obstruction. (Kovac, 2000) These justify the importance of reducing the likelihood of PONV occurrence.

Robot-assisted thyroidectomy using gasless transaxillary approach, first described in 2008, has gained popularity despite its high cost. (Kang et al, 2009; Lee et al, 2010) It offers several benefits over open thyroidectomy including excellent cosmetic effects, reduced pain and swallowing discomfort. (Kang et al, 2009; Lee et al, 2010; Lee et al, 2012; Tae et al, 2011) Open thyroidectomy is associated with high rate of PONV, with a reported incidence of 65-70% in women anesthetized with sevoflurane or isoflurane. (Won et al, 2011; Vari et al, 2010; Ewalenco et al, 1996; Sonner et al, 1997) There are several factors that might underlie the different incidence of PONV after robot-assisted thyroidectomy over open thyroidectomy: younger female patients tend to choose robot-assisted thyroidectomy, surgery durations may increased in robot thyroidectomy, less severe postoperative pain or discomfort in neck area and less surgical manipulation of the anterior neck area. (Watcha and White, 1992; Kovac, 2000; Kang et al, 2009; Lee et al, 2010; Lee et al, 2012; Apfel et al, 1999; Koivuranta et al, 1997; Lee et al, 2007; Hong et al, 2010; Anderson and Krohg, 1976; Palazzo and Strunin, 1984) However, there have been no reports on PONV after robot-assisted thyroidectomy.

The present study was carried out to compare the incidence of PONV in women undergoing open or robot-assisted thyroidectomy anesthetized with sevoflurane in 50% air.

II. MATERIALS AND METHODS

A. Materials

After approval by the Institutional Review Board and obtaining informed consent from patients, 170 euthyroid women (aged 20-60 years, American Society of Anesthesiologists physical status I or II) scheduled to undergo open thyroidectomy (Group O) or robot-assisted endoscopic thyroidectomy using the Da Vinci[®] S Surgical System robot (Intuitive Surgical Inc., Sunnyvale, CA, USA) by a gasless transaxillary approach (Group R) were enrolled. Patients with more than 30% over ideal body weight, gastrointestinal disease, and those who had taken antiemetics within 24 hr prior to surgery were excluded from the study.

The patients were serially enrolled within each group and those who underwent thyroidectomy with modified radical neck dissection were excluded from the study. A medical history (including previous motion sickness, PONV and smoking history) was recorded along with demographic information and body mass index (BMI) was calculated from the data.

B. Methods

On the day of surgery, preanesthetic medication or prophylactic antiemetics were not administered. A standard general anesthesia was induced with thiopental sodium 4-5 mg/kg, rocuronium 0.6-0.8 mg/kg and alfentanil 0.25 mg, and maintained with sevoflurane (2.0-2.5 minimal alveolar concentration) in 50% oxygen/air. Ventilation was mechanically controlled with O₂/air mixture (fractional inspired oxygen [F_IO₂] = 0.6) and adjusted to keep an end-tidal concentration of CO₂ between 35 and 40 mmHg throughout the operation with an anesthetic/respiratory analyzer (Dräger, Lübeck, Germany). Muscle relaxation was antagonized by a combination of glycopyrrolate 0.002 mg/kg i.v. and pyridostigmine 0.03 mg/kg i.v. at the end of surgery.

Anesthesia duration was defined as the period from induction until extubation and was recorded for all patients. In surgery duration, draping time was excluded and docking time/ console time were included.

All episodes of PONV (nausea, retching or vomiting) were recorded during the first 24 hours after anaesthesia, covering three time periods (0-1 h in the postanesthesia care

unit, 1-6 h and 6–24 h in the general ward). The patients were followed by specially trained nurses or trainees who were blinded to the study groups.

Nausea was defined as a subjective, unpleasant sensation associated with awareness of the urge to vomit. Retching was defined as laboured, spastic, rhythmic contraction of the respiratory muscles without the expulsion of gastric contents and vomiting was defined as the forceful expulsion of gastric contents from the mouth. Each emetic episodes was recorded as either present or absent. Presence of retching was regarded as the presence of vomiting. The severity of nausea was graded using an 11-point verbal rating scale, with 0 = no nausea to 10 = worst possible nausea. The severity of retching/vomiting was graded using the following scale; 1=one episode, 2=two episodes and 3=more than 3 episodes. The highest score during each assessment period was recorded. Severe emesis was defined as the presence of nausea (≥ 7) or

retching/vomiting. At the end of the each periods, pain severity and the degree of satisfaction was assessed. The severity of postoperative pain was measured by an 11-point verbal analogue pain score (VAS 0-10), with 0 = no pain to 10 = worst imaginable pain. General satisfaction was measured using a verbal rating scale ranging from 0=complete satisfaction to 3= complete dissatisfaction and a scores ≤ 1 was defined as 'satisfied'.

The rescue antiemetic, metoclopramide 10 mg i.v. was given upon patient request or doctor's advice. Rescue analgesic, ketorolac tromethamine (Keromin[®] Hana Pharm, Seoul, Korea) 30 mg i.v. was given if the patient consistently complained of pain ≥ 5 on VAS.

Sample size estimation was predetermined in accordance with the results of a previous study. (Won et al, 2011; Vari et al, 2010; Ewanlenco et al, 1996; Sonner et al, 1997) The incidence of PONV in the sevoflurane group would be 65 % with a decrease of incidence to 40% considered as clinically significant of α value would be 0.05 with a power $(1-\beta)$ of 0.8. The analysis showed that 69 patients per each group would be sufficient to detect the stated difference in PONV incidence and we rounded up to 85 patients per group.

C. Statistics

Statistical analyses were performed using the statistical package (SPSS 17.0 for Windows; SPSS, Chicago, IL, USA). Data between the groups were compared using χ^2

test, Fisher's exact test, independent *t*-test, linear by linear association test, as appropriate. All values are expressed as means \pm SD or percentage (%). A *P* value of <0.05 was considered as statistically significant.



III. RESULTS

Demographic data such as history of smoking, motion sickness and PONV were comparable between the two groups (Table 1). However, anesthesia time/operation time were increased and BMI was decreased in Group R compared to Group O ($P<0.05$) (Table 1). The extensiveness of the thyroidectomy was comparable between the two groups (Table 2).

Postoperative data are shown in Table 3. The incidence of PONV, use of rescue antiemetics and severe emesis during the postoperative 0-6 h period was 51.8 % and 40.0% ($P=0.166$), 23.5 % and 10.6% ($P=0.040$), and 36.5 % and 16.5 % ($P=0.005$) in Group O and R, respectively. The mean pain score and proportion of satisfied patients 6 hr after the end of anesthesia was 4.8 ± 2.3 and 4.2 ± 2.1 ($P=0.131$), and 28.2% and 55.3% ($P=0.000$) in Group O and R, respectively.

The incidence of PONV, use of rescue antiemetics and severe emesis during the postoperative 6-24 h period was 44.7% and 18.8% ($P=0.000$), 10.6 % and 1.2% ($P=0.018$) and 29.4 % and 11.8 % ($P=0.007$) in Group O and R, respectively. The mean pain score and proportion of satisfied patients 24 hr after the end of anesthesia was 3.8 ± 1.8 and 2.8 ± 1.8 ($P=0.001$), and 58.8% and 82.4% ($P=0.000$) in Group O and R, respectively.

Overall, the incidence of PONV, use of rescue antiemetics and severe emesis during the postoperative 0-24 hr period was 63.5% and 42.4% ($P=0.009$), 27.1 % and 10.6% ($P=0.010$), and 43.5. % and 20.0 % ($P=0.002$) in Group O and R, respectively.

Table 1. Demographic characteristics and anaesthesia data

	Open thyroidectomy (n =85)	Robot-assisted thyroidectomy (n = 85)
Age (years)	44.8 ± 8.0	39.2 ± 7.1*
Body mass index (BMI, kg/m ²)	23.6 ± 4.2	22.2 ± 2.8*
Anaesthesia duration (min)	126.1 ± 28.2	147.3 ± 37.0*
Surgery duration (min)	101.8 ± 27.3	122.3 ± 33.1*
History of motion sickness	30 (35.3)	27 (31.8)
History of PONV	6 (7.1)	6 (7.1)
History of smoking	3 (3.5)	7 (8.2)

Values are mean ± standard deviation(SD) or number of patients (%).

*: P<0.05 between two groups.

PONV postoperative nausea and vomiting

Table 2. Comparison of the extensiveness of the surgery in two groups

	Open thyroidectomy (<i>n</i> =85)	Robot-assisted thyroidectomy (<i>n</i> = 85)
Extent of thyroidectomy		
Total thyroidectomy	68(80)	65(76.5)
Less than total thyroidectomy	17(20)	20(23.5)
Extent of cervical lymph node dissection		
No dissection	9(10.6)	8(9.4)
Central compartment dissection	76(89.4)	77(90.6)
Modified radical neck dissection	0	0

Data are number of patients (%).

Table 3. Postoperative data

	Open thyroidectomy (n=85)	Robot-assisted thyroidectomy (n=85)	P value
0-6 hr			
Nausea only	27(31.8)	22(25.9)	0.498
Vomiting with nausea	17(20.0)	12(14.1)	0.415
PONV	44(51.8)	34(40.0)	0.166
Rescue antiemetics	20(23.5)	9(10.6)*	0.040
Severe emesis	31(36.5)	14(16.5)	0.005
Mean pain score	4.8±2.3	4.2±2.1	0.131
Satisfied	24(28.2)	47(55.3)*	0.000
6-24 hr			
Nausea only	24(28.2)	8(9.4)*	0.003
Vomiting with nausea	14(16.5)	8(9.4)	0.253
PONV	38(44.7)	16(18.8)*	0.000
Rescue antiemetics	9(10.6)	1(1.2)*	0.018
Severe emesis	25(29.4)	10(11.8)*	0.007
Mean pain score	3.8±1.8	2.8±1.8*	0.001
Satisfied	50(58.8)	70(82.4)*	0.000
Overall			
Nausea only	31(36.5)	21(24.7)	0.134
Vomiting with nausea	23(27.1)	15(17.6)	0.197
PONV	54(63.5)	36(42.4)*	0.009
Rescue antiemetics	23(27.1)	9(10.6)*	0.010
Severe emesis	37(43.5)	17(20)*	0.002

Values are mean \pm standard deviation (SD) or number of patients (%).

PONV; Postoperative nausea and vomiting.

Severe emesis; Presence of nausea verbal rating scale ≥ 7 or retching/vomiting.



IV. DISCUSSION

The results of our study indicate that robot-assisted endoscopic thyroidectomy using the Da Vinci[®] S Surgical System robot (Intuitive Surgical Inc., Sunnyvale, CA, USA) by a gasless transaxillary approach reduce the incidence of PONV (42.4 % vs. 63.5 %) and severe emesis (20.0 % vs. 43.5 %) than conventional open thyroidectomy during the 24 h postoperative period.

The etiology of PONV is thought to be multifactorial, involving anesthetic, surgical, and patient factors. (Watcha and White, 1992; Kovac, 2000) Open thyroidectomy is associated with a high incidence of PONV as high as 65-70% (Won et al, 2011; Vari et al, 2010; Ewalenco et al, 1996; Sonner et al, 1997), which may be related to patient's age range/sex (mostly young or middle-aged women) and intense stimulation of vagal afferents during surgical handling of the neck. (Ewalenco et al, 1996; Sonner et al, 1997) In this study, both groups were comparable with respect to extensiveness of surgery, anaesthetic drugs used and demographic data such as history of motion sickness, PONV and smoking.

Recently, robotic technology using Da Vinci[®] S Surgical System robot has been used to thyroid surgery to overcome the limitations of open and endoscopic thyroidectomy. (Kang et al, 2009) In our hospital, the transaxillary approach in robot-assisted thyroidectomy has been introduced from 2009 and characteristic feature of it is significant tissue dissection to reach the anterior neck area from the axilla to achieve adequate working space. (Lee et al, 2010) However, comparison of robot-assisted and open thyroidectomy have shown that the latter provides better patient' outcomes, including reduced neck area pain/discomfort and swallowing difficulty. (Lee et al, 2012, Tae et al, 2011) Although the difference was not significant, Lee et al. reported that the incidence of severe pain in the neck and anterior chest, 24 hr after surgery was reduced in robot-assisted thyroidectomy than in open thyroidectomy. (Lee et al, 2012) Hong et al. reported on the effect of paracetamol for pain reduction in patients who underwent robot-assisted thyroidectomy anesthetized with sevoflurane. (Hong et al, 2010) In their report, the incidence of PONV in robot-assisted thyroidectomy was 65.6 % in the placebo group,

which is higher than that in our study. However, they used opioids as rescue analgesics in 29.5% of patients and opioids are known to increase PONV incidence. (Watcha and White, 1992; Apfel et al, 1999; Koivuranta et al, 1997; Lee et al, 2007) Their report also shows that reducing pain decreased PONV incidence to 28.5%, which is lower than that in our study. However, they treated pain more intensively than did in our study with 3 analgesics. In our study, mean pain score during the 6-24 h postoperative periods was decreased in Group R compared to Group O (2.8 versus 3.8, $P < 0.05$) and PONV incidence is mainly decreased during 6-24 hr after anaesthesia with decreased incidence of nausea, use of rescue emetics and severe emesis. With these results and regarding the fact that pain appears to be the common cause of PONV, (Watcha and White, 1992; Lee et al, 2007; Hong et al, 2010; Anderson and Krohg, 1976) reduction of pain or discomfort in the neck area may contribute to decrease the incidence of PONV in robot-assisted thyroidectomy.

Additionally, robot-assisted thyroidectomy does not involve midline dissection of the strap muscle and it

is associated with a reduction in traction over the paraesophageal area which may prevent development of swallowing problems and voice impairment. (Lee et al, 2012) Taking into account that intense stimulation of vagal afferents during surgical handling of the neck in open thyroidectomy is one of the causes of PONV, (Ewalenco et al, 1996; Sonner et al, 1997) the reduced neck area manipulation provided by the robotic technique may contribute to reduce PONV incidence and neck area pain score. Kim et al. reported on PONV incidence in women who underwent conventional endoscopic thyroidectomy. (Kim et al, 2011) Despite the use of CO₂ insufflation, which is emetogenic, the PONV incidence was lower (51.3%) than previously reported results (65-70%) for open thyroidectomy. (Watcha and White, 1992; Won et al, 2011; Vari et al, 2010; Ewalenco et al, 1996; Sonner et al, 1997; Kim et al, 2011; Duncan et al, 2007) This and our results may suggest that surgical techniques that could minimize neck area manipulation such as conventional endoscopic thyroidectomy or robot-assisted thyroidectomy could decrease the PONV incidence.

Use of inhalational drugs is known to be an important cause of PONV, especially during the early postoperative periods. (Watcha and White, 1992; Kim et al, 2011) In our study, anesthesia was maintained with sevoflurane in both groups. And, PONV incidence during

the 0-6 hr postoperative periods was not significantly different whereas that during the 6-24 hr postoperative periods was significantly decreased in Group R.

A positive correlation between obesity and PONV has been suggested (Watcha and White, 1992; Palazzo and Strunin, 1984) which might be due to the adipose tissue acting as reservoir for inhaled anaesthetic agents from which they continue to enter the blood stream even after their administration has been discontinued. (Watcha and White, 1992; Palazzo and Strunin, 1984) In our study, BMI was decreased in Group R compared to Group O (22.2 versus 23.6, $P < 0.05$), which may be due to decreased age of patients in Group R. Regarding BMI are within normal range in both groups and inhalational agents are emetogenic mainly during early postoperative periods, (Apfel et al, 2002) the cause of reduced PONV incidence during 6-24 postoperative periods may not be mainly from the differences of BMI between the groups.

Koivuranta et al. demonstrated that longer duration of surgery is one of the important predictive factors associated with increased risk for nausea and vomiting. (Koivuranta et al, 1997) In our study, although the surgery duration was slightly higher in Group R compared to Group O (122.3 min versus 101.8 min, $P < 0.05$), PONV incidence was lower in Group R.

Factors such as decreased mean pain score during the 6-24 postoperative periods, decreased BMI and reduced surgical manipulation without traction over the paraesophageal area in robot-assisted thyroidectomy could contribute to the decreased PONV incidence. On the other hand, factors such as increased anaesthesia/surgery duration and decreased age in robot-assisted thyroidectomy could lead to higher PONV incidence. Overall, our results show that PONV incidence was lower during the 0-24 hr postoperatively in Group R compared to Group O, mainly during 6-24 hr postoperatively.

V. CONCLUSION

In conclusion, compared to conventional open thyroidectomy, robot-assisted endoscopic thyroidectomy reduced the incidence and severity of PONV during the 0-24 hr postoperative period.



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-국문요약-

여성 환자에서 고전적 갑상선 절제술과 로봇-내시경적 갑상선 절제술 후 오심 구토 발생 빈도 비교

아주대학교 대학원 의학과

이 아 람

(지도교수 : 이숙영)

연구 목적:고전적 갑상선 절제술은 수술 후 오심, 구토의 발생 빈도가 70%에 이른다. 최근 소개된 가스를 사용하지 않고, 겨드랑이로 접근하는 Robot-assisted 내시경적 갑상선 절제술은고전적 갑상선 절제술에 비해 여러 장점이 있어,증가하고 있다. 본 연구는 고전적 갑상선 절제술과 Robot-assisted 내시경적 갑상선 절제술을 시행 받는 여성 환자에서 술 후 오심, 구토의 발생 빈도를 비교하였다.

연구 방법 :후향적, 이중 맹검의 방법으로 고전적 갑상선 절제술 (그룹 O) 또는 Robot-assisted 내시경적 갑상선 절제술 (그룹 R) 을 시행 받는 20~60세 170명의 여성을 선출하였다. Sevoflurane과 Air, oxygen을 이용하여 표준적인 마취를 시행하였다. 수술 후 0-24시간 동안 PONV의 발생률과 강도, (오심,구역/구토) 통증의 강도, 추가 항 구토제의 필요 여부, 만족도를 평가하였다.

결과 :수술 후 0-6시간 동안 오심, 구토의 발생률과 평균 통증 점수는 (40% vs. 51.8% 그리고 4.2 vs. 4.8 각각 그룹 R, 그룹 O) 두 그룹 간 유의한 차이는 없었다. 수술 후 6-24시간 동안 오심, 구토의 발생률(18.8% vs. 44.7%), 심한 구토 (11.8% vs. 29.4%), 평균 통증 점수 (2.8 vs 3.8)는 그룹 R에서 그룹 O 보다 유의하게 낮았다. 수술 후 0-6시간과 6-24시간의 만족도는 (55.3% vs. 28.2% 그리고 82.4% vs. 58.8%) 그룹 O와 비교하여 그룹 R에서 유의하게 높았다.

결론 :Robot-assisted 내시경적 갑상선 절제술이 고전적 갑상선 절제술과 비교하였을 때 수술 후 0-24시간 동안 오심, 구토의 발생률과 강도를 감소시킨다.

핵심어 :로봇 갑상선 절제술, 고전적 갑상선 절제술, 수술 후 오심, 구토

