

Local Anesthesia With Monitored Anesthesia Care vs General Anesthesia in Thyroidectomy

A Randomized Study

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Background: Early in the 20th century, thyroid surgery was performed using local anesthetic techniques. When general anesthesia became safer, surgeons started performing thyroidectomy exclusively under general anesthesia. However, recent descriptions of thyroidectomy under local anesthesia claim similar results to thyroidectomy under general anesthesia. Surgery conducted under local anesthesia can result in early discharge, ie, a hospital stay of less than 8 hours.

Hypothesis: Thyroidectomy can be performed under local anesthesia with monitored anesthesia care (MAC) with results similar to general anesthesia in an outpatient or inpatient surgery setting.

Design: A prospective randomized study comparing local anesthesia with MAC vs general anesthesia in adult patients undergoing thyroidectomy in a potential outpatient setting, defined as same-day discharge. Patients were excluded if they were not able to receive local or general anesthesia. In addition, we performed an outcome evaluation of the use of local anesthesia with MAC for thyroidectomy and the use of outpatient surgery for thyroidectomy. We compared 58 consecutive thyroidectomies performed prior to the study with 58 consecutive thyroidectomies performed after the study.

Setting: A 486-bed university-affiliated hospital.

Results: Fifty-eight patients undergoing thyroidectomy received random assignment: 29 to local anesthesia with MAC and 29 to general anesthesia under study protocol. Fifty-one surgical procedures (88%) were completed as outpatient surgery. No significant differences were found between the 2 study groups in demographics, postoperative adverse symptoms, complications, hospital admission, or patient satisfaction. Patients in the general anesthesia group spent, on average, more time postoperatively than patients in the group that received local anesthesia with MAC in the outpatient surgery center until same-day discharge ($P=.02$). When compared before the study, we found a significant increase after the randomized study in the use of local anesthesia with MAC ($P<.001$) and outpatient thyroidectomies ($P<.001$).

Conclusions: Thyroidectomy can be performed in the studied patient population under either general anesthesia or local anesthesia with MAC, expecting similar operative results, clinical results, and patient satisfaction. In addition, local anesthesia with MAC can reduce the postoperative time spent in an outpatient surgery setting with potential health care cost savings.

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HISTORICALLY, THYROID AND parathyroid surgery was done initially under local anesthesia.^{1,2} With the advent of safer general anesthetic techniques, the need for local anesthesia fell by the wayside. There were isolated reports of the use of local anesthesia for thyroid and parathyroid surgery until the 1990s, when favorable experience with larger groups of patients was described.³⁻⁵ With the development of minimally invasive parathyroidectomy techniques, the use of local anesthesia combined with monitored anesthesia care (MAC) became more frequent, particularly when combined with outpatient surgery.^{6,7}

Local anesthesia for thyroid surgery can be accomplished either by a regional block of the cervical plexus (C2-C4) combined with an anterior field block⁸ or by an anterior field block alone.⁵ Newer intravenous anesthetic agents like propofol, midazolam, and fentanyl citrate allow for the establishment of effective sedation and analgesia with a short duration of action. This allows for monitoring of the effectiveness of the anesthesia in combination with the local anesthetic during the surgical procedure. Levels of sedation and analgesia can be adjusted to meet the patient's comfort needs and the surgeon's technical needs. This approach allows for rapid recovery of alertness and early assessment of the pa-

patient's initial postoperative recovery. Additionally, it optimizes the potential for outpatient surgical care.

Previously, there were no prospective randomized studies, to our knowledge, comparing local anesthesia with MAC vs general anesthesia for thyroidectomy. The main objective of this study was to prospectively determine the effectiveness and safety of local anesthesia with MAC compared with general anesthesia in patients undergoing thyroidectomy. Secondary objectives included determining patient satisfaction with either of the anesthetic approaches for thyroidectomy and comparing costs of the 2 anesthetic procedures for thyroidectomy in a potential outpatient surgery setting. Finally, an outcomes analysis of the study was conducted to determine how this prospective randomization study affected the use of local anesthesia with MAC and outpatient surgery for thyroidectomy at a single institution.

METHODS

This study was a randomized effectiveness clinical trial conducted at the Scott & White Memorial Hospital, Temple, Tex. Thyroidectomy was conducted by a single surgeon. The institutional review board approved the study protocol, and informed consent was obtained from all of the participants. Patients aged 18 years and older who were scheduled to undergo thyroidectomy were recruited for potential randomization if it was felt by the responsible surgeon that thyroidectomy could be performed technically under either local anesthesia with MAC or general anesthesia. Patients who required procedures felt to be too technically challenging under local anesthesia with MAC were not offered study entry, ie, relative exclusion for more advanced thyroid cancer, very large goiter, significant morbid obesity, and so on. Other reasons for exclusion included inability of the patient to receive either local anesthesia with MAC or general anesthesia and if the patient was unable to discuss the study for any reason. The objective was to complete the thyroidectomy potentially as an outpatient surgery with same-day discharge if that mode of care was deemed reasonable and feasible by the responsible surgeon and acceptable to the patient. This objective, however, did not determine whether patients were offered study entry.

The study nurse coordinator obtained the consent of patients in the general surgery clinic after notification of eligibility from 1 of us (S.K.S.). Signing the informed consent constituted study entry. The biostatistics department independently assigned randomization after notification of the patient's enrollment.

Patients stopped receiving all anticoagulants, including aspirin and ibuprofen, for an acceptable time period preoperatively. Surgery was performed with the patient in the supine position. One percent lidocaine hydrochloride (Xylocaine) with epinephrine was used for local anesthesia and was administered as an anterior field block alone without regional cervical block. The manner of MAC and general anesthesia was left to the discretion and judgment of the treating anesthesiologist. The patients who received local anesthesia with MAC received midazolam, propofol drip, and fentanyl citrate for supplemental analgesia. The patients who received general anesthesia received midazolam, propofol, or thiopental sodium (Pentothal) for induction. Inhalation anesthesia with nitrous oxide plus isoflurane or desflurane was supplemented with fentanyl citrate or sufentanil citrate for analgesia. The cervical wound and strap muscles of all of the patients were anesthetized further after completion of the thyroidectomy and just prior to wound closure with 10 mL of 0.25% bupivacaine hydrochloride with epinephrine.

All of the vessel ligatures were visually inspected for hemostatic adequacy after thyroidectomy. Any residual bleeding vessels or visualized untied nonbleeding vessels were ligated until complete and thorough hemostasis was achieved. Finally, absorbable collagen pads (Helistat, Integra Lifesciences Corp, Plainsboro, NJ) soaked in saline solution were placed over the resected bed of the thyroid to reinforce subsequent small vessel hemostasis as needed. A thin, narrow, gauze bandage was placed over the closed wound and covered with a transparent adhesive covering (Tegaderm; 3M Health Care, St Paul, Minn) to allow for ready inspection of the wound area. If there was appreciable concern for postoperative bleeding based on the conduct of the surgical procedure and adequacy of hemostasis at the time of wound closure, then the patient was to be observed in the hospital overnight. Patients who underwent bilateral thyroidectomy were given instructions to ingest 500-mg tablets of calcium (Os-cal; GlaxoSmithKline, Research Triangle Park, NC) 3 times per day and were scheduled to have an initial blood calcium level checked between the second and fourth postoperative day and then approximately 30 days postoperatively. Patients received prescriptions for either hydrocodone bitartrate or propoxyphene hydrochloride with acetaminophen for postoperative pain relief. The nurse coordinator called the patients 24 hours after discharge to ask whether they experienced nausea and/or vomiting. The nurse coordinator saw the patients at their 30-day postoperative visits to determine whether any complications had occurred and to obtain patient satisfaction information.

To measure the impact of this randomized clinical trial on thyroidectomy practice, we conducted a retrospective review to compare data collected from 58 consecutive patients who underwent thyroidectomy and were treated before the study and 58 consecutive patients who underwent thyroidectomy and were treated after the conclusion of this randomized study. Treated patients included in this outcome review underwent surgery limited to the central neck compartment and no additional procedure that would influence the choice of anesthesia and/or potential outpatient management, eg, cholecystectomy or lateral neck dissection. Patients being surgically treated for hyperparathyroidism and undergoing additional thyroidectomy were excluded from this comparison as well. The types of anesthetic used and outpatient vs inpatient management were recorded.

Continuous variables were compared using a 2-sample *t* test or the Wilcoxon nonparametric procedure. Categorical variables, including sex, were compared using the χ^2 test or the Fisher exact test. All of the statistical comparisons were made using a 5% level of significance.

RESULTS

A total of 60 adult patients scheduled for thyroidectomy between January 27, 2000, and July 2, 2001, agreed to randomization; 30 patients were assigned to each study arm.

No data were available for 2 randomized patients. The interpreter refused to cosign the consent of a patient (in the local anesthesia arm); another patient was withdrawn from the study by the treating anesthesiologist (in the general anesthesia arm). The following analysis included only the remaining 58 patients.

The patients' ages ranged from 19 to 80 years, with a mean \pm SD of 49.5 ± 16.0 years. Mean \pm SD height and weight for this group were 167.1 ± 7.6 cm and 81.8 ± 18.2 kg, respectively. Fifty-three (91%) of the randomized patients included in the study were women.

Table 1. Baseline Characteristics of the Randomized Study Groups

Characteristic	Local Anesthesia With MAC (n = 29)	General Anesthesia (n = 29)	P Value
Age, mean ± SD, y	52.1 ± 16.7	46.9 ± 15.8	.23
Sex, female/male, No.	26/3	27/2	.64
Height, mean ± SD, cm	166.9 ± 7.4	167.1 ± 8.1	.85
Weight, mean ± SD, kg	83.0 ± 19.2	80.7 ± 17.0	.64
Primary diagnosis, No.			
Thyroid cancer	3	5	.71
Multinodular goiter	15	14	>.99
With hyperthyroidism	6	3	.47
Chronic thyroiditis	3	4	>.99
With hyperthyroidism	1	1	>.99
Graves disease	1	2	>.99
Prior thyroidectomy or tracheostomy	2	1	>.99
Surgical procedure			
Unilateral, No. (%)	9 (31)	9 (31)	>.99
Total lobectomy, No.	6	5	>.99
Subtotal lobectomy, No.	3	4	>.99
Bilateral, No. (%)	20 (69)	20 (69)	>.99
Total thyroidectomy, No.	2	7	.14
Total thyroidectomy plus central lymph node dissection, No.	2	3	>.99
Total and subtotal lobectomies, No.	6	3	.47
Subtotal lobectomies, No.	10	7	.56
Resected thyroid weight, mean, g	37	26	.26

Abbreviation: MAC, monitored anesthesia care.

Table 2. Total Thyroidectomy Lobectomies

Lobectomy Type	Local Anesthesia With MAC, No. (n = 49)	General Anesthesia, No. (n = 49)	P Value
Total lobectomy	20	28	.11
Subtotal lobectomy	29	21	

Abbreviation: MAC, monitored anesthesia care.

Table 1 summarizes the baseline characteristics of the randomized patients by study group. Both groups were similar in terms of patient demographics, primary diagnosis of treated patients, history of undergoing prior central cervical surgery, and surgical procedures. The groups were identical with respect to whether unilateral or bilateral thyroidectomy was performed (in each group, 9 patients [31%] received unilateral thyroidectomy and 20 [69%] received bilateral thyroidectomy). Combining unilateral and bilateral procedures, the numbers of total lobectomies and subtotal lobectomies were not significantly different statistically ($P = .11$) (**Table 2**). The mean weight of the resected thyroid was higher in the group that received local anesthesia with MAC (37 g) vs the general anesthesia group (26 g), but this difference was not statistically significant ($P = .26$).

The study groups were evaluated for time spent in various stages of their surgical care, inpatient vs outpatient

Table 3. Main Outcomes by Study Group

Main Outcome	Local Anesthesia With MAC (n = 29)	General Anesthesia (n = 29)	P Value
Surgical time, mean ± SD, min	109 ± 31	119 ± 33	.24
Time in OR, mean ± SD, min	150 ± 29	163 ± 37	.13
Admitted to PACU, No. (%)	2 (7)	29 (100)	<.001
Time in PACU, mean ± SD, min	4 ± 17	80 ± 42	<.001
Admitted to day surgery, No. (%)	27 (93)	26 (90)	.63
Time in day surgery, mean ± SD, min	160 ± 92	149 ± 82	.65
Time in day surgery and PACU, mean ± SD, min	165 ± 92	229 ± 112	.02
Hospital admission following surgery, No. (%)	3 (10)	4 (14)	.69
Additional hospital admissions within 30 d of initial discharge, No. (%)	0	2 (7)	.49
Total hospital admissions, No. (%)	3 (10)	6 (21)	.47
Nausea within 24 h of surgery, No. (%)	10 (34)	16 (55)	.11
Vomiting within 24 h of surgery, No. (%)	9 (31)	7 (24)	.56
Complications, No. (%)			
Transient vocal cord paresis or paralysis	1 (3)	1 (3)	>.99
Permanent vocal cord paresis or paralysis	0	0	>.99
Persistent voice change	0	1 (3)	>.99
Symptomatic hypocalcemia	2 (7)	1 (3)	>.99
Asymptomatic hypocalcemia	1 (3)	2 (7)	>.99
Persistent hypoparathyroidism	0	1 (3)	>.99
Hematoma	1 (3)	1 (3)	>.99
None, No. (%)	24 (83)	23 (79)	.74
Patient satisfaction with anesthesia management, scale of 1/2/3/4/5 (where 5 is most satisfied), No.*	1/1/10/3/13	1/2/6/7/12	.57
Patient satisfaction with surgery, scale of 1/2/3/4/5 (where 5 is most satisfied), No.*	2/1/9/2/14	2/2/6/5/13	.70
Would recommend to others, No. (%)*	27 (96)	27 (96)	>.99

Abbreviations: MAC, monitored anesthesia care; OR, operating room; PACU, postanesthesia care unit.

*For these analyses, the number of patients was 28.

management, initial postoperative nausea and/or vomiting, 30-day complications, and patient satisfaction with their anesthetic and surgical care (**Table 3**). There were no intraoperative conversions from local anesthesia with MAC to general anesthesia. The time spent in the surgical procedure and in the operating room was less in the group that received local anesthesia with MAC, but this was not statistically significant ($P = .24$ and $.13$, respectively). As might be expected, the need for spending time in a postanesthesia care unit (PACU) was essentially eliminated by the use of local anesthesia with MAC, and this significant difference ($P < .001$) resulted in an earlier recovery in the outpatient day-surgery unit. The time spent in the day-surgery unit was slightly greater for the group that received local anesthesia with MAC than for the general anesthesia group (160 minutes vs 149 minutes, respectively; $P = .65$), but they did not have to first recover in the PACU, so the time spent in the hospital prior to the same-day discharge was significantly less (165 minutes vs 229 minutes, respectively; $P = .02$). Overall, the

Table 4. Outcomes Analysis

Outcome	Before Study, No. (%) (n = 58)	After Study, No. (%) (n = 58)	P Value
Local anesthesia with MAC	12 (21)	29 (50)	<.001
General anesthesia	46 (79)	29 (50)	
Outpatient surgery	21 (36)	43 (74)	<.001
Inpatient surgery	37 (64)	15 (26)	

Abbreviation: MAC, monitored anesthesia care.

group that received local anesthesia with MAC spent about 1 hour and 15 minutes less in outpatient hospital care once they entered the operating room. The cost savings of this care to the hospital was figured to be \$315 per patient.

The vast majority of surgical care was accomplished as outpatient surgery (51 [88%] of 58 patients). Initial hospital admission occurred in 3 patients who received local anesthesia with MAC (1 who was elderly and lived out of state, 1 who underwent surgery late on a very large goiter and lived out of town, and 1 who experienced nausea and vomiting) and 4 patients who received general anesthesia (1 who underwent surgery late, 1 with in-hospital pain management need, 1 who underwent reoperation for hematoma, and 1 who experienced nausea and vomiting). Subsequently, no patients in the group that received local anesthesia with MAC required hospital admission, but 2 patients in the general anesthesia group were admitted to the hospital (same day as surgery for nausea and vomiting for 1 patient, and symptomatic hypocalcemia for 1 patient; overall $P = .47$).

Nausea occurred in 10 (34%) of the group that received local anesthesia with MAC and in 16 (55%) of the general anesthesia group during the first 24 hours ($P = .11$). Vomiting subsequently occurred in 9 (31%) of the group that received local anesthesia with MAC and in 7 (24%) of the general anesthesia group during the same time frame ($P = .56$). There was no significant difference between the groups with respect to nausea and vomiting within 24 hours of the surgery or complications noted within 30 days of the surgical procedure ($P = .11$, $.56$, and $.74$, respectively) (Table 3). However, the patients who received general anesthesia had a higher percentage of antiemetic use than the patients who received local anesthesia with MAC (28 of 29 patients vs 14 of 29 patients, respectively) and a greater number of doses administered than the patients who received local anesthesia with MAC (71 vs 19, respectively) ($P < .01$).

Both groups had 1 patient with transient vocal cord paresis or paralysis with subsequent eventual complete return of the voice to normal. Neither patient would agree to return for a laryngoscopic follow-up examination despite multiple attempts at encouraging them to do so. Only 1 patient (in the general anesthesia group) complained of persistent voice change. On laryngoscopic examination, the patient was found to have granulomata of the vocal cords, which was responsible for the altered voice.

Three patients (15%) in each group had documented hypocalcemia beginning at least 2 days after the surgi-

cal procedure. Two patients in the group that received local anesthesia with MAC and 1 in the general anesthesia group were symptomatic, with only the latter patient requiring inpatient hospital management beginning on postoperative day 2 for 2 days to resolve tetany symptoms with anxiety and a total serum calcium level of 7.0 mg/dL (3.5 mmol/L).

One patient in each group developed a postoperative hematoma. After bilateral subtotal lobectomies for nodular disease with lymphocystic thyroiditis, the patient who received general anesthesia was discovered in the PACU to have significant neck swelling without respiratory compromise. Suspicion for possible hematoma formation was diagnosed 30 minutes after the patient left the operating room, and the patient returned to the operating room 15 minutes later. Active bleeding from a small branch of the superior thyroid artery was controlled. Blood loss was estimated to be 100 mL. The patient who received local anesthesia with MAC who had a right subtotal lobectomy for nodular disease was discovered to have a small paratracheal hematoma on postoperative day 5 on ultrasound examination after complaining of local postoperative pressure in the neck. This patient was morbidly obese (142 kg) with a history of sleep apnea. He complained of some swallowing difficulty and a choking sensation when bending his neck down. There was no respiratory distress at any time postoperatively. A 22-mL hematoma was evacuated under local anesthesia with MAC on postoperative day 6, with reported symptomatic improvement. Overall, 24 patients (83%) who received local anesthesia with MAC and 23 patients (79%) who received general anesthesia had no identifiable complications ($P = .74$).

Patients in both groups were similarly satisfied with their anesthesia experience and surgical experience ($P = .57$ and $.70$, respectively). Only a few patients in each group expressed dissatisfaction with their anesthesia or surgery experiences. Nearly all of the patients in each group would recommend the same anesthesia management that they received to other patients (Table 3).

An outcome analysis of the effect of the randomized study on the practice of thyroid surgery at the Scott & White Clinic and Hospital (Table 4) showed a significant shift toward the use of local anesthesia with MAC, with half of the patients subsequently being managed in this manner ($P < .001$). This comparison was made with consecutive patients who underwent thyroidectomy without considering whether local anesthesia with MAC was feasible for each surgical procedure. There was also a significant shift toward the use of outpatient management of patients who underwent thyroidectomy ($P < .001$). Again, the comparison was done with consecutive patients, thus necessarily including some patients for whom outpatient management may not have been a reasonable option.

COMMENT

The advantage of general anesthesia to the patient is the total loss of awareness of the surgical procedure after the initial intravenous induction. The surgeon has a still op-

erative field, and the anesthesiologist has a controlled airway. The disadvantages of general anesthesia are possible prolonged postanesthesia recovery and adverse effects. The advantages of local anesthesia with MAC to the patient are faster postanesthesia recovery, no throat or vocal cord irritation, and potential avoidance of some of the adverse effects of general anesthesia. The disadvantages of local anesthesia with MAC to the patient are the vague awareness of being in the operating room and the sense of pulling and pressure on the surgical wound. Patients who are claustrophobic would not tolerate this approach. The surgeon has to contend with occasional motion of the operative field with swallowing, coughing, or patient movement, and the anesthesiologist has to monitor the adequacy of sedation and the airway more closely, with frequent adjustments of the level of sedation for patient comfort while maintaining proper oxygenation. The cooperation of the patient is necessary at some points, so individuals with dementia or language barriers are not the best candidates for this anesthetic approach. If the approach of local anesthesia with MAC proved unmanageable for the patient or surgeon, then the patient could be readily converted to general anesthesia by raising the surgical drape off of the patient's face while maintaining the sterile anterior neck field. This allows for safe intubation of the patient. There were no conversions to general anesthesia in this study. Lo Gerfo⁹ reported a similarly low conversion rate. He and others have used a local anesthesia cervical block along with an anterior field block effectively.⁷ This study shows equally satisfactory results with just an anterior field block. This is technically easier and avoids the potential injection of the carotid artery or block of the vagus nerve with a cervical plexus block.

General anesthesia has the potential to result in subsequent nausea and vomiting afterward. Sonner et al¹⁰ demonstrated an overall 54% incidence of postoperative severe nausea or vomiting with thyroidectomy, and significantly more severe nausea or vomiting in women who received isoflurane anesthesia than in those who received propofol anesthesia. Brooker et al¹¹ found a 71% incidence of nausea and vomiting after thyroidectomy. They demonstrated a significant decrease in nausea and vomiting with female patients in the first 6 hours after surgery with propofol anesthesia as compared with isoflurane anesthesia, but there was no difference between 6 and 24 hours postoperatively. There was an overall incidence of emesis in 72% of patients who received isoflurane anesthesia vs 50% of patients who received propofol anesthesia ($P = .12$) within 24 hours of thyroidectomy. Our study showed less frequent vomiting within 24 hours of surgery (31% for local anesthesia with MAC and 24% with general anesthesia), but there was no significant difference for postoperative nausea and vomiting between the 2 anesthetic approaches. Our lower-than-usual incidence of vomiting could be explained by the fact that most of our patients, especially those who received general anesthesia, received antiemetic prophylaxis. Other factors, such as narcotic use, also play a role in this common adverse effect.

The goal of thyroidectomy, besides correcting the primary disease, is to avoid complications of laryngeal nerve

injury, permanent voice change, hypoparathyroidism, and bleeding. The manner of anesthesia management should allow the surgeon to readily meet these objectives. There is an initial adjustment for the surgeon with local anesthesia with MAC because of more operative field movement with swallowing, coughing, or neck motion. Patient movement or vocalization does not always mean pain or discomfort, but it can indicate other issues such as the patient feeling hot from the surgical drapes or having an itchy nose from narcotic use. The heavily sedated patient may reflexively try to free their secured arms. With experience, the surgeon becomes accustomed to these intraoperative incidents of motion, and the incidents are of little consequence in performing thyroidectomy. Intubated patients receiving general anesthesia can also occasionally disturb the operative field with coughing spasms. There was no significant difference between the 2 randomized groups with respect to postoperative complications. Only 1 patient had persistent voice change, and that patient was discovered to have granulomata responsible for this. The 2 patients with identified altered vocal cord function (1 with paresis and 1 with paralysis) refused subsequent follow-up to document return of vocal cord function after return of normal voice function. It is recognized that compensation of the contralateral vocal cord can result in remarkably good voice function. These 2 patients could have had this, but they were satisfied enough with the return of normal voice function so as to flatly refuse further follow-up. Some intraoperative monitoring of voice function under local anesthesia with MAC is intermittently possible. However, intravenous sedation can alter voice function, making this an unreliable technique for assessing recurrent laryngeal nerve function. Only when the voice is clearly normal can there be some assurance of normal recurrent laryngeal nerve function. Following the surgical procedure, the voice quality is frequently excellent in patients receiving local anesthesia with MAC since there is no pharyngeal or laryngeal irritation by the endotracheal tube. Only 1 patient (from the general anesthesia group) (1.7%) in the entire study had a persistent complication of mild hypoparathyroidism and asymptomatic hypocalcemia (total serum calcium level of 8.1 mg/dL [4.1 mmol/L] at 4 months of receiving medication).

The cost of care in the operating room environment is greater than that in the PACU, which in turn is greater than in an outpatient day-surgery unit. The amount of time that the patient spends in each of these environments determines the level of staffing required and the equipment resources needed. In turn, outpatient surgery will necessarily be less expensive care to deliver than inpatient surgery (including a hospital stay of <24 hours). The group that received local anesthesia with MAC in this study spent a mean of 13 minutes less time in the operating room ($P = .13$). This was a reflection of the difference (10 minutes) in the actual time of the surgical procedure between the 2 study groups. The primary difference between the 2 study groups was the need for patients who received general anesthesia to spend more time than those who received local anesthesia with MAC in the PACU (80 minutes vs 4 minutes,

respectively; $P < .001$), and thus significantly more time in the outpatient day-surgery unit after leaving the operating room (229 minutes vs 165 minutes, respectively; $P = .02$). The cost savings for this will vary from institution to institution.

Hospitalization was needed in only 3 patients (10%) in the group that received local anesthesia with MAC, compared with 6 patients (21%) in the general anesthesia group (4 patients initially and 2 patients subsequently within 2 days of the surgery) ($P = .47$). Outpatient management for patients who underwent thyroidectomy was first described as feasible in 1986 by Steckler¹² in 41 of 48 patients in his personal series. These cases included thyroid lobectomies and bilateral subtotal lobectomies. In 1991, Lo Gerfo et al⁴ described their experience with outpatient thyroidectomy in 76 of 134 patients discharged the same day after a postoperative evaluation period of 4 to 8 hours. They included 21 patients undergoing total thyroidectomy in the outpatient group. In 1995, Mowschenson and Hodin¹³ treated 61 patients and felt that outpatient thyroid and parathyroid surgery was safe and feasible. They observed their patients for 6 to 8 hours after the surgical procedure in a surgical day care unit, calculating a 30% savings in hospital costs with outpatient management. Others^{14,15} have advocated a short-stay hospitalization (≤ 23 hours) as a defined outpatient management with longer observation periods.

In the past, hospitalization had been recommended for patients who underwent thyroidectomy, particularly when bilateral, to monitor for symptomatic hypocalcemia. In 1994, Moore¹⁶ demonstrated that a program of routine oral calcium supplementation could be used as the basis for a same-day or 1-day discharge program. The lowest calcium level was found 24 hours after surgery and trended slightly upward 48 and 72 hours after surgery. Only 1 patient in our study required inpatient management of symptomatic hypocalcemia with the increased administration of oral calcium and short-acting vitamin D, or calcitriol. The other instances of hypocalcemia could be adequately managed on an outpatient basis.

The other argument against outpatient thyroidectomy is the potential for the development of life-threatening neck hematoma requiring emergency bedside decompression for respiratory compromise. What constitutes an adequate observation period is debatable as well, but 75% of postoperative hematomas are reported to occur within 6 hours, and the remaining 25% generally occur within 24 hours, but occasionally beyond 24 hours.¹⁷ In the experience of Schwartz et al¹⁷ with 21 cases of postoperative bleeding, all of the patients had evidence of a bleeding problem within a few hours of undergoing their surgical procedures, and they had the potential for respiratory problems within 4 hours of undergoing their surgical procedures. The incidence of postoperative hemorrhage requiring return to the operating room is 0.5% to 1.0%. Typically, this does not require emergent bedside decompression. Most of the data concerning this infrequent complication come from retrospective studies. The largest described series is from the Mayo Clinic, Rochester, Minn, where Burkey et al¹⁸ reviewed the rec-

ords of 13 817 patients undergoing thyroidectomy and parathyroidectomy. They identified 42 patients with postoperative hematomas requiring cervical reexploration (1 in 333 patients [0.30%]); 9 patients required bedside hematoma decompression and/or emergent intubation (1 in 1429 patients [0.07%]). As anticipated, these patients were most likely to have an arterial bleeding source and earlier presentation ranging from 10 minutes to 16 hours postoperatively. Overall, 11 patients were determined to have an arterial bleeding source (0.08% or 1 in 1250 patients), including superior thyroid artery in 6 patients and inferior thyroid artery in 5 patients. The greatest risk for respiratory compromise after thyroidectomy comes from inadequate hemostasis from an arterial source.

Outpatient management of patients undergoing thyroidectomy requires careful, meticulous, and thorough hemostasis. Our preference is mechanical hemostasis of all of the vessels encountered in the dissection except for those that are the most minute. A thorough visual inspection of the operative field is necessary, looking particularly for the unligated vessel potentially in spasm and not actively bleeding. If the progress of the surgical procedure, difficulty of hemostasis, or inability to visually confirm hemostasis indicates an increased risk for compromising postoperative bleeding, then the patient should be observed in the hospital overnight. Even with these precautions, patients do require a minimum observation period to further detect a nonligated arterial branch that was initially in spasm and not bleeding. In our experience, this uncommon event happens shortly after the completion of the surgical procedure and prior to outpatient discharge, as in 1 of the study patients. This observation period was approximately 2 hours and 45 minutes in the group that received local anesthesia with MAC and 4 hours in the general anesthesia group. Patients were dressed with a small, thin, linear, gauze bandage to just cover the incision, and this was secured with a transparent dressing (Tegaderm) to allow for easy inspection of the wound for incisional bleeding, bruising, or considerable swelling that could indicate a postoperative bleeding problem. This approach did identify the 1 patient with postoperative arterial bleeding within 30 minutes of leaving the operating room. The second patient with a small, noncompromising, symptomatic hematoma could have been managed electively on an outpatient basis. Prior to outpatient discharge, patients and their companions need to receive instructions on the signs and symptoms of a potential postoperative bleeding problem and what response they should take.

Ultimately, patient satisfaction with the anesthesia management and surgical care is paramount. There was no statistical difference between the group that received local anesthesia with MAC and the group that received general anesthesia in their satisfaction of having expectations met with their anesthesia experience (93% vs 89%, respectively) or surgical experience (89% vs 86%, respectively). Nearly 50% of patients in both groups found their surgical experience to be much better than expected. Even though anesthesia assignment was random and many patients did not necessarily receive their preferred anesthesia management, 96% of patients in both

groups would recommend the same anesthesia to others scheduled for thyroidectomy.

The positive experience from this prospective randomized study indicated that either local anesthesia with MAC or general anesthesia could be offered to acceptable thyroidectomy candidates, such as those treated in this study, with the expectation of equal clinical outcomes and patient satisfaction. Day-surgery management could be recommended when reasonable and feasible. The prospective randomized study considerably increased the use of local anesthesia with MAC and outpatient thyroidectomy in a thyroidectomy clinical practice.

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