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ORIGINAL RESEARCH–ENDOCRINE SURGERY

Minimally invasive video-assisted thyroidectomy versus conventional thyroidectomy: A cost-effective analysis

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ABSTRACT

OBJECTIVE: To compare the cost of minimally invasive video-assisted thyroidectomy (MIVAT) with conventional thyroidectomy.
STUDY DESIGN: A cost-effectiveness study and chart review.
SETTING: Academic university hospital.
SUBJECTS AND METHODS: Pediatric and adult patients referred to the Department of Otolaryngology−Head and Neck Surgery for suspicious thyroid nodules, goiters, or known carcinomas. A tertiary care hospital's billing department was queried for all hemithyroidectomies and total thyroidectomies completed by the Department of Otolaryngology−Head and Neck Surgery between January 5, 2006, and November 1, 2007. The charges, including surgery, hospital, pathology, and anesthesia, for minimally invasive video-assisted thyroidectomy (MIVAT) and traditional or minimally invasive open thyroidectomies meeting MIVAT inclusion criteria were then reviewed retrospectively and compared statistically.
RESULTS: A total of 185 thyroidectomies were performed, 50.3 percent of which met criteria for MIVAT. Length of stay (days) was significantly shorter for patients undergoing MIVAT hemithyroidectomy (mean difference −0.8; 95% confidence interval [95% CI] −1.08 to −0.52) and not significantly different between groups for total thyroidectomy (mean difference 0.1; 95% CI −0.36 to 0.56). Mean anesthesia cost (U.S.$) was similar between groups for hemi- and total thyroidectomies. MIVAT mean pathology cost was significantly less than open thyroidectomy for hemithyroidectomy (mean difference −89.9; 95% CI −179.01 to −0.79) and approached significance for total thyroidectomy. There was no significant difference in hospital cost and total cost for hemithyroidectomy and total thyroidectomy.
CONCLUSION: In a group of matched cohorts, the cost of MIVAT appears to be equal to that of open thyroidectomy.

As in many other surgical fields, the desire for improved cosmesis has heavily influenced surgical technique within endocrine surgery. After the success of endoscopic parathyroidectomy at the end of the 20th century, surgeons began to explore the possibility of endoscopic thyroidectomy.[1,2] Although multiple techniques for endoscopic thyroidectomy exist worldwide, minimally invasive video-assisted thyroidectomy (MIVAT), championed by Miccoli et al at the University of Pisa,[2] has become the most popular. During MIVAT, a 1.5- to 2.5-cm incision is made that provides direct access to the thyroid via endoscopic visualization.

The most compelling analysis of MIVAT outcomes was performed by Miccoli and his colleagues in Italy in an 833-patient prospective cohort[3] published in 2006. Patient satisfaction, scar length, length of hospitalization, number of complications, and control of pain have consistently either equaled or surpassed the results of traditional open thyroidectomies.[3-5] In the United States, Terris et al[6,7] at the Medical College of Georgia and Ujiki et al[8] at Northwestern University have both shown MIVAT to be equivalent to conventional thyroidectomy or minimally invasive thyroidectomy (conventional thyroidectomy through a 3- to 5-cm incision). Ujiki et al[8] also found that patients who undergo MIVAT experience less postoperative pain.

By retrospectively reviewing thyroidectomies at the Medical University of South Carolina, we noted that operative times and hospital stays appeared to be shorter for MIVAT than traditional thyroidectomies. Given the worsening national health care crisis and growing concern over the allocation of health care dollars, we believe that a thorough cost comparison of MIVAT versus the traditional procedure is prudent. We project that MIVAT is less costly than open thyroidectomy as the result of shorter operative hospitalization times in a cost-effective analysis.

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Materials and Methods

With approval from the Medical University of South Carolina's (MUSC) Institutional Review Board, all thyroidectomies performed by head and neck surgeons at MUSC between January 5, 2006, and November 1, 2007, were reviewed retrospectively. MIVAT and traditional or minimally invasive open thyroidectomies meeting MIVAT inclusion criteria were then compared. There were two surgeons who performed MIVAT and seven who performed open thyroidectomy, including the two MIVAT surgeons, who also performed open thyroidectomy as the result of patient preference, equipment availability, or exclusion on the basis of criteria that were initially narrower. Exclusion criteria for MIVAT were as follows: previous ipsilateral thyroid surgeries, thyroiditis, metastatic disease, or significant substernal or retroesophageal extension. Visibly massive thyroids also were excluded.

Open thyroidectomies were considered appropriate for comparison with MIVAT if preoperative ultrasound nodule volume was 27 mL or less or by postoperative pathology data in patients without ultrasound if nodule volume was 27 mL or less, nodule cross-sectional area was 9 cm^2 or smaller, or nodule diameter was 3 cm or smaller. The basis of these exclusion criteria is that a 3-cm $\times$ 3-cm $\times$ 3-cm nodule is the largest size that can be expected to be delivered through a MIVAT incision per a personal communication with Dr. Miccoli. Patients undergoing procedures that would significantly increase time in the operating room, including lateral or central compartment lymph node dissection, partial thymectomy, parathyroidectomy/neck exploration, or excision of unrelated skin/buccal lesions, were excluded. Surgeries that included parathyroid reimplantation were included.

Our MIVAT technique was fashioned on the basis of the technique described by Miccoli et al.[9-11] Resident involvement in MIVAT and open thyroidectomy was comparable. All procedures were performed under general anesthesia. Use of standard endotracheal tubes versus Xomed laryngeal monitoring endotracheal tubes varied by surgeon. No drains were used in either group.

Patient data were obtained from electronic medical records and included gender, age, race, height, weight, preoperative diagnosis, total thyroid and thyroid nodule size on ultrasound, thyroid pathology specimen weight and size, and diagnosis and nodule size per pathology. Outcome data included length of operation, estimated blood loss, length of hospital stay (LOS), complications, and length of follow-up. Body mass index was calculated by the use of BMI+ v.1.2 Epocrates-AAC Essentials for Cardiology (Epocrates, Inc., San Mateo, CA).

Cost data (U.S.$) were obtained from University Medical Associates Coding, Revenue Enhancement & Charge Capture Department, including anesthesia, surgical, pathology, and hospital charges. Anesthesia charges included the fees of the anesthesiologist and nurse anesthetist (if used), anesthesia time charges, and agents used. The surgical costs reflected the hospital charges for Current Procedural Terminology codes included by the attending surgeon. Hospital costs included surgical and perioperative supplies, operating room time, and facility fees. Pathology costs included the specimen processing costs and the pathologist fees. We calculated the total cost (excluding the surgery cost) by adding the anesthesia, pathology, and hospital costs.

Data Analysis

All data analyses were performed with Sample Power 2.0, SYSTAT 8.0, and Sigma Stat 3.5 (SPSS Science, Chicago, IL). Categorical variables were presented as percentages (%), and continuous variables were presented as mean $\pm$ SD. All continuous variables were assessed for normality by use of the Kolmogorov-Smirnov test.

Comparisons of outcomes were performed by use of the χ^2 test (categorical variables), the *t* test (continuous variables), and the Fisher's exact test (expected observations in one or more groups (< 5). Linear regression was used to determine the learning curve associated with MIVAT. A $P < 0.05$ was considered statistically significant for all statistical tests. In addition, two (MIVAT vs open thyroidectomy) times two (hemithyroidectomy vs open thyroidectomy) analyses of variance (ANOVA) were performed for certain variables. All means reported from ANOVA were least square means unless stated otherwise. When an ANOVA model was found to be significant ($P < 0.05$), post-hoc comparisons were performed.

Finally, all data were applied to a cost-effective model in which the following variables were calculated and compared between MIVAT versus the conventional procedure for hemithyroidectomy and total thyroidectomy: hospital LOS, anesthesia cost, hospital cost, postoperative complications, and total cost. An independent *t* test or a Mann-Whitney rank sum test was used to compare between the two groups. A sample size was estimated on the basis of a two-tailed significance level of $P < 0.05$. A power analysis was performed by the use of a *t* test. For hemithyroidectomy hospital cost, the sample size requirement of 30 participants per group with standard deviations of 154.52 for MIVAT and 147.85 for the open procedure was estimated to provide a 99.8 percent power to detect the mean difference of 192.2. For total cost, standard deviations of 236.25 and 277.47, respectively, were estimated to provide a 97.0 percent power to detect the mean difference of 259.0. For total thyroidectomy hospital cost, the sample size requirement of 30 participants per group with standard deviations of 594.94 and 124.37 was estimated to provide a 100 percent power to detect the mean difference of 833.6; standard deviations of 481.12 and 317.67 were estimated to provide a 100 percent power to detect the mean difference of 2301.2.

Results

A total of 185 thyroidectomies were performed by surgeons in the MUSC Department of Otolaryngology−Head and