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A systematic review and meta-analysis comparing outcomes between robotic-assisted thyroidectomy and non-robotic endoscopic thyroidectomy

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ABSTRACT

Background: Despite its feasibility, using the *da Vinci* robot in remote-access thyroidectomy remains controversial. This meta-analysis compared surgical and oncological outcomes between robotic-assisted thyroidectomy (RT) and non-robotic endoscopic thyroidectomy (ET).

Methods: A systematic review was performed to identify studies comparing outcomes between RT and ET. Outcomes included operating time, drain output, complications, number of central lymph nodes retrieved, and preablation stimulated thyroglobulin level. A random-effects model was used.

Results: Six studies were eligible. Of the 3510 patients, 2167 (61.7%) underwent RT whereas 1343 (38.3%) underwent ET. Despite a higher drain output (185.8 mLs *versus* 173.3 mLs, $P = 0.019$), RT had fewer temporary recurrent laryngeal nerve injury (2.6% *versus* 3.3%, $P = 0.035$) and shorter length of hospital stay (3.4 d *versus* 3.5 d, $P = 0.030$). In terms of oncological outcomes, despite higher incidence of multicentricity and larger tumors, the number of central lymph nodes retrieved during unilateral central neck dissection in RT was significantly greater than ET (4.5 ± 2.6 and 3.4 ± 2.5, $P < 0.001$) whereas the preablation stimulated thyroglobulin was comparable (0.8 ng/mL *versus* 1.1 ng/mL, $P = 0.456$). However, follow-up data were relatively scarce.

Conclusions: Adding the robot in remote-access thyroidectomy was associated with a significantly lower risk of temporary recurrent laryngeal nerve injury and shorter length of hospital stay. However, despite achieving a comparable level of surgical completeness for low-risk differentiated thyroid carcinoma between RT and ET, this study highlighted the limitations with the current literature and the need for more prospective studies with adequate follow-up.

1. Introduction

Thyroidectomy is a common surgical procedure associated with a low morbidity in experienced hands [1]. However, to further improve cosmetic result and patient satisfaction, various endoscopic approaches to the thyroid gland (or endoscopic thyroidectomy [ET]) have been developed [2,3]. Unlike the conventional approach, these approaches involve

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making incisions away from the neck (i.e., remote-access thyroidectomy) and they are generally technically challenging [2,3]. Furthermore, they involve working in a small working space with rigid endoscopic instruments [2,3]. In 2007, a South Korean group aimed to improve the ergonomics of ET by pioneering the use of the da Vinci robot (the so-called "robotic-assisted thyroidectomy" or [RT]) [4–6]. Despite the higher cost, it has the advantages of improved flexibility of endoscopic instruments, availability of a more stable three-dimensional view, and lessening physiologic tremors [4]. However, despite these benefits, it remains unclear whether the addition of the robot in ET would translate into better outcomes [7]. Some studies found adding the robot prolonged the procedural time whereas other outcomes appeared comparable [8–10]. However, given the generally low incidence of surgically-related complications, these studies lacked the statistical power to detect a difference. To our knowledge, two meta-analyses have been published with one reporting comparable outcomes whereas the other reporting increased complications and drain output in the RT group [11,12]. Given the growing number of publications on this controversial subject and their indication has been extended to managing low-risk differentiated thyroid carcinoma (DTC), we conducted a systematic review and meta-analysis to compare the surgically-related complications and oncological outcomes between RT and ET.

2. Methods

This systematic review and meta-analysis was conducted in accordance with the PRISMA statement [13].

2.1. Search strategy

Studies comparing surgical-related and/or oncological outcomes between patients who underwent RT and ET were retrieved from the Scopus, Medline (PubMed) and Cochrane Library electronic databases on 12th November 2013. We used the following free text search terms in "All fields"

#1: "robotic thyroidectomy"
#2: "robotic-assisted thyroidectomy"
#3: "robot thyroidectomy"
#4: "endoscopic thyroidectomy"
#5: #1 OR #2 OR #3 OR #4.

There was no language restriction or methodological filters. The bibliographies of two previous meta-analyses on RT were searched for other additional relevant references [11,12].

2.2. Study selection

All titles identified by the search strategy were independently screened by three authors (B.H.-H.L., J.S.T., and K.P.W.). Search results were compared, and disagreements were resolved by consensus. Abstracts of potentially relevant titles were then reviewed for eligibility and full-length articles were selected for closer examination. Because there were no randomized trials, any prospective or retrospective study comparing at least one surgically-related and/or oncological outcomes between RT and ET was included. However, we excluded case reports, editorials, expert opinions, reviews without original data, studies on pediatric population, studies comparing outcomes between RT and open thyroidectomy, and studies evaluating patients undergoing robotic-assisted lateral neck dissection. Surgically-related outcomes included operating time, postoperative drain output, recurrent laryngeal nerve (RLN) injury, hypoparathyroidism after total thyroidectomy (TT), hematoma formation, length of hospital stay (LOS), cosmetic result, and any other possible complications such as infection, seroma, tracheal injury, chyle leakage, pain, brachial plexus injury, and flap paresthesia. Oncological outcomes included number of central lymph nodes (CLNs) harvested during central neck dissection (CND), postoperative stimulated thyroglobulin (sTg) level, and locoregional recurrence (LR). Multiple reports of the same dataset were assessed and the most representative and updated report of a study was included.

2.3. Data extraction

All data were extracted onto a standardized form. The primary data extracted from each article included: type or design of study, first authorship, country of origin, year of publication, patient demographics, selection method for RT and ET, weight or size of excised thyroid gland, number of lobectomies, number and extent of bilateral resections (TT or less than total thyroidectomy [LTT]), pathology, characteristics of DTC, number of CLNs harvested during unilateral (i.e., not bilateral) CND, operating time, volume of drain output, rate and definition of surgically-related complications, radioiodine (RAI) ablation, postoperative sTg level, and LR. TT included near-TT, TT, and TT with CND whereas LTT only included subtotal thyroidectomy or Dunhill procedure. Operating time was the duration in minutes from skin incision to closure. Operating times were stratified according to the extent of resection (lobectomy, bilateral thyroid resections, LTT, and TT). For studies that separately provided times for TT and LTT, a pooled estimate of the two was used to calculate overall mean in bilateral thyroid resection. Hypocalcemia rate was calculated by dividing the total number of hypocalcemia over the total number of TTs. RLN injury rate was calculated by dividing the total number of injuries over the total number of nerves at risk. In TT, two RLNs were considered at risk whereas in lobectomy and LTT only one RLN was considered at risk.

2.4. Statistical analysis

For comparison of dichotomous variables between RT and ET, chi-square tests and Fisher exact tests were used. Student *t*-test was used for comparison of continuous variables. The Pearson correlation test was used to correlate two continuous variables. All the individual outcomes were integrated with the meta-analysis software Review Manager Software 5.0 (Cochrane Collaborative, Oxford, England). Standardized mean differences (SMD) were calculated for total operating time, volume of drain output, LOS, tumor size, number of CLNs retrieved, and postoperative sTg level and odds ratios (OR) were examined for the other surgical outcomes. Results