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Main Article

Electrocautery for cutaneous flap creation during thyroidectomy: a randomised, controlled study

U Barbaros, Y Erbil, N Aksakal, G Çıtlak, H İşsever*, A Bozbora, S Özarmağan

Abstract

Background: Although electrocautery has been used widely in surgery, the fear of delayed wound healing and infection persists. We aimed to evaluate the risk factors for wound complications and the rate of wound complications, comparing the use of electrocautery or scissors in cutaneous flap creation during thyroidectomy.

Design: The study group comprised 239 consecutive patients scheduled for thyroidectomy.

Subjects: Patients were randomly assigned to cutaneous flap dissection by either electrocautery (group one, $n = 126$) or scissors (group two, $n = 113$). Age, gender, body mass index, American Society of Anesthesiology score, tissue weight, operating time, incision length, cutaneous tissue depth, thyroid function and surgeon experience were recorded and compared with the rate of post-operative wound complications in both groups.

Results: There were no significant differences between the overall rate of post-operative wound complications, comparing groups one and two (7.9 *vs* 10.6 per cent, respectively; $p = 0.74$). Significant positive correlations were found between wound complication and age (Spearman's rank coefficient (r_s) = 0.135, $p = 0.036$), body mass index ($r_s = 0.379$, $p = 0.0001$), cutaneous tissue depth ($r_s = 0.677$, $p = 0.0001$) and tissue weight ($r_s = 0.643$, $p = 0.0001$). According to logistic regression analysis, a body mass index of more than 27.5 kg/m^2 was associated with a 13.7-fold increased rate of post-operative wound complications.

Conclusion: When creating cutaneous flaps during thyroidectomy, the use of electrocautery is as safe as the use of scissors. Such electrocautery does not increase the risk of wound complications in thyroid surgery.

Key words: Thyroidectomy; Complications; Electrosurgery

Introduction

Thyroidectomy is one of the most frequent operations performed in iodine-deficient regions.[1] The morbidity of thyroid surgery has been reduced by general developments in surgical techniques and instrumentation, and also by improvements in antisepsis and anaesthetic techniques.[2] The main post-operative complications of thyroid surgery are recurrent laryngeal nerve palsy and hypoparathyroidism. Because of the resultant devastating, lifelong handicap, the most frightening complication of thyroid surgery is nerve palsy.[2,3] Wound complications of thyroid surgery have a low incidence and are considered rare; however, these complications, including wound infections, superficial haematoma and seroma, may be relatively frequent and are often underestimated. Wound complications of thyroid surgery occur in 0.3 per cent of all operations, accounting for 2.0 per cent of all thyroid surgery complications.[3,4] Although the risk factors and incidence of nerve palsy and hypoparathyroidism following thyroid surgery are well defined, the risk factors and incidence of wound complications have not been completely described.

Electrocautery has been used widely by general surgeons to create abdominal and thoracic incisions and cutaneous flaps.[5–7] Although an increasing body of clinical evidence demonstrates that electrocautery is as safe as scissors and does not have an increased risk of wound complications, fear of delayed wound healing and high infection risk still persist. The reported results of electrocautery use have been conflicting.[7–12]

The aims of this prospective clinical study were: (1) to evaluate the risk factors for wound complications following thyroidectomy; and (2) to compare the rate of wound complications following cutaneous flap creation during thyroidectomy, for electrocautery versus scissors. To our knowledge, this is the first reported study evaluating the effect of electrocautery on wound complications post-thyroidectomy.

From the Departments of General Surgery and *Public Health, Medical Faculty, Istanbul University, Turkey.
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Patients and methods

From September 2004 to September 2006, we undertook a prospective study to compare the rate of wound complications following cutaneous flap creation during thyroidectomy, for electrocautery versus scissors. Two hundred and thirty-nine patients with multinodular goitre were included in the study. Patients were allocated, according to a table of random numbers, to undergo two different types of cutaneous flap dissection – electrocautery or scissors. In the scissors group (group one, $n = 126$), the wound was created with a scalpel and the cutaneous flaps dissected with standart scissors. In the electrocautery group (group two, $n = 113$), the skin incisions were created with scissors and the cutaneous flaps dissected with diathermy in coagulation mode. In both groups, bleeding points were controlled by coagulation diathermy. Patient randomisation and follow up were done by residents, who were blinded to patients' cutaneous flap dissection method and other details.

Exclusion criteria were as follows: anticoagulant usage; previous thyroid surgery; antibiotics received as prophylaxis or treatment less than one week before surgery; and refusal to participate. The study plan was reviewed and approved by our institutional ethical committee, and informed consent was obtained from all patients.

The indications for surgical treatment were: a large, multinodular goitre with compression effect ($n = 149$); hyperthyroidism ($n = 58$); and a suspicious or positive (i.e. malignant) result on fine needle aspiration biopsy ($n = 32$). All patients were evaluated by physical examination, thyroid function testing and thyroid ultrasonography. All were euthyroid prior to surgery.

The operative procedures (i.e. total or near-total thyroidectomy) were performed by experienced endocrine surgeons, or residents under the supervision of an experienced surgeon. Total thyroidectomy was performed by extracapsular dissection. Near-total thyroidectomy was performed by the capsular dissection method, leaving less than 1 g of remnant tissue around the Berry ligament. Two grams of thyroid remnant, estimated by using 2 g of weighed tissue from the contralateral resected thyroid, was preserved in situ. The total weight of the thyroid gland was calculated as the weight of the resected gland (measured during the operation) plus 2 g.

No patients received antibiotic prophylaxis. The surgical site was painted with povidone-iodine.

Post-operatively, all patients underwent a medical examination within one week of surgery in order to identify early complications.

Wound infections were graded, using a classification system described elsewhere,[13] according to the presence of escalating signs, as follows: grade one, erythema, induration and pain (i.e. cellulitis); grade two, grade one signs plus serous fluid; grade three, contaminated fluid in less than half the wound; and grade four, grade three signs in more than half the wound.

A seroma was defined as any clinically detected collection of fluid under the flaps. A haematoma was defined as a collection of blood under the flaps which required evacuation. Wound complications included seroma, haematoma and wound infection. Wound complications were assessed by an external, independent physician. Each patient's body mass index (BMI) was calculated as the ratio of their weight (in kg) divided by the square of their height (in m^2). All the patients were evaluated according to the American Society of Anesthesiology scoring system.[14] Each patient's age, gender, BMI, American Society of Anesthesiology score, tissue weight, operating time (in minutes), incision length (in cm), cutaneous tissue depth (in mm) and thyroid function, and their surgeon's level of experience, were recorded. The rate of post-operative wound complications was compared for the two groups.

Statistical analysis

Data were reported as mean $\pm$ standard deviation (SD). Analyses were performed using the Statistical Package for the Social Sciences version 10.1 software (SPSS Inc, Chicago, Illinois, USA). Differences between continuous variables before and after treatment were compared using the Mann–Whitney U, Student's *t*- and chi-square tests. Spearman correlation analysis was performed for all patients, comparing wound complication with age, BMI and cutaneous tissue depth. Receiver operating characteristic curves were designed to identify the cut-off values, regarding age, BMI, cutaneous tissue depth and tissue weight, which determined the occurrence of wound complications. Logistic regression was used to investigate relationships between covariates and the occurrence of wound complications. Stepwise regression analysis was performed with wound complications as the dependent variable. The following continuous variables were selected for the stepwise regression model: age, gender, BMI, American Society of Anesthesiology score, tissue weight, operating time, incision length, cutaneous tissue depth, thyroid function, surgeon experience and flap dissection technique (electrocautery or scissors). Age, BMI and cutaneous tissue depth were entered into the logistic regression model as dichotomous variables, using cut-offs derived from receiver operating characteristic curve analysis. Study parameters which had a non-Gaussian distribution were transformed to log values. Results were considered statistically significant at $p < 0.05$.

Results

Patients

The median age of the patients was 46.5 ± 13 (range 18–79) years, with a female/male ratio of 6.2/1 ($n = 206/33$). Of the 239 patients, 181 were euthyroid (All were enthyroid prior to surgery. The Patients with hyperthyroidism were treatment anti thyroid medication Prior to Surgery and all were enthyroid Prior to surgery). Total and near-total thyroidectomy was performed in all patients. On histopathological evaluation, papillary thyroid cancer was detected in 15 patients (11.5 per cent), of whom 13 (86.6 per cent) had papillary microcarcinoma ($\leq$1 cm). The

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TABLE I

CLINICAL FEATURES AND WOUND COMPLICATION RATES FOR GROUPS 1 (ELECTROCAUTERY) AND 2 (SCISSORS)

Feature	Group 1*	Group 2†	*p*
Age (mean ± SD; yrs)	46.4 ± 13	46.5 ± 13	NS
Gender (F/M; *n*)	108/18	98/15	NS
BMI (mean ± SD; kg/m^2)	26.9 ± 2.8	27.1 ± 2.9	NS
ASA score (mean ± SD)	1.2 ± 0.5	1.2 ± 0.3	NS
Incision length (mean+SD; cm)	6.7 ± 0.7	6.2 ± 0.8	NS
Thyroid tissue weight (mean ± SD; g)	49.4 ± 28	52.3 ± 30	NS
Operating time (mean ± SD; min)	56.4 ± 13	63.5 ± 15	NS
Cutaneous tissue depth (mean ± SD; mm)	6.3 ± 3.2	6.5 ± 3.4	NS
Wound complication‡ (*n* (%))	10/126 (7.9)	12/113 (10.6)	NS
Euthyroid pathology‡ (n (%))	66/126 (76.1)	85/113 (75.2)	NS
Experienced surgeon‡ (*n* (%))	90/126 (71.4)	79/113 (69.9)	NS

*$n = 126$; †$n = 113$. ‡Of total group. SD = standard deviation; yrs = years; NS = not significant; F = female; M = male; BMI = body mass index; ASA = American Society of Anesthesiology; min=minutes

mean ± SD size of resected tumours was 5.6 ± 2.3 (range 2–13) mm. For all patients combined, the BMI was 27.02 ± 2.9 kg/m^2, the American Society of Anesthesiology score 1.2 ± 0.4, the incision length 6.2 ± 0.8 cm, the cutaneous tissue depth 6.4 ± 3.3 mm, the thyroid tissue weight 50.7 ± 29 g and the operating time 59.8 ± 14 min.

There was no operative mortality. The incidences of transient vocal fold paralysis and hypoparathyroidism were 5.4 and 10.8 per cent, respectively. Persistent vocal fold paralysis and hypoparathyroidism were not encountered.

Of the 239 patients, 22 (9.2 per cent) developed post-operative wound complications. Wound complications included grade one wound infection ($n = 7$; 2.9 per cent), superficial haematoma ($n = 6$; 2.5 per cent) and seroma ($n = 9$; 3.7 per cent). The patients with grade one wound infection were successfully treated with appropriate antibiotics and anti-inflammatory agents. The cases of seroma and haematoma were aspirated and cultured. All of these patients had negative cultures, and the problem resolved in 10 days with conservative treatment. None of the patients developed wound abscess requiring incision and drainage.

Electrocautery vs scissors cutaneous flap dissection

These two groups were similar as regards age, gender, BMI, American Society of Anesthesiology score, incision length, cutaneous tissue depth, surgeon experience and thyroid function. There were no significant differences between the overall post-operative wound complication rates of groups one and two (7.9 *vs* 10.6 per cent, respectively; $p = 0.74$). Although there was no statistically significant difference, the operating time in group one patients was less than that in group two patients (56.4 ± 13 *vs* 63.5 ± 15 min, respectively; $p = 0.09$) (Table I).

Wound complications vs no wound complications

Age, BMI, cutaneous tissue depth and tissue weight were greater in patients with wound complications compared with those without wound complications. There were no significant differences regarding gender, American Society of Anesthesiology score, incision length, surgeon experience or thyroid function, comparing patients with and without wound complications (Table II).

Correlations

Significant positive correlations were found between wound complications and age (Speaiman' rank correlation coefficient (r_s) = 0.135, $p = 0.036$), and BMI ($r_s = 0.379$, $p = 0.0001$) and cutaneous tissue depth ($r_s = 0.677$, $p = 0.0001$), and and tissue weight ($r_s = 0.643$, $p = 0.0001$). Strongly positive correlation was also found between age and BMI ($r_s = 0.349$, $p = 0.0001$), age and cutaneous tissue depth ($r_s = 0.262$, $p = 0.0001$), and BMI and cutaneous tissue depth ($r_s = 0.840$, $p = 0.0001$) (Figure 1).

TABLE II

CLINICAL FEATURES FOR PATIENTS WITH AND WITHOUT WOUND COMPLICATIONS

Feature	Complications*	No complications†	*p*
Age (mean ± SD; yrs)	50.4 ± 8	45.9 ± 13	0.008
Gender (F/M; *n*)	17/5	190/27	NS
BMI (mean ± SD; kg/m^2)	30.4 ± 1.8	26.6 ± 2.7	0.05
ASA score (mean ± SD)	1.18 ± 0.3	1.23 ± 0.4	NS
Incision length (mean ± SD; cm)	6.1 ± 0.6	6.2 ± 0.8	NS
Thyroid tissue weight (mean ± SD; g)	109.54 ± 31	44.8 ± 21	0.01
Operating time (mean ± SD; min)	62.5 ± 15	59.6 ± 14	NS
Cutaneous tissue depth (mean ± SD; mm)	13.6 ± 0.9	5.7 ± 2.5	0.001
Euthyroid pathology‡ (*n* (%))	18/22 (81.8)	163/217 (75.1)	NS
Experienced surgeon‡ (*n* (%))	16/22 (72.7)	153/217 (70.5)	NS

*$n = 22$; †$n = 217$. ‡Of total group. SD = standard deviation; yrs = years; F = female; M = male; NS = not significant; BMI = body mass index; ASA = American Society of Anesthesiology; min=minutes

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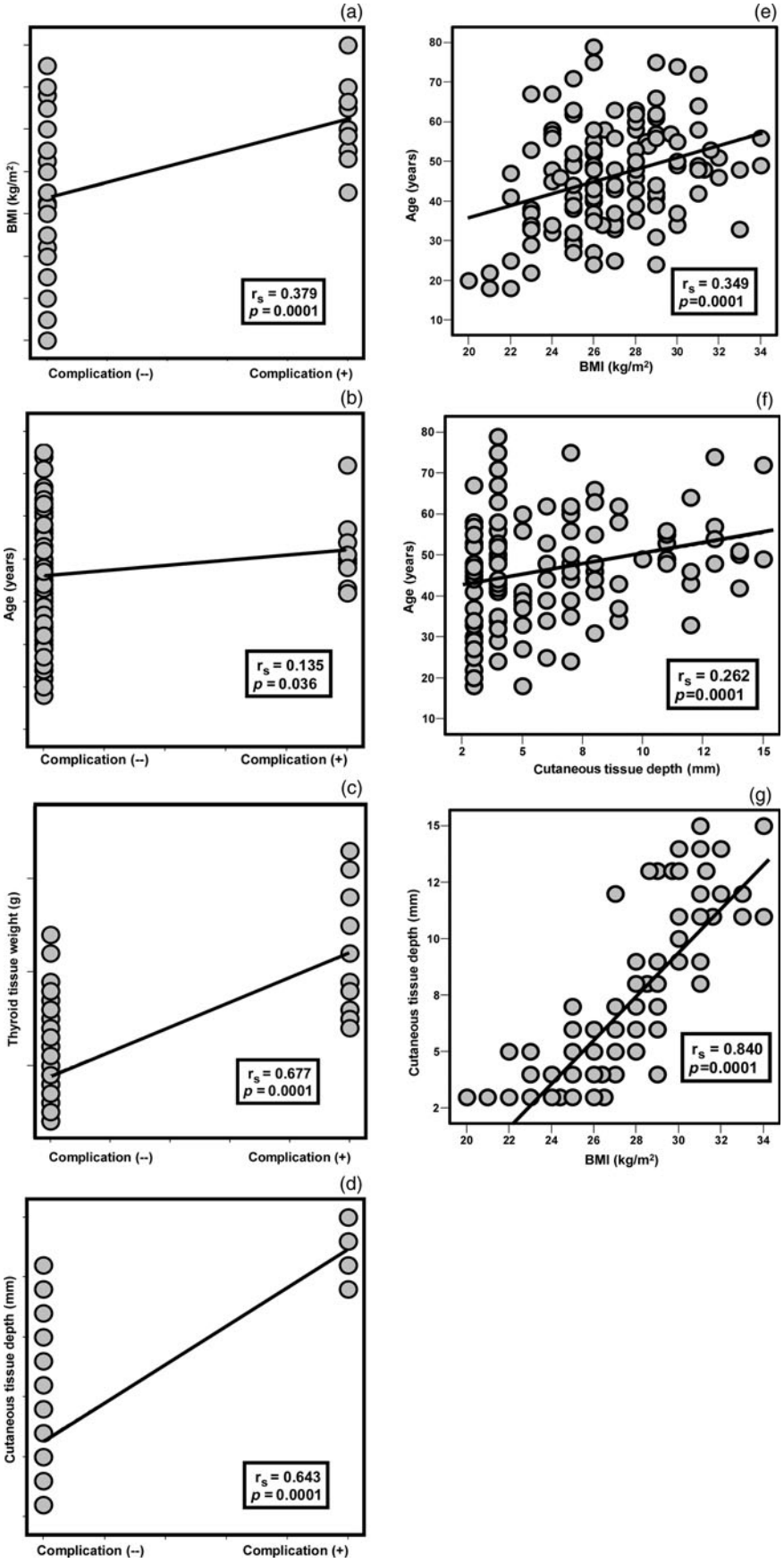

FIG. 1

Relationship between post-operative wound infection rate and (a) body mass index (BMI), (b) age, (c) thyroid tissue weight and (d) cutaneous tissue depth, and relationship between (e) BMI and age, (f) cutaneous tissue depth and age, (g) BMI and cutaneous tissue depth. r_s = Spearman's rank correlation coefficient

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Stepwise regression analysis

Receiver operating characteristic curve analysis demonstrated a significant relationship between wound complications and BMI (area under the curve 0.875, $p = 0.0001$), and age (area under the curve 0.648, $p = 0.02$), and tissue weight (area under the curve 0.957, $p = 0.0001$), and cutaneous tissue depth (area under the curve 0.996, $p = 0.0001$). The cut-off values derived from the receiver operating characteristic curves which gave the best sensitivity and specificity were a BMI of 27.5 kg/m^2, an age of 46 years, a tissue weight of 67.5 g and and a cutaneous tissue depth of 10 mm. When age, gender, BMI, American Society of Anesthesiology score, tissue weight, operating time, incision length, cutaneous tissue depth, thyroid function, surgeon experience and flap dissection technique (electrocautery or scissors) were included as independent variables, BMI was found to be the only significant independent determinant of wound complication (odds ratio 13.7, 95 per cent confidence intervals 2.80 to 67.4, $p = 0.001$). A BMI of more than 27.5 kg/m^2 was associated with a 13.7-fold increased rate of post-operative wound complications.

Discussion

In this study, we compared the effects on post-operative wound complications of the use of electrocautery versus scissors for cutaneous flap creation during thyroidectomy. The use of electrocautery did not influence the rate of wound complications. Positive correlations were found between wound complications and age, BMI, cutaneous tissue depth and tissue weight. According to regression analysis, BMI was the only independent factor influencing the wound complication rate.

- **Electrocautery has been used widely in general surgery to create abdominal and thoracic incisions and cutaneous flaps**
- **This prospective clinical study aimed to evaluate risk factors and to compare the rate of wound complications, for electrocautery *vs* scissors, in cutaneous flap creation during thyroidectomy**
- **Electrocautery was as safe as scissors for cutaneous flap creation, and was not associated with an increased risk of wound complications following thyroid surgery**

'Clean operative wound is almost always elective and is performed under sterile conditions. Thyroidectomy and elective inguinal hernia repair are good examples of clean operative wounds. The risk of surgical site infection is minimal and usually originates from contaminants in the operating theatre environment, the surgical team or, most commonly, skin flora. Surgical site infection rates for clean surgical procedures should be 2 per cent or less, depending upon other clinical variables.[15,16] What causes wound infections? Many factors have been evaluated, including patient age, obesity, type and extent of surgery, surgeon experience, and type of wound drain.[15] Recent studies investigated the effect of electrocautery versus scissors on wound complication rates in patients undergoing various procedures.[5–11]

Although it has become common practice to use electrocautery in abdominal, thoracic and breast surgery, its use increases the incidence of indurated wound margins, infection and wound weakness, compared with scissors and scalpels.[9,10,17,18] It is believed that the use of electrocautery increases the amount of devitalised tissue within the wound, which consequently leads to increased wound infection and delayed wound healing. However, the study groups in question were not homogeneous with regards to patient age, weight, type and extent of surgery, surgeon experience, type of wound drain, and antiseptic used.[9,10] The patients in our study were similar in terms of age, gender, BMI, American Society of Anesthesiology score, incision length, cutaneous tissue depth, surgeon experience, procedure type, drain type and thyroid function. Several studies found no difference in wound infection rates, comparing scissors and electrocautery, for clean, 'clean/contaminated' or contaminated wounds.[7,8,11,12] In addition, these authors demonstrated significant advantages for electrocautery, including shorter operating time and reduced post-operative pain.[19,20] Our results showed that the use of electrocautery to create cutaneous flaps carries a similar risk of wound infection to the use of scissors.

The incidence of wound infection for all thyroidectomy procedures is less than 1 per cent.[3,4] In our study, the incidence of wound infection was 2.9 per cent. This is higher than previously published results. However, in our study the majority of patients classified as having wound infection had grade one infection (i.e. cellulitis). Grade one wound infection may have been accepted as non-infectious wound induration by other authors. Although wound infection, superficial haematoma and seroma may be relatively frequent, they may often be underestimated and under-reported, being overshadowed by the more frightening complication of thyroid surgery, nerve palsy. The higher incidence of wound infection in our patients, compared with other series, might be due to differences in the definition of wound infection. Ours is the first published study to evaluate the effect of electrocautery on wound complications following thyroidectomy.

Conclusion

We found that BMI was the only independent factor influencing the wound complication rate. Electrocautery was as safe as scissors in creating cutaneous flaps, and was not associated with an increased wound complication risk following thyroid surgery.

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Address for correspondence:
Dr Yesim Erbil,
Department of General Surgery,
Istanbul Medical Faculty,
Istanbul University,
34340 Capa,
Istanbul, Turkey.

Fax: +90 212 6319771
E-mail: yerbil2003@yahoo.com

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