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Harmonic focus in thyroidectomy for substernal goiter

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ABSTRACT

Objectives: No previous prospective study has evaluated harmonic scalpel in thyroidectomy for substernal goiter. The objective of this study was to evaluate the use of harmonic scalpel (FOCUS shear, Ethicon Endo-Surgery) in thyroidectomy for substernal goiter for blood loss, operative time, hospital stay and complications.
Materials and methods: Prospective non-randomised study of 242 consecutive patients with substernal goiter out of 2258 patients (11%) who underwent thyroidectomy. A total of 121 patients had thyroidectomy performed with bipolar electrocoagulation and knot-tying techniques and 121 patients had harmonic scalpel thyroidectomy.
Results: The use of harmonic scalpel was associated with significant reduction in intraoperative blood loss (50 vs. 100 mL, $p = 0.001$), postoperative haemorrhage (4% vs. 12%, $p = 0.03$) and length of hospital stay (2 vs. 3 days, $p = 0.001$). The mean operative time was significantly longer in the harmonic group.
Conclusion: Harmonic scalpel is a safe tool for thyroidectomy for substernal goiter. Its utilisation is associated with reduced blood loss, lower incidence of postoperative haemorrhage and shorter hospital stay.

1. Introduction

Thyroidectomy is a frequently performed operation in ENT surgery. The thyroid gland has one of the richest blood supplies, with numerous blood vessels entering the parenchyma [1]. Thus, meticulous haemostasis is important in order to avoid damage to adjacent structures, e.g. the recurrent laryngeal nerves and the parathyroid glands, and to prevent postoperative haematomas [2]. Complication rates are reported between 5 and 15% for transient hypocalcaemia and recurrent laryngeal nerve injury [3–5], 1% for permanent paralysis of the recurrent laryngeal nerve and hypocalcaemia [6,7], and 0–5% for postoperative haemorrhage in large cohort studies [8,9].

Haemostasis can be performed by suture, clip ligation, electrocoagulation or ultrasound technology. A harmonic scalpel uses ultrasound technology to denature proteins in vessel walls and tissues. Harmonic scalpel is able to seal vessels up to 5 mm in diameter, whereas bipolar electrosurgical devices only seal vessels reliably up to 2 mm in diameter [10,11]. It can be used for ligation, dissection and cutting. In cervical goiters, the harmonic scalpel is safe and confers some advantages over conventional dissections methods, including decreased intraoperative blood loss and lower operative time [2].

The complication rate is higher in substernal than cervical thyroidectomy [6,12–14], as dissection of the mediastinal component sometime forces the surgeon to perform blind manoeuvres. Furthermore, intraoperative bleeding complicates the surgical dissection, stains and obscures important structures. In a large study of over 19,000 patients the risk of haematoma, hypocalcaemia and laryngeal recurrent nerve palsy was roughly double in substernal goiters compared to cervical goiters [6]. Until now, no study has evaluated harmonic scalpel in substernal goiter. Therefore, we sought to determine whether the use of harmonic scalpel is a safe alternative to conventional haemostasis method in surgery for substernal goiter. We compared operative blood loss, operative time and rate of complications.

2. Materials and methods

In this prospective non-randomised trial, all patients scheduled for substernal thyroid surgery at Copenhagen University Hospital, Gentofte, Denmark were enrolled from January 2001 to April 2012. The study was a part of the THYKIR Database [8], approved by the Danish Data protection Agency (journal number 2000-41-0010). In 2008 the department started to use the

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harmonic scalpel. We included patients with benign and malign thyroid disease. A goiter was considered substernal if any part of the gland extended through the thoracic inlet. All patients with goiters were examined with ultrasound examination. If the caudal border of the thyroid grand was not visible on ultrasound examination, a CT scan without contrast was performed throughout the whole study period.

The following parameters were recorded in the database: age, gender, earlier thyroid surgery, degree of substernal involvement, weight of surgical specimen, surgical procedure, histology of thyroid specimens, operative time, bleeding during surgery, postoperative haemorrhage, temporary and permanent recurrent laryngeal nerve injury, infection, hypoparathyroidism, surgeon, and length of hospital stay. Degree of substernal involvement was divided into three categories: (1) 1–4 cm, (2) 5–9 cm and (3) >10 cm below the thoracic inlet. Operative time was recorded as the time interval between skin incision and closure. Mobility of the vocal cords was checked by laryngoscopy before and after surgery. Patients with postoperative vocal cord palsy were examined 3, 6 and 12 months after the operation or until full recovery had been confirmed. Bleeding during surgery was measured as weight of sponge and blood in suction. Postoperative haemorrhage was defined as bleeding after wound closure that required reoperation in general anaesthesia. Four senior surgeons performed all operations. Three surgeons (Surgeons 2–4, Table 4) used the conventional method until 2007, and harmonic scalpel from 2008 until 2012. The last surgeon (Surgeon 1, Tables 4 and 5) used the conventional method in the whole period from 2001 until 2012.

SPSS 20.0 was used for statistical analysis. Length of hospital stay and bleeding during surgery were not normally distributed (Shapiro–Wilk test of normality), and were analysed with Mann–Whitney's test and Kruskal–Wallis test when appropriate. Age, weight of surgical specimen, operative time and parathyroid hormone level were all normally distributed, and were tested with the unpaired *t* test and ANOVA test when appropriate. The Chi-square test was used to test gender, surgical procedure, histology, degree of substernal goiter, postoperative haemorrhage and hypoparathyroidism. Fisher's exact test was used to test infection and recurrent laryngeal nerve injury.

2.1. Surgical procedure

Following a Kocher incision, the skin flaps were constructed. The strap muscles were divided in the midline and retracted laterally. Capsular dissection was conducted. In the harmonic group, the inferior, middle and superior vessels were divided with harmonic scalpel (FOCUS shear, Ethicon Endo-Surgery). In the conventional group, all vessels were ligated with suture ties, clips and electrocautery. In both groups, the recurrent laryngeal nerves and parathyroid glands were identified and protected, and the thoracic component of the thyroid was retracted manually to the cervical region. If sternotomy was necessary, a thoracic surgeon was called.

3. Results

During the study period a total of 2258 patients underwent thyroidectomy. Of these, 242 patients (11%) were operated for substernal goiter.

3.1. Substernal goiter versus cervical goiter

Patients operated for substernal goiter were older compared to patients operated for cervical goiter (59 vs. 48 years, $p = 0.001$) and more often male (29% vs. 18%, $p = 0.001$). Furthermore, the incidence of total thyroidectomy was higher (35% vs. 25%, $p = 0.04$), the mean size of the goiter was over three times larger (140 g vs. 30 g, $p = 0.001$), the mean operative time was significantly longer and bleeding during surgery and postoperative haemorrhage was significantly larger in substernal goiters (Table 1).

3.2. Harmonic versus conventional haemostasis in substernal goiter

A total of 121 patients (50%) underwent harmonic thyroidectomy and 121 patients (50%) underwent conventional thyroidectomy (Table 2). No patients needed a sternotomy. Most patients (76%) had a goiter reaching 1–4 cm substernally. Twenty-two percent had a goiter 5–9 cm substernally, and only 3 patients (1%) had goiter extending more than 10 cm substernally. No significant

Table 1
Substernal vs. cervical goiter.

Characteristics	Cervical goiter *n* = 2016	Substernal goiter *n* = 242	*p*-value
Gender			0.001
Male, *n* (%)	363 (18)	70 (29)	
Female, *n* (%)	1653 (82)	172 (71)	
Mean age, years (SD)	48 (14)	59 (14)	0.001
Surgical procedure			0.05
Lobectomy, *n* (%)	1518 (75)	158 (65)	
Total thyreoidectomy, *n* (%)	498 (25)	84 (35)	
Histology			0.2
Malign, *n* (%)	298 (15)	28 (12)	
Benign, *n* (%)	1718 (85)	214 (88)	
Mean weight, g (SD)	30 (105)	140 (121)	0.001
Mean operative time, min (SD)	92 (42)	112 (42)	0.001
Post-operative haemorrhage, *n* (%)	103 (5)	20 (8)	0.03
Median bleeding during surgery, ml (IQR)	50 (70)	75 (100)	0.001
Infection, *n* (%)	34 (1.7)	7 (3)	0.2
Permanent recurrent laryngeal nerve injury, *n* (% NAR)	37 (1.4)	9 (2.7)	0.08
Temporary recurrent laryngeal nerve injury, *n* (% NAR)	72 (2.8)	12 (3.6)	0.08
Median hospital stay, days (IQR)	2 (1)	2 (1)	0.001
Total thyroidectomy	**n = 498**	**n = 84**	
Mean parathyroidea hormone, pmol/l (SD)	4.1 (3.4)	3.8 (2)	0.3
Hypoparathyroidism requiring Calcium and D-vit, *n* (%)	23 (4.6)	4 (4.9)	0.7

IQR, Interquartile range; SD, Standard deviation; NAR, nerve at risk.