Original Article

Use of the Electrothermal Vessel Sealing System Versus Standard Vessel Ligation in Thyroidectomy

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OBJECTIVE: The electrothermal vessel sealing system (LigaSure™) facilitates operative haemostasis by fusing blood vessel walls to form a collagen seal. The LigaSure™ is currently used in a variety of gastrointestinal, gynaecological and urological operations. We report our experience with LigaSure™ for thyroidectomy to test the hypothesis that it reduces operating time without increasing complications compared with standard vessel ligation.

METHODS: This non-randomized, retrospective review included 234 consecutive patients who underwent thyroidectomy by one surgeon. Standard vessel ligation was used in 99 patients between 1997 and 2000, and the LigaSure™ was used in 135 patients between 2001 and 2003. The following data were collected: patient demographics, thyroid pathology, type of operation (total thyroidectomy vs lobectomy), operating time, complications (transient or permanent hypocalcaemia, ≤ 8 mg/dL), recurrent or superior laryngeal nerve injury, neck haematoma, wound complications, prolonged intubation), incision length and hospital stay.

RESULTS: The two groups had similar demographics, thyroid pathology, types of operations and complication rates. The LigaSure™ group had lower operating times and incision lengths.

CONCLUSION: We found that the LigaSure™ was as safe as standard vessel ligation for thyroidectomy, with the benefit of reduced operating time. A future prospective study has been designed. [*Asian J Surg* 2005;28(2):86–9]

Key Words: electrothermal, LigaSure, ligation, thyroidectomy, vessel

Introduction

The electrothermal vessel sealing system facilitates operative haemostasis by applying controlled electrothermal energy to blood vessel walls, resulting in a fused collagen seal.[1] The LigaSure™ (ValleyLab Corp, a division of Tyco Healthcare Group LP, Boulder, CO, USA) is the most widely used electrothermal vessel sealing device. There have been several reports in the past few years describing the use of the LigaSure™ in a variety of gastrointestinal, gynaecological and urological operations.[2–6] The LigaSure™ is used to achieve haemostasis of blood vessels encountered during dissection, and can also be used to divide certain vascularized tissues such as the mesentery and omentum. Several studies have demonstrated a reduction in operating time when the LigaSure™ is used.[1–4] The risk of bleeding does not appear to increase with LigaSure™ use, and some reports have even shown reduced operative blood loss.[2,3] The LigaSure™ also has a reduced energy spread profile (< 2 mm) when compared with unipolar cautery, with a potential decreased risk of injury to adjacent structures. However, it is not applicable to all operative procedures. For example, one study demonstrated that the LigaSure™ alone was not effective for transecting the cystic duct during cholecystectomy.[3]

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Some authors have recently reported their experience with the use of new devices to facilitate haemostasis during thyroid surgery. Two of these reports describe the use of the harmonic scalpel in thyroidectomy.[7,8] With numerous institutions beginning to perform minimally invasive or videoscopic thyroidectomy, there is an increased interest in devices or techniques that reduce the need for conventional knot-tying or suture ligation for haemostasis. At the University of California, San Francisco (UCSF), we have used the LigaSure™ for haemostasis during thyroidectomy for the past 3 years. In this paper, we present our experience with the LigaSure™ in thyroidectomy and compare it with our previous experience with standard vessel ligation using ties and suture ligatures. We hypothesized that use of the LigaSure™ would reduce operating time while resulting in a similar rate of complications.

Patients and methods

We reviewed the medical records of 234 consecutive patients who underwent thyroidectomy by one surgeon (QYD) at UCSF between January 1997 and January 2003. The main outcome measures included patient demographics, thyroid pathology, type of operation performed (total thyroidectomy vs lobectomy), operating time (recorded by the circulating nurse as the time from skin incision to the application of the wound dressing), complications, incision length and hospital stay. The complications recorded included transient or permanent hypocalcaemia (defined as serum calcium ≤ 8 mg/dL), transient or permanent recurrent or superior laryngeal nerve injury, neck haematoma, wound complications and prolonged intubation. We excluded patients undergoing re-operation, including completion thyroidectomy, as well as those undergoing concomitant operations outside the neck.

During the first 4 years of this study period (January 1997–December 2000), operative haemostasis was achieved using standard vessel ligation with ties and suture ligatures. In January 2001, we changed our operative technique and used only the LigaSure™ electrothermal sealing system to achieve haemostasis. Our current practice is to use the LigaSure™ on all visible blood vessels, as well as on thyroid tissue when it needs to be divided. When using the LigaSure™ on blood vessels, it is our routine practice to place a single tie on the end of the vessel that remains in the patient, without tying the end that will be removed with the specimen. Thus, the LigaSure™ has reduced the number of vessel ties that we use by approximately 50%. In addition to reducing the number of ties, use of the LigaSure™ has allowed us to change our operative strategy for thyroidectomy. It is currently our routine practice to use the LigaSure™ to divide the thyroid isthmus (provided there is no evidence of cancer in the isthmus) at the beginning of each thyroidectomy, for both total thyroidectomy and lobectomy. We then retract the thyroid lobe medially using Allis clamps and use the LigaSure™ on the lower and upper pole blood vessels.

Patients who underwent thyroidectomy using standard vessel ligation were compared with those who underwent thyroidectomy using the LigaSure™. Statistical analysis was performed using the *t* test and Chi-squared test, where appropriate. Results are presented as mean ± standard error of the mean, unless otherwise noted.

Results

Between 1 January 1997 and 31 December 2000, 99 patients (20 men, 79 women) with an average age of 42.8 years underwent thyroidectomy with standard vessel ligation. Between 1 January 2001 and 31 December 2002, 135 patients (27 men, 108 women) with an average age of 45.0 years underwent thyroidectomy with the LigaSure™. There was no significant difference in age ($p > 0.05$, *t* test) or in gender ($p > 0.05$, Chi-squared test) between the two groups (Table 1).

The type of operation and thyroid pathologies did not differ between the two groups ($p > 0.05$, Chi-squared test) (Table 1). In the standard vessel ligation group, 37% underwent thyroid lobectomy and 63% underwent total thyroidectomy, while in the LigaSure™ group, 34% underwent lobectomy and 66% underwent total thyroidectomy. The same percentage of patients in both groups had benign thyroid disease (73%) and thyroid cancer (27%). The number of patients with Graves' disease was not significantly different

Table 1. Comparison of patients undergoing thyroidectomy by standard vessel ligation or using the LigaSure™

	Standard ligation	LigaSure™
Patients, *n*	99	135
Gender	20 M, 79 F	27 M, 108 F
Age, yr	42.8 ± 1.6	45.0 ± 1.3
Lobectomy, *n* (%)	37 (37.4)	46 (34.1)
Total thyroidectomy, *n* (%)	62 (62.6)	89 (65.9)
Benign pathology, *n* (%)	72 (72.7)	98 (72.6)
Malignant pathology, *n* (%)	27 (27.3)	37 (27.4)

M = male; F = female.

between the two groups ($p > 0.05$, Chi-squared test): seven (7%) in the standard vessel ligation group and 16 (12%) in the LigaSure™ group.

There was a significant reduction in operating time in the LigaSure™ group (Table 2; 2.9 vs 3.6 hours; $p < 0.05$, *t* test). We further divided the patients in each group by the type of operation. The mean operating time for lobectomy in the standard vessel ligation group (2.7 hours) was significantly longer than that in the LigaSure™ group (2.2 hours; $p < 0.05$, *t* test). A similar result was obtained for total thyroidectomy (4.1 vs 3.2 hours; $p < 0.05$, *t* test). We also identified a reduction in incision length for patients in the LigaSure™ group (Table 2; 5.7 vs 6.2; $p < 0.05$, *t* test).

There was no significant difference between the two groups in the rates of transient or permanent complications (Table 3; $p > 0.05$, Chi-squared test). In the standard vessel ligation group, 15 transient complications included 11 cases of transient hypocalcaemia, two wound seromas, one case of transient hoarseness that resolved within 2 weeks and one prolonged intubation after removal of a large goitre. The two permanent complications in this group were both recurrent laryngeal nerve injuries. In one of these cases, there was thyroid cancer invasion of the nerve necessitating nerve transection. In the LigaSure™ group, 12 transient complications included seven cases of transient hypocalcaemia, three cases of transient hoarseness and two wound complications (1 seroma and 1 infection). The one permanent complication was a superior laryngeal nerve injury.

Table 2. Comparison of operating time and incision length

	Standard ligation	LigaSure™
Operating time, hr	3.6 ± 0.1	2.9 ± 0.1*
Lobectomy time, hr	2.7 ± 0.1	2.2 ± 0.1*
Total thyroidectomy time, hr	4.1 ± 0.1	3.2 ± 0.1*
Incision length, cm	6.2 ± 0.1	5.7 ± 0.1*

*$p < 0.05$.

Table 3. Comparison of postoperative complications and hospital stay

	Standard ligation	LigaSure™
Transient complications, *n* (%)	15 (15.2)	12 (8.9)
Permanent complications (RLN/SLN injury), *n* (%)	2 (2.0)	1 (0.7)
Hospital stay, d	1.2 ± 0.1	1.1 ± 0.03

RLN = recurrent laryngeal nerve; SLN = superior laryngeal nerve.

It is our routine practice for patients to remain in the hospital overnight following thyroidectomy. The mean hospital stay was similar in the standard vessel ligation and LigaSure™ groups (Table 3; $p > 0.05$, *t* test).

Discussion

Any modifications to established operative techniques for thyroidectomy should result in similar or improved patient outcomes and similar or lower rates of complications. In this paper, we present our experience with the use of the LigaSure™, an electrothermal vessel sealing system, in thyroidectomy. We compared 99 patients who underwent thyroidectomy using standard vessel ligation with 135 who underwent thyroidectomy using the LigaSure™. The two groups had similar demographics, thyroid pathology and rates of lobectomy versus total thyroidectomy. Mean operating time was reduced by more than 30 minutes in the LigaSure™ group; for patients undergoing lobectomy, there was a 30-minute reduction in operating time, and for patients undergoing total thyroidectomy, there was a nearly 1-hour reduction in operating time. The mean incision length was reduced by 0.5 cm in the LigaSure™ group. The rates of transient and permanent complications were not significantly different between the two groups. Mean hospital stay was also similar.

The reduction in operating time in the LigaSure™ group was most probably a reflection of changes in operating technique. The LigaSure™ allows us to reduce the number of ties that we use for blood vessel ligation by approximately 50%. When dividing thyroid tissue, we no longer have to use multiple suture ligatures and, instead, use the LigaSure™ for this purpose. In addition, our strategy for thyroidectomy has changed since we began using this device. We now routinely begin each operation by using the LigaSure™ to divide the thyroid isthmus. We then retract the thyroid lobe medially using Allis clamps and use the LigaSure™ to divide the lower and upper pole blood vessels. We believe that this change in technique facilitates dissection of the thyroid lobes and helps to reduce operating time. We have also found that this technique results in a decreased requirement for lateral skin retraction; the reduction in incision length in the LigaSure™ group is probably a result of this decreased need for lateral retraction.

This study was a retrospective, unblinded review of one surgeon's experience. In addition, the time periods for the two study groups were different. The standard vessel ligation group underwent thyroidectomy between 1997 and 2001, while the

LigaSure™ group underwent thyroidectomy between 2001 and 2003. We did not control for the factor of surgeon experience in our analysis of these two groups. It is possible that the reductions in operating time seen in the later time period are actually a result of increased surgeon experience rather than use of the LigaSure™. However, at the time of commencement of the first study period (1997), the surgeon had already been in practice for 9 years and had performed more than 100 thyroidectomies. We believe that by this time, the surgeon had already passed the steep portion of the learning curve and was performing thyroidectomies in an efficient and safe manner.

In order to compare the use of standard vessel ligation and LigaSure™ for thyroidectomy in a more rigorous fashion, we have designed a multicentre randomized prospective trial. This trial will preoperatively randomize patients undergoing first-time thyroidectomy to either standard vessel ligation using ties and sutures or vessel ligation using the LigaSure™. In addition to comparing patient demographics, clinical profiles, operating time, incision length, hospitalization and complications, we would also like to determine whether the thermal energy transferred during LigaSure™ use has any effect on postoperative pain and/or nausea. These factors could be studied by measuring medication requirements following operation.

Conclusion

In our retrospective review of our experience over the past decade, patients undergoing thyroidectomy using the LigaSure™ had reduced operating times and similar rates of complications compared with patients undergoing thyroidectomy using standard vessel ligation.

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