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How I do it:

Sutureless thyroidectomy using electrothermal system: a new technique

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Abstract
Bleeding is a dangerous complication of thyroid surgery. We describe a new technique of vessel and tissue sealing and bleeding control using an electrothermal sealer. The technique has some potential advantages over the current methods used for this purpose.

Key words: Thyroidectomy; Treatment Complication; Bleeding; Haemostasis, Surgical

Introduction

Bleeding is a known complication of thyroid surgery. The bleeding can be intra-operative or post-operative. In about one per cent of thyroid surgery the bleeding is severe and requires re-exploration of the neck in order to seal the vessel and control the bleeding.[1,2] Intra-operative bleeding is potentially dangerous by virtue of haemodynamic shock or even death. The main sources of bleeding are an injured thyroid vessel, thyroid parenchymal bleeding or injury of one of the great vessels of the neck. Intra-operative efforts to control bleeding can put at risk adjacent organs including the recurrent laryngeal nerve, the superior laryngeal nerve (especially the external branch), the parathyroid glands (the gland itself or its blood supply) and the trachea. Other consequences of intra-operative bleeding are prolongation of the operative time and the need for blood transfusion.

These consequences emphasize the importance of more efficient and safer bleeding control methods in thyroid surgery. The current methods used are ligations, sutures, clips, staples and coagulation (unipolar, bipolar and ultrasonic).[3]

This report describes a new technique of vessel and tissue sealing and bleeding control in thyroid surgery using an electrothermal sealer (LigaSure®, Valleylab, CO). The technique, previously described in other surgical fields, is now presented for thyroid surgery.

The electrothermal sealing system

The electrothermal sealing system was originally designed to seal vessels in abdominal surgery.[4,5] The system includes a feedback controlled electrothermal mechanism designed to seal vessels by application of energy and physical pressure. While the vessel walls are being held in tight apposition under pressure the electrothermal energy 'melts' the collagen and elastin fibres of the walls. The feedback mechanism automatically stops the energy delivery when tissue sealing is complete. After a brief cool-down phase the partially denatured proteins produce a translucent sealed zone. The entire process takes from two to five seconds depending on the vessel size and the included tissue. The sealed zone is then divided with scissors. Sealing with this technique is effective in vessels up to 7 mm in diameter.[6]

The electrothermal sealing system is an improved device using bipolar electrocautery technology. The electrothermal sealing system is fully automatic with the settings predetermined while the bipolar method is mainly user dependent. The advantages of the system in comparison to routine bipolar electrocautery are: (1) a larger sealing zone due to the wide contact surface of the forceps (available in various sizes). This enables sealing of unskeletonized vessels, saving the time of dissecting those from adjacent tissues. (2) Full and controlled sealing with high resistance to higher pressures than the systolic one.[6] The device is monitoring continuously the tissue resistance between the jaws. When the resistance reaches its maximal value, the energy flow ceases. The device includes an indicator that alerts when the sealing is not completed. When using the conventional bipolar the proper resistance was not always achieved, making the sealing improper for the systolic pressure acting upon it.[6] Using bipolar

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FIG. 1

Identification of the inferior thyroid artery and preparation of the artery for application of the sealing electrode.

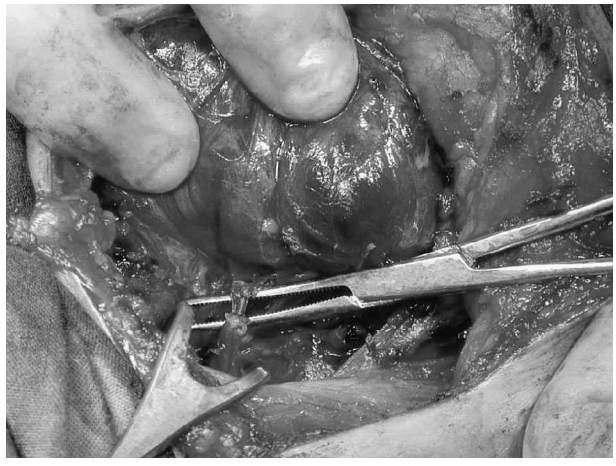

FIG. 3

The 'seal zone' of the inferior thyroid artery after sealing by the electrode. No blood flow is seen in the lumen of the artery.

electrocautery clot formation has a crucial role, in contrast with the electrothermal sealing system where the sealing is achieved by protein denaturation only.[6] (3) Minimal surrounding tissue damage as the output voltage and action duration are automatically controlled in order to produce minimal sticking, charring or thermal spread to adjacent tissue.

The surgical technique

Surgery is performed under general anaesthesia with endotracheal intubation. A transverse cervical incision is made between the two sternocleidomastoid muscles. Skin flaps are developed and the strap muscles are separated in the midline. During these stages the bleeding control, including that of large vessels (i.e. anterior jugular veins if needed) is achieved solely by the electrothermal sealer. Using blunt dissection the gland is identified, mobilized and retracted medially and superiorly. The recurrent laryngeal nerve and the parathyroid glands are identified using fine blunt dissection and then the inferior thyroid artery and vein are identified (Figure 1). The vessels are sealed separately using the electrothermal sealer. Each vessel is grasped by the jaws of the sealer which is ten activated by a foot pedal (Figure 2). During the energy delivery period the sealer makes a whistling sound. When sealing is complete the feedback mechanism automatically stops the energy delivery and the whistle sound. The sealer is then taken out and the sealing zone is divided with scissors (Figures 3 and 4). The next stage is dissection of the upper pole of the gland and identification of the superior thyroid vessels at their entrance to the gland. Sealing of these vessels is carried out by using the same technique as with the electrothermal sealer. In this area the dissection is not fine and sealing includes the vessel and connective tissue. When the surgery is less than total thyroidectomy a part of the superior pole of the thyroid is sealed as well with these vessels. In the final stage the isthmus is disconnected from the trachea. The isthmus, including all the blood vessels inside, is sealed with the electrothermal sealer (Figures 5 and 6). No sutures, ligatures or clips are left. In case of an isthmus that is longer than the jaws of the sealer sealing is carried out in stages. When

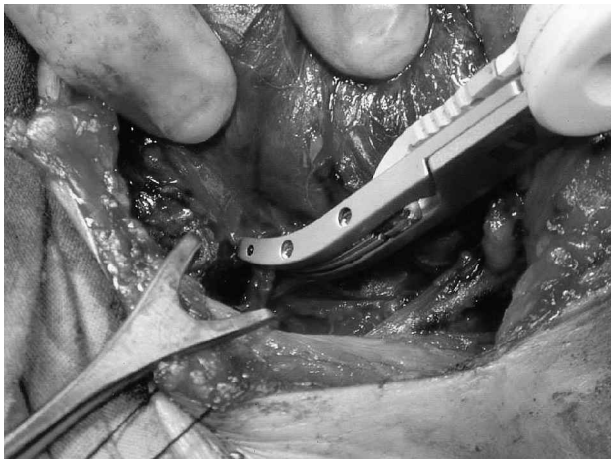

FIG. 2

Sealing the inferior thyroid artery using the clamp-like electrode of the electrothermal sealer.

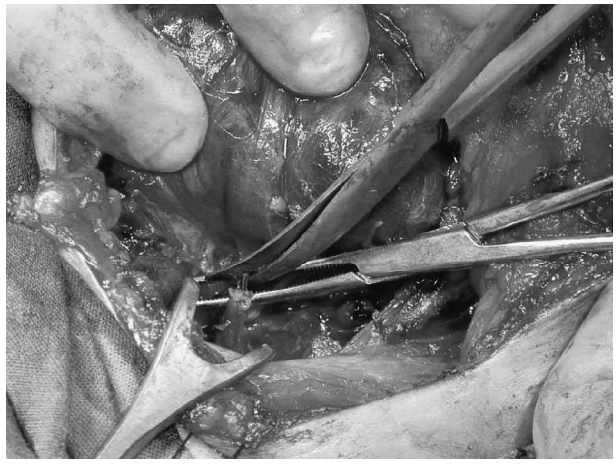

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FIG. 5
Sealing the thyroid isthmus using the clamp-like electrode of the electrothermal sealer.

the isthmus is completely sealed it is divided by scissors or by scalpel (Figure 7).

Discussion

The method of thyroidectomy using the electrothermal sealer for sealing the thyroid vessels has been used recently in our department without any complications. In all of the stages of the 20 consecutive thyroidectomy operations performed during this period haemostasis was achieved solely by the electrothermal sealing system (no sutures or ligatures were used). Although the sealer was used in the immediate environment of the recurrent laryngeal nerve, the latter was not damaged in any of the patients. There was no leak or oozing from any of the sealed areas, including the isthmal, superior thyroid pole or inferior thyroid artery stumps.

Kennedy *et al.*[6] described the advantages of the method: (1) The seal area has a burst strength comparable to that of ligature and clips and higher than that of the unipolar or bipolar electrosurgical coagulator. The burst strength always extends well above the physiological systolic pressure. (2) The sealing is made by direct adhesion of the vessel walls to each other produced by the denatured proteins so it is not dependent on the existence of an intraluminal thrombus as needed with the use of an electrosurgical coagulator. (3) Thermal damage is limited to less than 1.5 mm beyond the tissue within the jaws of the device. (4) The seal zone is translucent therefore it is possible to see, before cutting, whether the sealing is complete or the vessel lumen is still patent. (5) Dislodgment is not a problem as is the case with sutures and clips.

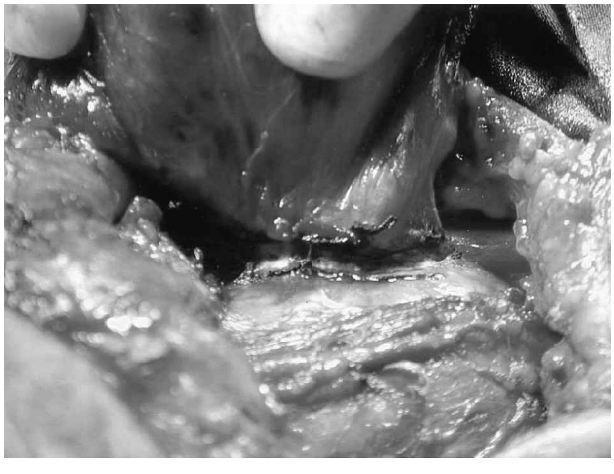

FIG. 6
The 'seal zone' of the thyroid isthmus after sealing by the electrothermal sealer.

FIG. 7
Division of the 'seal zone' of the thyroid isthmus.

The two main disadvantages we found using the method are the gross size of the forceps and the cost of the device compared to other methods of haemostasis. The gross size is especially problematic when working near delicate structures and in small spaces. In these settings even the smallest forceps available are too big. The electrothermal sealing system costs on average four to six times more than the conventional bipolar cautery.

This paper describes a pilot study of a new technique of bleeding control in thyroid surgery. The main advantages that we found using this technique are shortening the operative time and avoiding possible consequences of using sutures and clips. We believe that the procedure using the electrothermal sealer is safer and less time consuming than in conventional thyroid surgery.

A complementary study is planned to measure the parameters of operative time and post-operative complications such as bleeding. In the future this

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method will be considered for other neck operations such as parotidectomies, laryngectomies and all kinds of neck dissections.

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