Review Article

Energy based devices for transoral thyroidectomy

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Abstract: Instruments [energy based devices (EBDs)] that utilize energy to divide tissue with inappreciable bleeding serve surgical procedures. EBDs erroneous use increase morbidity [recurrent laryngeal nerve (RLN), injury]. This article reviews different EBD in terms of their possible application for transoral endoscopic thyroidectomy vestibular approach (TOETVA). Endocrine surgeon skills and perfect judgment on EBD proprieties are essential elements for safe use. Furthermore, surgeons should evaluate carefully if certain EBD is indicated for TOETVA.

Keywords: Energy based devices (EBDs); transoral thyroidectomy; safety; clips; transoral endoscopic thyroidectomy vestibular approach (TOETVA)

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Introduction

Energy based devices (EBDs) are essential accessories in endoscopic and robotic thyroidectomy (1). In a first study by Barczyński *et al.*, 67 patients were randomized into two groups for the minimally invasive video-assisted thyroidectomy (MIVAT) "Miccoli" technique (1): the clip-ligation group (CL-G) and the harmonic scalpel group (HS-G) use. HS-G *vs.* CL-G procedures were notably shorter (31.4 *vs.* 47.5 min). Mean blood loss was consequently smaller (12.9 *vs.* 32.8 mL). Mean scar length positively was shorter (15.6 *vs.* 21.5 mm), with better cosmetic results. The use of HS was 20–30 euros more expensive. No major complications were observed in both groups (1).

The thyroid surgeon cannot perform a transoral endoscopic thyroidectomy vestibular approach (TOETVA) with the hand ligation of the vessels, both of the mean thyroid vein, or the superior and inferior thyroid vessels (2-9). Intraoperative bleeding control cannot be managed without the aid of the EBD or clip applier (9-14). Furthermore, EBD provide a full range of solutions to support every phase of surgery including tissue and vessel dissection, sealing, cauterization, and ablation applications.

EBD for TOETVA

Accurate haemostasis is imperative when working in a limited space, such as that encountered in TOETVA procedure (2-5). Bleeding may cause conversion to an open procedure (6,7). The following sections will explore the application and limitations of EBD when used in TOETVA.

HARMONIC ACE®+7 Shears with Advanced Hemostasis (Johnson & Johnson, New York, NY, USA)

HARMONIC ACE®+7 Shears is the ultimate refined

Figure 1 HARMONIC ACE®+7 Shears with Advanced Hemostasis (Johnson & Johnson, New York, NY, USA).

Figure 2 ENSEAL® Round Tip Tissue Sealer (Johnson & Johnson, New York, NY, USA).

Figure 3 Thunderbeat (Olympus, Tokyo, Japan).

Figure 4 LigaSure™ Maryland jaw (Medtronic, Dublin, Ireland).

curved blade design, designed to enable visibility and fine dissection, with fewer instrument exchanges (*Figure 1*). The refined blade design includes a tapered tip with a proprietary, nonstick coating to enable fast, precise dissection. This EBD seals vessel sizes up to and including 7 mm diameter with hand control button. The adaptive tissue technology of HARMONIC ACE®+7 Shears enables greater surgical precision and performance, provides critical thermal management by dynamically optimizing energy delivery in response to changing tissue conditions. This EBD is available in three shaft lengths: 23, 36, and 45 cm. According to neck length the surgeon will decide for the 23 or 36 cm ones. The EBD provides reduced mist generation helps maintain endoscopic visibility during TOETVA.

ENSEAL® Round Tip Tissue Sealer (Johnson & Johnson, New York, NY, USA)

The ENSEAL® Tissue Sealing Device is indicated for bipolar coagulation and mechanical transection of tissue during both laparoscopic and open procedures (*Figure 2*).

Thunderbeat (Olympus, Tokyo, Japan)

Thunderbeat is a both bipolar and ultrasonic technology device, i.e., surgeons no longer need to choose between rapid dissection and reliable hemostasis when selecting an advanced energy device (*Figure 3*). The EBD allows the surgeon to simultaneously seal and cut vessels up to and including 7 mm in size with minimal thermal spread, with fewer instrument exchanges. The jaw design provides precise, controlled dissection and fast available bipolar hemostasis without sacrificing grasping ability. The EBD provides reduced mist generation helps maintain endoscopic visibility during TOETVA.

LigaSure™ Maryland jaw (Medtronic, Dublin, Ireland)

LigaSure™ Maryland jaw is a 37 cm laparoscopic sealer and divider (code LF1737). This EBD is a multifunctional device that delivers efficiency and versatility by combining one-step sealing and the functionality of a Maryland dissector, atraumatic grasper, and cold scissors with the reliability of LigaSure™ technology (*Figure 4*). The design of the LigaSure™ Maryland jaw allows for more efficient transection speed with one-step sealing, allows for minimal steps when sealing and dividing, and enables reduced instrument exchanges. This EBD technology provides a combination of pressure and energy to create vessel fusion. It permanently fuses vessels up to and including 7 mm in diameter and tissue bundles without dissection or isolation. Average seal cycle is 2 to 4 seconds, when used with the

ForceTriad™ energy platform. Feedback-controlled response system automatically discontinues energy delivery when the seal cycle is complete, eliminating the guesswork.

EBD safety

Smoke effect

EBD in TOETVA may determine two problems during the procedures: (I) recurrent laryngeal nerve (RLN) thermal injury; (II) smoke effect which determines unsafe, bad vision and loss of time. At present is one of the significant obstacles of EBD use for TOETVA safety, because too much smoke effect disturb the view during important steps. "Smoke effect" is always discussed in the operating room with visiting surgeons. For the smoke effect, it is hard to prove if HARMONIC is better than Thunderbeat or LigaSure™, because it depends certainly on surgeon preferences, his perception of dissection and security and how much use of EBD. Furthermore, the use of one or the other depends on availability in the operating room and the lowest economic offered to the administration of the hospital.

The perception is that smoke effect is generally more at the beginning of TOETVA when creating the workspace, the air pocket. Probably because the working space is smaller, and more muscle needs to dissect. Then the perception is there is less smoke, probably because there is more working space available and the smoke is dissipated, and probably because there is less muscle to coagulate, more anatomical plane.

Possible tips to prevent dense smoke effect are: (I) keep the 5 mm ports valves open; (II) keep the tips of the EBD clean; (III) work on anatomical planes, fascia plane produces less smoke effect than muscle; (IV) keep CO_2 at maximum flow; (V) when too much smoke, pull/retract the camera just inside the 10 mm trocar without going out, waiting for the smoke melts.

EBD around the RLN

EBDs are designed to produce minimal temperatures and thermal spread to surrounding tissues. However EBDs are associated with inadvertent thermal transfer to surrounding tissue (15).

Recently, authors have alert that the temperature from EBD may cause laryngeal nerves injury, resulting in vocal cord palsy (15). Standardized experimental studies proved that when EBDs are activated near the RLNs, the heat produced can be conducted through the tissues to the nerve and cause thermal trauma and risk of permanent function deficit (15).

De facto, thermal injury is the second most common mechanism of RLN damage after traction injury during thyroidectomy (15).

Furthermore, the effectiveness of saline irrigation to reduce the chance of nerve root injury during EBD application has not been investigated, despite irrigation having been shown to decrease the temperature.

Conclusions

Currently there are no specific studies that evaluate or compare EBD in TOETVA (8-10). Current EBD developed meet stringent design specification and performance requirements for most of laparoscopic or thoracoscopic procedures. Unfortunately there are no EBDs with precise design specifications and requirements specifically developed for the TOETVA procedure (9).

The ideal EBD may present low temperatures proprieties in order not to damage the overlying skin of the airpoket, or other vital structures such as RLN and parathyroid glands. The ideal EBD should produce little or no smoke effect during their application, to maintain perfect endoscopic view and not to longer the operative time.

Considering the wide adaption of TOETVA, a full range of solutions to support every phase of the thyroid dissection for access instruments is required (11,12). Endoscopic thyroidectomy and TOETVA in particular is an exciting opportunity for improved techniques and accessories to improve EBD outcomes (13,14).

Future perspective for EBD in TOETVA is a neuromodulation product category that can offer a comprehensive breadth of technologies and capabilities, ensuring the surgeon that receives an EBD instruments superior quality in an efficient, cost-effective, repeatable/reusable, dissecting, coagulating, cutting and with neural monitoring capabilities.

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