Modified Radical Mastectomy With Axillary Dissection Using the Electrothermal Bipolar Vessel Sealing System

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Hypothesis: The use of the electrothermal bipolar vessel sealing system is feasible, safe, and effective in modified radical mastectomy with axillary dissection in terms of lymph vessel sealing, hemostasis, and perioperative complications.

Design: Prospective study.

Setting: University surgical department.

Patients: Between January 1, 2003, and December 31, 2003, 60 patients with locally advanced breast cancer (T2 or T3) admitted for modified radical mastectomy with axillary dissection were included in this study. The entire procedure was performed by the same surgical team using the electrothermal bipolar vessel sealing system.

Main Outcome Measures: Final outcome, operative time, hospitalization stay duration, intraoperative blood loss, postoperative mastectomy and axillary drainage volume and duration, and postoperative complications (seroma, bleeding, skin burn, hematoma, lymphedema, pneumothorax, and wound infection or necrosis).

Results: The mean (SD) intraoperative blood loss was 45 (12) mL, and the mean (SD) operative time was 105 (7) minutes. No postoperative bleeding, seroma, hematoma, lymphedema, or other complications occurred. The mean (SD) mastectomy and axillary drainage volumes were 20 (8) and 155 (35) mL, respectively, and the mean (SD) drainage durations were 1.3 (0.2) and 2.7 (0.5) days, respectively. The mean (SD) hospital stay was 3.7 (0.6) days.

Conclusions: In this first report (to our knowledge) of modified radical mastectomy with axillary dissection using the electrothermal bipolar vessel sealing system, the technique was feasible, safe, and effective. The device simplified the surgical procedure, while achieving efficient lymph vessel sealing and hemostasis. Compared with historical data regarding the conventional or harmonic scalpel, this technique seems to result in reduced operative time, perioperative blood loss, drainage volume and duration, and incidence of seroma or lymphedema. Prospective randomized controlled studies are necessary to evaluate the effect of this technique on perioperative complications.


ALTHOUGH SURGICAL TREATMENT for breast cancer has shifted dramatically from radical operations to breast-conserving surgical techniques, modified radical mastectomy with axillary dissection remains the most frequently performed surgical procedure for locally advanced breast cancer. The most common complications of conventional modified radical mastectomy with axillary dissection using scalpel, suture ligation, and electrocauterity are seroma and lymphedema, with incidences of 11% to 85% and 2% to 50%, respectively. Other frequent complications are hematoma, prolonged axillary drainage, wound infection or necrosis, and intraoperative and postoperative bleeding. Lymph vessel sealing and hemostasis are usually performed using clips, suture ligation, or electrocauterity. However, suture ligation is time-consuming and carries the risk of knot slipping, while clips may become dislodged. Moreover, electrocauterity produces thermal spread to adjacent tissues and is considered a risk factor for seroma and other wound complications after mastectomy. Recently, modified radical mastectomy and axillary dissection using the harmonic scalpel have been described. The electrothermal bipolar vessel sealing system, a novel hemostatic device, has been used in general surgery with safety and efficacy regarding hemostasis, complications, and reduction of operative

See Invited Critique at end of article

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To our knowledge, there is no report of its use in modified radical mastectomy, breast-conserving surgery, or axillary dissection. The objectives of this study were to evaluate the feasibility, safety, and efficacy of modified radical mastectomy with axillary dissection using the electrothermal bipolar vessel sealing system in terms of lymph vessel sealing, hemostasis, and perioperative complications and to describe and standardize this novel operative technique.

**METHODS**

This was a prospective study of modified radical mastectomy with axillary dissection. Surgery was performed using the electrothermal bipolar vessel sealing system (LigaSure Precise; Valleylab, Boulder, Colorado).

**PATIENTS**

Sixty consecutive adult female patients with unilateral, locally advanced primary breast cancer (T2 or T3) admitted for modified radical mastectomy with axillary dissection between January 1, 2003, and December 31, 2003, were included in the study. Patients with early breast cancer (T1), previous breast surgery, and neoadjuvant chemotherapy were excluded. Institutional review board approval was obtained before study initiation, and written informed consent was obtained from all patients before surgery. Modified radical mastectomy and axillary dissection were performed by the same surgical team in all cases.

**OPERATIVE TECHNIQUE**

Following skin incision with the conventional scalpel, flaps were raised using the electrothermal bipolar vessel sealing system. Dissection of the breast tissue, being reflected off the pectoralis major muscle, was performed with the device. Clavpectoral fascia was opened, and the axilla was exposed. The pectoralis major and pectoralis minor were retracted upward. The axillary vein was exposed, and all of its small tributaries were ligated with the device. Axillary lymph node dissection was initiated from the lateral end of the vein. A plane of dissection was created along the inferior border of the axillary vein, and all the fat, lymph nodes, and blood vessels were dissected off the axillary vein toward the breast. All axillary vein and artery branches directed toward the breast and pectoralis major muscle were ligated by the device. The thoracodorsal vessels and nerve and the long thoracic, subscapular, medial, and lateral anterior thoracic nerves were identified and protected. Two closed suction drains were placed, one in the axilla and the other on the chest wall.

Level II axillary dissection was performed in all patients, and if the level III lymph nodes were positive on frozen section analysis, the dissection was extended to include level III (this occurred in 3 of 60 patients). Frozen section analysis of level III axillary lymph nodes was performed when macroscopically enlarged or palpable lymph nodes were identified. Sentinel lymph node biopsy was not performed in any patient because of the lack of necessary equipment and experience to perform this technique and because there is no nuclear medicine department in our hospital.

In all cases, the entire procedure of modified radical mastectomy with axillary dissection was performed using the electrothermal bipolar vessel sealing system device (Figure 1). Lymph vessel sealing and hemostasis were achieved using the electrothermal bipolar vessel sealing system device; no clips, sutures, or electrocautery was used. Histopathologic evaluation of the specimens confirmed that permanent complete sealing of lymph and blood vessels was achieved (Figure 2 and Figure 3).

**POSTOPERATIVE TREATMENT**

Each drain was removed when the drainage volume was less than 30 mL in 24 hours. All patients were discharged from the hospital after drain removal and were followed up weekly for...
4 weeks and then every 2 months. Postoperative complications were evaluated during the hospital stay and at follow-up visits. To assess lymphedema, arm circumference was measured at 3 positions (10 cm below, 5 cm above, and 10 cm above the olecranon) in both arms before surgery and at every postoperative visit. Lymphedema was defined as at least a 2-cm difference in arm circumference between the treated (ipsilateral) side and the contralateral arm at any 1 of 3 sites for arm circumference measurement. Patients with tumor size exceeding 5 cm (stage pT3) and those with 4 or more positive axillary lymph nodes on histopathologic examination received postoperative radiation therapy.

**DATA COLLECTED**

Collected data were age, final outcome, pathologic findings, hospitalization stay duration, intraoperative blood loss, operative time (from skin incision to skin closure), postoperative mastectomy and axillary drainage volume and duration, and postoperative complications such as bleeding, seroma, skin burn, hematoma, lymphedema, pneumothorax, need for blood transfusion, and wound infection or necrosis. Data are given as the mean (SD) and range or as the number and percentage of patients.

**RESULTS**

During the 1-year study, 60 consecutive modified radical mastectomies with axillary dissection were performed by the same surgical team. Lymph vessel sealing and hemostasis were achieved using the electrothermal bipolar vessel sealing system in all patients; no clips, sutures, or electrocautery was used.

The follow-up period among our patients ranged from 3 to 4 years, with a mean follow-up of 3.7 (0.2) years. Clinical data and postoperative complications among the study patients along with historical data from other studies in the literature are given in the **Table**. Intraoperative bleeding was not significant in any patient, and no seroma, hematoma, lymphedema, pneumothorax, flap necrosis, wound infection, or postoperative bleeding was observed. Because great care was taken to avoid the skin surface during coagulation with the jaws of the device, no patient experienced skin burns. No perioperative blood transfusion was required, and there was no mortality.

Among 60 study patients, 13 patients (22%) had positive axillary lymph nodes: 9 patients (15%) had 1 to 3 positive lymph nodes, and 4 patients (7%) had 4 or more positive lymph nodes. Five patients (8%) with stage pT3 tumor and 4 patients (7%) with 4 or more positive lymph nodes received postoperative radiation therapy.

**COMMENT**

Conventional modified radical mastectomy with axillary dissection using scalpel, clamp-and-tie techniques, and electrocautery is frequently associated with complications such as seroma and lymphedema. Other less common complications include hematoma, prolonged axillary drainage, wound infection or necrosis, and intraoperative and postoperative bleeding.

The rate of seroma formation has been reported to be affected by the type of surgical procedure. It is more frequent if the flaps are raised by electrocautery than by scalpel and if axillary dissection is performed with the conventional technique than with the harmonic scalpel, as well as occurring more often in modified radical mastectomy than in breast-conserving surgery. In axillary lymph node dissection than in sentinel lymph node dissection, and in modified radical mastectomy without immediate reconstruction than with immediate recon-
dioxide laser. Porter et al reported that, compared with the scalpel, the use of electrocautery resulted in a 44% increase in the probability of a wound complication (such as seroma, necrosis, infection, hematoma, lymphedema, and pneumothorax), resulting in a prolonged hospital stay.

The electrothermal bipolar vessel sealing system and the harmonic scalpel are innovative devices designed as alternatives to conventional vessel sealing techniques. Recently, the harmonic scalpel has been used in modified radical mastectomy and in axillary dissection. Deo and Shukla reported encouraging results in terms of operative time, axillary drainage, seroma formation, and intraoperative blood loss. In a comparison of electrocautery with the harmonic scalpel, significantly reduced blood loss and drainage volume and duration were found in the group operated on using the harmonic scalpel, but there was no difference in the rate of seroma formation, which was high in both groups (16% vs 22%). In contrast, in a prospective controlled study comparing conventionally performed modified radical mastectomy with that performed using the harmonic scalpel (with both groups undergoing conventional axillary dissection), Galatius et al reported similar operative times, perioperative bleeding, and wound complications with the 2 techniques. However, a high incidence of seroma formation was found, developing in two-thirds of the patients in both groups, while the use of the harmonic scalpel resulted in greater drainage and seroma volume and more seroma aspirations, although this was not statistically significant. In axillary dissection, the use of the harmonic scalpel (compared with the conventional technique) has been reported to result in a significant reduction in drainage volume and duration and in a nonsignificant reduction in seroma formation; however, the reported incidence of seroma formation with this technique was high (20%).

To our knowledge, there are no previous reports about the use of the electrothermal bipolar vessel sealing system in modified radical mastectomy, breast-conserving surgery, or axillary dissection. The benefits of using this device in breast surgery are minimal thermal injury to the tissue and better sealing of small vessels and lymphatic channels.

The electrothermal bipolar vessel sealing system uses a combination of mechanical pressure and high-current low-voltage energy. Electrical energy denatures collagen and elastin fibers within the vessel walls and surrounding connective tissue, while mechanical pressure applied by the instrument apposes the walls to allow proteins to form as a seal. The device fuses the vessel walls, obliterating the vascular and lymph vessel lumen; this seems to be an efficient way to seal blood and lymph vessels permanently and completely (Figure 2 and Figure 3). A precise and optimal amount of energy is delivered that ensures complete coagulation with minimal surrounding thermal spread. The tissue fusion mechanism of the device results in strong burst strength measurements compared with conventional monopolar, bipolar, and ultrasonic coagulation systems. Vessels sealed with the electrothermal bipolar vessel sealing system were shown to withstand well above (≥3 times) physiologic systolic blood pressure without bursting. An important issue concerning the use of this modality is the extent of lateral thermal spread and associated tissue in-
logic,32 and general surgical cases.18,19 Similar results have been reported in other studies.6,7,15 Surgical technique, par-}


ticularly in axillary dissection, as it allows safe lymph vessel and vascular ligation, with minimal risk of damage to deli-


cate adjacent structures such as the long thoracic nerve, the thoracodorsal pedicle, the great vessels of the axilla, and the brachial and subdural pleura.

The electrothermal bipolar vessel sealing system has been proven to be safe and effective regarding hemosta-


sis, complications, and reduced operative time in several surgical procedures, including urologic,31 gyneco-


lologic,32 and general surgical cases.18,19 Similar results have been observed in a previous study33 of total thyroidec-


tomy. The present study was conducted to evaluate the feasibility, safety, and efficacy of the use of the electro-


thermal bipolar vessel sealing system in modified radical mastectomy with axillary dissection in terms of lymph vessel sealing, hemostasis, and perioperative complica-


tions and to standardize this operative technique. Our results using this technique are encouraging. The de-


device is handy, easy to use, and reliable, and no technical difficulties were noted. In addition, it was safe and ef-


effective with respect to hemostasis, complications, operative time, and lymph vessel sealing. Although there was no control group in our study, a comparison of our re-


cuits show that modified radical mastectomy with axil-


ary dissection using this device is feasible, safe, and effective. The main advantage of this technique is that it simplifies the surgical procedure and eliminates the need for clips, electrocautery, and clamp-and-tie maneuvers, while achieving efficient lymph vessel sealing and he-


mstasis. In our study, which is the first reported series of the use of the electrothermal bipolar vessel sealing sys-


ystem in breast surgery to our knowledge, the device was found to be safe and effective in terms of hemostasis, lymph vessel sealing, operative time, and complications. Although our investigation was not a randomized controlled study and may be limited by the small number of patients, the technique seems to result in reduced operative time, perioperative blood loss, drainage vol-


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nique on perioperative complications.


In conclusion, the electrothermal bipolar vessel sealing system is a useful adjunct for breast surgery. Our re-


sults show that modified radical mastectomy with axil-


lary dissection using this device is feasible, safe, and effective. The main advantage of this technique is that it simplifies the surgical procedure and eliminates the need for clips, electrocautery, and clamp-and-tie maneuvers, while achieving efficient lymph vessel sealing and hemostasis. In our study, which is the first reported series of the use of the electrothermal bipolar vessel sealing system in breast surgery to our knowledge, the device was found to be safe and effective in terms of hemostasis, lymph vessel sealing, operative time, and complications. Although our investigation was not a randomized controlled study and may be limited by the small number of patients, the technique seems to result in reduced operative time, perioperative blood loss, drainage volume and duration, and formation of seroma or lymphedema compared with historical data regarding conventional or harmonic scalpel techniques. Prospective randomized controlled studies comparing this technique with conventional or harmonic scalpel techniques are necessary to evaluate the effect of this technique on perioperative complications.


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Kafiri, Filis, and Zografos. **Statistical analysis:** Markogiannakis and Filippakis. **Study supervision:** Manouras, Kafiri, and Zografos.

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