A challenging therapeutic method for breast cancer: Non-lipolytic endoscopic axillary surgery through periareolar incisions

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Abstract. Surgical treatment of breast cancer is becoming increasingly precise, less invasive, and more cosmetically pleasing. Sentinel lymph node biopsy (SLNB) and axillary lymph node dissection (ALND) remain the standard treatment methods for breast cancer. However, these methods still require incisions in the breasts or axilla. Mastoscopic axillary lymph node dissection (MALND) surgery, although first reported several years ago, has not been widely used as it involves lipolysis. Non-lipolytic mastoscopy may be more appealing; however, the lack of a cavity in the breast and the abundant fat and glands make this procedure challenging. In addition, incision of the trocar in the axilla has been shown to have no advantage over traditional breast-conserving surgery. The present study describes 16 cases of non-lipolytic endoscopic axillary surgery without incisions in the axilla.

Introduction

Breast cancer is one of the most common malignant diseases and poses significant morbidity and mortality to women worldwide. As the study of breast cancer has progressed and the biological behaviors of tumors are starting to be elucidated, increasing evidence has suggested that breast cancer is a systemic disease. This is in opposition to the traditional view, which suggested that the disease only occurred in the breast (1-4).

Treatment strategies for breast cancer have been gradually moving toward a systemic approach. Breast-conserving surgery together with post-operative radiotherapy and chemotherapy do not increase the risk of recurrence, and even if there are one or two positive sentinel lymph nodes, comprehensive treatment after surgery can result in similar effects to those of traditional radical surgery (5). The surgical treatment of breast cancer has vastly improved in recent years, and is becoming more precise and with improved cosmetic outcomes. Endoscopic techniques for breast surgery were first reported by Kompatscher (6), who removed breast contracture implants under endoscopy. Since then, endoscopic techniques have been applied to other surgeries. In 1994, Fine *et al* (7) reported endoscopic-assisted muscle flap harvest to guide abdominal visceral surgery. The first endoscopic surgery for the treatment of breast cancer was reported by Salvat *et al* (8), who performed an endoscopic axillary lymph node dissection (ALND). In 2000, endoscopic sentinel node detection in patients with breast cancer patients was documented by Kühn *et al* (9). Therefore, endoscopic techniques have been used in benign and malignant breast disease treatment.

Mastoscopic axillary lymph node dissection (MALND) has become one of the most important methods for the treatment of breast cancer. MALND results in less trauma and blood loss, fewer post-operative complications and faster post-operative recovery (10). However, the breast is a solid organ with no natural lumen. Furthermore, the abundant fat and gland increase make this procedure challenging and have limited the wider development of endoscopic techniques in the surgical treatment of breast cancer. The most widely used mastoscopic technique is the lipolysis method which has been mostly performed on patients with limited breast tissue and mostly Asian women. In 1998, Brun *et al* (11) reported fat and lymph node suction in breast cancer axillary lymphadenectomy. Luo *et al* (10) also shared their abundant experience on lipolytic endoscopic axillary surgery. Although certain reports indicate that lipolysis does not increase the risk of recurrence of breast cancer and does not reduce the overall survival of patients, liposuction may destroy, not only the whole tumor, but also the lymph nodes, thereby increasing the risk of local and distant metastases (12). Therefore, lipolytic therapy is not a popular treatment method for breast cancer. Endoscopic axillary lymphadenectomy without prior liposuction was reported in 1999 (13). This therapeutic approach has not been comprehensively used for wounds close to the armpits and does not result in improved outcomes compared with traditional small-incision-axillary surgery.

In order to overcome these flaws, the present study described a novel endoscopic axillary lymphadenectomy technique without prior liposuction and less visible scarring after surgery.

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Patients and methods

Case selection. A total of 16 female patients with breast cancer who underwent MALND from 2016.01.12 to 2018.06.01 at the Second Affiliated Hospital of Fujian Medical University (Quanzhou, China) were selected. The mean age of the patients was 44.81 years (range, 27-58 years). Patients had masses 1.1-4.0 cm in diameter that were located in the upper outer quadrant of the breast. The patients had a mean body mass index (BMI) of 21.21 kg/m^2 (range, 17.93-24.35 kg/m^2). The BMI of the 16 patients is presented in Table I.

Table I. Patient characteristics.

No.	Height (m)	Weight (kg)	BMI (kg/m^2)
1	1.53	57	24.35
2	1.59	59	23.34
3	1.69	66	23.11
4	1.59	57	22.55
5	1.59	56	22.15
6	1.6	55	21.48
7	1.56	52	21.37
8	1.61	55	21.22
9	1.64	57	21.19
10	1.64	56	20.82
11	1.65	56	20.57
12	1.56	50	20.55
13	1.66	56	20.32
14	1.62	51	19.43
15	1.67	53	19.00
16	1.67	50	17.93

BMI, body mass index.

Breast cancer was diagnosed by core needle biopsy, and the relevant examination was completed prior to surgery. If the preoperative ultrasound suggested an axillary lymph node (ALN), fine needle aspiration was performed to determine whether a sentinel lymph node biopsy (SLNB) should be performed. The inclusion criteria for this study were as follows: Non-obese breast cancer patients, and patients with breast tumors not in the inward quadrant. The exclusion criteria for this study were: Obese breast cancer patients, breast cancer patients with tumors in the inner quadrant, and elderly patients with severe heart or lung disease. For the surgical procedure, periareolar incision on the quadrant ring was made as the main incision and the other 0.5 cm trocar incision was located on the anterior axillary line (Fig. 1A).

The study was approved by the Ethics Committee of the Second Affiliated Hospital of Fujian Medical University (Quanzhou, China). Written informed consent was obtained from all patients.

Resection of malignant tumor and margin of the breast. The patients were placed in a supine position with the ipsilateral arm at a 90˚ abduction under general anesthesia (Fig. 1B). An endoscopic operating system (Storz HD Xenon Nova 300 system.) was used. The whole tumor was excised through a periareolar incision. During the process, safety margins were identified and a core needle biopsy puncture was used for resection. Cavity shaving was used to confirm that the margins were negative. A fast-frozen pathology report indicated that the margins were negative.

Endoscopic surgery and tracer lymph nodes. Prior to endoscopy, two trocars (5 and 10 mm, respectively) were placed in the cavity through the periareolar incision. The wound between the two trocars was closed to ensure that the carbon dioxide did not leak out. A third trocar was placed in the cavity through the 0.5 cm incision located on the anterior axillary line. A 30˚ 10 mm endoscope was inserted through the 10 mm trocar, and carbon dioxide was infused into the cavity until ~8 mmHg pressure was reached (Fig. 1C). The sentinel lymph node-labeled tracer (methylene blue dye double diluted with normal saline) was injected along the anterior axillary line close to the armpit to ensure that the dye did not leak into the cavity. The subcutaneous tissue was subsequently separated and sentinel lymph node progress was observed.

SLNB. Tissues were separated along the pectoralis muscle to the axilla. Sentinel lymph nodes are often located outside the margin of the superficial layer of fascia coracocleidopectoralis of the pectoralis minor muscle. During this process, attention should be paid to finding blue-stained lymph nodes and lymphatic channels. After locating the blue-stained areas, the tissue was separated, but not removed, from the lymphatic tissue. A total of 2-3 lymph nodes were found (Fig. 2A). The lymph nodes were subsequently resected and sent for further pathological examination. ALND should be performed when SLNB is not successful or pathological reports indicate cancer cells in the lymph nodes.

ALND. The axillary vein was exposed by separating the pectoralis and the pectoralis minor muscles in the direction of the axilla. During this process, the axillary vein was used to indicate direction (Fig. 2B). Next, the structure was separated as follows: Thoracodorsal vein and nerve, axillary vein and long thoracic nerve, as observed by mastoscopy (Fig. 2C), other important structures and anatomical landmarks. Certain important structures, such as the medial pectoral nerve, were preserved if possible. Axillary level I and II lymph nodes were dissected. When visible lymph nodes appeared between the pectoralis major and minor, the lymph nodes between the pectoralis muscles were also resected. In the present study, two methods were used to create a good view of the back of the pectoral muscle. The first method was the rotation and displacement of the endoscope lens for a better exposure of the back of the pectoral muscle. The second method was the use a special V-shaped hook for a better exposure of the back of the pectoral muscle. The V-shaped hook (Fig. 2D) is often used for endoscopic surgery of thyroid tumors. The axillary lymph tissue was removed. The axilla was washed with warm distilled water, and drained using a suction tube placed in the inferior trocar hole. Lastly, the chest and axilla were bandaged.

Results

Post-surgical results. The post-surgical results are evident in Figs. 2C and 3. Fig. 2C presents the overview following surgery. The thoracodorsal vein and nerve, axillary vein and

Figure 1. (A) A periareolar incision was marked, the tumor position was identified, and 0.5 cm trocar incision was marked on the anterior axillary line. (B) Patient in supine position with the ipsilateral arm at a 90˚ abduction. (C) Outside view of the operation with three trocars placed in the cavity.

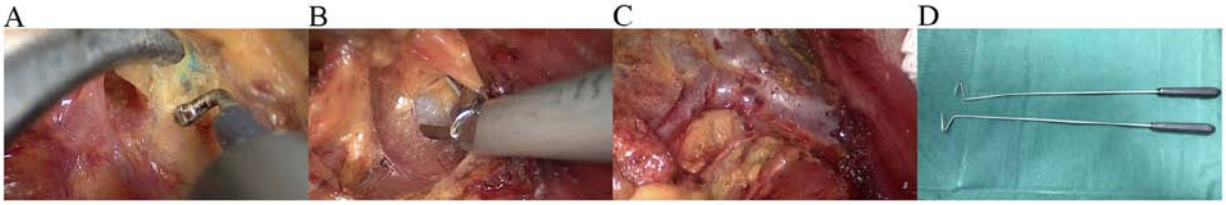

Figure 2. (A) A sentinel lymph node stained by blue dye was separated out under endoscopy. A lymph node duct was observed on the screen. (B) The axillary vein was exposed during the endoscopic procedure. (C) Important structures, such as thoracodorsal vein and nerve, axillary vein and long thoracic nerve, were observed under mastoscopy. (D) V-shaped hook was used for better exposure of the back of the pectoral muscle.

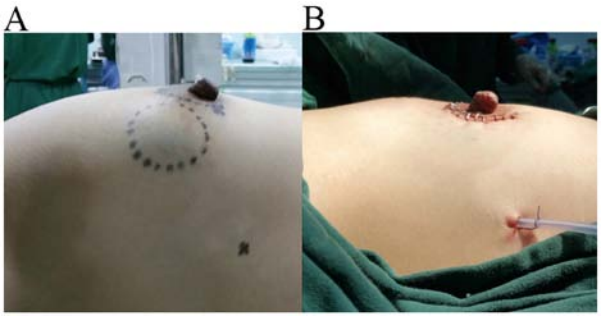

Figure 3. (A) Preoperative and (B) post-operative image of the breast.

long thoracic nerve are clearly seen. Fig. 3A and B show the pre- and post-operative breast, respectively.

Patient characteristics and MALND. A total of 16 cases of MALND were examined between 2016.01.12 and 2018.06.01. The statistical results are presented in Tables II and III. The patients' average age was 44.81±6.82 years, the average tumor diameter was 2.43±0.82 cm and the average BMI was 21.21±1.66 kg/m^2. A total of 4 patients received SLNB, 7 received ALND and 5 received both. The mean operation time of SLNB was 35.11±3.82 min and that of ALND was 51.08±5.92 min. The mean intraoperative blood loss was 29.25±8.93 ml and the volume of drainage of SLNB and ALND was 63.25±6.36 and 148.42±21.18 ml, respectively. The average duration of drainage was 6.56±1.50 days. The mean follow-up period was ~28 months (range, 12-41 months). One of the 16 patients presented paresthesia in the medial upper arm, which decreased or disappeared 3 months after the operation. One patient developed mild edema in the upper arm 3 months after the operation, which decreased following treatment with elastic bandage compression, local massage and functional exercise to promote lymphatic reflux. The other patients exhibited no wound effusion, upper limb edema or flap necrosis. Post-operative B-ultrasound and molybdenum target X-ray examination showed no tumor recurrence, and the motion of shoulder joint was good. A total of 30 sentinel lymph nodes were harvested from 9 patients, with a mean number of 3.33±0.50 sentinel lymph nodes per patient and a positive rate of 20%. A total of 189 ALNs were excised from 12 patients and the mean number of ALNs per patient was 15.75±2.67. The percentage of patients tested positive for ALNs was 18.52%. A pathology report revealed that 14 patients were diagnosed with invasive breast cancer, 1 with mucinous breast cancer and 1 with ductal carcinoma in situ. Histology also revealed 62.5, 12.5 and 25% positive rates for ER/PR(+), HER2(+) and triple negative breast cancer, respectively.

Discussion

Endoscopic techniques have been used in breast surgery for several years. A number of mastoscopic therapeutic methods including benign tumor resection, SLNB, ALND and breast reconstruction have been previously reported (6,9,14,15). Endoscopic methods are broadly divided into lipolytic and non-lipolytic methods, of which the former are more widely used. The majority of mastoscopic incisions are located in or next to the axilla (9,13,16,17). A number of innovative cases have also been reported (18-21). However, mastoscopic surgery has several shortcomings. Lipolytic mastoscopy remains controversial and non-lipolytic therapy is challenging to perform. As normal ALND and SLNB can be performed with a small incision through the armpits, endoscopic incisions in this region offer no advantage with respect to appearance. The present study revealed that ALND can be achieved under mastoscopy with additional incisions, and can result in a cosmetically pleasing result. Furthermore, the operation time, intraoperative blood loss, drainage flow and direction of drainage have been reported to offer no disadvantage compared

Table II. Patient and tumor characteristics.

Parameters	Values
Age (years)	
Mean	44.81±6.82
Range	27-58
Tumor diameter (cm)	
Mean	2.43±0.82
Range	1.1-4.0
BMI (kg/m^2)	
Mean	21.21±1.66
Range	17.93-24.35
T stage [n (%)]	
T1	6 (37.5)
T2	10 (62.5)
SLNB and/or ALND [n (%)]	
SLNB alone	4 (25)
ALND alone	7 (43.8)
SLNB and ALND	5 (31.2)
N stage [n (%)]	
N0	4 (25)
N+	12 (75)
Quadrant [n (%)]	
Upper outer	16 (100)
Upper inter	0 (0)
Lower outer	0 (0)
Lower inter	0 (0)
Areolar	0 (0)
Histological type	
Invasive breast cancer	14
Mucinous breast cancer	1
Ductal carcinoma in situ	1
Estrogen receptor status [n (%)]	
Positive	10 (62.5)
Negative	6 (37.5)
Progesterone receptor status [n (%)]	
Positive	10 (62.5)
Negative	6 (37.5)
Human epidermal growth factor receptor-2 status [n (%)]	
Positive	2 (12.5)
Negative	14 (87.5)

BMI, body mass index; SLNB, sentinel lymph node biopsy; ALND, axillary lymph node dissection.

Table III. Clinical results of 16 patients.

Parameters	Values
Average operation time (min)	
SLNB	35.11±3.82
ALND	51.08±5.92
Operative blood loss (ml)	29.25±8.93
Volume of drainage (ml)	
SLNB	63.25±6.36
ALND	148.42±21.18
Average duration of drainage (days)	6.56±1.50
Complications	
Paresthesia (pain, numbness)	1
Wound effusion	0
Upper limb edema	1
Flap necrosis	0
Local and distant recurrence	0
Shoulder joint movement disorder	0
Average number of lymph nodes	
SLNs from 9 patients	3.33±0.50
ALNs from 12 patients	15.75±2.67

SLNB, sentinel lymph node biopsy; ALND, axillary lymph node dissection; SLNs, sentinel lymph nodes; ALNs, axillary lymph nodes.

with traditional radical excision (10,12). A retrospective study suggested that endoscopic axillary lymphadenectomy without liposuction does not increase the risk of complications and is safe to perform (22). In the present study, only two cases presented complications among the 16 cases of non-lipolytic endoscopic axillary surgery. The complications were paresthesia and upper limb edema, which were significantly improved following treatment. Therefore, MALND requires further investigation.

Breast-conserving surgery is gradually becoming the first choice for the treatment of breast cancer for several patients with clinical stage I and II cancer. In the field of breast surgery, safety, acceptable cosmetic outcome and minimal invasiveness are of paramount importance. Non-lipolytic mastoscopic SLNB is challenging to perform (9,23) and the appearance of the affected area has not been satisfactory, as locating lymph nodes tracts is difficult even in open surgery. However, as sentinel lymph node dye continues to advance, locating sentinel lymph nodes under endoscopy may become less difficult. In the present study, methylene blue dye was used to locate sentinel lymph nodes. Experience suggests that the application of methylene blue dye is an examination technique worth using with mastoscopy. The present study also suggested that non-lipolytic mastoscopy may be performed without the need for an additional incision next to the armpits and can result in good outcomes following surgery.

However, non-lipolytic endoscopic axillary surgery also has shortcomings. Firstly, the operation is more difficult in obese patients and those with large breasts, and may not be suitable for patients with inner quadrant breast cancer. Secondly, the number of cases evaluated in the present study was limited and longer-term follow-up data are required. Thirdly, non-lipolytic endoscopic cavity mirror technology increases the difficulty of the surgery and the operation time, and requires expert surgeons. Prior to developing this therapy, 210 cases of endoscopic thyroid operation were performed in order to prepare for this technique (24).

The present study introduced a novel practice for breast-conserving surgery. SLNB and ALND may be performed without other incisions. Non-lipolytic mastoscopic axillary surgery may be a good choice for breast cancer therapy and may become part of the repertoire of breast cancer treatment strategies.

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Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Authors' contributions

YC conceived the study, wrote and edited the manuscript. SX edited the paper and made substantial contributions to the conception of the study. JX was involved in the design, conception, and data of the article and provided advice on its revision. XZ and YL analyzed the data. All authors read and approved the final version of the manuscript.

Ethics approval and consent to participate

The study was approved by the Ethics Committee of the Second Affiliated Hospital of Fujian Medical University (Quanzhou, China). Written informed consent was obtained from all patients.

Patient consent for publication

All participants gave their consent to the use of personal data for scientific purposes.

Competing interests

The authors declare that they have no competing interests.

References

1. Guerra MR, Silva GA, Nogueira MC, Leite IC, Oliveira RV, Cintra JR and Bustamante-Teixeira MT: Breast cancer survival and health iniquities. Cad Saude Publica 31: 1673-1684, 2015.
2. Donninger H, Hobbing K, Schmidt ML, Walters E, Rund L, Schook L and Clark GJ: A porcine model system of BRCA1 driven breast cancer. Front Genet 6: 269, 2015.
3. Koroukian SM, Bakaki PM, Han X, Schluchter M, Owusu C, Cooper GS and Flocke SA: Lasting Effects of the Breast and Cervical Cancer Early Detection Program on Breast Cancer Detection and Outcomes, Ohio, 2000-2009. Prev Chronic Dis 12: E116, 2015.
4. Zeichner SB, Herna S, Mani A, Ambros T, Montero AJ, Mahtani RL, Ahn ER and Vogel CL: Survival of patients with de-novo metastatic breast cancer: Analysis of data from a large breast cancer-specific private practice, a university-based cancer center and review of the literature. Breast Cancer Res Treat 153: 617-624, 2015.
5. Giuliano AE, McCall L, Beitsch P, Whitworth PW, Blumencranz P, Leitch AM, Saha S, Hunt KK, Morrow M and Ballman K: Locoregional recurrence after sentinel lymph node dissection with or without axillary dissection in patients with sentinel lymph node metastases: The American College of Surgeons Oncology Group Z0011 randomized trial. Ann Surg 252: 426-432, discussion 432-433, 2010.
6. Kompatscher P: Endoscopic capsulotomy of capsular contracture after breast augmentation: A very challenging therapeutic approach. Plast Reconstr Surg 90: 1125-1126, 1992.
7. Fine NA, Orgill DP and Pribaz JJ: Early clinical experience in endoscopic-assisted muscle flap harvest. Ann Plast Surg 33: 465-469, discussion 469-472, 1994.
8. Salvat J, Knopf JF, Ayoubi JM, Slamani L, Vincent-Genod A, Guilbert M and Walker D: Endoscopic exploration and lymph node sampling of the axilla. Preliminary findings of a randomized pilot study comparing clinical and anatomo-pathologic results of endoscopic axillary lymph node sampling with traditional surgical treatment. Eur J Obstet Gynecol Reprod Biol 70: 165-173, 1996.
9. Kühn T, Santjohanser C, Koretz K, Böhm W and Kreienberg R: Axilloscopy and endoscopic sentinel node detection in breast cancer patients. Surg Endosc 14: 573-577, 2000.
10. Luo C, Guo W, Yang J, Sun Q, Wei W, Wu S, Fang S, Zeng Q, Zhao Z, Meng F, *et al*: Comparison of mastoscopic and conventional axillary lymph node dissection in breast cancer: Long-term results from a randomized, multicenter trial. Mayo Clin Proc 87: 1153-1161, 2012.
11. Brun JL, Rousseau E, Belleannée G, de Mascarel A and Brun G: Axillary lymphadenectomy prepared by fat and lymph node suction in breast cancer. Eur J Surg Oncol 24: 17-20, 1998.
12. Langer I, Kocher T, Guller U, Torhorst J, Oertli D, Harder F and Zuber M: Long-term outcomes of breast cancer patients after endoscopic axillary lymph node dissection: A prospective analysis of 52 patients. Breast Cancer Res Treat 90: 85-91, 2005.
13. Kamprath S, Bechler J, Kühne-Heid R, Krause N and Schneider A: Endoscopic axillary lymphadenectomy without prior liposuction. Development of a technique and initial experience. Surg Endosc 13: 1226-1229, 1999.
14. Mátrai Z, Kunos C, Pukancsik D, Sávolt A, Gulyás G and Kásler M: Modern breast reconstruction with endoscopically assisted latissimus dorsi flap harvesting. Orv Hetil 155: 106-113, 2014 (In Hungarian).
15. Veir Z, Dujmović A, Duduković M, Mijatović D, Cvjeticanin B and Veir M: Endoscopically assisted latissimus dorsi flap harvesting and breast reconstruction in young female with Poland syndrome. Coll Antropol 35: 1303-1305, 2011.
16. Chengyu L, Jian Z, Xiaoxin J, Hua L, Qi Y and Chen G: Experience of a large series of mastoscopic axillary lymph node dissection. J Surg Oncol 98: 89-93, 2008.
17. Yamamoto D, Tsubota Y, Yoshida H, Kanematsu S, Sueoka N, Uemura Y, Tanaka K and Kwon AH: Endoscopic appearance and clinicopathological character of breast cancer. Anticancer Res 31: 3517-3520, 2011.
18. Tukenmez M, Ozden BC, Agcaoglu O, Kecer M, Ozmen V, Muslumanoglu M and Igci A: Videoendoscopic single-port nipple-sparing mastectomy and immediate reconstruction. J Laparoendosc Adv Surg Tech A 24: 77-82, 2014.
19. Wu SD, Fan Y, Kong J and Yu H: Single incision for quadrantectomy and laparoscopic axillary lymph node dissection in the treatment of early breast cancer: Initial experience of 5 cases. J Laparoendosc Adv Surg Tech A 24: 791-794, 2014.
20. Gomatos IP, Filippakis G, Albanopoulos K, Zografos G, Leandros E, Bramis J and Konstadoulakis MM: Complete endoscopic axillary lymph node dissection without liposuction for breast cancer: Initial experience and mid-term outcome. Surg Laparosc Endosc Percutan Tech 16: 232-236, 2006.
21. Sakamoto N, Fukuma E, Higa K, Ozaki S, Sakamoto M, Abe S, Kurihara T and Tozaki M: Early results of an endoscopic nipple-sparing mastectomy for breast cancer. Ann Surg Oncol 16: 3406-3413, 2009.
22. Malur S, Bechler J and Schneider A: Endoscopic axillary lymphadenectomy without prior liposuction in 100 patients with invasive breast cancer. Surg Laparosc Endosc Percutan Tech 11: 38-41, discussion 42, 2001.
23. Avisar E, Ikramuddin S and Edington H: Thoracoscopic internal mammary sentinel node biopsy: An animal model of a new technique. J Surg Res 106: 254-257, 2002.
24. Xu ST: Present situation and prospect of endoscopic thyroid surgery. Chin J Endoscopic Surg 9: 80-82, 2016.