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Original article

A pilot study on thoracoscopic internal mammary lymphatic chain dissection for breast cancer

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Abstract

Purpose: To evaluate the feasibility of internal mammary lymphatic chain dissection by thoracoscopic surgery.
Material and methods: Thirty-two breast cancer women were involved in this pilot study, who were with lesion located at central area or internal quadrant, or with cN2 or cN3 ALNs, or with T4 tumor, or indicating IMNs drainage by preoperative lymphoscintigraphy, but without distant metastasis. Subareolar injection and peritumoral injection of 5 ml methylene blue were done before operation. Double cavity intubation was used to permit collapse of the homolateral lung and set-up the endoscopic operation space. Trocars were introduced through three thoracic incisions of less than 15 mm at the third, the fifth and the seventh intercostal spaces along the midaxillary line. Dissection of internal mammary lymphatic chain was performed by a thoracoscopic grasper and ultrasonically activated scalpel.
Results: Thoracoscopic internal mammary lymphatic chain dissection was successfully finished in 28 patients. The procedure time was 30–70 min (45.2 ± 9.6 min). A total of 128 internal mammary nodes were removed. Among the 28 patients, 11 had internal mammary node metastasis. Only one patient had internal mammary node metastasis without axillary node metastasis. All internal mammary nodes were located at the first rib to the fourth intercostal space. Thoracoscopic internal mammary lymphatic chain dissection in four patients was impossible because of unfavorable local anatomic conditions. There was no damage on great vessels or the lungs, nor pulmonary atelectasis or pulmonary infection.
Conclusions: Thoracoscopic internal mammary lymphatic chain dissection is feasible, and it is easy to perform without serious additional complications. It may improve nodal staging of breast cancer with internal mammary node.

Keywords: Endoscopic surgery; Internal mammary lymphatic chain; Breast cancer

Introduction

It is well established that the rate of internal mammary lymph nodes (IMNs) metastasis in patients with breast cancer is around 20%.[1] Recently, several clinical reports have suggested that patients with regional metastasis in both axillary lymph nodes (ALNs) and IMNs would have worse prognosis than patients with only ALNs metastasis.[2,3] Clinical studies have also demonstrated that a positive IMN and a positive ALN have equal negative influence on the prognosis of breast tumor.[4] Therefore, the renewed interest in the internal mammary lymphatic chain has been developing recently.

Ideally, IMNs radiotherapy should be based on the documentation of their metastasis.[5] Indeed, the proposed changes of the American Joint Committee on Cancer Staging Manual have added the emphasis on the status of the IMNs in the staging of breast cancer.[6] Although IMNs biopsy is a good method to check the metastasis, it may have technically challenge.[7] Alternatively, thoracoscopic internal mammary lymphatic chain dissection may be a better method to check the status of IMNs in some patients. However, few studies have reported the thoracoscopic internal mammary lymphatic chain dissection. We thus performed the current study to

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determine the feasibility of thoracoscopic internal mammary lymphatic chain dissection in patients with breast cancer.

Patients and methods

Patients and preoperative preparation

From April 2005 to March 2006, thirty-two breast cancer women were involved in this pilot study, who were with lesion located at central area or internal quadrant, or with cN_2 or cN_3 ALNs, or with T4 tumor, or indicating IMNs drainage by preoperative lymphoscintigraphy, but without distant metastasis. The mean age was 44.3 years (range, 33–61 years). Each patient has received peritumoral injection of radiolabeled tracer on the day before operation. 1.5 ml of 2 mCi ^{99m}Tc-Dextran (Chengdu Gaotong Isotope Corporation, China) or ^{99m}Tc-Carbon Nanoparticles Suspension Injection (Chang Qing Lummy Pharmaceuticals) was injected in the 12, 3, 6, 9 o'clock positions surrounding the breast mass and at the same depth as the mass or adjacent to the biopsy scar. The same dose was injected into the parallelism breast parenchyma of the contralateral breast. Scintigraphic images were obtained in 5 min, 10 min, 15 min, 20 min, 30 min, 60 min, 120 min, 4 h and 6 h after injection. The localization of axillary and non-axillary hot dot was marked on the skin. The thirty-two patients were available for enrolment into the clinical trial with their signature on informed consent form of surgical operation.

Surgical procedure

After the general anesthesia of the patient with double cavity intubation and sterile draping of the operation field, subareolar or peritumoral injection of 5 ml of Methylene blue (1% solution, Jiangsu Jumpcan Pharmaceutical, China) was made. Gentle massage was performed for 5–10 min at the site of injection. 18 of the 32 patients were treated with modified radical mastectomy, and 14 patients were given breast-conserving surgery firstly, then thoracoscopic internal mammary lymphatic chain dissection was performed.

Collapse of the lung at operation side was applied. The patient was placed in a semioblique position and supported by an inflatable pillow. Trocars were introduced into thoracic cavity through three less than 15 mm incisions at the third, fifth and seventh intercostal spaces along the midaxillary line (Fig. 1). 10 mm rigid thoracoscopy of 30° (Stryker, USA) was used to visualize the thoracic cavity, identificate and expose the internal thoracic vessels and blue IMNs. The position of the camera port and working ports could be modified as required for optimal visualization or manipulation of the instruments.

The first step of the procedure consisted of exposing the internal thoracic artery and vein. The right internal thoracic artery was identified most easily just distal to its origin at the subclavian artery, the blue or black node and lymphatic chain were identified most easily only by a thin covering of parietal pleura (Fig. 2). The left artery sometimes was covered by pericardial fat, the aorta or pleural adhesions (Fig. 3). The 30° scope introduced through the 10-mm access site at the third intercostal space could give better visualization of the internal thoracic artery's path. Therefore, thoracoscopy, dissecting forceps and ultrasonically activated scalpel (Ethicon, USA) were introduced through the three trocars from above down. The parietal pleura was incised at 1.5 cm external border of the artery from the first to the sixth rib using diathermy. Each extreme of the internal thoracic vessels was mobilized and clamped by two vascular clips. Then, the distal parts of the internal thoracic vessels were sectioned between each two vascular clips by ultrasonically activated scalpel (Fig. 4). All collateral branches issuing from the internal thoracic vessels were transected by ultrasonically activated scalpel. This technique allowed a complete dissection of the internal mammary lymphatic chain from the first to the sixth rib (Figs. 5 and 6). The resected specimen was removed through the 10 mm trocar.

After removing the internal mammary lymphatic chain, the endoscopic operation field was douched by 500 ml physiological saline, which was then collected for detection of exfoliative cancer cells. Then, thoracic cavity was douched by 1000 ml distilled water. A 12-Fr pleural drain was inserted

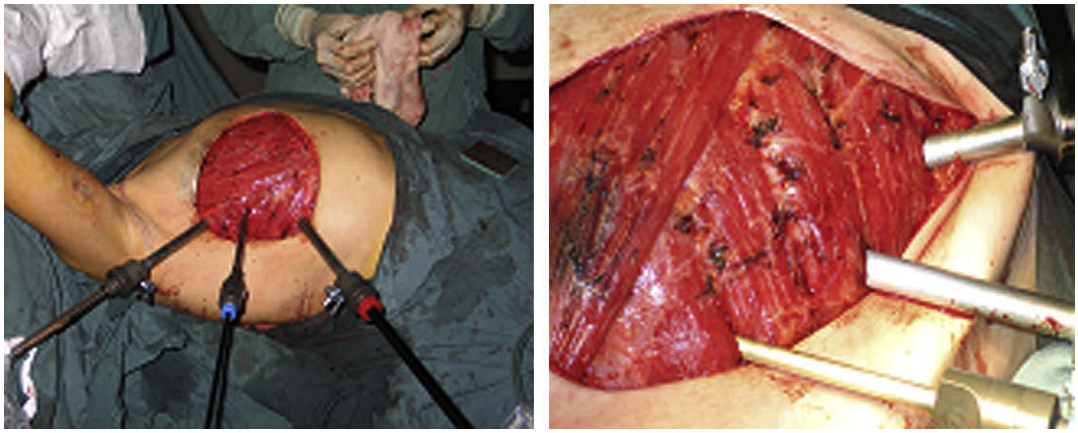

Fig. 1. Trocars site for thoracoscopic internal mammary lymphatic chain dissection.

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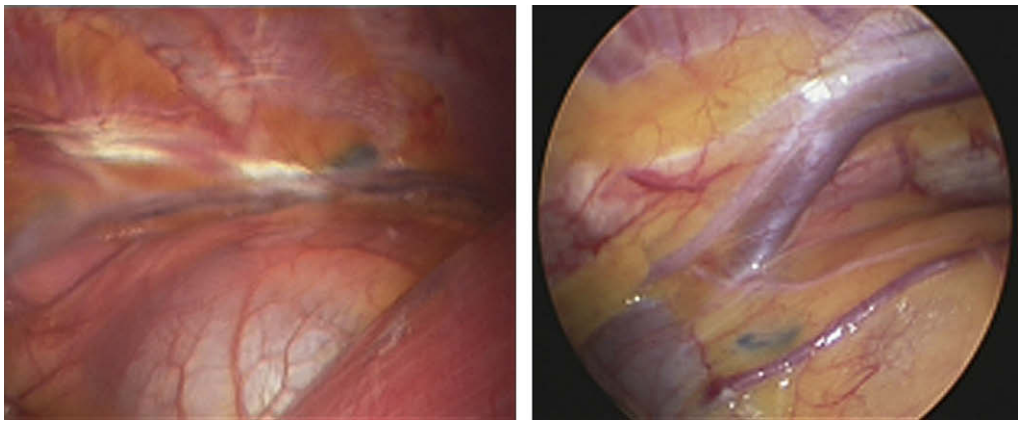

Fig. 2. The internal mammary vessels, blue or black lymph node.

through the inferior trocar port and positioned in the thoracic cavity. Other ports were closed in layers. The pleural drain was absorbed sostenuto on 8 cm water pressure, and was removed safely on the day after surgery.

Washing liquid (500 ml) from each of the 28 cases with breast cancer who underwent endoscopic internal lymph lymphatic dissection was collected to smear by HE staining. Cytological examination was done by two pathologists. It was identified positive if cancer cells were found on one smeared piece (Fig. 7). The internal mammary lymphatic chain was immersed in lymph node-revealing solution for 12 h. The lymph nodes stood out as white chalky nodules on the background of the yellow fat (Fig. 6). The nodes were then excised and examined.

Postoperative radiotherapy and adjuvant treatments were applied according to the protocols based on NCCN Clinical Practice Guidelines in Oncology (Breast Cancer v 2.2005 or 2.2006). All patients were examined in the Outpatient Department at 3 monthly intervals. Special attention was paid to the trocar ports, which were examined by a careful palpation and explored by ultrasounds whenever it was deemed necessary. The median follow-up of the patients was 20.3 months (range, 13–24 months).

Results

Exposure was adequate with the 30° camera positioned in the third intercostal space in the midaxillary line. Local anatomic condition could be discerned easily by the thoracoscopy magnifying. 28 of the 32 patients underwent thoracoscopic internal mammary lymphatic chain dissection, and the operation was successful in each of the all 28 patients. The mean duration of the thoracoscopic operation was 45.2 ± 9.6 min (range, 30–70 min). Totally, 128 IMNs (4.6 ± 1.8) were removed from these patients. All the IMNs were located at the area from the first rib to the fourth intercostal spaces. In other 4 of the 32 patients, dissection of the internal mammary lymphatic chain was impossible because of unfavorable local anatomic conditions. Three patients had pleural adhesions and one patient's internal thoracic artery was covered by the pericardium and the aorta.

Nineteen patients had ALN metastasis and eleven had IMN metastasis. Only one case had positive IMN without ALN metastasis. One had parietal pleura metastasis (Fig. 3). Exfoliative cancer cells were found in the operation field washing liquid of thoracoscopic internal mammary chain dissection in one case (Fig. 7). One patient had short-term hypoxemia after

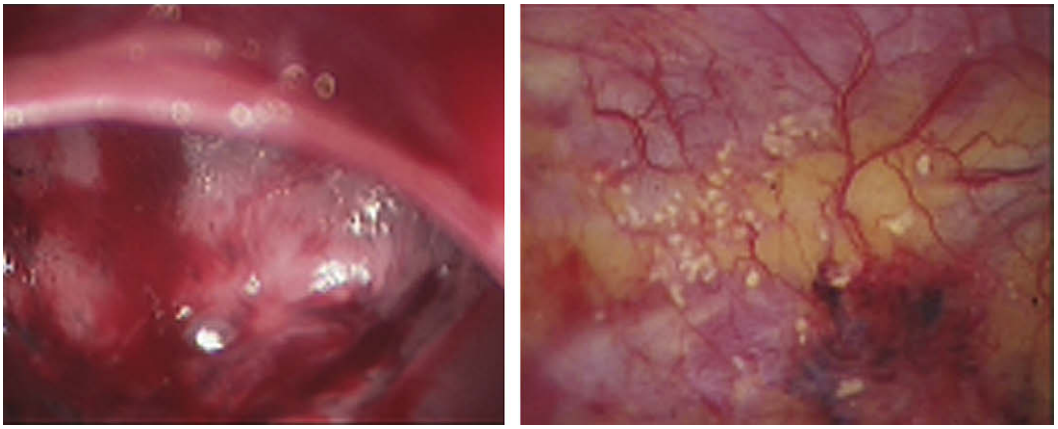

Fig. 3. a. Pleural adhesions; b. the parietal pleura metastasis.

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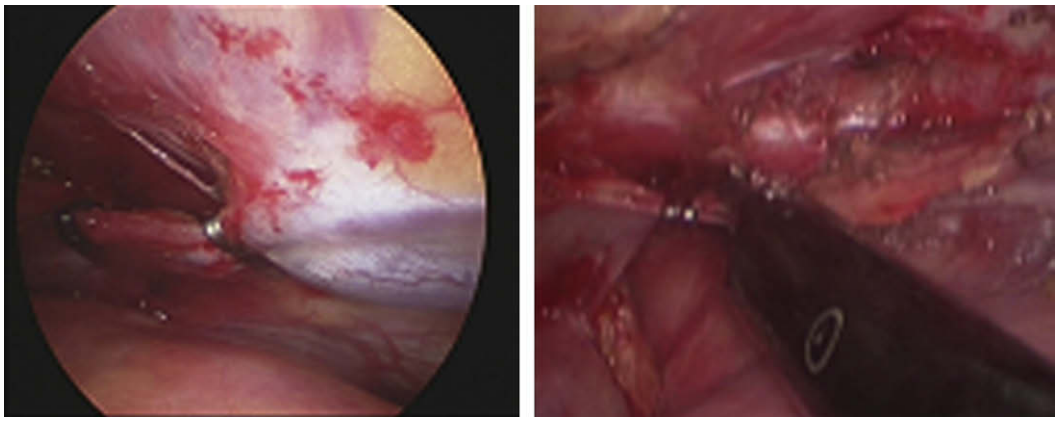

Fig. 4. The internal mammary vessels would be sectioned between two vascular clips.

the operation, and cured by mask oxygen inhalation. One case had pleural effusion. There was no damage to great vessels or the lungs, no pulmonary atelectasis or pulmonary infection occurred. No patients required reoperation for postoperative complications.

During the follow-up, no patients developed local recurrence (port-site relapse) or systemic disease.

Discussion

Extended radical mastectomy for breast cancer is used rarely today because of its much larger surgical trauma and no more survival advantage than modified radical mastectomy. In standard modified radical mastectomy and breast-conserving therapy for breast cancer, there are no effective surgical methods on the treatment of the IMNs. Whether the internal mammary area should be given radiotherapy depends on the position and size of primary tumor and ALN status of the patient with breast cancer. The patient with breast cancer has not been provided survival benefit from the radiotherapy because of the radiotherapy-related pulmonary fibrosis and serious cardiac complication.[8] Recent studies have demonstrated that IMN status was an independent prognostic factor as important as ALN status in breast cancer.[9] Sugg et al. found in their follow-up that the outcome of breast cancer with IMN metastasis was poor, whatever the ALN status was.[10] The results of Yao and his colleague's study indicated that positive IMN predicted a nearly threefold increased mortality risk in breast cancer patients with positive ALN.[11] Therefore, the treatment on IMNs is extremely requisite in the patients with IMN metastasis.

Currently the status of IMNs of breast cancer is estimated mainly according to the position and size of tumor and ALN status. Huang's retrospective study on 1679 Chinese breast cancer patients who underwent extended radical mastectomy without any preoperative management from 1956 to 2003 showed that patients with following conditions had high risk (more than 20%) of IMN metastasis: (1) patients with 4 or more positive ALNs, (2) patients with medial tumor and positive ALNs, (3) patients with T3 tumor and younger than 35 years, (4) patients with T2 tumor and positive ALNs, and (5) patients with T2 tumor and medial tumor.[12] The statistical result by Sugg et al shows approximately 2% patients with subcentimeter tumor have IMN metastasis, but no ALN metastasis.[10] In this study, we found that eleven patients had IMN metastasis, one of twenty-eight (3.57%) patients with breast cancer had positive IMN only. So there has not been a reliable method to assess IMN status nowadays. Endoscopic internal mammary lymphatic chain dissection has provided a convenient procedure for obtaining IMNs for pathological

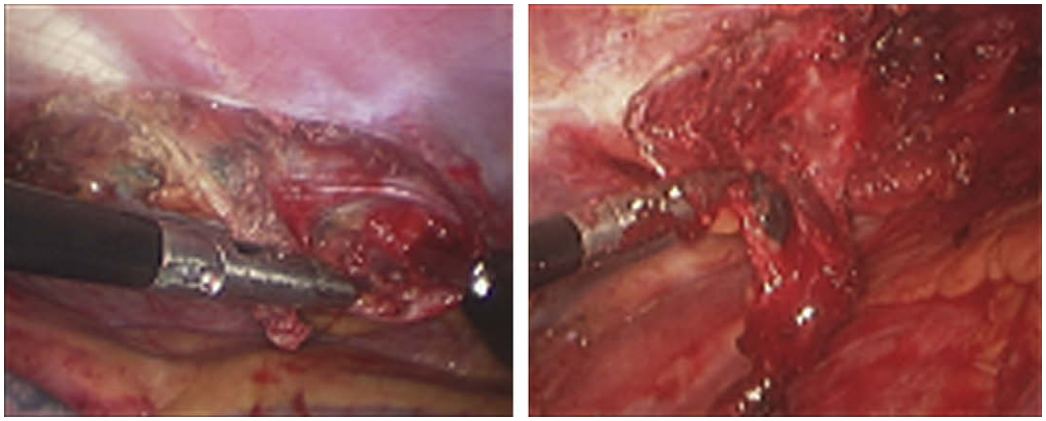

Fig. 5. a. The pleura was partially torn; b. the internal mammary lymphatic chain would be removed.

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Fig. 6. a. The internal mammary lymphatic chain had been removed; b. Macroscopical picture of the internal mammary nodes after immersion in lymph node-revealing solution.

examination, making pathologic staging more accurate to direct postoperative treatment and avoiding postoperative radiotherapy and the related severe pulmonary and cardiac complications caused by radiotherapy.

In this study double cavity intubation and general anesthesia were used. During operation collapse of the lung at operation side was made and the costal support was used to set-up the endoscopic operation space. This method could evade CO_2 infiltration and might avoid tension pneumothorax, hypercapnia, the implantation of cancer cells at the chest incision caused by air atomization and so on. On the other hand, patients were required to have good cardiorespiratory function and keep normal blood oxygen partial pressure and O_2 saturation under the condition of single lung ventilation. Because the internal thoracic vessels could be easily recognized under endoscope and the internal mammary lymphatic chain could be displayed clearly due to preoperative injection of methylene blue to the surrounding of the tumor, IMNs and blood vessels could be observed clearly in operation under the amplification of endoscopy. The exposure of operation field was much better than that of traditional internal mammary lymph lymphatic dissection. Meanwhile, IMNs both behind the chest bone and in the first intercostal space could be even thoroughly resected by endoscopy compared to traditional surgery. Besides, endoscopy could also found whether there was pleura metastasis during operation. In this series one patient was found to have pleural metastasis during the endoscopic operation and confirmed by biopsy, and she was given chemotherapy, radiotherapy and endocrine therapy after surgery. No recurrence has been found in 2-year follow-up. In addition, endoscopic internal mammary lymphatic chain dissection exempted costal cartilage excision in traditional operation, with no influence on thoracal stability and the intactness of pleural membrane.

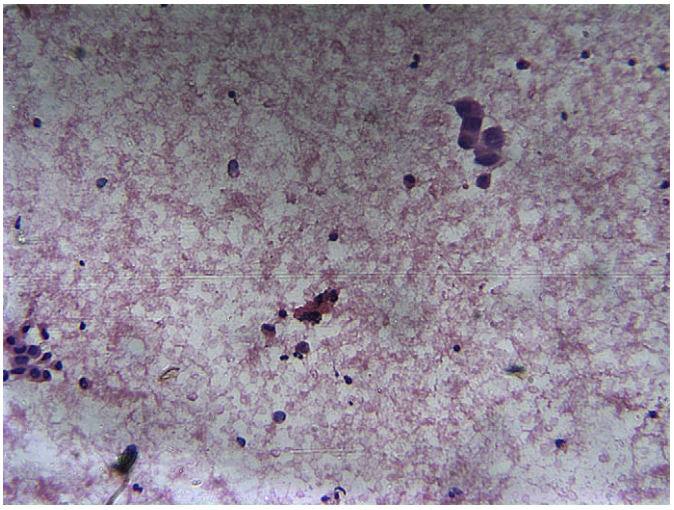

Fig. 7. Exfoliative cancer cells in the surgical field, *200.

Each surgical operation had its shortcomings, so did the endoscopic internal mammary lymphatic chain dissection. Firstly, the operation at the left side was more difficult than at the right because the heart could make the operating field hidden from view. In such condition the patient could be put in a right arm reclining position. If the patient's heart was so big to influence the exposure, the operation should be given up. Secondly, if there was severe pleura adhesion, the operation field might not be exposed completely, and the operation could be difficult to perform. The operations were quited in three patients due to this condition in this series. Thirdly, the operation might cause pulmonary infection, pulmonary atelectasis and pleural effusion, so thorough intraoperative haemostasis, postoperative thoracic drainage, and observation of the drainage volume and property were very important. However, the indication, contraindication and long term effect of endoscopic internal mammary lymphatic chain dissection need to be further studied.

Conflict of interest statement

None declared.

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