Heliyon 10 (2024) e23446

Contents lists available at ScienceDirect

Heliyon

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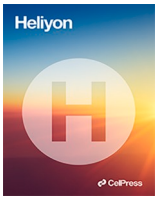

Gasless endoscopic transaxillary subcutaneous mastectomy and immediate reconstruction with implants (GETSMIRI) for breast cancer: Lei's five-step method

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A R T I C L E I N F O

Keywords:
Breast cancer
GETSMIRI
Breast reconstruction
Laparoscopy

A B S T R A C T

Background: Endoscopic nipple-sparing mastectomy (E-NSM) is a promising procedure in the treatment of breast cancer, but the limitations of endoscopic tools and intrinsic technical complexity of the technique hinder its applicability. Here, we introduce a novel surgery, gasless endoscopic transaxillary subcutaneous mastectomy and immediate reconstruction with implants (GETSMIRI), for breast cancer. and early effects.

Methods: A retrospective analysis of the clinical data of 11 female patients, aged 50 (27–78) years, admitted to our hospital from January to December 2022, who underwent gasless endoscopic transaxillary subcutaneous mastectomy and immediate reconstruction with implants (GETSMIRI), was conducted. This study was designed to assess patient satisfaction before and after breast reconstruction, early complications, and breast function.

Results: The tumors were all solitary, with a mean maximum diameter of 1.0 (0–2.0) cm and a mean distance of 2.3 (2–4) cm from the nipple, the mean intraoperative bleeding volume was 47.5 mL, and the mean hospital stay was 1.5 d. Postoperatively, 1 patient developed depigmentation of the nipple due to mild ischemia. There were no incisional complications, subcutaneous emphysema, infection, areola necrosis, skin flap necrosis, or removal of the prosthesis and/or patch. No tumor recurrence or metastasis was observed during the follow-up period. The difference between breast satisfaction and psychosocial health scores was not statistically significant ($P = 0.680$; $P = 0.612$).

Conclusion: GETSMIRI, immediate implantable breast reconstruction, is less invasive than other such procedures, and short-term follow-up results show good postoperative satisfaction, making it an alternative surgical method.

1. Introduction

Breast cancer (BC) is the most prevalent malignancy in the world [1,2]. With the advancement of comprehensive breast cancer treatment and patient demands for better aesthetics and quality of life, nipple-sparing mastectomy (NSM) and endoscopic NSM

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https://doi.org/10.1016/j.heliyon.2023.e23446
Received 31 August 2023; Received in revised form 4 December 2023; Accepted 4 December 2023
Available online 8 December 2023

(E-NSM) have become increasingly popular [3–7]. E-NSM alone or in combination with instant breast reconstruction (IBR) using implants or autologous flaps is associated with a minimal incision and good aesthetic results [8–12]. Because of the limitations of endoscopic tools and intrinsic technical complexity of the approaches, neither traditional E-NSM nor single-access E-NSM has been widely used in the surgical care of breast cancer [13,14]. Recently, our group has routinely performed lumpectomy procedures for breast cancer through a new axillary approach: gasless endoscopic nipple-sparing mastectomy and immediate implant-based breast reconstruction with titanium-coated polypropylene mesh (TiLoop Bra) via a single axillary incision. We named this technique Gasless Endoscopic Transaxillary Subcutaneous Mastectomy and Immediate Reconstruction with Implants (GETSMIRI). The procedure is safe and does not require CO_2 gas insufflation, resulting in fewer gas-related problems and a clean operational field. We summarize the surgical procedure in a five-step technique. This approach is straightforward and practical, and it is easy to implement in a large number of centers.

2. Methods

2.1. General information

This study was retrospectively designed and included 11 female patients who were pathologically diagnosed with BC between January 2022 and December 2022 at the Seventh Affiliated Hospital of Sun Yat-sen University; all of these women were between 27 and 78 years of age, with a mean age of 50 years, height: 160.2 (155–166) cm, weight: 54.6 (50–58) kg, body mass index: 21.3 (18.8–23.6) kg/m2, no infiltration of the breast skin and pectoralis major fascia, and no distant metastases. The preoperative clinical stage was stage I in 11 cases. The tumors were located on the left side in 7 cases and on the right side in 4 cases. The tumors were all solitary, with a mean maximum diameter of 1.0 (0–2.0) cm and a mean distance of 2.3 (2–4) cm from the nipple, and none of the patients had more than moderate sagging of the breasts. All patients had strong cosmetic needs.

2.2. Surgical steps, operating techniques, and precautions

2.2.1. Preparation and markings

The basal width, convexity, and width-to-height ratio (plane) should be measured on the healthy breast. The tightness of the skin on the affected breast, medial and lateral margin pinch thickness and upper pole pinch thickness along with the anterior triangle of the breast should then be estimated. The required implant type, volume and extent of the prosthetic cavity to be freed during surgery should also be carefully evaluated. While the patient stood naturally, and the surgeon drew both inframammary folds; medial and lateral solid contour markers were drawn on both sides of the axillary, and the posterior border of the pectoralis major muscle at the top of the axillary fossa was marked with a 5–6 cm horizontal incision line along the transverse skin folds of the axilla. The incision line was curved. The anterior edge of the axillary incision should not extend beyond the anterior axillary line to ensure that the incision scar is completely covered when the patient's upper arm naturally drops. If the prosthesis is large, the incision may be extended backward as appropriate. After achieving a satisfactory level of general anesthesia, the affected upper limb was routinely disinfected and

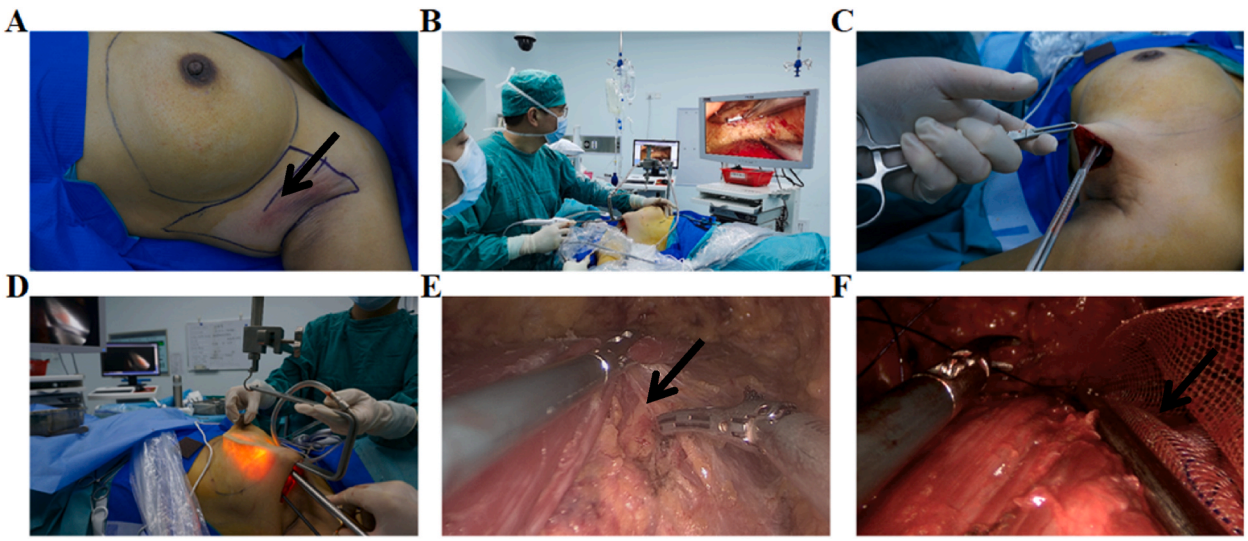

Fig. 1. Surgical procedure
Fig. 1:A. Surgical positioning and markings for axillary lymph node treatment (the arrow shows the anterior lymph node incisions). B. Dissection of the prepectoral space. C. Subcutaneous dissection using a scalpel with a long handle. D. Treatment of the gland behind the nipple with surgical scissors. E. Dissection of the subpectoral space (the arrow shows the pectoralis major). F. Patch suturing and prosthesis placement (the arrow shows the patch).

abducted 90° for fixation (Fig. 1A).

2.2.2. Axillary lymph node treatment (step 1)

Sentinel lymph node biopsy (SLNB) was recommended for patients with negative lymph nodes according to clinical assessments. Axillary lymph node dissection (ALND) was recommended for those with positive preoperative aspiration biopsy or SLNB results. An incision was made along the embedded-in-axilla line.

2.2.3. Sentinel lymph node biopsy (SLNB)

If the patient's preoperative examination did not show obviously enlarged axillary lymph nodes, a direct visualization of the sentinel lymph node biopsy was performed. Ten minutes before surgery, 2 ml of methylene blue was injected subcutaneously around the areola to visualize the sentinel lymph nodes and the lymphatic vessels connecting them to the areola. The fibrofatty tissue was incised with an electrocoagulator along the course of the lymphatic vessels, and the blue-stained sentinel lymph nodes were separated and progressively visualized towards the axilla. Resection of the blue-stained sentinel lymph nodes was performed. The identified sentinel lymph nodes were removed and sent for frozen pathology biopsy. If the results reported metastasis in the sentinel lymph nodes, the axillary lymph nodes were cleared further.

2.2.4. Subcutaneous glandular excision and preparation of the implant cavity (steps 2–4)

The dissection followed the order of prepectoral layer, to subcutaneous layer, and finally submuscular layer.

First, the upper outer quadrant was released through the axillary incision, and approximately 5–8 cm of the superficial pectoralis major muscle was segregated under direct vision with proper retractors. With the assistance of a suspension hook and endoscopy, the deeper prepectoral gap was separated with a long-headed electric knife or an ultrasonic knife (Fig. 1B). The integrity of the membrane of the pectoralis major muscle was maintained during division. The extent of the excision was as follows: inferior to the inframammary, superior to the subclavian, medial to the parasternal line, and lateral to the anterior edge of the latissimus dorsi. This was step 2.

Then, the subcutaneous gap was separated with an electric knife or scalpel with a long handle (Fig. 1C). A subcutaneous injection of epinephrine solution (1 mg of epinephrine injection in 250 ml of physiological saline) with a long needle helped separate the scalp. The skin flap was made as thin as possible (approximately 0.3 cm) within 4–5 cm around the tumor, and as much adipose tissue as possible was removed to reduce the chance of local recurrence. The residual gland behind the nipple was detached with surgical scissors and sent for frozen biopsy, which is recommended (Fig. 1D). This was step 3.

After removal of the mammary gland, step 4 was performed, detaching the submuscular gap. The intermuscular tissues between the pectoralis major and minor muscles were sharply divided from the lateral inferior border of the pectoralis major muscle (Fig. 1E). The pectoralis major was partially cut off from the muscle attachment point at inner lower quadrant at approximately 45°. This gap could be made with an electric knife or ultrasonic knife to obtain an appropriate cavity for prosthesis placement. After achieving glandular excision and complete removal through the incision, the wound cavity was fully rinsed with 2000 mL of sterile distilled water.

2.2.5. Patch suture and prosthesis placement

The volume of the excised tissue was measured using the Archimedes method (3 times, average). The appropriate implant was selected according to the transverse and longitudinal diameter, height and volume of the breast, and based on the measured volume and diameter and the prosthesis parameter table, an appropriate breast prosthesis was selected.

Since the lower and outer patches need to be folded and wrapped around the prosthesis, a 1-cm skin incision was made at the inner lower quadrant of the inferior breast crease near the vertical line of the nipple to create an auxiliary hole. The outer and lower edges of the pectoralis major were sutured with a patch to widen the implantation cavity (Fig. 1F). One internal chest wall drainage tube was placed through the auxiliary hole. The prosthesis was then imbedded. The outer portion of the patch was adjusted directly through the incision, and the lower portion of the patch was gently framed through the auxiliary hole with an Allis tissue forceps so that it could smoothly cover the prosthesis and the excess could be folded behind the prosthesis. After adjusting to achieve symmetrical shapes of the bilateral breasts, two other drainage tubes were placed in the axillary cavity and subcutaneous area around the new implant.

2.2.6. Statistical analysis

SPSS 27.0 software was used to analyze all data. The $\chi 2$ test was used for the comparison between groups; normally distributed measures are expressed herein as the mean ± standard deviation (X^2). The paired *t*-test was used for the comparison between groups; nonnormally distributed measures are expressed as the median (range). The BREAST-Q results were converted into total scale scores, and the total score for each subtopic ranged from 0 to 100, with higher scores representing higher satisfaction and better quality of life; the postoperative BREAST-Q results were evaluated by comparing preoperative and postoperative outcomes, with $P \leq 0.05$ indicating a statistically significant difference.

Statement of ethics

All participants provided their written informed consent. This study was conducted in compliance with medical ethics rules and with approval by the Ethics Committee of the Seventh Affiliated Hospital, Sun Yat-sen University [No.KY -2022-041-01].

3. Results

3.1. Postoperative condition of the patient

All patients underwent anterior sentinel lymph node biopsy, and the pathological findings were negative in 9 cases and positive in 2 cases. Therefore, axillary lymph node dissection was not performed in 9 cases and was performed in 2 cases. The mean operation time was 180.5 (125–220) min, the mean intraoperative bleeding volume was 47.5 mL, and the mean length of hospital stay was 1.5 d. The postoperative pathological examination showed 9 cases of invasive ductal carcinoma and 2 cases of intraductal carcinoma. Postoperative pathological staging revealed stage 0 in 2 cases, stage I in 7 cases and stage II in 2 cases.

3.2. Recent postoperative complications of patients

The incisions of all patients healed in the first stage. One patient had depigmentation of the nipple after surgery, which returned to normal 1 month later without any special treatment. There were no incisional complications, subcutaneous emphysema, intrabreast hematoma formation, infection, nipple and areola necrosis, skin flap necrosis, removal of the prosthesis and/or patch, or other adverse events. No tumor recurrence or metastasis was found during follow-up.

4. Short-term postoperative effects of patients

The patients' chest function decreased 1 month after surgery, and the difference was statistically significant compared with that before surgery ($P = 0.016$), whereas there was no statistically significant difference in breast satisfaction and social and psychological health scores compared with those before surgery ($P = 0.680$); $P = 0.612$) (see Table 1 and Fig. 2). Because none of the 11 patients reported their sexual life satisfaction score 1 month after surgery, a statistical analysis of the difference in sexual life satisfaction before surgery and 1 month after surgery was not possible.

5. Discussion

Gruber et al. pioneered open inframammary posterior prosthesis reconstruction, which increases the surface of the prosthesis and reduces the size of the incision, amount of covered tissue and loss of prosthesis rate due to incisional complications; moreover, it significantly improved safety and thus became the standard approach for postoperative breast cancer prosthesis reconstruction [15].

In comparison to conventional prosthesis reconstruction, GETSMIRI is safe and leads to high patient satisfaction due to the satisfactory shape and feel of the reconstructed breast. Additionally, the resulting wounds were invisible from the front view, which also improved patient satisfaction. The five-step GETSMIRI method was suitable for subpectoral breast reconstruction. For prepectoral breast reconstruction, GETSMIRI could be reduced to four steps without detaching the submuscular gap. The patch was sutured in a pouch to contain the protheses instead of suturing with the edge of the pectoralis major in the last step.

Because radiotracers are not accessible for routine medical practice in China, SLNB using a double tracer method with intradermal or subcutaneous injections of indocyanine green (ICG) [16] and methylene blue around the areola or on the surface of the lump was recommended on the day of surgery. We always made the incision by following the middle and lower quarter of the breast parallel to the axillary folds, similar to the parallelogram formed by the axillary apex fold, the outer margin of the pectoralis major, the outer margin of the mammary gland, and the anterior edge of the latissimus dorsi (Fig. 1A). This incision allowed for easy identification of the blue-stained lymphatic vessels and nodules.

A previous study on E-NSM performed in 50 patients with breast cancer reported that the rate of nipple areolar complex (NAC) necrosis was approximately 2 % [3,17]. A periareolar incision was not needed in patients who underwent GETSMIRI, which can minimize injury to the blood supply of the NAC. In addition, energy devices, such as electrothermal dissectors and ultrasonic shears, are used to dissect the retromammary and subcutaneous flaps in E-NSM. These devices result in lateral thermal spread and might cause skin necrosis during surgery. We preferred to separate the subcutaneous gap with a scalpel with a long handle, which was more beneficial in protecting the blood supply from thermal injury.

In our practice, the implant was placed behind the pectoralis muscle. The pectoralis major muscle was elevated and sometimes divided inferomedially [18]. Alternatively, the caudal side of the pectoralis major muscle was dissected completely [19]. We always dissected the caudal side of the pectoralis major muscle at the level of the bilateral nipple line if the nipple was located medial to the midline of the clavicle; otherwise, the caudal side of the pectoralis major muscle was dissected in the lower inner quadrant.

The construction of the "auxiliary hole" was very useful. The access granted by this hole could greatly increase the operating range

Table 1
Pre- and postoperative BREAST-Q scores (n = 11).

Subscale	Preoperative	1 month postoperative	P value
Satisfaction with Breasts	63.75 ± 6.61	65.25 ± 19.05	0.680
psychosocial Well-being	63.07 ± 8.99	52.06 ± 9.74	0.016
Physical Well-being	63.74 ± 5.29	62.28 ± 9.56	0.612

*p values refer to before vs. after intervention comparisons.

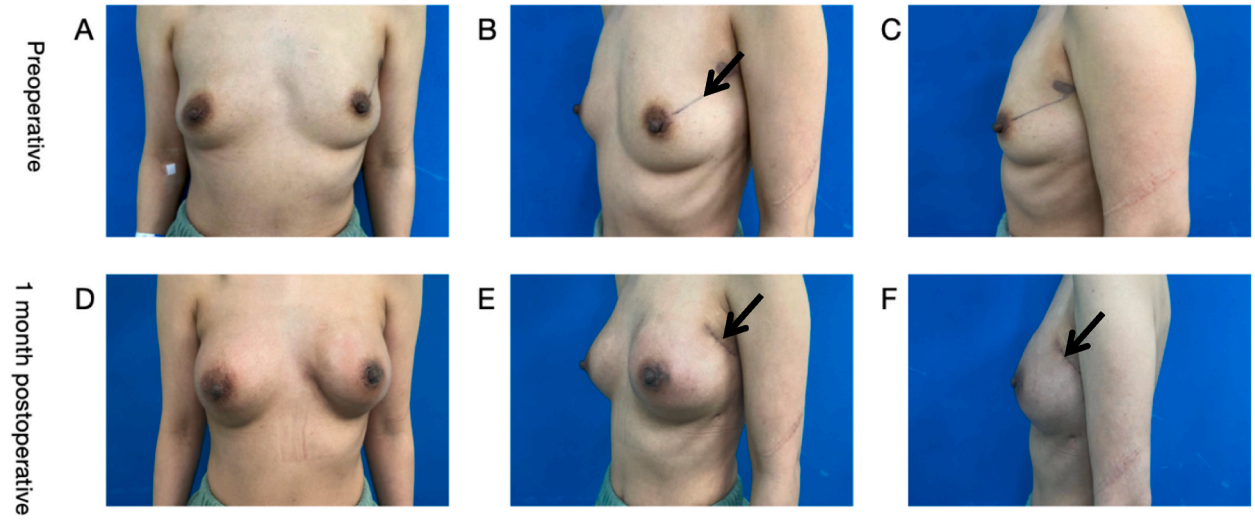

Fig. 2. Pre- and postoperative comparisons.
Fig. 2: Operative pictures taken for representative techniques for gasless endoscopic transaxillary subcutaneous mastectomy and immediate reconstruction with implants(GETSMIRI).This 42 y/o female with left breast ductal carcinoma (stage I).
A. Preoperative front view. B. Preoperative left oblique view (Marked lines show the direction of surgical access, indicated with black arrow). C. Preoperative left lateral view. D. Postoperation 1months front view for patient received GETSMIRI, the bilateral breast was symmetry and nipple areolar complex was well perfused. The wound was hidden in the inconspicuous axillary region. E. Postoperation 1 months left oblique view forpatient received GETSMIRI, the wound (indicated with black arrow) was located in the inconspicuous axilla region. F. Postoperation 1 months left lateral view for patient received GETSMIRI, the wound (indicated with black arrow) was hidden in the inconspicuous axillary region.

of the electric knife in the cavity, making it easy to free the superficial surface of the gland in the lower and inner parts of the gland. Furthermore, this auxiliary hold was helpful in wrapping the prosthesis patch backwards. This made patch suturing during GETSMIRI much simpler than that in Du's approach [20].

6. Conclusion

Here, we introduced a novel surgery, GETSMIRI, for immediate implant-based breast reconstruction procedures. The summary of this surgical procedure and the discussion of the precautions for each step have the potential to further inform and promote the application of this technique in more clinical settings for patients with indications for NSM.

Funding sources

The authors have not received any funding support

Data availability statement

All data generated or analyzed during this study are included in this article. Further inquiries can be directed to the corresponding author.

CRediT authorship contribution statement

Aierken Nijiati: Writing - review & editing, Writing - original draft. **Lingfei Cui:** Methodology, Conceptualization. **Xidi Wang:** Methodology, Conceptualization. **Zhaomin Xing:** Methodology, Conceptualization. **Mingxia Zhang:** Formal analysis. **Zhuolin Yuan:** Formal analysis. **Wenyu Xie:** Resources. **Kefeng Lei:** Project administration.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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