Single-port 3-dimensional Videoscope assisted Endoscopic Nipple-sparing Mastectomy Followed by Immediate Pedicled Transverse Rectus Abdominis Myocutaneous (TRAM) Flap Reconstruction: Report of Two Cases

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Research Article

Keywords: breast surgery, mastectomy, E-NSM

Posted Date: February 25th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-237054/v1>

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Abstract

Background: Minimal access surgery has become the mainstreams of breast surgery, and it is applied for benign lesion, partial mastectomy and total mastectomy. Dual axillary-areolar incision was the most frequent surgical approach in the early stage, but single axillary incision hybrid technique was proposed in recent years. Endoscopic nipple sparing mastectomy was usually applicable to patients with small to medium sized breast. Here, we reported two cases of breast cancer patients, who presented with large and ptosis breast, underwent single port 3-dimension (3D) endoscopic nipple sparing mastectomy (E-NSM) followed by pedicled transverse rectus myocutaneous (TRAM) flap breast reconstruction.

Case presentation: The first patient was a 42-year-old woman had palpable right breast mass and enlarged axillary lymph nodes for 4 months. Core needle biopsy(CNB) revealed invasive ductal carcinoma of breast and lymph node metastasis. Breast Magnetic Resonance Imaging(MRI) revealed multi-centric masses in right upper breast, about 6.1 cm in size, without nipple and skin invasion, and right axillary lymphadenopathy. Neoadjuvant chemotherapy was suggested, but the patient refused and preferred surgery first. She underwent single-port 3D E-NSM with immediate pedicled TRAM flap reconstruction. The post-operative recovery was uneventful except partial nipple ischemia/necrosis, which recovered after 2 to 3 months of wound care.

The second case was a 39-year-old woman had one palpable mass over right breast for one month. CNB showed ductal carcinoma in situ with focal infiltrating ductal carcinoma. MRI revealed multi-focal mass, 8.7 cm in size, without skin or nipple invasion and no lymph node metastasis. NSM was suggested, but she decided to undergo single-port 3D E-NSM with immediate pedicled TRAM flap reconstruction due to previous history of Cesarean section and obese abdomen. The post-operative recovery was uneventful.

Conclusion: Single-port 3D E-NSM followed by pedicled TRAM flap reconstruction is a feasible, safe procedure with satisfactory cosmetic outcome. Time-consuming and technical demanding are two limiting factors of this procedure.

Introduction

Minimal access surgery has become one of the mainstreams of breast surgery, and it is widely used in excision of benign breast lesions, breast conserving surgery (BCS), skin or nipple-sparing mastectomy (NSM)[1-3]. With the improvement of endoscopic instruments, operative visualization improved and thereby facilitating oncologic resection through small incisions. In the early development of conventional 2-dimensional (2D) endoscopic-NSM (E-NSM), dual axillary-areolar incision was the most frequently reported surgical approach[2-5]. New surgical developments of E-NSM, either single axillary incision hybrid technique with retraction-type endoscopic instruments[6] or single-port E-NSM insufflation

system[7], were proposed in recent years with the advantage of sparing areolar incision and decreasing nipple areolar complex (NAC) ischemia/necrosis complications[6, 8].

Three dimensional (3D) imaging system was a new technologic innovation, and had been proved to provide better depth perception and showed improved performance of advanced endoscopic or laparoscopic operations[9]. We had adopted single-port air inflation with 3D videoscope optic system in endoscopic-NSM for the surgical treatment of breast cancer[10], and demonstrated promising cosmetic outcome for patients receiving immediate breast reconstruction (IBR) with gel implant. E-NSM was usually proposed for patients with small to medium sized breast, and prosthesis type breast reconstruction was the preferred reconstruction choice[1-4]. Here, we reported two cases of breast cancer patients who presented with large and ptosis breast, who were usually not good candidate for E-NSM and IBR with gel implant. They had been successfully managed by single port 3D E-NSM followed by pedicled transverse rectus myocutaneous (TRAM) flap breast reconstructions, which was a new surgical innovation and never been reported before.

Patient And Operative Methods

Two breast cancer patients underwent single-port 3D E-NSM followed by immediate pedicled TRAM flap reconstruction at Changhua Christian Hospital (CCH) were reported. The medical records of the patients for breast cancer and cosmetic outcome were obtained. The study was approved by the Institutional Review Board of the CCH (CCH IRB No.:141224). The consent to use of clinical records was also obtained from each participant. The current study includes photos of two patients, and they agreed and signed the consent for publication of their pictures.

Clinical history

Case 1

A case of 42 year-old woman found one palpable right breast mass and enlarged axillary lymph nodes for 4 months. Breast ultrasonography revealed one mass with 4.6 X 2.5 cm in size at right breast 12'/3cm region and enlarged axillary lymph nodes, suspicious for metastases. Mammography showed right diffuse microcalcification. Core needle biopsy (CNB) revealed invasive ductal carcinoma (IDC) of breast and lymph node metastasis, grade 2, estrogen receptor(ER): positive (90%), progesterone receptor(PR):negative, Her2/neu: not overexpressed, Ki-67:10%. *Magnetic Resonance Imaging (MRI) revealed multi-centric masses in right upper breast, about 6.1 cm in size, without nipple and skin invasion. Right axillary lymphadenopathy involving level I and II nodes were also recognized* . Whole body survey showed no distant metastases. Neoadjuvant chemotherapy was suggested, but patient preferred and insisted surgery first.

Due to large (cup size E) & ptosis breast (Gr II), and post mastectomy radiotherapy indicated, TRAM flap reconstruction was recommended and she decided to received single port 3D E-NSM after shared decision making. A 6 cm axillary wound was created first, then axillary lymph node dissection (ALND) was

performed. After completion of ALND, skin flap dissection under direct vision was performed for development of working space. Another 4cm length infra-mammary fold incision was created for facilitation of lower inner quadrant skin flap dissection and creation of tunnel for transposition of pedicled TRAM flap. After creation of working space and initial skin flap dissection, single-port 3D NSM was performed and intra-operative sub-nipple biopsy showed no invasion of malignant cells. The resected mastectomy specimen weight was 644 gm, then immediate pedicled TRAM flap reconstruction was performed. Contra-lateral Pedicled TRAM flap, about 750 gm in size, was selected due to post mastectomy radiotherapy indicated, and shifted to right breast after de-epithelialization. The total operation time was 521 mins, and blood loss was 200 ml. The post-operative recovery was uneventful except partial nipple ischemia/necrosis, which recovered spontaneous after 2 to 3 months of conservative wound care (Figure 3b & 3c).

The final pathological report revealed invasive carcinoma, mixed micropapillary and of no special type with mucinous differentiation, with tumor size 8-cm in size and 24 out of 28 lymph nodes metastases, pT3N3aM0 (anatomic stage IIIC, prognostic stage IIIA, AJCC 8th edition). She received adjuvant chemotherapy with docetaxel + cyclophosphamide x 4 cycles followed by epirubicin + cyclophosphamide x 4 cycles. Post mastectomy radiotherapy and endocrine therapy with letrozole were prescribed. No disease recurrence was observed after post operation 8 months follow-up.

Case 2

A 39 year-old female found one palpable mass over right breast for one month. She visited our CCH breast clinic for help, and sonography revealed one hypoechoic lesion about 13 X 10 mm in size at 10 o'clock/4 cm. CNB was performed, and pathologic report showed diffuse ductal carcinoma in situ (DCIS) with focal IDC, ER(+, 90%), PR(+, 80%), Her-2: not overexpressed, Gr II, and Ki-67: 10%. MRI revealed multi-focal mass, approximate 8.7 cm in size, without skin or nipple invasion and lymph node metastasis. Whole body survey showed no distant metastasis. NSM was suggested and she decided to receive IBR with pedicled TRAM flap due to obese abdomen and prior two Cesarean section histories. Single port 3D E-NSM was performed, and showed negative sentinel lymph node biopsy (SLNB) and sub-nipple biopsy. The resected mastectomy specimen weight was 570 gm (pre-operative breast size cup D, ptosis grade I), and IBR with ipsilateral pedicled TRAM flap, which weighted 650gm, was performed smoothly. The total operation time was 394 mins, and blood loss 170ml. The final pathological report revealed two focal tumors, with 19 X 15 mm and 14 X 11 mm in size, IDC of no special type and diffuse DCIS lesions. The pathological staging was T1cN0M0, stage IA. She received adjuvant chemotherapy with liposomal doxorubicin + cyclophosphamide x 4cycles, followed by endocrine therapy with GnRHa + Tamoxifen. The post-operative recovery was smooth, without nipple ischemia/necrosis or other wound related complications (Fig 3e & 3f). She remained disease free 7 months post operation.

Surgical Techniques of Singe port 3D E-NSM and IBR with pedicled TRAM flap.

Preoperative Marking

The infra-mammary fold, superior and lateral border of breast were identified and marked while patients were standing in upright position. The spindle-shaped incision mark of TRAM flap was designed for tension-free abdominal wound closure (Fig 2A).

Single-Port 3D videoscope assisted Endoscopic nipple sparing mastectomy (E-NSM)

Patient positioning

The technique of single port 3D E-NSM had been published in a short report[10], and we summarized as below. After general anesthesia, patients were put in supine position, and both arms were abducted 90 degree and the ipsilateral shoulder was elevated to 30° to facilitate the ongoing of surgery. The tumescent solution, containing lactated Ringer's solution with lidocaine 0.05% and epinephrine 1:1000000, was injected subcutaneously into the whole breast to facilitate hydrodissection and reduce bleeding.

Surgical procedures

A 4-6 cm incision (depending on the size of breast to be removed) wound was placed over axillary or lateral chest at anterior axillary line area. Axillary lymph node surgery (SLNB or ALND) was performed first as indicated, then NSM was started by skin flap dissection. The skin flap dissection of upper and lower outer breast was done through the axillary or lateral chest wound as far as possible under direct vision with light retractor (Fig 1a). The lower inner breast skin flap dissection was performed through another 4 cm infra-mammary fold incision, which could also use for creation of tunnel between breast and TRAM flap. After creation of adequate working space, about 4cm in length, the single port (Glove Port, Nelis, Gyeonggi-do, Korea, Fig. 1b) could be inserted. The infra-mammary incision was closed temporarily by skin staple and covered by sterile plastic tap (OP-site) to prevent air leakage (Fig).

After single port (Figure 1b (G)) placement, carbon dioxide insufflation, which with air pressure set at 8 mmHg, was inflated to create space for subsequent skin flap dissection and mastectomy. A camera of 3D VIDEO Endoscope cam(30°) (Figure 1b (F)) was used during E-NSM. Dissection was done with laparoscopic curved Metzenbaum scissors (KARL STORZ) and laparoscopic grasping forceps (Figure 1b (B) & (A)). During skin flap dissection, a 30° upward facing 3D endoscope was turned into 30° downward by reversing 180° to give a clear 3D vision. The field of vision could be adjusted with either upward or downward by reverse of the 3D endoscope when necessary. Laparoscopic hook scissor (Figure 1b (C)) was used to transect the dense glandular tissue while dissecting beneath the nipple areolar complex (NAC) area. After total mastectomy, the sub-nipple biopsy of two separate specimens (inner and outer) was performed and sent for frozen section. If the NAC was invaded by cancer cell, the entire NAC was removed and skin-sparing mastectomy was performed instead.

Breast Reconstruction with TRAM Flap

Breast reconstruction with pedicled TRAM flap was performed after total mastectomy. The upper border of pedicled TRAM flap design was above umbilicus to harvest more rectus abdominis muscle perforators to increase flap survival, but the umbilicus was preserved. The contralateral or ipsilateral TRAM flap was performed per patient' factor & doctor' consideration. The flap harvest continued by elevating the flap with subcutaneous flap from lateral to medial until the lateral and medial margins of the rectus abdominis muscle were approached. The whole rectus abdominis muscle sheath remained intact to ensure blood supply.

The superior aspect of TRAM flap was harvested until the costal margin was reached (Figure 2f). At the inferior aspect of TRAM flap, the rectus muscle was transected at the level of preserving adequate perforator for perfusion of flap. During the rectus muscle transection, the deep inferior epigastric artery and vein were identified and ligated. At the posterior aspect of the TRAM flap, the posterior rectus sheath was separated from the preperitoneal fat and rectus myocutaneous flap was lifted up to the costal margin. The zone 1 and partial zone 2&3 (depends on the weight of the excised breast) of TRAM flap was preserved, and the superfluous tissue was removed (Fig 2f). The flap was de-epithelialized before transposition.

The subcutaneous tunnel was created from the infra-mammary fold incision from subcoastal margin to the mastectomy site. The TRAM flap was pulled through the tunnel to the mastectomy site. A Jackson-Pratt drain was placed in the mastectomy site, and another one placed in the axillary area if axillary lymph node surgery was performed. The axillary and infra-mammary wound were closed with 3-0 vicryl and 4-0 monocryl subcuticular sutures.

The defect of rectus abdominis muscle was approximated by using 3-0 prolene running sutures. Light weight mesh was used to cover the defect of rectus abdominis muscle and fixed by using 3-0 prolene interrupted sutures(Figure 2h). Two Jackson-Pratt drains were placed in the abdominal donor site. The patients were flexed to facilitate the donor site wound closure and assure the tension of donor site as less as possible. The new umbilicus position was located and the skin was removed for the umbilicus and then skin approximating by 4-0 monocryl. The donor site wounds were closed by approximating Camper and Scarpa fascia using 1-0 vicryl continuous sutures and skin closure using 3-0 vicryl and 4-0 monocryl running subcuticular sutures.

Postoperative results and aesthetic outcome

The post operation aesthetic results were recorded at the time of surgery and 3-month postoperative outpatient follow-up (Figure 2i, j & 3b, c, e, f). All these two patients were satisfied with the post-operative cosmetic outcome, and remained disease free.

Discussion

In current study, we presented two cases of breast cancer patients received single port 3D E-NSM followed by IBR with pedicle TRAM flap. Minimal access breast surgery has become the new innovative

surgical advance in recent two decades, and endoscopic and robotic assisted breast surgeries are the representatives[1, 6, 10-14]. Robotic assisted NSM had been shown to have potential in NSM with small and inconspicuous scar and shown promising aesthetic results[11-14]. However, long operation time, increasing medical cost, and required facility of robotic surgical platform limited the widespread use of this surgical innovation[15, 16]. Our previous results revealed single-port 3D E-NSM is a feasible and safe surgery with satisfactory cosmetic outcomes[10]. Moreover, the cost of single port 3D E-NSM and IBR with gel implant was more cost saving than R-NSM and IBR with gel implant ($7,522 \pm 470$ versus $10,587 \pm 554$ US Dollars, approximately 2,500 US dollars could be spared)[10, 15, 16].

Implant based breast reconstruction has become the major breast reconstructions following mastectomy[17], and IBR following minimal invasive/access mastectomy (endoscopic or robotic assisted) were usually with the use of prosthesis based (tissue expander or gel-filled implants) breast reconstructions[1-4], which had been shown to be associated with good cosmetic outcome. The advantage of implant based breast reconstruction following E-NSM were associated with short operation time and no additional donor site scar needed[1-3], which match with the characteristics of the long operation time and small-hidden scar of E-NSM.

In patients with large and ptosis breast, however, sub-pectoral direct to gel implant-based breast was not associated with good cosmetic outcome, and associated with higher implant failure rate[18, 19]. Our preliminary study showed that endoscopic-assisted total mastectomy followed by immediate pedicled TRAM flap reconstruction is a feasible and safe procedure[20], and this kind of surgery brings out the good cosmetics outcome, especially for patients with large or ptosis breast, with previous low abdominal transverse operation scar, or indicated for post-operative radiotherapy.

Conventional 2D E-NSM were reported to be operated through dual axillary-areolar incisions[1-4], and the areolar incision had been reported with higher risk of NAC ischemia/necrosis, which associated with 9%-19% NAC ischemia/necrosis[2, 3, 19, 20]. In large and ptosis breast, this dual axillary-areolar incision E-NSM was associated with higher complication and not easy to perform. That's one of the reasons that large or ptosis breast was not good candidate for E-NSM[1-4, 6]. In these two patients, we adopted dual axillary (or lateral chest)-inframammary incision, which spare the peri-areolar skin incision to prevent blood flow interruption of NAC and decreasing NAC ischemia/necrosis complication. In patients with large and ptosis breast, this infra-mammary incision could also facilitate lower inner breast dissection, creation of tunnel for TRAM flap, shortening the operation time, and could be well hidden under the breast. The wound incision design benefits cosmetic outcome, and decreases the NAC complication rate. These benefits could be confirmed from our patients' peri-& post-operative results (Fig 2,3).

These two patients were associated obese abdomen, multiparity, and one patient had previous Cesarean scar, and the other indicated for post mastectomy radiotherapy (Fig 2,3). The Patients with loose abdominal wall tissue would have less tension during donor site wound closure, which may lessen the donor site wound complications. Besides, the patients would be benefit from the effect of abdominoplasty. Moreover, patients with Cesarean scar are more likely to endure the additional scarring

over the lower abdomen. Comparing with the gel-filled implant, the shape of TRAM flap reconstruction looks more natural in large or ptosis breast. In patients post mastectomy radiotherapy was indicated, TRAM flap are more endurable to radiotherapy compared with gel-filled implant reconstruction, which usually end up with capsular contracture[18].

There are still some limitations of this single port 3D E-NSM and IBR with pedicled TRAM flap, such as technical requirement, prolonged operative time, risk of flap failure, and NAC ischemia/necrosis risk in large & ptosis breast. In our current practice, two-team approaches, which one surgeon performed mastectomy and the other performed flap harvest at the same time, would decrease operative time as the first patient took 521mins, and in second case shorten to 394 mins. We found that by adopting dual axillary (or lateral chest)-inframammary incision, instead of peri-areolar wound incision, could decrease NAC ischemia/necrosis. We also think that omitting the inframammary incision is also feasible as we had recently done with R-NSM and IBR with pedicle TRAM flap (unpublished result).

Conclusions

Single-port 3D endoscopic-NSM followed by pedicled TRAM flap reconstruction is a feasible, safe procedure, and associated with good cosmetic outcome. Patients with large, and ptosis breast, who indicated for NSM would like receiving pedicle TRAM flap, minimize operation scar and hidden in inconspicuous area, would be potential candidates. Time-consuming and technical demanding are two limiting factors of this procedure.

Declarations

Ethics approval and consent to participate: The study was approved by the institutional review board (IRB) of CCH, and the IRB number is 141224.

Consent for publication: The consent to use of clinical records was also obtained from each participant. The current study includes photos of two patients, and they agreed and signed the consent for publication of their pictures.

Availability of data and materials: The datasets generated and/or analysed during the current study are not publicly available due to patients privacy but are available from the corresponding author on reasonable request.

Competing interests: None of the authors have conflicts of interest or financial ties to disclose.

Funding: This study was funded by the Ministry of Science and Technology of Taiwan, and the number of this funding was: MOST 109-2314-B-371-002. This study was also sponsored by research funding provided by the Changhua Christian Hospital 108-CCH-IRP-122, and 109-CCH-IRP-093. We also received sponsored by research funding provided by Intuitive Surgery.

Authors contributions: Conceptualization: Hung-Wen Lai; Data collection: Shou-Tung Chen, Dar-Ren Chen, Hung-Wen Lai, Yi-Lin Chang; Manuscript preparation: Yi-Lin Chang; Revision of Manuscript: Hung-Wen Lai, Yi-Lin Chang.

Acknowledgements: The authors would like to thank Yun-Ting Chang for her assistance in this study.

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Figures

Figure 1

Operative pictures of instruments and settings a: Instruments for endoscopic hybrid technique for nipple-sparing mastectomy; b: Laparoscopic instruments for single-port nipple-sparing mastectomy; c: Subglandular dissection under the help of Endoscopic Vein Retractor; d: Skin flap dissection via Glove-port with the help of carbon dioxide inflation by laparoscopic hook scissors, e: 3D-scope image without

3D glasses; f: 3D-scope image with 3D glasses; g: Posterior view of operator and scope-man position; h: Anterior view of operator and scope-man position

Figure 2

a: spindle-shaped wound incision ; b: wound of anterior axillary line and inframammary line; c: Glove-port placement over anterior axillary wound; d: 3D-scope view of mastectomy with the help of laparoscopic curved Metzenbaum scissors and laparoscopic grasping forceps; e: the resected breast; f: TRAM flap; h:

the TRAM flap after deepithelization; i: the image of TRAM flap breast reconstruction, lateral view; j: the image of TRAM flap breast reconstruction and donor site wound closure, anterior view

Figure 3

Cosmetic Outcome a: Case 1, prior to operation; b: Case 1, 3 months after operation, anterior view; c: Case 1, 3 months after operation, lateral view; d: Case 2, prior to operation; e: Case 2, 3 months after operation, anterior view; f: Case 2, 3 months after operation, lateral view

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