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Breast

Vacuum-assisted minimally invasive surgery—An innovative method for the operative treatment of gynecomastia

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ABSTRACT

Background: Gynecomastia is the most common benign enlargement of the mammary gland and adipose tissue in males. Because a feminine-looking chest contour can bring severe psychologic burden to patients, subcutaneous mastectomy has become the standard treatment for this condition. Conventional open surgery causes conspicuous scarring that may affect the appearance of the breast. We provide a novel surgical operative for the treatment of gynecomastia.

Method: With approval from our institutional ethics committee and written informed consent, 22 patients with 33 abnormally hyperplastic breasts were enrolled at The First Affiliated Hospital with Nanjing Medical University between June 2016 and September 2018. Vacuum-assisted minimally invasive surgery was performed under general anesthesia. Patients were followed up with physical examination and ultrasonography.

Result: Vacuum-assisted minimally invasive mastectomy was performed successfully in all cases, with no residual glands or adipose tissue observed on ultrasonography. The operation had a mean duration of 73.5 minutes per side, ranging from 40 to 102 minutes. An average of 320 specimens were excised from each side with mean blood loss of 34 mL. Of these 33 operative sides, 2 complications occurred, but satisfactory chest contour was attained eventually in all patients. All patients were satisfied with their cosmetic outcome, graded as excellent by 22 patients (100%). Redundant skin was observed in 1 patient at 1 month postoperatively, whose breast, defined as graded III, was the largest before operation.

Conclusion: Vacuum-assisted, minimally invasive mastectomy is a feasible approach for the treatment of gynecomastia with acceptable complications.

Introduction

Gynecomastia is the most common benign mammary disease in men.[1,2] Such patients, especially adolescents, can have psychologic burdens owing to their abnormally large breasts, which can lead to adjustment or anxiety disorder and dysthymia.[3] Consequently, treatment for this condition is needed; of all the therapeutic methods, operative mastectomy is the most effective.[4] Currently, several conventional approaches have been reported, such as liposuction, subcutaneous mastectomy, and a combination of the 2 methods.[2] Among them, lipectomy combined with subcutaneous mastectomy is the most prevalent technique used. The breast tissue can be excised with a subcutaneous approach, but there is a not consequential incidence of complications, such as saucer-like deformity, necrosis of the nipple, and contour irregularity, that cannot be neglected.[5] Also, this procedure inevitably leaves a scar on the anterior chest wall, which may have a psychologic impact on patients, especially in adolescents.[6,7] In general, the cosmetic outcome after conventional surgery is not satisfactory to some patients.

There is a trend to apply a more minimally invasive method. This vacuum-assisted, minimally invasive mastectomy is a promising technique, especially using a sharp rotation needle to excise the target tissue. Currently, this technique has been used primarily for biopsy of a breast mass and resection of known benign breast mass.[8] Under the guidance of ultrasonography (US), the mass can be removed precisely with little damage to the surrounding tissue, especially small lesions (<1 cm) near the posterior space. This procedure is considered to be a safe and accurate method.

Compared with conventional methods, vacuum-assisted, minimally invasive mastectomy can overcome some of the inherent limitations and complications of conventional operative treatment

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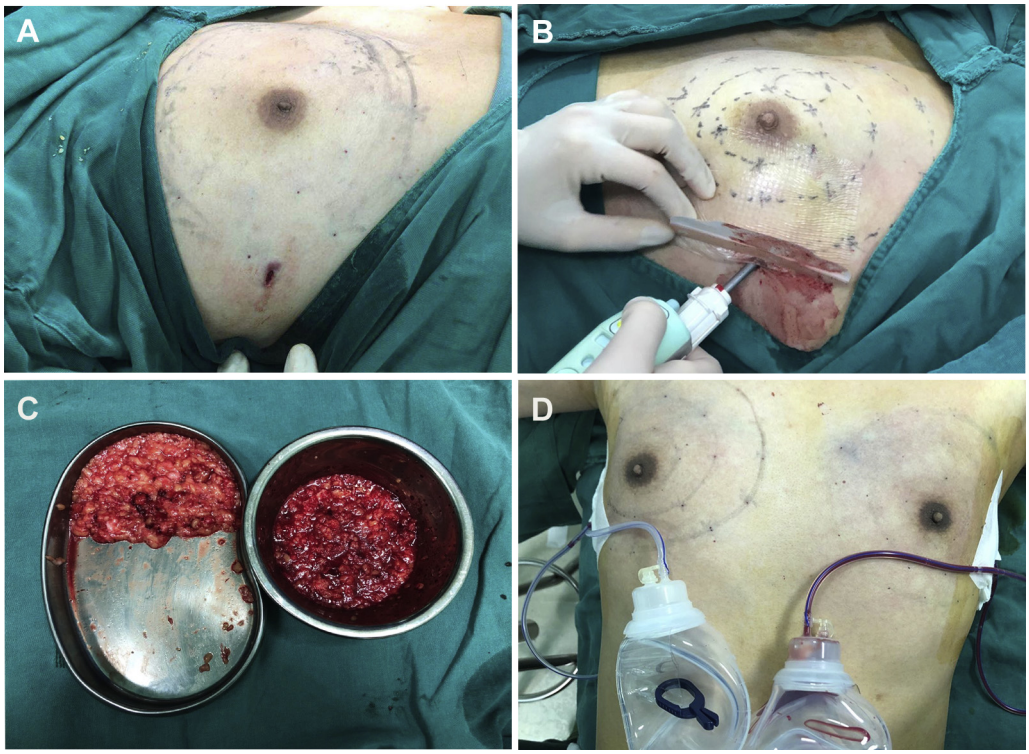

Fig 1. The surgical technique of vacuum-assisted minimally invasive mastectomy. (*A*) The 3-mm incision is located at the intersection of the midaxillary line and the horizontal line through the nipple. (*B*) A rotation needle is inserted into the posterior breast space. (*C*) Macroscopic appearances of excised specimens after minimally invasive therapy. (*D*) A surgical drain is left in place.

of gynecomastia while minimizing apparent scars on the chest wall and complaints of deformities of chest wall contour. In other minimally invasive systems, such as the endoscopic subcutaneous mastectomy, CO_2 gas is needed to be insufflated from 3 incisions for creating a working space. Besides, liposuction is also essential. Our operation is performed through only one incision, and the technique is easier to learn and to perform.

The purpose of this nonrandomized clinical study was to determine the feasibility of vacuum-assisted, minimally invasive mastectomy for the treatment of gynecomastia.

Patients and Methods

Between June 1, 2016, to September 30, 2018, 22 patients diagnosed with gynecomastia in our hospital (The First Affiliated Hospital, Nanjing Medical University, Nanjing, China) were recruited for this prospective, nonrandomized study. This research was approved by our institutional ethics committee, and all patients offered their informed consent to take part in our study before operation.

Preoperative evaluation of the disease for all the patients included a thorough history, physical examination, sex hormone evaluation, breast and testicular ultrasonography, and computed tomography of the adrenal glands. Preoperative routine examination included electrocardiography and routine screening of blood parameters and coagulation function. Patient eligibility criteria included the following: (1) no history of hormone use; (2) no history of endocrine-related diseases; (3) no clear cause of disease; (4) preoperative US showing proliferation of mammary glands and fat on one or both sides of the breast with no obvious lump found in the breast or axilla; and (5) no surgical contraindications.[3,9–11]

The Simon grade was used to assess the degree of breast enlargement.[12,13] The minimally invasive device we used is equipped with an automatic sampling system with a preprogrammed probe which can cut samples consecutively. The size of the rotation needle is 7-gauge.[8,14]

Technique of vacuum-assisted minimally invasive mastectomy

Preoperative markings were made with US in the standing position before anesthesia, including the superior border, inframammary fold, inner border, and the area that would be used for incision. A 3-mm incision was made in the intersection of the midaxillary line and the horizontal line through the nipple. Then, the patient was placed on the operating table in a supine position and was treated under general anesthesia. A side arm board was extended carefully to 90 degrees to avoid any traction injury to the arm and then and raised up about 15 to 30 degrees.

A dilute epinephrine solution was injected into the subcutaneous and retromammary spaces. The solution was composed of 1 mL epinephrine:100 mL 0.9% NaCl. The volume of injection depended on the size of the breast, usually 200 to 300 mL solution per breast was adequate.

Next, a rotation needle was inserted from the incision into the posterior space between the superficial fascia of the pectoralis major and the breast tissue (Fig 1). Breast glands and adipose were excised simultaneously. The extent of the breast tissue removed depended on the preoperative markers outlining the extent of the breast tissue. Once underneath the nipple and areola complex, a 5-mm-thick disc of the gland was retained to avoid depression of the nipple. The resected specimens were strip-like in shape (Fig 1). In general, 2 doses of a hemostatic drug (hemocoagulase injection; Zhaoke Pharmaceutical [Hefei] Co., Ltd, Hefei, Anhui province, China) were injected intravenously in advance to prevent bleeding. At the end of the procedure, US was used to determine whether there was residual glandular tissue or any hemorrhage.

Table I
Detailed characteristics of 22 male patients with gynecomastia

Parameters	n	Data (mean or percentage)	Range
Age (y)	22	26.3 ± 7.9	15–45
BMI	22	24.0 ± 2.4	20.1–28.4
Site			
Bilateral	11	50%	
Unilateral	11	50%	
Simon's classification			
I	2	9.1%	
IIA	13	59.1%	
IIB	5	22.7%	
III	2	9.1%	
Follow-up period (mo)	22	6.1	2–15

Simons classification.[12]
BMI, body mass index.

A drain tube was inserted through the incision after surgery (Fig 1). It was removed after <5 mL drain fluid per day was observed. The patient's chest wall was wrapped tightly with bandage for 3 to 5 days.

Follow-up

Physical examination and US were performed at 1 week, 1 month, 3 months, and 6 months after operation. The cosmetic appearance of the area of the breast(s) was evaluated by 2 surgeons at each follow-up. US was applied to assess whether there was any remnant gland under the nipple or whether there was any residual seroma fluid in the breast area. All patients were required to grade their satisfaction with the postoperative appearance as poor, average, good, or excellent.

Data and statistical analysis

Numerical data were reported as the mean ± standard deviation. All statistical analyses were performed by using IBM SPSS Statistics 25.0 (IBM Corp, Armonk, NY).

Results

Basic characteristics

Our patient population was made up of 22 male patients with 33 abnormally enlarged breasts. Of these 22 patients, 11 patients were diagnosed with bilateral gynecomastia, and the other 11 with unilateral gynecomastia. The mean age of the patients was 26.3 years, ranging from 15 to 45 years of age. The average body mass index of patients was 24.0, ranging from 20.1 to 28.4 kg/m^2. In the classification of Simon et al,[12] of these 33 breasts, 3 were classified as grade I, 19 breasts as grade IIa, 8 as grade IIb, and 3 breasts as grade III. The clinical data of this patient population are summarized in Table I.

Therapeutic response

Vacuum-assisted minimally invasive mastectomy was performed successfully in all patients under general anesthesia, including one with intraoperative bleeding. No patient needed to be converted to an open operation and no skin damage or remnant glandular tissue (other than that small disc of breast tissue directly under the nipple) was observed. Detailed operational data are summarized in Table II. A mean operative duration of 73.5 minutes per side was required (40–102 min). An average of 320 specimens ranging from 207 to 650 were excised in each breast, and mean volume of blood loss was 34 mL, ranging from 15 to 200 mL. The mean postoperative days before removing the drains were 4.5, ranging from 2 to 9, whereas the average volume of the drained liquid was 116 mL for each side, ranging from 40 to 440 mL.

Table II
Detailed operative data of 22 male patients undergoing minimally invasive, vacuum-assisted mastectomy for gynecomastia

Parameters	n	Data (mean ± SD or percentage)	Range
Operation data			
Operation time (min)	33	72 ± 18	40–102
Volume of specimens	33	305 ± 97	207–650
Blood loss (mL)	33	32 ± 31	15–200
Drainage time (d)	33	4.5 ± 1.6	2–9
Volume of drainage (mL)	33	116 ± 1.034	40–440
Complications			
Postoperative bleeding	1		
Nipple sensation abnormality	1		
Satisfactory rate	33		

There was one individual who developed intraoperative bleeding. Four doses of the hemostatic drug were administered intravenously. The minimally invasive operation continued after applying external compression on the chest wall for half an hour.

The postoperative pathologic results were glandular hyperplasia (some with glandular ductal dilation) in 22 patients.

Follow-up

The total follow-up time was 2 to 15 months with an average of 6.1 months. Nobody was lost during the follow-up. The postoperative results were both evaluated by surgeons and patients. Patients underwent US at least once after this minimally invasive mastectomy. Of the 33 breasts operated on from 22 patients, US was performed on seven breasts (21%) from 5 patients 1 week after operation, and US was performed on the other 26 breasts (79%) from 17 patients after the first week postoperatively. Of the 33 breasts, no remnant breast tissue was identified by US other than the disc of breast tissue directly under the nipple and no residual seromas were observed. There were no postoperative scars or nipple retraction. Redundant skin was observed in 1 case 1 month postoperatively; this patient had graded III gynecomastia, and this was the largest breast for which we performed this technique. A later follow-up was taken to observe the process of the retraction of redundant skin (Fig 2). Despite this, all patients were satisfied with their cosmetic outcome (Fig 3), graded as excellent by 22 patients (100%).

Complications

Complications were observed in 2 patients (Table II). One patient had more than just minimal bleeding on the right side for an hour postoperatively, which was managed successfully with external pressure. Another patient had abnormal sensation in the left nipple postoperatively but recovered fully within 2 months with conservative treatment. There were no other short-term complications, including acute pain, infection, or necrosis of nipple-areola complex, in any patients. There was also no asymmetry, saucer-like deformity, gland hyperplasia, or other long-term adverse effects.

Discussion

Gynecomastia is the most common benign enlargement of male breasts and is a result of an imbalance between endogenous estrogen and androgen hormones.[6,15] In most cases, indeterminate pathologic results and psychologic stress will ultimately lead to a

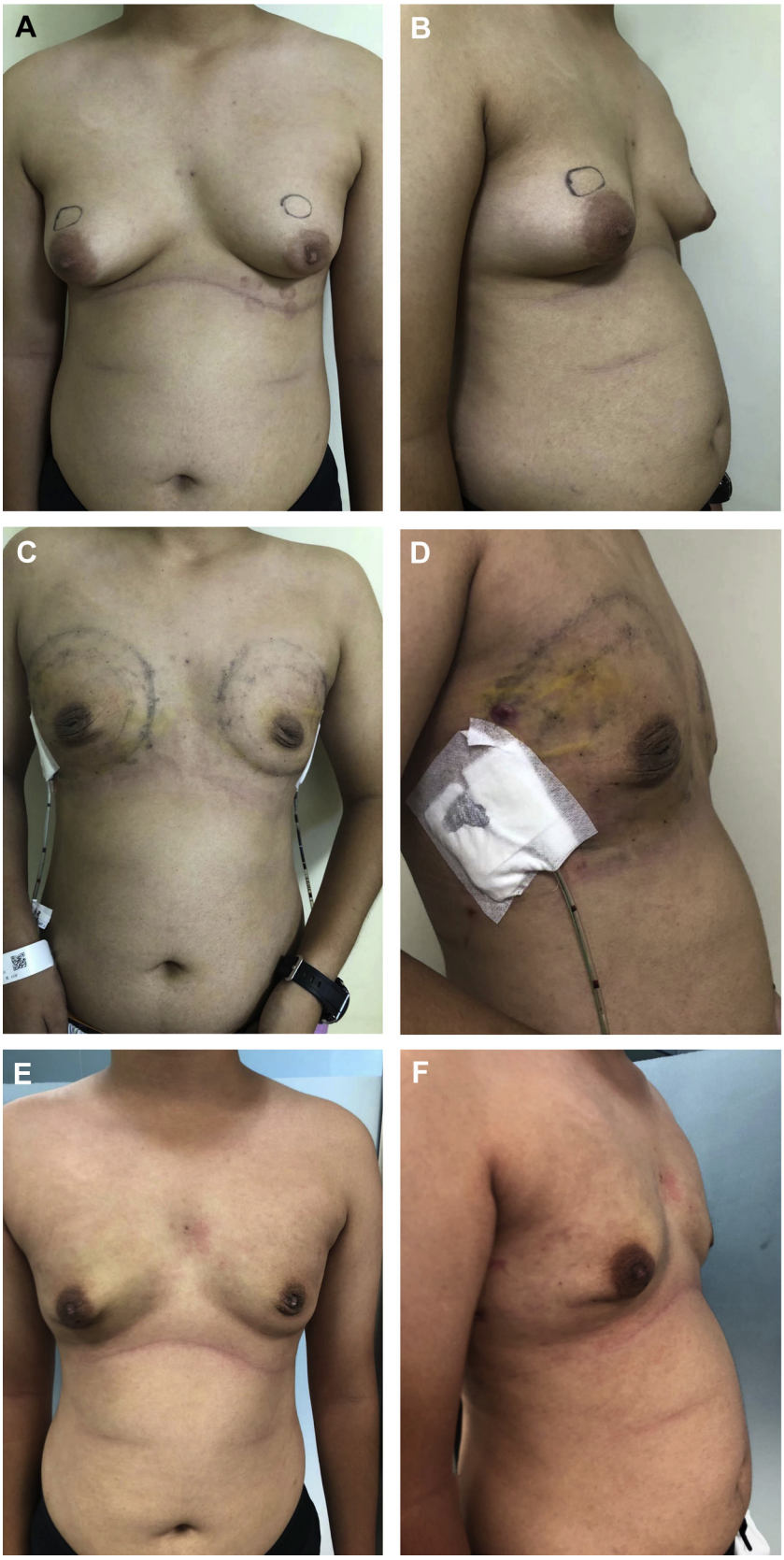

Fig 2. A 15-year-old boy with a Simon grade III gynecomastia. (*A*) Preoperative, anterior view. (*B*) Preoperative, lateral view. (*C*) Postoperative 7 days, anterior view. (*D*) Postoperative 7 days, lateral view. (*E*) Postoperative 2 months, anterior view. (*F*) Postoperative 2 months, lateral view.

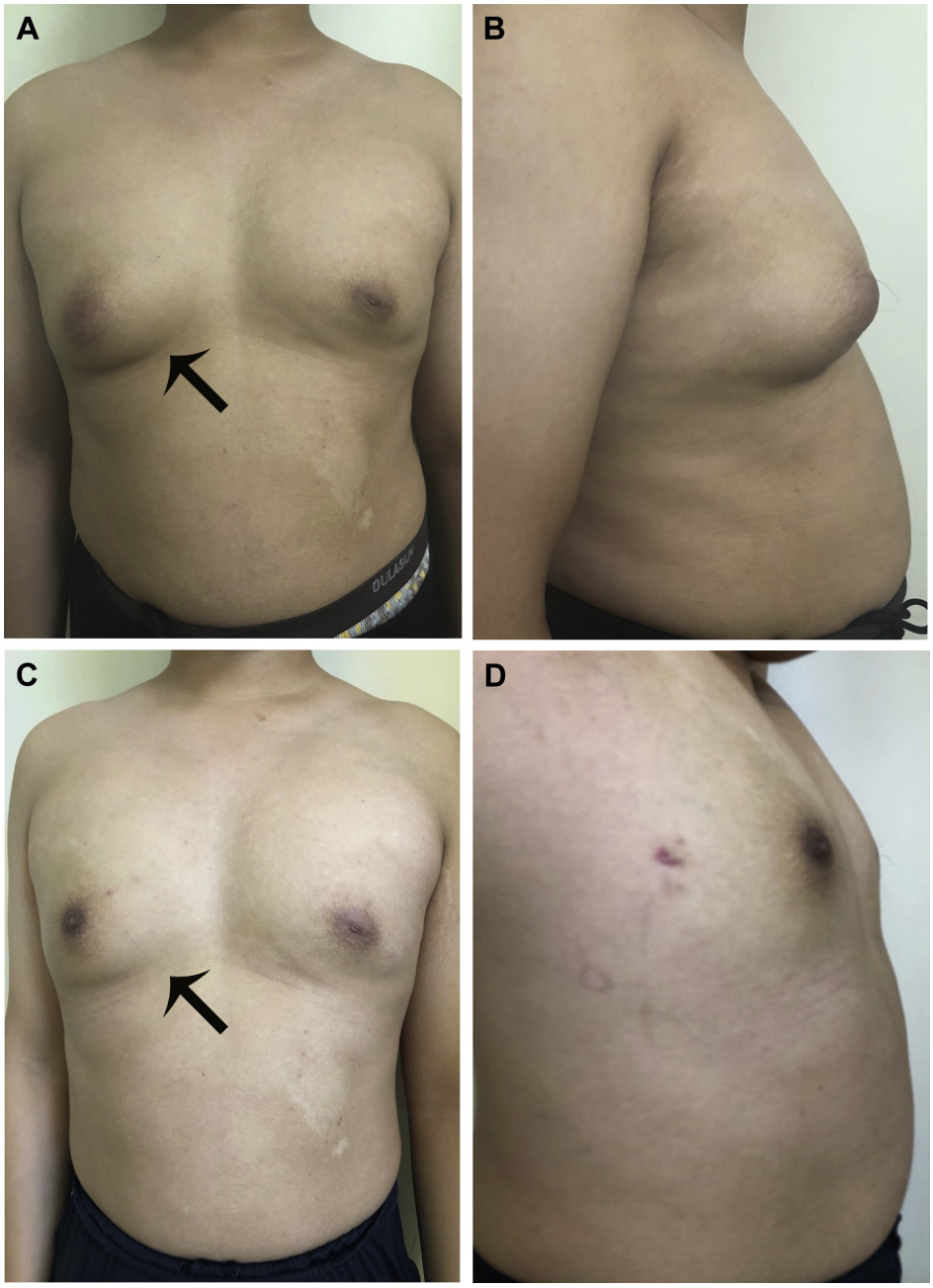

Fig 3. An 18-year-old boy with Simon grade IIB gynecomastia. (*A*) Preoperative, anterior view. (*B*) Preoperative, lateral view. (*C*) Postoperative 3 months, anterior view. (*D*) Postoperative 3 months, lateral view.

desire for operative intervention.[4,16] The subsequent demands placed on surgeons is to achieve the best aesthetic outcome and the least complications using the simplest method.[6,11] This is not only a common goal pursued by surgeons or patients, but also an indicator of success.

There are 3 types of traditional operative methods used, including conventional lipectomy, subcutaneous mastectomy, and a combination of the 2 approaches. Various diverse techniques, such as liposuction-like syringe liposuction, suction-assisted liposuction, power-assisted liposuction, and ultrasound-assisted liposuction have been described. Compared with other techniques, these are easier to manipulate and can create a superficial plane between the skin and the breast tissue, leaving no obvious scar on the breast.[17] While effective in the appropriate patient, they can only be applied for fat type breasts. Also, there is a concerningly high rate of recurrence (35%) owing to remnant glandular when using these techniques. Now, it is applied as a previous step in open excision in most cases.[13,16] Dufourmentel[18] in 1928 first proposed using a periareolar incision for a subcutaneous mastectomy. This technique was gradually modified by Webster,[19] Morselli,[20] and others. It should be noted that there are many selections of the location for the incision, such as at the edge of the areola, the inframammary fold, and the axilla.[21] Currently, periareolar incisions are used most frequently. The method is applied into the glandular type. While operating via an open excision, the entire breast tissue can be excised under a direct view through a small incision. In addition, intraoperative bleeding can be dealt with quickly and effectively, and the rate of hematoma and seroma is low.[22] In contrast, the incidence of necrosis of nipple-areola complex, a saucer-like deformity, and irregularities in the contour of the chest can occur.

In addition, a conspicuous scar may remain on the chest wall, which can be considered by the patient to not be a satisfactory aesthetic result.[13,21] In 2005, Hammond and colleagues described a new operation that consisted of an ultrasonographically assisted liposuction for operative mastectomy for gynecomastia.[23] This method combines the advantages of the 2 approaches mentioned in the present article and is applied for gynecomastia in a fatty breast, but the operative scar is still a problem.

Other minimally invasive techniques have made great progress in the past decades. Compared with other approaches, 2 advantages were observed in the study. First, no scar would be left on the anterior chest wall owing to the position of the incision. The incision is only 3 mm in length, whereas the length of an open excision is at least 3 cm. Second, no liposuction is required before the minimally invasive surgery. An electrotome cannot excise adipose tissue owing to its characteristic of liquefaction at high temperature. In a conventional operation, lipectomy is required. However, both breast tissue and fat can be excised with the technique we introduced.

Next, we will discuss several tips we use in this technique. First, the epinephrine solution (1 mL/100 mL 0.9% NaCl) helps to prevent bleeding from small vessels because it causes vasoconstriction. In addition, the intravenous hemocoagulase injection we used, although controversial in its effectiveness,[24,25] helped as well. Also, by inserting the rotation needle into the posterior breast space between the breast and the pectoralis muscle fascia, not only can the breast tissue and fat be removed completely, but the integrity of the pectoralis muscle fascia also can be preserved. The major advantage of this technique is that the abnormally hyperplastic breast tissue and adipose tissue can be removed with the vacuum-assisted minimally invasive approach, and there will be no scars on the anterior chest wall. There have been no reported complaints about disfigurement such as contour irregularity, saucer-like deformity, or necrosis of nipple compared with conventional operation methods.

The postoperative complication rate was 6.0% (2 of 33 breasts). Both complications occurred in the first 10 cases during the initial stages of our study but did not impact the ultimate shape of the chest wall. As expected, with further experience, the incidence of complications decreased. There are several potential limitations, however. One is that there is no effective method to completely deal with the problem of intraoperative bleeding other than external pressure and possibly application of some topical hemostatic agent. In addition, patients with extremely large gynecomastia (grade III) may not be considered ideal candidates for this approach.

Vacuum-assisted minimally invasive mastectomy is a feasible approach to treat grade I to II gynecomastia, especially in a more aesthetically pleasing chest contour; leaving no scars will lead to superior patient outcomes in terms of satisfaction.

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Conflict of interest

The authors report no proprietary or commercial interest in any product mentioned or concept discussed in this article.

References

1. Ratnam BV. A new classification and treatment protocol for gynecomastia. *Aesthet Surg J*. 2009;29:26–31.
2. Hosnuter M. An ameliorated approach for sharp resection in gynecomastia surgery. *Indian J Surg*. 2014;76:419–424.
3. Wyrick DL, Roberts M, Young ZT, Mancino AT. Changing practices: The addition of a novel surgical approach to gynecomastia. *Am J Surg*. 2018;216:547–550.
4. Iwuagwu O, Drew P. Minimal invasive surgery for gynecomastia: A novel approach. *Can J Plast Surg*. 2004;12:145–146.
5. Cao H, Yang ZX, Sun YH, Wu HR, Jiang GQ. Endoscopic subcutaneous mastectomy: A novel and effective treatment for gynecomastia. *Exp Ther Med*. 2013;5:1683–1686.
6. Benito-Ruiz J, Raigosa M, Manzano M, Salvador L. Assessment of a suction-assisted cartilage shaver plus liposuction for the treatment of gynecomastia. *Aesthet Surg J*. 2009;29:302–309.
7. Fan L, Yang X, Zhang Y, Jiang J. Endoscopic subcutaneous mastectomy for the treatment of gynecomastia: A report of 65 cases. *Surg Laparosc Endosc Percutan Tech*. 2009;19:e85–e90.
8. Wang ZL, Liu G, Huang Y, Wan WB, Li JL. Percutaneous excisional biopsy of clinically benign breast lesions with vacuum-assisted system: Comparison of three devices. *Eur J Radiol*. 2012;81:725–730.
9. Zampieri N, Castellani R, Modena S, Camoglio FS. Class III gynecomastia in pediatric age: A new modified surgical treatment. *Pediatr Surg Int*. 2012;28:1015–1019.
10. Blau M, Hazani R. Correction of gynecomastia in body builders and patients with good physique. *Plast Reconstr Surg*. 2015;135:425–432.
11. Tu LC, Tung KY, Chen HC, Huang WC, Hsiao HT. Eccentric mastectomy and zigzag periareolar incision for gynecomastia. *Aesthetic Plast Surg*. 2009;33:549–554.
12. Simon BE, Hoffman S, Kahn S. Classification and surgical correction of gynecomastia. *Plast Reconstr Surg*. 1973;51:48–52.
13. Innocenti A, Melita D, Ghezzi S. Closed-suction drains after subcutaneous mastectomy for gynecomastia: Do they reduce complications? *Aesthetic Plast Surg*. [Epub ahead of print]
14. Mariscotti G, Durando M, Robella M, et al. Mammotome(®) and EnCor(®): Comparison of two systems for stereotactic vacuum-assisted core biopsy in the characterisation of suspicious mammographic microcalcifications alone. *Radiol Med*. 2015;120:369–376.
15. Mohapatra S, Chakraborty S. A young male with bilateral gynecomastia. *Clin Chem*. 2018;64:756.
16. El-Sabbagh AH. Combined approach for gynecomastia. *GMS Interdiscip Plast Reconstr Surg DGPW*. 2016;5:Doc10.
17. Abdelrahman I, Steinvall I, Mossaad B, Sjoberg F, Elmasry M. Evaluation of glandular liposculpture as a single treatment for grades I and II gynaecomastia. *Aesthetic Plast Surg*. 2018;42:1222–1230.
18. Dufourmentel LL. Incision areolaire dans la chirurgie du sein. *Bull et mem Soc chir Paris*. 1928;20:9–14.
19. Webster JP. Mastectomy for gynecomastia through a semicircular intra-areolar incision. *Ann Surg*. 1946;124:557–575.
20. Morselli PG. "Pull-through": A new technique for breast reduction in gynecomastia. *Plast Reconstr Surg*. 1996;97:450–454.
21. Waltho D, Hatchell A, Thoma A. Gynecomastia classification for surgical management: A systematic review and novel classification system. *Plast Reconstr Surg*. 2017;139:638e–648e.
22. Shirol SS. Orange peel excision of gland: A novel surgical technique for treatment of gynecomastia. *Ann Plast Surg*. 2017;79:326.
23. Hammond DC, Arnold JF, Simon AM, Capraro PA. Combined use of ultrasonic liposuction with the pull-through technique for the treatment of gynecomastia. *Plast Reconstr Surg*. 2003;112:891–895; discussion 896-897.
24. Li H, Huang Y, Wu X, et al. Effects of hemocoagulase agkistrodon on the coagulation factors and its procoagulant activities. *Drug Des Devel Ther*. 2018;12:1385–1398.
25. Wei JM, Zhu MW, Zhang ZT, et al. A multicenter, phase III trial of hemocoagulase Agkistrodon: hemostasis, coagulation, and safety in patients undergoing abdominal surgery. *Chin Med J*. 2010;123:589–593.