

Risk Factors for Postoperative Hematoma after Chest Wall Contouring for Female-to-Male Transsexuals: A Clinical Study

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Gender dysphoria is a condition in which a discrepancy between biological sex and gender identity causes distress. Many female-to-male transsexuals (FTMTS) are uncomfortable with female breasts. Chest wall contouring surgery is effective for obtaining a male-type chest, reducing mental stress, and increasing sexual satisfaction in such cases. At the Okayama University Hospital Gender Center, we have obtained positive results using an algorithm to determine the most appropriate surgical method for chest wall contouring in FTMTS patients. However, serious complications requiring reoperation, such as hematoma, may still occur. Postoperative hematomas were found in 15 (4.18%) of 358 FTMTS patients who underwent chest contouring surgery at our hospital between 2006 and 2018. Postoperative hematoma was examined retrospectively. The median time to the onset of hematoma was 7 (6-12) h after the initial surgery. The main blood vessels causing bleeding were those in the head-side skin flap region where visual confirmation was difficult and the perforator vessels from the pectoralis major muscle. Intraoperative bleeding and the operation time had a significant impact on the onset of postoperative hematoma. This is the first retrospective study that investigated the blood vessels and other factors contributing to postoperative hematoma development after chest wall contouring.

Key words: female-to-male transsexuals, chest wall contouring, postoperative hematoma

In Japan, gender identity disorders have been diagnosed and treated in accordance with Japan's guidelines since 1996, when various experts, including psychiatrists, urologists, gynecologists, plastic surgeons, and psychotherapists, joined in consultation to establish a standard diagnosis and treatment policy [1]. In addition, since April 2018, chest wall contouring surgery for female-to-male transsexuals (FTMTS) has been partially covered by the national health insurance policy. As a result of these advances, the number of patients wishing to undergo this surgery is expected to increase.

In many FTMTS cases, the natural contouring of the chest wall is different than in cisgender males and can be

a major cause of mental stress. The purpose of male-type chest contouring surgery is to facilitate adaptation of the patient to the desired gender both personally and at a social level, thereby reducing mental stress and improving sexual satisfaction. Moreover, a male-type chest wall cannot be obtained with breast reduction and hormone therapy alone. For these reasons, the vast majority of FTMTS wish to undergo male-type chest wall contouring, including mastectomy and nipple reduction [2, 3-7].

At our institution, an algorithm assists in the selection of chest wall contouring surgeries and treatment policies to ensure that the most appropriate approach is chosen [8, 9]. The key to this contouring surgery is to remove the surplus mammary gland tissue and skin,

which are feminine features, and reduce the nipple and the areola, thereby obtaining a male-type chest wall outline without noticeable scarring.

Postoperative hematomas affect postoperative chest morphology and are serious complications that sometimes require reoperation. However, there have been no reports investigating the risk factors associated with the onset of postoperative hematoma after chest wall contouring. To address this issue, the present retrospective study examines the risk factors for postoperative hematoma development.

Material and Methods

This study was approved by the Ethics Committee of Okayama University Hospital (Study No. 1808-030). The participants were 358 FTMTS who underwent chest wall contouring under general anesthesia at the Okayama University Hospital Gender Center between January 2006 and June 2018. Informed consent was obtained from all study participants.

Since 2009, the policy at the Okayama University Hospital Gender Center has been to classify breasts as Group 1 or Group 2 based on size, and to determine the method of surgical treatment according to an algorithm [12] (Fig. 1). In Group 1, the lowermost point of the areola ring edge was on the cephalic side of the inframammary line. In Group 2, the upper side of the areola was on the pedal side of the inframammary line, and breast ptosis was severe. In Group 1, regardless of

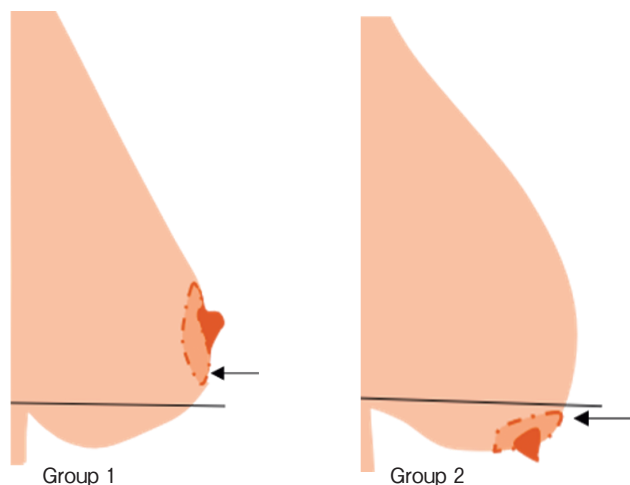


Fig. 1 The algorithm used to determine the appropriate method for chest wall contouring surgery.

the size of the areola, a mastectomy was performed from the areola using a lower-half incision. In Group 2, it was difficult to make a lower-half circumferential incision on the areola. Therefore, after the nipple and areola were collected as a composite graft, the mammary gland and skin were cut. After the chest wall was formed, the nipple and areola were then transplanted onto the chest wall as a composite graft [10-12].

One plastic surgeon performed the mastectomy and nipple and areola reductions on the left side, and another plastic surgeon performed these operations on the right side. In chest contouring surgery, the mammary gland tissue is excised above the fascia of the pectoralis major muscle, leaving the mammary gland under the areola. Adipose tissue surrounding the mammary gland also affects the chest wall contour, so it should also be resected. In addition, to preserve the blood flow to the areola, the preservation of blood vessels in the subcutaneous flap on the cephalic side is crucial [4-7,13]. Using a J-VAC™ Drainage System (Ethicon, Somerville, NJ), a 15 Fr. BLAKE™ Silicon Drain (Ethicon) was set subcutaneously on each side and connected to the J-VAC™ suction reservoir. Postoperatively, the chest wall was pressed and fixed with both a chest band and tape. In all cases, surgery was performed under general anesthesia, and the hospitalization period was 6 days.

Postoperative hematoma is a serious complication that requires emergency surgery [4-7]. Of the 358 cases of chest contouring surgery included in this study, 15 resulted in postoperative hematoma. A patient who developed pain, development of purpura, rapid swelling, and a blockage due to a blood clot in the indwelling drain was diagnosed with a postoperative hematoma (Fig. 2). We statistically examined all 15 cases using the remainder of the chest contouring surgery cases for which data could be obtained from medical records as a control group. The factors examined included age, body mass index (BMI), history of hormone treatment, operation time, intraoperative bleeding volume, smoking history, bleeding site, time to onset of postoperative hematoma, weight of resected mammary gland, and physical examination findings. In addition, we examined the bleeding blocks of the 15 cases and defined the bleeding regions caused by damaged blood vessels anatomically (Fig. 3).

Statistical analyses were performed using BellCurve for Excel version 2.00 (Social Survey Research Informa-

tion, Tokyo). Spearman's correlation coefficient was calculated for the resected mammary gland weight and blood loss. The surgical time and resected mammary gland weight were analyzed using a rank test. Wilcoxon's signed rank test was used to compare the weights of the resected mammary glands on the hematoma and non-hematoma sides of patients who developed hematoma. An unpaired *t*-test, chi-square test, and Mann-Whitney *U* test were performed to determine the significance of age, BMI, mastectomy volume, bleeding volume, initial surgery time, hormonal therapy history, and smoking history. Subsequently, risk factors for postoperative hematoma were assessed with

multiple logistic regression modeling. A *p*-value of 0.05 was considered significant.



Fig. 2 Postoperative hematoma on the right side after chest wall contouring surgery.

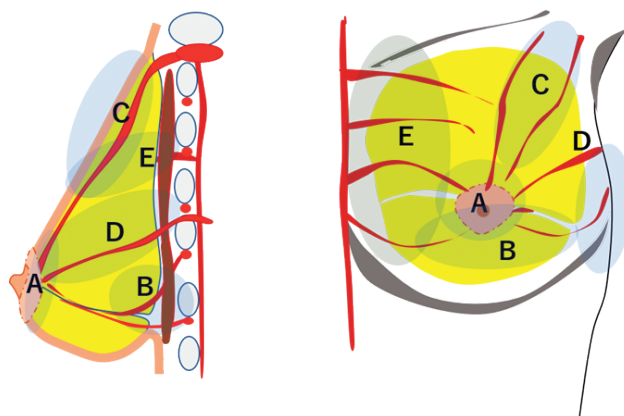


Fig. 3 The main sources of the blood supply to the breast. Region (A) is a bleeding site arising from the residual mammary gland. Region (B) is a site where bleeding was caused by blood vessels arising from the thoraco-acromial and intercostal arteries. Region (C) is a bleeding site caused by the subcutaneous blood vessel of the cephalic side arising from the lateral thoracic artery. Region (D) is a bleeding site caused by intercostal artery perforator vessels. Region (E) is a bleeding site arising from the internal mammary artery perforator vessels.

Table 1 Patient demographics in the female to male group

Characteristics	Patients with hematoma onset (n=15)		Patients without hematoma onset (n=137)		<i>p</i>
	n	%	n	%	
Age, mean (SD), y			27.7 (6.0)		> 0.05
Body mass index, mean (SD) kg/m ²			23.0 (2.8)		> 0.05
Past smoker	4	26	73	53	> 0.05
Medical History					
asthma	3	20	14	10	
Preoperative hormone therapy ^a	14	93	119	86	> 0.05
group1	14	93	134	97	
group2	1	7	3	2	
Initial operation time, median (IQR), minutes			145 (116–182)		> 0.05
Bleeding volume of					
initial surgery, median (IQR), gram			40 (90–20)		< 0.05*
Time to the onset of postoperative hematoma, median (IQR), hours			7.0 (6.0–12)		

^aPreoperative hormonal therapy (cross sex hormone therapy)

This number of the patients is that testosterone therapy had been used more than 3 months.

**P* < 0.05 (Mann-Whitney's *U* test)

Results

The clinical backgrounds of the FTMTS population in the present investigation are shown in Table 1. The intraoperative characteristics of chest contouring surgery are shown in Fig. 4. Operative time correlated with resected mammary gland weight (right side: $r=0.44$, $p<0.005$; left side: $r=0.39$, $p<0.005$) (Fig. 5A). Intraoperative blood loss correlated with operative time ($r=0.40$, $p<0.005$) (Fig. 5B). Hematomas developed in 15 of the 358 cases (4.2%). Of these 15 cases, 14 belonged to Group 1, and 1 belonged to Group 2. The

age of the patients ranged from 19-44 years (mean 27.7 ± 6.0). The period from the initial surgery to the detection of the postoperative hematoma ranged from 2 to 40 h after the surgery (median (IQR), 7.0 (6.0-12) h). In all cases, re-operation was performed within 3 h of detection of the postoperative hematoma. Hematomas were detected in 10 cases within 24 h, in 2 cases within 24 to 48 h, and in 3 cases more than 48 h after surgery. During reoperation, arterial bleeding occurred in 9 cases from the perforator vessels in the pectoralis major muscle and in 10 cases from subcutaneous vessels on the cephalic side flap. In 14 cases, hematomas

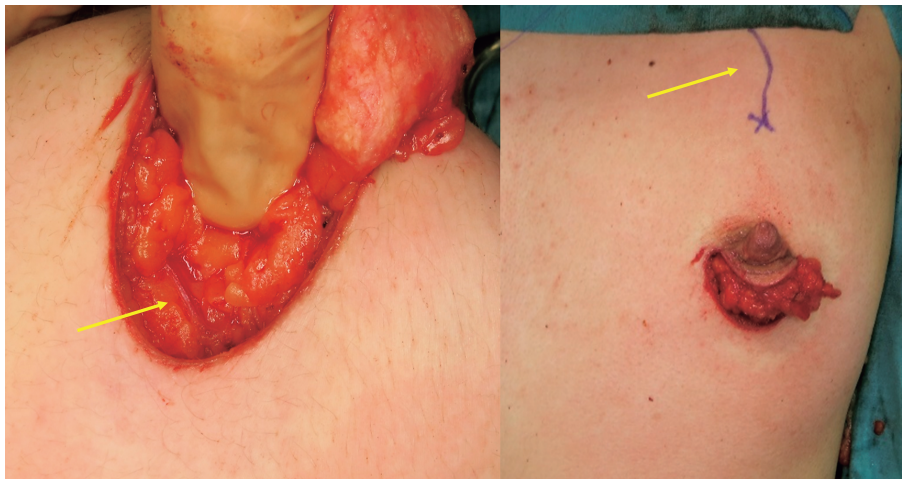


Fig. 4 Delayed dilation of the subcutaneous blood vessel in the cephalic side skin flap.

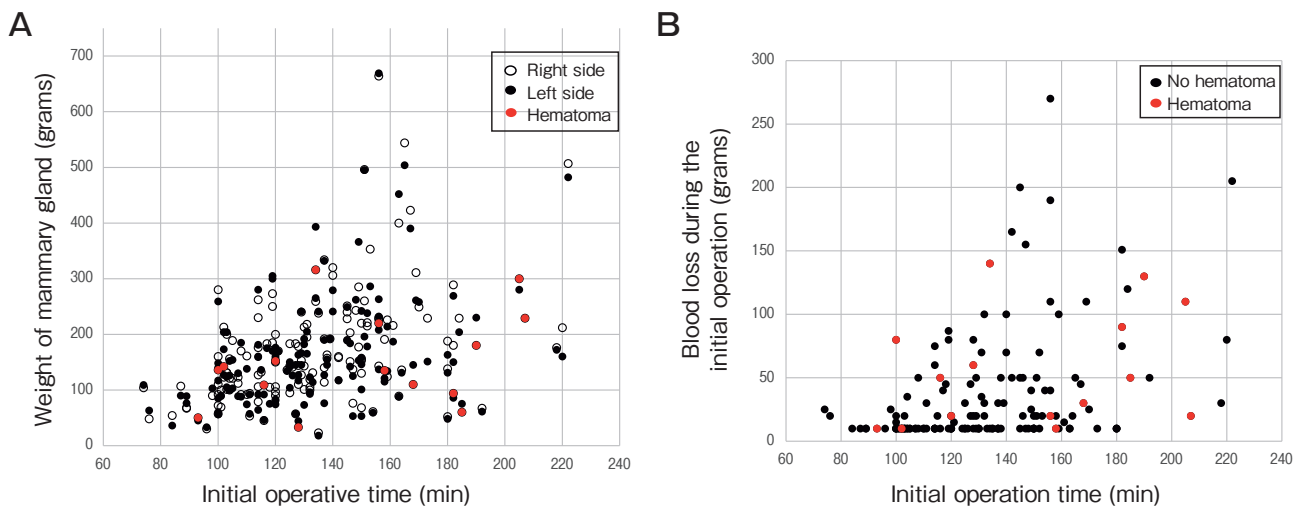


Fig. 5 (A) Scatter plot of the weight of the mammary gland versus the initial operative time (Spearman's correlation: right side, $r=0.44$, $p<0.005$; left side, $r=0.39$, $p<0.005$). (B) Scatter plot of the estimated blood loss versus the initial operative time (Spearman's correlation: $r=0.40$, $p<0.005$).

occurred despite a drain being in place. In 14 cases, a clot was found in the lumen of the drain, which was completely occluded (Fig. 2). In one case, a hematoma occurred in the vicinity of the drain insertion just after drain removal.

The bleeding site was localized to the right side in 10 cases and to the left side in the other 5 cases. Two cases involved bleeding from the residual mammary gland vessels under the areola (A), 9 cases involved bleeding from the perforator vessels over the pectoralis major muscle (B), 10 cases involved bleeding from the subcutaneous vessels on the cephalic flap side (C), 3 cases involved bleeding from the vessels of the lateral chest (D), and 1 case involved bleeding from the vessels in the chest midline (E) (Table 2, Fig. 3). After hematoma removal surgery, there were no cases that required further additional surgery. All patients were discharged on the 6th day after the first operation.

There were no cases in which a hematoma occurred simultaneously on both sides. There was also no significant difference between the left and right weights of the excised mammary gland tissue of patients who had a hematoma (Wilcoxon signed-rank test; $p > 0.05$). There

was a significant difference between patients with and without hematomas in the initial intraoperative bleeding volume, but not in age, BMI, mastectomy volume, initial operation time, hormonal therapy history, or smoking history (Table 1). Logistic regression analysis was performed, including the weight of the excised mammary gland, the initial operation time, and the amount of bleeding at the initial operation as predictor variables. The weight of the resected mammary glands and the initial operation time were significantly associated with the odds of developing a hematoma (Table 3).

Discussion

The weight of the mammary gland tissue correlated with the operation time, and the operation time and intraoperative bleeding volume were also correlated (Fig. 5). In addition, because a significant difference was found in the amount of intraoperative bleeding between patients with a postoperative hematoma and those without one (Table 1), it was initially predicted that the risk of postoperative hematoma would be high in patients with a large mammary gland (Fig. 5). However, in the logistic regression analysis, this prediction was only born out for the left breast, since there was a significant difference in the odds ratios of the weights of the right and left resected mammary glands with respect to the onset of hematoma (Table 3).

There were no predictable risk factors before surgery, and the only risk factors during surgery were an increase of intraoperative hemorrhage in univariate analysis, mastectomy in multivariate analysis, and prolongation of the operation time. Case studies suggest that the larger the breast, the greater the amount of intraoperative hemorrhage, and the higher the risk of developing a hematoma (Table 1). In other words, the amount of intraoperative bleeding and extension of the operation time are risk factors for the development of

Table 2 Postoperative hematoma development region

Region of blood vessels causing hematoma	n = 15	%
Region A	2	13
Region B	9	60
Region C	10	66
Region D	3	20
Region E	1	6

- A: Residual mammary gland vessels under areola
- B: Perforator vessels from pectoralis major muscle
- C: Subcutaneous vessels on the cephalic flap side
- D: Vessels from the lateral chest
- E: Vessels from the chest midline

Table 3 Odds ratios for hematoma onset group

	Odd ratios	95% CI	p value
Weight of right mammary gland	0.96	0.93–0.98	.001*
Weight of left mammary gland	1.04	1.01–1.06	.003*
Initial operation time (minutes)	1.03	1.00–1.05	.015*
Bleeding volume of initial surgery (gram)	1.01	1.00–1.02	.148

CI, confidence interval.

* $p < 0.05$ (Multivariate logistic regression analysis)

postoperative hematoma. However, in our multivariate analysis, the smaller the weight of the right breast resection and the greater the weight of the left breast resection, the higher the risk of developing a hematoma (Table 3). In the case of the right breasts, hematomas may have occurred even in small breasts because it was difficult to obtain an operative field of view from a half circumferential incision of the areola in a small breast. In our study, one surgeon operated on left breasts and another on right breasts, so the differing skills of the “left” and “right” surgeons may have affected the onset of hematoma. Therefore, when the bleeding site was examined, the bleeding site showed a certain tendency, and it is considered that defining the hemostatic site is a method of reducing the incidence of postoperative hematoma.

Regardless of breast size, it is important to carefully confirm the hemostasis of blood vessels in regions (A) to (E) to prevent postoperative hematomas (Fig. 3). We examined the cutting direction of the damaged blood vessels during the removal of mammary gland tissue. In regions (B), (D), and (E), it was necessary to cut the blood vessels vertically when peeling back the mammary gland tissue, which is thought to have caused bleeding from the blood vessel incisions. In regions (A) and (C), the mammary gland tissue was peeled perpendicular to the direction of the blood vessels, and it seemed that the blood vessels were damaged in the longitudinal direction and that hemorrhage occurred at multiple points.

Among all 15 hematoma cases, regions (B) and (C) bled most frequently (Table 2). In region (B), the cut end of the blood vessel was easily buried in the pectoralis major muscle at the time of excision of the mammary gland; therefore, it was difficult to obtain confirmation of hemostasis. In region (C), it was difficult to visually confirm the blood vessels traveling in the cephalic-side subcutaneous tissue, and it seemed that bleeding in this region was caused by the longitudinal damage caused in the subcutaneous vessels when peeling away the mammary gland and the subcutaneous tissue. In some cases, dilation of the subcutaneous vessels of the cephalic side skin flap was observed around 30 min after mammary resection (Fig. 4). Because of the postoperative changes in hemodynamics, even if bleeding did not occur immediately after resection, the remaining blood vessels expanded over time, bleeding from the vascular injury increased, and a hematoma developed.

Hematomas usually develop approximately 7 h after surgery, even if bleeding from drainage is not observed immediately after surgery. It was confirmed during reoperation that the drain was clogged in 14 cases due to hematomas. As the bleeding volume rapidly increased in a brief time period, blood clots formed in the lumen, and the hematoma increased in size.

The limitations of this study include its retrospective nature and single-center design, as there were only 15 cases that experienced postoperative hematomas.

In conclusion, there were no predictable risk factors before surgery. Increased intraoperative bleeding and prolonged surgery are risk factors for the development of postoperative hematoma. The operative skill of the surgeon also affects the onset of hematoma, and it is believed that achieving reliable hemostasis at the hemorrhage site intraoperatively is a method of reducing the incidence of post-operative hematoma.

The bleeding sites that should be closely observed during surgery include the subcutaneous blood vessel on the cephalic side, which is a blind spot, and the perforator vessels emerging from muscles. A hematoma can develop within 24 h after surgery, and pain, swelling, purpura, and drainage volume should be carefully monitored during this time.

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