



## The effect of high volume adrenalin solution infiltration on blood loss in reduction mammoplasty

High volume infiltration in mammoplasty

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### Abstract

**Aim:** One of the important complications during and after the reduction mammoplasty operation is blood loss. The most implemented method to decrease the amount of bleeding is adrenaline infiltration, but adrenalin is mostly infiltrated with the fluid in the volume less than 250cc in the clinic. It is expected that adrenaline will accumulate more in the tissue and thus, exhibit more bleeding-reducing effect by increasing the fluid volume used in the infiltration. In this study, it is aimed to indicate the effect of the infiltration of adrenaline with the high volume fluid, on the amount of blood loss occurring due to the reduction mammoplasty operation. **Material and Method:** Patients who had undergone bilateral reduction mammoplasty between July 2013 and August 2017 were retrospectively examined. Patients not subjected to infiltration were described as Group 1, patients infiltrated with adrenalin 100cc were described as Group 2, and patients infiltrated with adrenalin 500cc were described as Group 3. **Results:** The average decrease in the hemoglobin level (bleeding) after the operation was calculated to be  $3.4 \pm 0.97$  in Group 1,  $2.8 \pm 0.83$  in Group 2,  $1.0 \pm 0.46$  in Group 3 and the average amount of bleeding in Group 2 and Group 3 in comparison with Group 1 and the average amount of bleeding in Group 3 in comparison with Group 2 were statistically significantly lower ( $p < 0.001$ ). **Discussion:** The infiltration of adrenaline in the same concentration with a fluid of a higher volume decreases blood loss after the reduction mammoplasty operation.

### Keywords

Reduction Mammoplasty; Blood Loss; Infiltration

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## Introduction

The reduction mammoplasty operation is one of the procedures frequently performed in plastic surgery [1,2]. There are many techniques described in relation to reduction mammoplasty surgery; however, the common characteristic of these techniques are considerable blood loss during and after the operation [3]. This blood loss causes exhaustion, delayed postoperative recovery, a prolonged stay at the hospital, may require blood transfusion and all of these conditions results in patient morbidity and increased treatment costs [4]. The most implemented method to decrease the amount of bleeding after reduction mammoplasty is adrenaline infiltration. There are many prospective and retrospective studies in which it has been indicated that the infiltration of adrenaline and lidocaine mixture into the breast tissue applied before the surgery decreases the need for blood transfusion by reducing the blood loss, and this makes the surgery easier and faster by providing an opportunity for a blood-free operation and increases patient comfort by ensuring intraoperative and early postoperative analgesia [2,5]. Although adrenaline infiltration has these positive effects on the reduction mammoplasty operation, adrenaline in the concentration less than 1:100000 is mostly infiltrated with the fluid in the volume less than 250cc in the clinic due to side effects such as circulatory impairment in the pedicle and nipple, this results in rebound bleeding and hematoma in the postoperative period, leading to a delay in wound healing, increasing the risk of infections, and causing necrosis in the breast skin [2,5,6].

The amount of adrenaline accumulated in the breast tissue with infiltration is in direct proportion to the fluid volume infiltrated with adrenaline concentration in the infiltrated solution. It is expected that adrenaline will accumulate more in the tissue and thus, exhibit more bleeding-reducing effect without causing any change in the concentration by increasing the fluid volume used in the infiltration.

In this study, it is aimed to indicate the effect of the infiltration of adrenaline in 1:1000 000 concentration with the high volume fluid on the amount of blood loss occurring due to the reduction mammoplasty operation and side effect level.

## Material and Method

In this study, patients who had undergone bilateral reduction mammoplasty in our clinic between July 2013 and August 2017 were retrospectively examined. The ages and preoperative hemoglobin (Hb) and hematocrit (Hct) values of all patients, weight of the breast tissue removed during the surgery, the fact whether infiltration was performed or not, and if performed, adrenaline concentration used, Hb and Hct levels 24 hours after the surgery, the number of blood transfusion performed, the duration of hospitalization and complications occurring in the patients were recorded. Patients with a bleeding problem and receiving anticoagulant and antithrombotic therapy were not included in the study.

At our clinic, the reduction mammoplasty operations were performed without infiltration between July 2013 and September 2014. Due to the significant blood loss and need for blood transfusion in these patients, a solution containing adrenaline at the rate of 1:1000000 has begun to be infiltrated as being 100cc in volume into each breast in the reduction mammoplas-

ty operations since September 2014. Because of blood loss and the ongoing need for blood transfusion, a solution containing adrenaline at the rate of 1:1000000 has begun to be infiltrated as being 500cc in volume into each breast since August 2015. Patients not subjected to infiltration were described as Group 1, patients infiltrated with 100cc were described as Group 2, and patients infiltrated with 500cc were described as Group 3. All procedures were performed under general anesthesia. All patients underwent single dose prophylactic antibiotic treatment 1 hour before the anesthesia. The patients were laid on the operating table in the supine position. The body was lifted up by 30 degrees, and arms were positioned in abduction. Infiltration was performed in the breast gland and retroglandular region by starting on incision lines with a 50cc injector and 21 gauge needle following putting the chlorhexidine antiseptic solution on the skin. Infiltration was not performed into the pedicle. The surgery was initiated 10 minutes after infiltration. The reduction mammoplasty operation was performed by the same surgeon in all patients in accordance with the vertical mammoplasty technique with the superior and superomedial pedicle and by using electrocautery. The complications were described as follows: hematoma; hemostasis requiring to be drained with a needle or to be surgically explored, wound infection; erythema, strain, cellulite appearance and purulent discharge from the wound, wound healing impairment; partial or complex suture separation from the wound site and secondary healing lasting for longer than 3 weeks, flap necrosis; necrosis on the breast skin flap, nipple necrosis; partial or total necrosis on the nipple areola complex.

## Results

The average age of the patients was 38.9±8.4 years in Group 1 (not infiltrated), 37.7±8.6 years in Group 2 (infiltrated with 100cc) and 37.0±9.2 years in Group 3 (infiltrated with 500cc) and there was no statistical difference between the groups (Table 1).

Table 1. Demographical and clinical characteristics

	Group 1 (n=78)	Group 2 (n=71)	Group 3 (n=94)	p-value
Age (years)	38.9±8.4	37.7±8.6	37.0±9.2	0.760†
Resection of tissue	1400 (700-3500)	1500 (700-2800)	1400 (700-2900)	0.689‡
Blood transfusion	58 (74.4%) <sup>ab</sup>	38 (53.5%) <sup>ac</sup>	3 (3.2%) <sup>bc</sup>	<0.001¶
Unit of transfused blood	1 (0-3) <sup>ab</sup>	1 (0-2) <sup>ac</sup>	0 (0-1) <sup>bc</sup>	<0.001‡
Hospitalization (days)	3 (2-6) <sup>b</sup>	3 (2-6) <sup>c</sup>	2 (1-3) <sup>bc</sup>	<0.001‡

† One-Way ANOVA, ‡ Kruskal Wallis test, ¶ Pearson's Chi-square test, a: Group 1 vs Group 2 (p<0.05), b: Group 1 vs Group 3 (p<0.001), c: Group 2 vs Group 3 (p<0.001).

The average preoperative hemoglobin levels were calculated to be 12.1±0.94 g/dl in Group 1 (not infiltrated), 11.7±0.73 g/dl in Group 2 (infiltrated with 100cc) and 11.4±0.97 g/dl in Group 3 (infiltrated with 500cc), and there was no statistically significant difference between the groups (p=0.436) (Figure 1) (Table 2). The average postoperative hemoglobin levels were calculated to be 8.7±1.08 g/dl in Group 1, 9.0±1.01 g/dl in

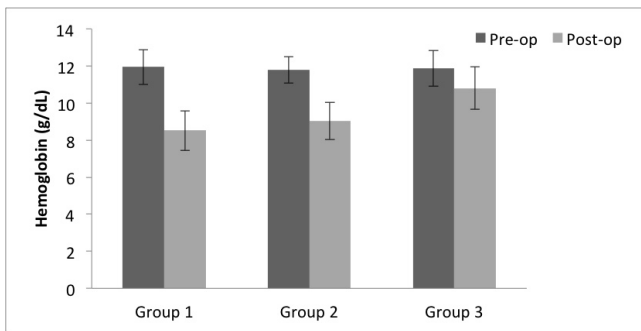


Figure 1. Pre- and post-op hemoglobin measurements regarding for study groups

Group 2 and 10.4±1.14 g/dl in Group 3. When the postoperative hemoglobin levels among the groups were compared, there was a statistically significant difference between the groups (p<0.001) (Table 2). When compared to the preoperative period, an average decrease in the hemoglobin level (bleeding) during the postoperative period was calculated to be 3.4±0.97 g/dl in Group 1, 2.7±0.83 g/dl in Group 2 and -1.0±0.46 g/dl in Group 3 and when these differences were compared among the groups, there was a statistically significant difference between the groups (p<0.001) (Table 2).

Table 2. Pre- and post-op hemoglobin measurements regarding for study groups

	Pre-op	Post-op	p-value †	Difference
Group 1 (n=78)	12.1±0.94	8.7±1.08 <sup>ab</sup>	<0.001	-3.4±0.97 <sup>ab</sup>
Group 2 (n=71)	11.7±0.73	9.0±1.01 <sup>ac</sup>	<0.001	-2.7±0.83 <sup>ac</sup>
Group 3 (n=94)	11.4±0.97	10.4±1.14 <sup>bc</sup>	<0.001	-1.0±0.46 <sup>bc</sup>
p-value ‡	0.436	<0.001		<0.001

Data were shown as mean ± standard deviation, † The comparisons between pre- and post-op within each group, Paired t-test, ‡ The comparisons among groups, One-Way ANOVA, a: Group 1 vs. Group 2 (p<0.01), b: Group 1 vs. Group 3 (p<0.001), c: Group 2 vs. Group 3 (p<0.001).

When the blood transfusion rates among the groups were examined, it was determined that 1 or more units of blood transfusion was performed in 74.4% of the patients in Group 1 (not infiltrated), in 53.5% of the patients in Group 2 (infiltrated with 100cc) and in 3.2% of the patients in Group 3 (infiltrated with 500cc) and there was a statistically significant difference between the groups (p<0.001) (Table 2).

The median amount of the tissue removed from the patients was calculated to be 1400gr (700-3500gr) in Group 1 (not infiltrated), 1500gr (700-2800gr) in Group 2 (infiltrated with 100cc) and 1400gr (700-2900gr) in Group 3 (infiltrated with 500cc), and it was determined that there was no statistical difference among the groups (p: 0.689) (Table 1). It was observed that as the amount of the tissue removed increased in all groups, the hemoglobin level during the postoperative period statistically significantly decreased more when compared to the preoperative period, the amount of the transfused blood statistically significantly increased and the duration of hospitalization statistically significantly increased (Table 3).

Table 3. The coefficients of correlation and significance levels between resection of tissue and decrease in hemoglobin, blood transfusion, duration of hospitalization

	n	r	p-value †
Group 1			
Decrease in hemoglobin	78	-0.879	<0.001
Blood transfusion	78	0.716	<0.001
Duration of hospitalization	78	0.717	<0.001
Group 2			
Decrease in hemoglobin	71	-0.896	<0.001
Blood transfusion	71	0.722	<0.001
Duration of hospitalization	71	0.735	<0.001
Group 3			
Decrease in hemoglobin	94	-0.822	<0.001
Blood transfusion	94	0.287	0.005
Duration of hospitalization	94	0.784	<0.001

r: Coefficient of correlation, † Spearman's rank correlation test.

When the complications occurring in the patients in the present study were examined, it was observed that there was complication at the rate of 4.7% in all patients, and there was complication at the rate of 5.8% in the Group 1 (no infiltration), at the rate of 4.2% in the Group 2 (infiltrated with 100cc) and at the rate of 4.2% in the Group 3 (infiltrated with 500cc) and when the groups were compared there was no statistically significant difference determined (p>0.05) (Table 4).

Table 4. The rates of complication

	Group 1 (n=78)	Group 2 (n=71)	Group 3 (n=94)	p-value
Hematoma	-	-	-	-
Infection	1 (1.3%)	-	-	0.320†
Wound dehiscence	7 (9.0%)	6 (8.5%)	8 (8.5%)	0.992‡
Skin necrosis	-	-	-	-
NAK necrosis	1 (1.3%)	-	-	0.320†

Data were shown as number of cases and percentages, † Likelihood ratio test, ‡ Pearson's Chi-square test.

When the average duration of hospitalization of the patients was examined, the average duration of hospitalization of the patients was determined to be 3 (2-6) days in Group 1 (no infiltration), 3 days (2-6) in Group 2 (infiltrated with 100cc) and 2 (1-3) days in Group 3 (infiltrated with 500cc). When the duration of hospitalization were compared among the groups, it was identified that the hospitalization duration of the patients in Group 3 was statistically significantly lower in comparison with Group 1 and Group 2 (p<0.001 and p<0.001) and there was no statistically significant difference between Group 1 and Group 2 (p=0.528). (Table 1)

### Discussion

A decrease in blood loss occurring in relation to the reduction mammoplasty operation is undoubtedly significant since it ensures the early postoperative recovery of patients, protects patients from the complications of blood transfusion and anemia treatment and decreases the risk of skin and pedicle necrosis occurring due to hypotension [3]. Bretteville-Jensen G. in 1974

demonstrated for the first time that bleeding decreases with the infiltration of solutions containing adrenaline in the reduction mammoplasty and this condition has been supported by further studies [6]. Due to side effects like skin necrosis, decreasing flap viability and increasing the risk of wound site infection, infiltration solutions containing adrenaline at the concentration rates varying between 1:100,000 and 1:1,000,000 are used in reduction mammoplasty, and these liquids are infiltrated in the volume less than 250cc [2,5-7].

Adrenaline causes vasoconstriction in blood vessels, has a bleeding-reducing effect and this effect increases as the amount of adrenaline increases. Thus, it is expected that the amount of bleeding in the breast will decrease as the amount of adrenaline in the breast tissue increases. The amount of adrenaline accumulated in the breast tissue after infiltration is in direct proportion to the concentration of the adrenaline in the infiltration fluid and the amount of the fluid used in infiltration. It is required to increase either the concentration or the amount of the fluid used to increase the amount of adrenaline in the breast tissue. Since it was indicated in many studies that an increase in concentration also increases the prevalence of side effects, the only way to increase the amount of adrenaline in the medium without increasing concentration is to increase the volume of solution used in infiltration [2,5,6].

The first study with the theory that the adrenaline level in the tissue can be increased by increasing the infiltrated fluid volume was conducted by Beveridge and Bell [8]. In their study, the amounts of bleeding in 23 patients not subjected to infiltration, in 20 patients infiltrated with 250cc of the solution in 1:1,000,000 adrenaline concentration, and in 21 patients infiltrated with 10 mg/kg per kilogram of the solution in 1:1,000,000 adrenaline concentration (on average 350cc per person) were compared, and it was observed that as the amount of infiltration increased, the amount of bleeding decreased. However, in another study conducted on 100 patients by Kaplan et al. [2] when the patients who were not infiltrated and infiltrated with 500-1,000cc of the solution containing 1:1,000,000 adrenaline were compared, it was identified that the hemoglobin value decreased on average by 2.4 units in the group subjected to infiltration and on average by 1.9 units in the group not subjected to infiltration, and there was no statistically significant difference among them in terms of the amount of bleeding. In this study, the hemoglobin value decreased on average by  $3.4 \pm 0.97$  g/dl in the Group 1 (no infiltration), by  $2.8 \pm 0.8$  g/dl in the Group 2 (infiltrated with 100cc) and by  $1.0 \pm 0.46$  g/dl in the Group 3 (infiltrated with 500cc), and the difference among them was statistically significant. The amount of a decrease in hemoglobin in the group that was not infiltrated and in the group infiltrated with 100cc in this study is consistent with the other studies [7]. In this study, the blood loss considerably decreased in the group infiltrated with 500cc in accordance with the result of the study of Beveridge and Bell and the need for blood transfusion in patients during the postoperative period decreased almost by 30 times together with an increase in the infiltration volume, and it was observed that patients' recovery during the postoperative period was considerably better and thus, the hospitalization durations of the patients decreased [8].

The reason for the difference between the results of this study

and the study of Kaplan et al. can be explained by the way of infiltration [2]. While infiltration was performed into the retro-glandular tissue in this study and in the study of Beveridge and Bell [8], it was not performed in the study of Kaplan et al. [2]. Infiltration into the retroglandular region ensures vasoconstriction in intercostal and lateral perforator vessels extending to the breast tissue, and this difference among the studies indicates that vasoconstriction in intercostal and lateral perforator vessels causes a significant decrease in bleeding occurring in the reduction mammoplasty operation [4].

When the complications occurring in the patients in the present study were examined, it was observed that there were complications at the rate of 4.7% in all patients, and there was no statistical difference among the groups in terms of the prevalence of complications. In previous studies in the literature in which infiltration was performed, Steven et al. [9] reported complications at the rate of 14%, Kaplan et al. [2] reported complications at the rate of 4%, DeBono et al. [5] reported complications at the rate of 12.5%, Mandrekas et al. [10] reported complications at the rate of 5.7% in their studies. These results indicate that increasing the adrenaline level in the tissue by increasing the amount of the fluid infiltrated does not increase the rates of complications.

A decrease in the blood loss occurring with high volume fluid infiltration in reduction mammoplasty is ensured not only with an increase in vasoconstriction occurring in relation to an increase in the amount of adrenaline but also with high volume fluid pressure on the local blood vessels in the tissue [11]. However, there may be some disadvantages such as that the fluid in the tissue makes it difficult for electrocautery to work in resections performed especially with electrocautery and that the evaporation of the fluid in the tissue, secondarily to the temperature increase occurring with electrocautery, causes the excessive surgical smoke. In particular, surgical smoke can be very disturbing, and smoke removal is required. However, these disadvantages have not caused any prolongation in any of our patients during the surgery.

### Conclusion

The infiltration of adrenaline in the same concentration with a fluid of a higher volume decreases the amount of bleeding, the need for postoperative blood transfusion and the duration of hospitalization and thus decreases patient morbidity and treatment costs. We recommend administering fluid in high doses while performing infiltration, especially in big breasts.

### Scientific Responsibility Statement

*The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.*

### Animal and human rights statement

*All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No ani-*

mal or human studies were carried out by the authors for this article.

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#### **Conflict of interest**

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