



Management tactics at high risk of ischaemic complications of the nipple-areolar complex during secondary mammoplasty

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Abstract. Plastic surgery in Kyrgyzstan has undergone significant growth in recent decades. In conditions of insufficient postoperative follow-up, the country's medical institutions are facing an increase in complaints about complications related to the prolonged stay of outdated implants in the body. As the service life of the implants expired (on average 10-15 years), cases of ageing, capsular contracture, deformation, rippling, and intracapsular and extracapsular ruptures began to be recorded more often. The increase in the number of secondary mammoplasty caused by ageing of implants and complications increases the risk of ischaemia of the

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nipple-areolar complex. Existing risk assessment scales do not fully consider the specific factors of secondary interventions. In this regard, the purpose of this study was to demonstrate the effectiveness of the modified preoperative scale for assessing the risk of ischaemia of the nipple-areolar complex in secondary breast surgery using the example of a clinical case of a high-risk patient and to evaluate the effectiveness of multifactorial therapeutic tactics. This tactic can help minimise the severity of ischaemic complications in high-risk patients after further validation of the scale in an expanded sample

Keywords: secondary mammoplasty; ischaemia of the nipple-areolar complex; nipple necrosis; breast implants; implant rupture; microcirculation; risk assessment scale

Introduction

Breast plastic surgery, including augmentation and subsequent revision interventions, is showing steady growth both globally and in the Kyrgyz Republic. According to ASPS (American Society of Plastic Surgeons) data for 2023, breast implant removal is one of the most frequently performed procedures, the number of which continues to increase [1]. Secondary mammoplasty, often performed due to ageing of implants, capsular contracture, or ruptures, is associated with a higher risk of complications (15-30%) compared with primary surgery (10-15%) [2]. One of the most serious complications is ischaemia of the NAC (nipple-areolar complex), the frequency of which can reach 6% with complex interventions, especially in patients with a burdened medical history and risk factors [2,3]. Patients with prolonged absence of dynamic follow-up, in particular routine US (ultrasound examinations), are also the most vulnerable, which can lead to late diagnosis of complications such as implant rupture [4]. Preoperative risk assessment in such cases is an integral part of safe surgery planning, which increases patient compliance and improves treatment outcomes [5].

The vulnerability of the NAC blood supply is conditioned by its nutrition from several sources (internal thoracic, lateral thoracic, thoracoacromial and intercostal arteries) with high individual anatomical variability in their contribution and location, and the presence of a superficial subcutaneous vascular network (Haller's venous plexus), which increases the risk of intraoperative damage during breast manipulation [6]. Contemporary literature describes risk assessment scales such as the Colwell *et al.* scale, intraoperative assessment of mastectomy flap ischaemia risk by J.D. Frey *et al.*, and the nipple-areolar complex (NAC) ischaemia and necrosis grading system by H.W. Lai *et al.*, and the classification of NAC ischaemia by Ahn *et al.* These scales often focus on individual parameters (preoperative factors, intraoperative perfusion, degree of necrosis) and do not fully consider the specifics of secondary aesthetic surgery, including detailed surgical history, subcutaneous adipose tissue (SAT) condition, and preoperative doppler ultrasonography (DUS) data on microcirculation [3,7-10].

Thus, there is a significant gap in the preoperative assessment of the risk of NAC ischaemia in patients who have undergone previous breast surgery.

Development of a tool that integrates these specific factors is an urgent task to improve the safety and predictability of secondary mammoplasty results. The purpose was to analyse the typical clinical situation of a patient with a high risk of ischaemic complications of the NAC complex during secondary mammoplasty in order to demonstrate the effectiveness of the developed preoperative risk assessment scale and complex multifactorial management tactics to minimise ischaemic complications.

Materials and Methods

A 60-year-old patient complained of swelling of the left breast and asymmetry of the mammary glands. The medical history showed that 10 years ago, primary augmentation mammoplasty was performed using a periareolar approach with round implants, the volume of which the patient did not remember. Breast control ultrasounds have not been performed in the last 3 years. Complaints of oedema and asymmetry appeared a week before the treatment. The patient suffered from tobacco addiction (has been smoking for more than 10 years), was underweight (BMI 17.8) (body mass index), and had minimally pronounced SAT in the mammary glands. She also had a history of varicose veins disease of the lower extremities for more than 15 years, for which she was registered with a vascular surgeon and received constant treatment. A written informed voluntary consent was received from the patient to publish the clinical case, clinical data, and photographic materials. All personal data was anonymised in accordance with the principles of bioethics.

On local examination of the mammary glands, pronounced asymmetry was noted, due to an increase in the left breast, palpation revealed discomfort without pronounced soreness. There was rippling in the medial lower quadrant of the right breast. The inframammary fold on the left was located 1.5 cm lower. The NAC were slightly ptosed, 1 cm lower on the left. Along the edge of the areolae, there were round-shaped post-operative normotrophic scars, slightly fused with the surrounding tissues (more on the left), rising above the skin level, the colour of the areolae. The rate of capillary filling in the right NAC is preserved, on the left it is slowed down, especially along the periphery of the areola. The pinprick test (capillary bleeding test using an injection

needle) on the right was normal, on the left it was slowed down along the periphery of the areola. There was a slight decrease in sensitivity in the scar area.

Results

An ultrasound scan of the mammary glands was performed on the patient, which revealed signs of extracapsular rupture of the implant on the left with infiltration of its contents into surrounding tissues and soft tissues under the NAC. The DUS showed a significant difference in the characteristics of blood flow between the NAC of both mammary glands: a rare signal in the area of the left areola, indicating reduced vascularisation, a decrease in the number of perforating vessels detected. The resistance index on the left was 0.78, which indicated increased vascular resistance and

decreased blood supply [10]. Laboratory tests were also performed to prepare this patient for surgery, such as: complete blood count, urinalysis, haemostasis profile, blood chemistry panel, chest X-ray, electrocardiogram, and history of infectious diseases (HIV, hepatitis B, C, syphilis). The results of these analyses were within the age range.

Based on preoperative data, the risk of ischaemic complications of the NAC was assessed according to the scale developed by the authors of this study (Table 1). The scale considers the following criteria: the size of the implant (when it is replaced, the volume of the newly installed implant is calculated), the state of the SAT in the areola area, systemic risk factors, surgical history of the breast, the planned operation, blood supply to the nipple according to DUS.

Table 1. A scale for preoperative assessment of the risk of ischaemic complications of NAC in secondary reconstructive and aesthetic breast surgery

No.	Criterion	Points
1	Implant size (intended for installation or previously installed)	< 200 ml – 0 points; 200-300 ml – 1 point; > 400 ml – 2 points
2	State of subcutaneous tissue in the areola area (according to ultrasound/CT or palpation)	Preserved – 0 points; Depleted or significantly reduced – 1 point; Missing – 2 points
3	Systemic risk factors (indicated in the notes)	Absent – 0 points; 1 factor – 1 point; 2 or more factors – 2 points
4	Surgical history of the breast	No operations – 0 points; 1 operation without mastopexy and without periareolar access – 1 point; 1 operation with mastopexy or periareolar access – 2 points; 2 or more operations, including capsulotomy/implant removal – 3 points
5	Planned operation	Simple implant removal – 0 points; Mastopexy, capsulotomy – 1 point; Combination of several interventions – 2 points
6	Blood supply to the nipple (according to DUS)	Resistance index <0.65 – 0 points; 0.65–0.75 – 1 point; > 0.75 – 2 points

Source: created by the authors

For this patient, the scores were distributed as follows: implant size (greater than 200 and less than 300 ml): 1 point, subcutaneous tissue condition: depleted/reduced: 1 point, systemic risk factors (smoking, varicose veins disease): 2 points, surgical history (1 operation with periareolar access): 2 points, planned surgery

(implant removal+capsulectomy+ implant replacement + mastopexy): 2 points, blood supply to the nipple according to DUS (Resistance index > 0.75): 2 points, the sum of the points was 1 + 1 + 2 + 2 + 2 + 2 = 10 points. According to the author’s scale, a score of 7 or more points corresponds to a high risk of NAC ischaemia (Table 2).

Table 2. Assessment of scores on a scale for preoperative assessment of the risk of ischaemic complications of NAC in secondary reconstructive and aesthetic breast surgeries

Total points	Risk of NAC ischaemia	Recommended actions
0–3	Low	Standard postoperative tactics
4–6	Average	Enhanced monitoring and drug prevention
7 or more	High	Personalised tactics, including microcirculatory therapy and postponement of loading techniques (compression, etc.)

Note: Systemic factors: diabetes mellitus, a history of smoking <5 years, obesity, hypertension, thrombophilia, varicose veins disease, atherosclerosis, increased blood clotting, uncontrolled intake of anticoagulants, GCS therapy, antitumour therapy, and other factors contributing to an increased risk of ischaemia of skin and vascular flaps. If there are doubts about the adequacy of the NAC blood supply, Doppler examination and photofixation of the area at rest, and a capillary bleeding test are recommended. The scale is not used in patients after total mastectomy and free NAC transplantation

Source: created by the authors

The patient's risk of venous thromboembolic complications (VTE) on the Caprini scale was 8 points (very high). After consultation with a vascular surgeon, it was decided to mobilise early, wear compression stockings, and prescribe enoxaparin. Enoxaparin was prescribed not only for the prevention of VTE, but also to improve microcirculation in the NAC: 40 mg subcutaneously 12 hours before surgery and 40 mg subcutaneously once a day for 7 days after surgery [1,11]. Considering the high risk of NAC ischaemia and the presence of extracapsular rupture of the implant with infiltration, an individualised surgical tactic was chosen. The operation

included: removal of the damaged implant and total capsulotomy with limited use of electrocoagulation in the area of invasion of the contents into the NAC region, formation of a two-plane pocket for new implants, reconstruction of the inframammary fold, and anchor mastopexy with careful isolation and preservation of the upper medial pedicle with symmetrisation of the position and size of the NAC. Upon completion of the operation, the pinprick test on the left side turned out to be negative, which confirmed the presence of arterial stasis (pronounced ischaemia) and served as the basis for the immediate initiation of targeted therapy (Table 3).

Table 3. Dynamics of clinical manifestations of NAC ischaemia in the postoperative period

Observation period	Clinical signs	Interpretation	Comments / Influencing factors
Early postoperative period	NAC is cold, pale, negative pinprick test	Significant ischemia with extremely slow or absent arterial flow	High risk. A negative Pinprick test confirms a perfusion disorder.
Day 1 after surgery	NAC is cold, pale, weakly positive pinprick test (slowed down)	Significant ischaemia with extremely slow arterial flow	High risk. Pinprick test confirms perfusion disorder.
Day 3	NAC is bluish purple, capillary reaction is present, venous stasis, positive pinprick test	Signs of a more active arterial inflow with venous congestion	Hirudotherapy and HBO therapy have been prescribed to eliminate stasis.
Day 7	Improvement of colour to light pink, the appearance of a haemorrhagic area on the lateral part of the nipple	Formation of the necrosis zone	Significant improvement of microcirculation during therapy.
Day 14	Marginal necrosis of the lateral lower part of the nipple (size <1 cm), without signs of infection	Limited necrosis – the prognosis is relatively favourable	Lack of compression and slow healing of necrosis under the crust
Month 1	NAC is warm, the capillary action is normal, the crust has disappeared, the wound has healed	Forecast is favourable	Dynamic observation
Month 3	NAC is warm, capillary play is normal, the scar is in the process of maturation	Forecast is favourable	Dynamic observation

Source: created by the authors

In the early postoperative period, complex multifactorial therapeutic tactics aimed at improving microcirculation and preventing necrosis of the NAC was applied. Intradermal small-pulse injection of 1 ml of pentoxifylline solution (to improve microcirculation by increasing the deformability of red blood cells and reducing blood viscosity) into and around the NAC twice a day for 3 days. Intravenous administration of 5 ml of pentoxifylline per 250 ml of saline solution twice a day for 5 days under arterial pressure control [12]. Starting from the Day 4 after the appearance of signs of venous stasis, hirudotherapy was performed to improve venous outflow and relieve venous stasis for up to Day 8. Hirudotherapy was performed despite the high risk of infection, as no alternative mechanical method for resolving venous stasis in such a small area was found. For preventive antibacterial therapy, Ceftriaxone 1 mg intravenously twice a day

for 5 days was prescribed, along with Metrid 100 ml intravenously twice a day for up to 10 days after the operation. In addition, the postoperative area was treated more thoroughly during dressing changes. Hirudin therapy helps normalise microcirculation and improve tissue regeneration [13]. Hyperbaric oxygenation (HBO) was also prescribed once a day from Day 4 to saturate tissues with oxygen and accelerate healing [14]. The patient was strongly advised to completely stop using tobacco in the postoperative period. Compression underwear was used for preventive purposes, but it was not fastened at the NAC level in order to avoid excessive pressure, its main function was to fix compression garment and provide comfortable support for the breasts [15].

Follow-up was carried out in dynamics with an assessment of clinical signs, a pinprick test, and photo documentation with an assessment of local status

(Table 3). Quality of life was assessed using the Breast-Q questionnaire (validated questionnaire for prospective evaluation of the results of reduction mammoplasty)

in the preoperative period and 1 week, 1 month, and 3 months after surgery. A license was previously obtained for the use of the questionnaire [16] (Table 4).

Table 4. Dynamics of quality of life indicators according to the Breast-Q questionnaire

Breast-Q module	Before the surgery	1 week	1 month	3 months	P-value
Psychosocial well-being	45	50	65	78	<0.05
Breast satisfaction	38	42	58	71	<0.01
Physical condition	52	48	60	68	>0.05
Sexual satisfaction	40	41	55	67	<0.05

Note: p-value – significance level (p < 0.05 is significant, p-value ≥ 0.05 → not significant)

Source: created by the authors

The results were evaluated daily during bandaging. Dynamic observation revealed reversible ischaemic damage to the NAC, followed by marginal necrosis ≤1 cm, which developed against the background of restored arterial inflow and elimination of venous stasis. Complex therapy (hirudotherapy, HBO) and the absence of compression contributed to the regression of ischaemic manifestations and a favourable outcome. The Breast-Q questionnaire showed a significant improvement in indicators of psychosocial well-being, breast satisfaction, and sexual

satisfaction within 3 months after surgery (p < 0.05). The physical condition also improved, but the changes did not reach statistical significance (p > 0.05) (Table 4).

A patient with a high preoperative risk of NAC ischaemia (10 points) developed marginal necrosis of the NAC (≤1 cm) after secondary augmentation mammoplasty with anchored mastopexy, which successfully healed under the crust with the formation of a small scar. Despite the predicted high risk, complete necrosis of the NAC was avoided (Table 5).

Table 5. Comparative characteristics of NAC risk assessment tools

Name of the scale / method	Estimated parameters	Application context	Assessment stage
Colwell <i>et al.</i> scale	BMI, breast volume and ptosis, smoking, radiation therapy, access type	Breast surgery planning, mainly for NSM (Nipple saving mastectomy)	Preoperative
Intraoperative flap ischaemia risk assessment tool	8 binary parameters: flap thickness, perfusion, use of colourants and coagulation	Immediate reconstruction after mastectomy	Intraoperative
NAC ischaemia grading system [11]	Grades 0-3: from normal blood supply to severe necrosis	Clinical monitoring after interventions with risk of NAC ischaemia	Postoperative
Classification of NAC ischaemia (Ahn <i>et al.</i>)	Grades 0-5 in the area of ischaemia/necrosis	Scientific research, analysis of risk factors, including physique	Postoperative
fluorescent angiography with indocyanine green	Visual patterns (V1-V3), quantitative indicators of fluorescence	Real-time assessment of perfusion during various breast interventions	Intraoperative

Source: created by the authors

The aesthetic result 3 months after the operation was assessed as good with minimal defect. The breasts retained their high position, but the swelling remained longer than usual, which could be conditioned by insufficient use of compression garments.

Discussion

The presented clinical case illustrates an atypical but increasingly common situation in the practice of reconstructive and aesthetic surgery – the development of ischaemic complications of the NAC in an elderly patient against the background of many predisposing factors. In the context of the increasing need to remove and replace outdated breast implants, such cases require a particularly thorough preoperative assessment [1]. The key feature of this observation is the combination of several

high-risk factors at once: prolonged absence of dynamic ultrasound observation, rupture of the implant, presence of varicose veins disease, low BMI, SAT deficiency, and the presence of signs of impaired microcirculation according to DUS. A comparative analysis of existing scales and tools for assessing NAC ischaemia demonstrates that the scale of Colwell *et al.* remains the most versatile preoperative risk stratification tool, especially for persistent mastectomy, but remains little applicable for aesthetic and reconstructive operations [3]. Intraoperative techniques, including visual assessment scales, allow for real-time adaptation of tactics. Postoperative gradations [11] serve more for clinical classification and scientific interpretation than for intervention [7-9].

Focusing only on visual and palpatory assessment may not be sufficient. In this case, Dopplerography

proved to be particularly informative, which helped to detect signs of decreased capillary flow before surgery [10]. A paradoxical but favourable sign, the appearance of venous stasis on days 3-4 of the postoperative period, was interpreted as an early sign of restoration of blood flow, despite the initially zero capillary reaction (negative pinprick test). Thus, within the framework of this observation, the clinical value of a modified risk assessment scale adapted to the conditions of secondary mammoplasty and supplemented with individualised diagnostic criteria has been demonstrated. The limitation of this observation remains the isolated nature of the case, however, the presented example highlights the clinical applicability of the developed scale and the validity of its further validation in an expanded sample.

Conclusions

The developed modified scale for assessing the risk of ischaemic complications of the nipple-areolar complex is a promising preoperative tool that takes into consideration the specific factors of repeated breast surgeries in reconstructive and plastic surgery, and this tool allows for an objective stratification of patients by risk. The use of the scale allows predicting the need for

personalised management tactics and microcirculatory support in high-risk patients.

A complex multifactorial therapeutic tactic applied in a high-risk patient has demonstrated potential effectiveness in minimising the severity of an ischaemic complication, making it possible to avoid complete necrosis of the nipple-areolar complex. Further prospective validation of the scale on an expanded cohort of patients is needed to confirm its prognostic accuracy and develop clear clinical recommendations based on a point assessment.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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