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Additional Criteria For Assessing the Effectiveness of Anesthesia in the Process of RPO (Reconstructive Plastic Surgery)
In Patients with Post-Burning Contractures of the Face, Neck and Chest

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Abstract: 56 patients aged 16 to 50 were under the experience of reconstructive plastic surgery for post-burn contractures of the face, neck and chest. According to the anesthetic manual we used, the patients were divided into 2 groups: in the first (1) group - 27 patients (48.2%) used regional anesthesia (blockade of the cervical plexus and 3 branches of the trigeminal nerve). In the second (2) group of 29 patients (51.8%), reconstructive plastic surgery (RPS) was performed under the conditions of total intravenous anesthesia with benzodiazepines, ketamine, fentanyl with myoplegiaarduan in standard age dosages.

Oxygen pressure in the soft tissue ($P_{TK}O_2$) of the operated area was examined using a Clark-type transducer using percutaneous contact polarography. The temperature was measured with an electric thermometer with fixation of the central T_1C (oral cavity) and peripheral T_2C (subclavian region), as well as the affected area T_3C.

Compared temperature gradients of the flaps at the stages in the groups indicate (indirectly) a microcirculation with regional anesthesia better than TVA. Our obtained results according to the data of thermometry of the flaps at the stages of surgical intervention are quite consistent with those changes in oxygen tension in the tissues of the flap ($P_{TK}O_2$-) in the patients examined by us. This resultsare less complicated in the operated tissues rather than other proven anesthesia methods when using regional anesthesia.

Key words: reconstructive plastic surgery, methods of anesthesia, regional anesthesia, oxygen pressure.

Topicality

A rational approach to anesthesia in reconstructive plastic surgery (RPS) allows maintaining adequate hemodynamics, gas exchange and microcirculation in the perioperative period, which contributes to good wound healing and is of no small importance in the successful outcome of operations of this type [3,4,6,16].

Unfortunately, the existing generally accepted criteria for assessing the adequacy of anesthesia can not always inform in a timely manner about disorders of the microcirculatory bed of blood circulation, especially in the area of surgical intervention [2,5,9,14]. Expanding the possibilities of perioperative control of the peripheral blood flow in the operated area in RRP can provide deeper information about the effectiveness of anesthesia during this type of surgical intervention [8,11,19]. The method of continuous transcutaneous determination of oxygen tension in tissues ($P_{TK}O_2$) using a contact electrode makes it possible to obtain constant information on oxygen delivery in transplanted tissues, which is very important in the early diagnosis of possible wound complications associated with microcirculatory disorders.

In this regard, it is not less informative to monitor temperature changes in different parts of the body in the perioperative period and to determine the temperature-central and peripheral gradient [7,12,15,17] - see the articles. In RPH, the assessment of thermal homeostasis and its indicators is useful for controlling the depth of anesthesia and analgesia from the standpoint of maintaining an adequate state of the microcirculatory bed, which affects the viability of autotissue complexes [1,10,13,18].

Based on the above mentioned statements, in this section, the goal of our research was to study the effect of the methods of anesthesia used on the indicators of the temperature gradient and oxygen tension in

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the soft tissues of the operated area with an assessment of their information content as a criterion for the adequacy of anesthesia, in the elimination of contractures of the face, neck and chest.

Aim and objectives: To determine the efficiency of anesthesia in the process of reconstructive plastic surgery in patients with post-burn contractures of the face, neck and chest.

Materials And Research Methods

56 patients of a prospective study were examined.

The nature of surgical interventions was as follows: combined plasty (12), flap plasty (15), cross plasty (18), free skin plasty (5). The duration of the operation was within 136+15min.

According to the anesthetic manual we used, the patients were divided into 2 groups: in the first (1) group - 27 patients (48.2%) used regional anesthesia (blockade of the cervical plexus and 3 branches of the trigeminal nerve). In the second (2) group of 29 patients (51.8%), RP was performed under conditions of total intravenous anesthesia with benzodiazepines, ketamine, fentanyl with myoplegia, arduan in standard age dosages. No anesthesia-related complications were noted.

The adequacy of anesthetic management was controlled by clinical changes (shifts) in terms of systolic (BP syst), diastolic (BP diast), mean arterial pressure (AP mean), heart rate (HR), pulse oximetry and thermometry.

Oxygen tension ($P_{TK}O_2$) at the base of the soft tissues of the operated area was studied preoperatively by percutaneous contact polarography performed on a TCM-2 device from Radiometer (Denmark). We used a Clark-type contact sensor for this. The control zone of these studies was the determination of $P_{TK}O_2$ in the subclavian region far from surgical intervention (control zone). $P_{TK}O_2$ data were taken at the indicated points before and after the functional test (breathing with humidified pure oxygen through a mask in a semi-open system for 5-7 minutes). In addition,data was determined before the surgery in the ward, at the surgical stage of anesthesia, during the main stage of the operation - fixation of the flap, at the end of the surgery when awakening patients had spontaneous breathing. The temperature was measured with an electric thermometer with fixation of the central T_1C (oral cavity) and peripheral T_2C (subclavian region), as well as the affected area of T_3C with the determination of the temperature gradient (ΔT_1C - between T_1C and T_2C), ΔT_2C - between T_1C and T_3C, ΔT_3C - between T_1C и T_2C, ΔT_3C– between T_1C и T_2C. All of the above indicators were recorded on the eve of the operation (stage 1), upon reaching the surgical stage of anesthesia (stage 2), during the main stage of the operation (stage 3), and at the end of the operation (stage 4).

According to the data obtained, the indicators of blood pressure, heart rate, pulse oximetry in patients of both groups were within the physiological range during the entire observation. And this result is reflected in the table below.

Table 1

Changes in the studied parameters of hemodynamics and gas exchange in patients of the surveyed groups - at the main stages of reconstructive-plastic interventions on the neck.

Groups	Indicators	Stages			
		1	2	3	4
BShS (n = 27)	SAD, mm.	88.1±2.4	84.7±1.3	85.5±3.1	84.1±4.5
	ЧСС, min	72.7±2.8	68.8±2.1	73.5±3.9	77.3±2.9* ** ***
	SpO2, %	97.9±0.3	97.6±0.1	97.7±0.3* **	96.3±0.1* **
TVAKF (n = 29)	SAD, мм.рт.ст.	86.5±2.6	97.6±2.3	85.5±2.5	84.3±2.2
	ChSS, min	72.9±1.8	80.7±2.9	85.3±3.7* 0 00	84.0±3.5*
	SpO2, %	96.9±0.3⁰⁰	98.2±0.2*⁰⁰	98.0±0.3*⁰⁰	96.9±4.4** ***

Notes: * - p<0.05 compared to stage 1,

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** - $p < 0.05$ compared to stage 2,

*** - $p < 0.05$ compared with stage 3,

00 - p < compared to BShS

Therefore, focusing on the standards and generally accepted methods for monitoring the adequacy of anesthesia, there were no obvious signs of ineffective protection of the patient from intraoperative factors of influence.

The reaction of the local tissues, from which the flap was formed, was different - depending on the anesthesia used. (Table 2).

Table 2

Indicators of changes in oxygen tension in the tissues (RTCO2 mm Hg) of the flap,which is observed in patients of the examined groups, at the main stages of reconstructive-plastic interventions on the neck (M±m).

Groups	Research Zones	Stages							
		Before surgery		Surgicalstep		Flapfixation		End of surgery	
		1	2	1	2	1	2	1	2
I	Control	126.1± 4.2	295.6± 37.4	123.3± 4.0	247.9± 41.0	115.4± 4.5*	231.1± 26.4	112.13.0* **	244.8±27.8
	Main			82.8±1.7	286.6± 9.4	78.2±2.3	274.9± 7.8	71.9±2.5	257.1±6.3
II	Control	121.0± 3.8		116.7± 4.6		105.1± 2.6$^\Delta$		101.2± 4.3$^\Delta$	
	Main			73.8±2.0º		65.1±4.4º		61.6±3.ºᐃ	

Notes: * - $p < 0.05$ significance relative to stage 1 of the study

** - $p < 0.05$ significance relative to the 2nd stage of the study

Δ - $p < 0.05$ significance between groups of control zones

o - $p < 0.05$ reliability between groups of the main study areas

At the beginning of the operation, in flaps in patients of the 1st group, indicators of $P_{TK}O_2$ 1 were lower by 2.3% than in the control zone and by 57.8% after performing a functional test.

In patients who received TBA (group 2), $P_{TK}O_2$ at the base of the flaps was lower than in the control zoneand at the 2nd stage of the study it was by 36.8%. In the phase of flap fixation and at the end of the operation in patients of 1st group, $P_{TK}O_2$ in the main zone was lower than in the control zone by 32.3% and 35.9%, respectively.

As for the 2nd group of patients, at the 3rd and 4th stages indicated, the difference between the $P_{TK}O_2$ between the main and control zones was 38.1% and 39.2%, respectively.

The difference between the $P_{TK}O_2$ and between the controlled indicators in the groups at stages 2, 3 and 4 was 5.4%, 9.0% and 9.8%, respectively. And in the main zones at the same stages of the study it was 10.9%, 16.8%, 14.4%, respectively, indicating a better degree gas exchange in the soft tissues of the operated area (flaps) within patients of the 1st group operated under BSS conditions.

The data we obtained showed that when performing RPO - transplantation of flaps after the elimination of post-burn contracture on the neck, oxygen delivery to the area of surgical manipulations worsens. The degree of these disorders depends on the method of anesthesia used. According to the data obtained, BSS allowed maintaining more satisfactory indicators of $P_{TK}O_2$ at the base of transplanted flaps than TVA with ketamine and fentanyl. The data obtained had an impact on the results of the RPR, which is reflected in Table 4.3

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Table 3
Flap-related complications

Groups	Number of complications (%)			
	Flap necrosis	Wound suppuration	Sub-flap hematoma	Graft lysis
1	1.6	-	4.1	-
2	4.9	2.1	4.5	1.1

The presented data clearly indicate the least % of complications in the implementation of RP on the neck under regional anesthesia (RAS), which we associated with better blood supply in the flaps, after regional anesthesia. Monitoring of temperature measurement and its indicators at the stages of RPH are reflected in the table below.

Table 4
Indicators of changes in temperature and temperature gradient at the stages of our research - in patients of the examined groups at the main stages of reconstructive-plastic interventions on the neck (M±m).

Groups		Research Stages			
		1	2	3	4
(BShS)	T_1S (center)	36.8±0.2	36.7±0.3	36.2±0.2	36.1±0.2
	T_2S (perif.)	29.7±0.3	28.9±0.3	28.6±0.3*	28.4±0.3*
	T_3S (flap)	28.4±0.4	27.4±0.2*	28.1±0.3$^\Delta$	27.4±0.3*$^\Delta$
	$\Delta T_1S - T_3S$	8.4±0.3	3.3±0.2*	8.1±0.2*$^\Delta$	6.7±0.3*$^\Delta$
	$\Delta T_2S - T_3S$	1.3±0.2	1.5±0.2	0.5±0.1*$^\Delta$	1.0±0.2$^\Delta$
TVA (KF)	T_1S (center)	36.9±0.2	36.5±0.3	36.3±0.3	36.2±0.4
	T_2S (perif.)	29.4±0.3	28.8±0.2	28.9±0.4	28.4±0.4^o
	T_3S (flap)	27.9±0.3	26.7±0.2*	27.1±0.3^o	25.7±0.3*
	$\Delta T_1S - T_3S$	9.0±0.2	9.8±0.2^o	8.2±0.3$^\Delta$	10.5±0.3^o
	$\Delta T_2S - T_3S$	1.5±0.2	2.1±0.2*	1.8±0.1^o	2.7±0.3^o*

Notes: * - $p < 0.05$ relative to the 1st stage of the study

Δ - $p < 0.05$ relative to each stage

o - $p < 0.05$ relative to the corresponding indicators in the groups

From the presented data, it can be seen that the central temperature (cheek) had a certain tendency to decrease from stage to stage, becoming the lowest at the end of the operation in both groups of patients. The same trend was noted for T_2C indices in groups reflecting peripheral body temperature.

As for the temperature of the flaps (T_3C), its dynamics at the stages of the operation was different in the observed groups. So, if in the 1st group at the beginning of the operation, the average temperature of the flap was 27.4°, then at the stage of fixation of the flap it was 3.6° (13.1%) - higher, and by the end of the operation it remained 1° lower than the peripheral temperatures.

The temperature dynamics of the flaps in the 2nd group of patients was less pronounced. Its lowest rates were noted at the end of the operation.

At the preoperative stage, the temperature parameters of the affected area (T_3C) did not differ significantly from the temperature in healthy areas of the body. The difference between T_3C and T_2C in both groups was within 1.3 - 1.5o (p>0.05).

However, immediately, after regional anesthesia in patients of the 1st group, the temperature of the affected area increased by almost 1 degree from the previous indicators.

Compared to the temperature gradients of the flaps at the stages in groups (T_2C - T_3C), then this difference is already obvious from the 2nd stage. So, $T_2C - T_3C$ at the 2nd, 3rd and 4th stages of RPH was 0.6o (2.6%), 3.0o (7.2%), 1.7o (6.6%). These results indicate (indirectly) better microcirculation with regional anesthesia than TVA.

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Our obtained results and the data of thermometry of the flaps at the stages of surgical intervention are quite consistent with those changes in oxygen tension, in the tissues of the flap ($P_{TK}O_2$-) and in the patients examined by us.

Conclusion:

In our research of this section, it can be clearly noted that monitoring oxygen tension in the tissues of the flap ($P_{TK}O_2$) and its temperature can serve as a fairly informative method in order to monitor the state of microcirculation. It, of course, affects the engraftment of the flaps.

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