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STRATEGY FOR SCAR-PREVENTION HEALING OF TRAUMATIC AND BURNS WOUNDS

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СТРАТЕГИЯ ПРОФИЛАКТИКИ ОБРАЗОВАНИЯ РУБЦОВ ПРИ ВЕДЕНИИ ТРАВМАТИЧЕСКИХ И ОЖОГОВЫХ РАН

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Treating patients with burns and massive wounds while the complications only start to develop, including pathological scarring (PS), is the most urgent task that purulent and reconstructive surgery currently faces. The study involved following up forty-two patients (age range: 21–59 years) suffering from traumatic injuries and burns wounds. Patients were broken into equal groups, namely, a study group and a control group. All this done to evaluate the efficiency of wound healing auto-stimulation through using a cold plasma flow and introducing platelet-enriched autoplasm. The outcomes the study produced point to the fact that the impact of the proposed complex provides an improvement of the healing process by an average of 4.5±0.3 days, also reducing the risk of the patient developing PS. The reason is a faster, rapid, and homogenous recovery entailed by stimulated epithelization.

Keywords: platelet-rich autoplasm, epithelization, autodermaplasty, pathological scarring

Одной из наиболее актуальных проблем, стоящих перед гнойной и реконструктивной хирургией сегодня, является лечение больных с ожогами и обширными ранами, обеспечивающее предупреждение развития патологического рубцеобразования. В ходе данного исследования, нами осуществлялось лечение 42 пациентов (возраст – 21–59 лет), у которых были обширные травматические повреждения и ожоги кожных покровов. Из общего числа пациентов были сформированы две группы (исследования и контроля) с равным количеством участников. Исследовалась эффективность заживления ран при применении потока холодной плазмы с введением обогащенной тромбоцитами аутоплазмы. Как показали полученные в ходе исследования результаты, используемая комбинация в комплексном лечении травматических ран ускоряет процесс их заживления на 4,5±0,3 суток, а также снижает риск развития патологических избыточных рубцов за счет более быстрого и равномерного заживления со стимулированной эпителизацией.

Ключевые слова: обогащенная тромбоцитами аутоплазма, эпителизация, аутодермопластика, патологические рубцы

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PRPA – platelet-rich autoplasm

PS – pathological scarring

Treatment of patients with burns and massive wounds observed. At the same time, complications only come into being (including pathological scarring/PS), which is viewed currently as the most urgent issue belonging to the realm of purulent and reconstructive surgery [1–3]. The pace and result of the repair will differ from case to case. They are based on a combination of factors in the engagement of the mechanism of damage, depth, and area of the primary damage surface, adequate and timely treatment of the wound, and its system of repair and regeneration of the body. The wound-healing process can be controlled by controlling some of these components [4, 5]. Early control of negative outputs such as excessive scars and tissue deformation implies good knowledge of healing wounds of physiology and other factors involved. These factors and components of pathogenesis are not always controllable. However, advanced medical techniques have proven highly effective and widely applicable due to pathogenic feasibility and safety [6, 7]. PRPA is one of many ways to affect the process [8, 9].

This study focused on boosting autodermoplasty results along with a shorter in-hospital treatment and the initial post-surgery stages in patients suffering from chronic issues with wound healing, at the same time reducing the patient's risk of developing PS.

Material and Methods. The clinical setting for the study was the Department for Purulent Surgery, where intraoperative PRPA infusion with using a cold plasma flow were used. The latter, however, was employed in combination with the wound surgical treatment and its closure with an autodermal graft. Further on, another plasma infusion followed through the initial post-surgery stage. The patients (N – 42; age – 21–59) were under observation for the next two years. It is to be noted that the traumatic wounds observed in them included third-degree burns (5–20 % of the entire body) and traumatic injuries (within the range of 2 % to 5 % of the whole body area), where no covering tissues could be seen.

All the patients were selected following the principle of comorbidity and physical status. The study relied on such tools as lab tests and vascular Doppler ultrasound examination. It also took an overall comprehensive bloodwork

test, the identification of the coagulation status, and the blood chemical test – all these are important because of evaluating the platelet count, the issues potentially affecting coagulation, and the elements related to the protein status. All the patients were found to have their blood indicators within normal ranges, with no significant deviation detected. Anticoagulant and systemic antimicrobial therapy have been based on the results of bacterial culture testing and sensitivity. Local wound therapy using consistent methods and tools was offered as a pre-operative drug.

The whole pool of patients was distributed into two groups, where the control group (N – 21) was administered a standardized treatment resting on a conventional approach. Following the necrectomy interval and the preliminary stage preceding the surgery (anticoagulants, nonsteroidal anti-inflammatory agents, antibiotics), a mesh autodermoplasty implying the use of a protective coating and post-surgery treatment (lengthy treatment with antibiotic and antimicrobial dressings) was proposed. The study group was patients (N – 21) who had undergone (preoperationally) a course of treatment simi-

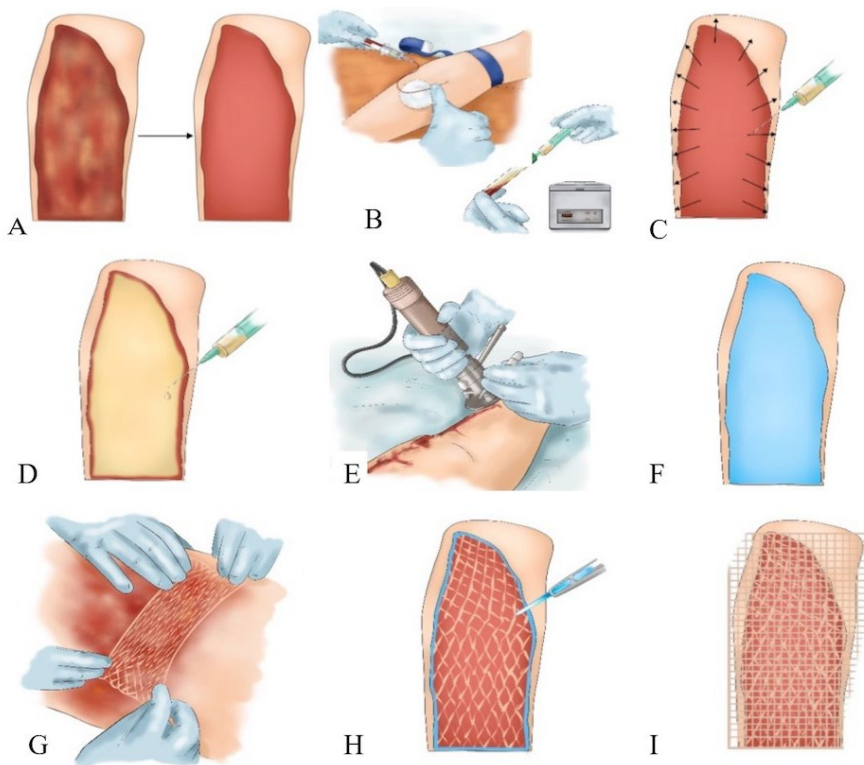


Fig. Steps of the surgery: A – necrectomy; B – taking blood from a vein, centrifugation and obtaining the PRPA; C – injection of PRPA into healthy skin from the side of the wound; D – irrigation of the wound bottom with PRPA; E – taking the skin flap with disc electrodermatome; F – treatment of a donor wound with a cold plasma flow; G – adaptation of a perforated skin flap on a wound; H – treatment of healthy skin edges and flaps with cold plasma flow; I – graft closure with mesh wound dressing

lar to that the control group was offered. The wounds had all granulations and necrotic chunks eliminated from them down to the basal layer (granulation tissue tangential excision) using either a surgical scalpel or disk electrodermatome with a cold plasma flow (Figure). Due hemostasis is achieved then.

Along with starting the surgical intervention, blood is taken from a peripheral or central vein (central venous catheter) in 9 ml with a vacutainer into a sterile tube containing an olefin oligomer and sodium citrate. The test tube for 5 minutes at 2500–3500 rpm was centrifuged. The surgeon injects a plasma layer with platelets into the syringe with a sterile syringe and needle after treating the tube with an antiseptic solution – replacement of the needle with another sterile caliber 17G (1.5x30). From the wound side, PRPA is injected into undamaged skin, whereas the injection is carried out in parts (0.1 ml for 0.2–0.3 cm of the needle length inserted). The intervals along the wound perimeter measured from 0.5 to 1 cm. The wound bottom is treated with PRPA by drip irrigation, covering the whole wound surface evenly with plasma. From the donor site of intact skin, a skin flap is taken with a disk electrodermatome to a depth of 0.2 mm. The flap is perforated 1:2–1:4 and adapted to the wound.

Donor wound and skin graft covered with mesh bandage and dry sterile bandages.

Using a combination of a cold plasma flow with PRPA and autodermoplasty injections to create a plasma substrate for the donor flap, taking the flap to a depth of 0.2 mm allows you to fix the transplant on the wound with the help of hemostasis. Effects were also improved and stimulated. In the postoperative period, the treatment offered relied on means similar to those that were administered to the control group patients. On Day 2 following the surgery, an around the wound PRPA was reintroduced with local terminal anesthesia. The statistical data processing was done with the Statistica 10.0 software (StatSoft, USA), and the statistically significant difference was set at $p < 0.05$.

Results and Discussion. As monitoring revealed, two days into the post-surgery period, partial graft retention could be seen in 17 patients (this accounts for 81.0 % of the entire number) in the study group. As far as the controls are concerned, the number of patients featuring graft retention was 14, i. e., 66.7 %. Emerging epithelialization at the margins together with reliably safe graft adhesion was to be observed, too, even with some time difference: in the study group, the effect was seen on Days 4–5, while Days 7–8 were the point for the control patients.

Further (nine days later), the study group patients' surviving grafts demonstrated no severe inflammatory process. As for active epithelialization, its rate reached 96 %. Patients could ambulate independently in as many as three days after the surgery, and 1st class elastic compression was offered continuously. On Day 9, the patients were discharged to surgical outpatient follow-up.

Patient activation was observed in a 4–5 days control group with 50–70 % survival of transplant zone 9 days after surgery. On the 14th day, a reliable Autodermograft nozzle with clear lysis patches was observed and recovered due to marginal and island epithelial. All patients were released for 14–15 days.

The early postoperative period was proved free of complications in either group. Follow-up monitoring to assess the development of connectivity in the field of autodermograft was carried out using remote technologies and medical consultations. Remote monitoring was done using the Scar Diary app, which

allowed registering daily changes; this was done through the patient filling out an individual card, where the measurements and estimates took into account the specific features of the scar, the personal experience, and feelings as reported by the patient, and any factors related to the patient's life quality [2]. Additionally, the patient's attached pictures of their scars. Visits were scheduled on Days 30, 60, and 90 after surgery. Antiscar therapy was initiated in all patients who had signs of progressive pathological scarring.

Now, speaking of pathological scars, which means here excessive or hyper-trophic, such issues could be observed in 14 control cases, which account for 66.7 % of the whole group. The study group patients, however, had only 6, i. e., 28.6 % of the cases featuring the same issue.

Other complaints reported by 14 (66.7%) control patients through the lengthier post-surgery period included itching, dragging sensations at the healing area, as well as cosmetic severe issues, which were due to disturbed skin plasticity and a mismatch to be seen between the skin on the wound surface and that around.

The study group patients reported similar complaints in 6 (28.6 %) cases. Moderate hypertrophy involving no serious complaints pointing at dragging sensations, pressure, or restricted mobility potential at the developing scars was registered in 7 (33.3 %) control cases versus 5 study group patients (23.8 %).

A concentrated, made from patient blood bioactive molecular and platelet suspension with growth factors infused into the injury area facilitates tissue re-generation, reducing subsequent complications associated with scar formation. The authors offer the method of using PRPA as a combination of wound therapy and prevention of PS [10–12]. The autologicity of the respectively used components helped arrive at significantly better post-surgery treatment outcomes. Other benefits registered included a lower number of complications, faster regeneration of the tissue function, a shorter time required to reach full recovery, and last yet not least – a better level of the patient's life quality [13].

PRPA is a product, manufacturing which takes a single-step centrifugation of the patient's blood. This is done using a special vessel with a purified separating gel, which is based on heparin. The entire substance helps ensure sustainable separation and concentration of platelet growth factors, cytokines, and bioactive molecules [13, 14].

Compared to autologous blood therapy, which uses whole blood, this composition minimizes the possibility of inflammatory and allergic reactions of tissues to blood elements [4, 10, 15]. Based on the results obtained from the study, the use of PRPA in combination therapy of traumatic wounds improves the healing process by an average of 4 to 6 days. It reduces the risk of excessive scarring due to faster and more homogenous healing with stimulated epithelialization.

Conclusions

1. PRPA with a cold plasma flow have shown promising outcomes in case it is used jointly with conventional treatment offered for patients suffering from burns and traumatic injuries. It also facilitates graft healing while helping avoid complications, promotes the rehabilitation process (this means shorter hospitalization time and inpatient treatment), and, speaking in economic terms, allows reducing the related costs.

2. A multi-faceted approach involving a joint effect of autodermoplasty and stimulated transplant survival shows the potential to help eliminate the wound defect;

it also brings down the risk of any potential lysis, as well as increases any odds against possible PS development.

3. The treatment method described above, if employed when dealing with patients running a significant

risk of developing PS, stands every chance to be good enough for an individually designed or tailor-made approach while enhancing the patient's life quality, at the same time boosting rehabilitation and the patient's chances for regaining their working capacity.

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