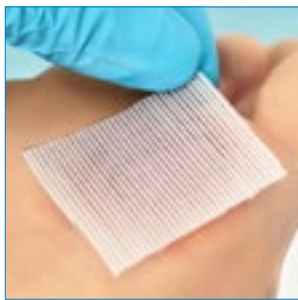


Poster Presentation

Wound Care 2022



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Regulating AGE/RAGE signalling to revert macrophage dysfunction in wound microenvironment to assist healing in diabetic scenario

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Wound healing progress through four interconnected stages- hemostasis, inflammation, proliferation and remodelling. However, hallmarks of diabetic wound healing include a prolonged inflammatory phase that leads to a disturbed distribution of classically and alternatively activated macrophage population, altered protease equilibrium, degradation of the deposited ECM, and sustained bacterial infection leading to impaired healing. Several studies have reported that the chronic wound microenvironment also contains advanced glycation end product (AGE), reactive oxygen species (ROS), inflammatory cytokines, and low levels of growth factors (GF) over an extended duration of time. The accumulation of AGE and its binding to the receptor (RAGE) and repeated microbial infection enhances ROS production resulting in constant infiltration of inflammatory cells at the wound bed. The upregulation of AGE/RAGE signalling is also responsible for the increase in apoptotic bodies, decrease in the phagocytotic potential and loss of phenotypic switch of the wound macrophages. As a result, the apoptotic cell load increases in the wound bed and generates more proinflammatory stimulus and cytokines. Though the initial impulse helps recruit the inflammatory cells, however, their prolonged expression delays the progression of healing. Overexpression of proteases like matrix metalloproteinases (MMPs) degrades the essential molecules (GFs) necessary for the healing. As a result, the signal required for the migration and proliferation of fibroblasts, keratinocytes, along with the synthesis of collagen, is lowered in the chronic wound bed. Overall, the existing anarchy results in a situation that is completely reverse of the optimal conditions required for efficient healing and causes

disoriented deposition of mechanically weak collagen fibres, reducing the strength and quality of the regenerated skin. Thus, our approach aims to regulate the microenvironmental anarchy by addressing the altered macrophage function to provide a holistic treatment alternative for chronic wounds.

Recent Publications

1. Kimball A, Schaller M, Joshi A, Davis F M, et al. Ly6Chi Blood Monocyte/Macrophage Drive Chronic Inflammation and Impair Wound Healing in Diabetes Mellitus. *Arteriosclerosis, thrombosis, and vascular biology*, (2018) 38(5), 1102–1114.
2. Dokumacioglu E, Iskender H, Sen T M, et al. The Effects of Hesperidin and Quercetin on Serum Tumor Necrosis Factor-Alpha and Interleukin-6 Levels in Streptozotocin-induced Diabetes Model. *Pharmacognosy magazine*, (2018) 14(54), 167–173.
3. Barman P K & Koh T J. Macrophage Dysregulation and Impaired Skin Wound Healing in Diabetes. *Frontiers in cell and developmental biology*, (2020) 8, 528.

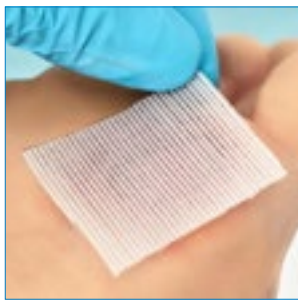
Speaker Biography

Ahana Banerjee is a PhD scholar at the Centre for Biomedical Engineering (CBME), which is a joint initiative of the Indian Institute of Technology, Delhi and the All India Institute of Medical Sciences, Delhi. She is a 5th year PhD scholar developing materials for the treatment of chronic wounds. Her research interest lies in developing biomimetic and sustainable therapies to modulate the chronic wound microenvironment to elevate the standard of living in patients suffering from diabetic foot ulcers by improving the standard of care and reducing cases of amputations. She explores various biomaterials and drug delivery techniques to address the altered physiological conditions associated with chronic wound healing and pivot the therapeutic effect around regulating different signal transduction pathways to achieve the desired result.

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E-Poster

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Features of the course of generalized associated infection in burn injury (experimental research)

Sakharov S P, Molokova O A, Frolova O I and Molokova A S

Tyumen State Medical University, Russia

It is known that *P.aeruginosa* and *S.aureus* are often cultivated from patients with burn injury, contributing to the generalization of the disease and high mortality. It appears interesting to study the features of the burn disease development in experimental animals infected with the association of *P.aeruginosa* and *S.aureus* isolated from patients with burn injury. With associated infection, the severity of vascular, destructive, inflammatory processes in vital organs is significantly greater due to the inability of the body to develop an adequate protective and adaptive response to the combined effect of toxins of dying tissue and bacterial flora. In the lungs - pronounced manifestations of DAD, in the liver and, especially, in the kidneys, intense blood sludge, uneven blood filling, destructive changes in parenchymal cells, in the intestine - hemorrhagic colitis, in the brain - perivascular and pericellular edema of the brain substance. Multiple thrombosis, which is clearly excessive, contributes to a deep violation of the rheological properties of blood and reflects the manifestations of DIC syndrome. The lymphocytic nature of the inflammatory infiltrate with a large number of CD8+ suppressor lymphocytes indicates an autoimmune nature of inflammation. The morphological image of kidney damage corresponds to stage 1-2 of ARF and stage 1-2 of DIC syndrome, leading to the development of renal form of the renal failure. A closed pathological circle is formed, in which shock manifestations in combination with

DIC syndrome cause multiple organ failure, which is the cause of death in the period of toxemia.

Recent publications

1. Klimenchenko I A, Sakharov S P. Correction of the emotional-volitional sphere in children with disabilities using color therapy. World of Science. Pedagogy and psychology. 2020 №2.
2. Sakharov S P, and Shen N P. Mechanisms of bacterial complications against the backdrop of burn injuries in the experiment. Messenger of Anesthesiology and Resuscitation, Vol. 13, No. 3, 2016.
3. Sacharov S P, Ivanov V V, Zoroastrov O M, Zo M O. Analysis of lethal outcomes in children with burn diseases. Bulletin of Experimental and Clinical Surgery. Volume 3, №3 2010.

Speaker Biography

Sakharov S P is associate professor, candidate of medical sciences, surgeon of the highest qualification category. In 1998 he graduated from the Tyumen State Medical Academy. In 1998 he was enrolled in clinical residency in the specialty "Pediatric Surgery". After graduating from clinical residency, he studied at the graduate school in the specialty "Pediatric Surgery". In 2003, he defended his PhD thesis on the topic: Violation of the immune status and its correction in the treatment of children with burn disease. His research interests are thermal injury, microbiology, immunology, pathology. He is an author of more than 85 scientific papers, including 1 monograph, 8 textbooks, manuals for doctors and guidelines, 6 patents for inventions.

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Interaction of exo- and endogenous microorganisms as part of associations in infections (Experimental research)

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Tyumen State Medical University, Russia

Over recent years, the frequency of infections caused by associated pathogenic microflora and associated with hospital infection of patients has been increasing. It appears interesting to study the microbiocenosis formed in the animals body with generalized infection in an experiment. Analysis of the experimental animals internal organs microflora infected with cultivated (CFB) and uncultivated (NCFB) forms of *S.aureus* and *P.aeruginosa* selected from patients with burn disease indicates the interaction of the macroorganism with microorganisms, as well as interactions between microorganisms in microbial populations. The mutual influence of associates on each other was revealed. The properties of *E.coli* translocated from the intestine to the internal organs were studied and it was found that in the cultivated form it can exist as a monoculture, showing antagonistic properties in relation to *P.aeruginosa* and *S.aureus* or form a new microbial association with them, contributing to a more severe course of the infectious process due to the synergistic effect in the association. A microbial association consisting of three associates - *P.aeruginosa*, *S.aureus* and *E.coli* was detected in the liver and kidneys of experimental animals, infected with CFB and NCFB. Translocated *E.coli* acquired atypical properties that enhance its virulence. High mortality of the animals, infected with CFB is due to the increased role of Gr- bacteria in the association. An earlier

translocation of *E.coli* was detected in animals infected with NCFB, which leads to an extremely fast disease course with the death of most animals due to bacterial shock.

Recent publications

1. Klimenchenko I A, Sakharov S P. Correction of the emotional-volitional sphere in children with disabilities using color therapy. World of Science. Pedagogy and psychology. 2020 №2.
2. Sakharov S P, and Shen N P. Mechanisms of bacterial complications against the backdrop of burn injuries in the experiment. Messenger of Anesthesiology and Resuscitation, Vol. 13, No. 3, 2016.
3. Sacharov S P, Ivanov V V, Zoroastrov O M, Zo M O. Analysis of lethal outcomes in children with burn diseases. Bulletin of Experimental and Clinical Surgery. Volume 3, №3 2010

Speaker Biography

Molokova O A have an academic degree of Doctor of Medical Sciences, an academic title of associate professor. In the year 1982, I graduated from the Tyumen State Medical Institute and immediately started working as a professor at the department of pathological anatomy and forensic medicine. I have 200 scientific articles, methodological recommendations published in leading Russian journals. The main directions of scientific activity: the study of regenerative abilities of various organs and tissues in pathological conditions. I actively cooperate with doctors of various specialties - pathologists, surgeons, microbiologists. I take part in scientific conferences and congresses devoted to the issues of pathological anatomy, surgery, microbiology, ophthalmology.

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Negative pressure wound therapy in treating spinal epidural abscess

Konilov Artyom Victorovich, Kubrakov Konstantin Mikhailovich, Alekseev Denis Sergeevich and Kubrakov Kirill Konstantinovich

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Isolated spinal epidural abscess (without spondylodiscitis) is a rare type of vertebral infection and accounts for 0.22% of all pathology of the spine and spinal cord. A timely surgical operation with adequate debridement of the infectious focus helps the patient to avoid the development of paralysis. The classical method of debridement of epiduritis includes decompression of the spinal cord (usually laminectomy) and wound drainage. At the same time, one of the most progressive methods of treating a purulent process is negative pressure wound therapy. We have developed a method for the surgical treatment of an epidural spinal abscess without compromising the integrity of the posterior ligamentous complex using negative pressure wound therapy. Access to the epidural space is carried out by performing a resection of 25-30% of the upper and lower adjacent arches (interlaminectomy) of the vertebrae in the projection of the infectious focus. We recommend debriding with an ultrasonic cavitator at low power to avoid damaging the nerve roots and dura mater. Next, we put a vacuum closure para spinally and make pressure -125 mm Hg in continuous mode. We carry out vacuum therapy of the wound until it is completely cleansed, and active granulations appear. Then we sew up the wound. The method was applied in 11 patients. One patient died due to sepsis (sepsis-3). Relapses of the disease were also not observed. Postoperative kyphotic deformity of the spine was not observed in any case

within 1 year. Pain syndrome decreased from 8.5 (8-9) to 1 (0-2) point on the VAS scale ($p_{Wilcoxon}=0.01$). In 67% of patients, the neurological deficit decreased (increase in the Frankel class, $p_{Wilcoxon}=0.03$). Thus, the developed method of surgical treatment of spinal epidural abscesses using negative pressure wound therapy has good results.

Recent publications

1. Vidalis B, Ngwudike S, McCandless M, and Chohan M. Negative Pressure Wound Therapy in Facilitating Wound Healing After Surgical Decompression for Metastatic Spine Disease. *World Neurosurgery*, (2022) 159, pp.e407-e415.
2. Zwolak P, König MA, Osterhoff G, Wilzeck V, Simmen HP, Jukema GN. Therapy of acute and delayed spinal infections after spinal surgery treated with negative pressure wound therapy in adult patients. *Orthop Rev (Pavia)*. 2013 Nov 6;5(4):e30.
3. Nordmeyer M, Pauser J, Biber R, Jantsch J, Lehl S, Kopschina C, Rapke C, Bail HJ, Forst R, Brem MH. Negative pressure wound therapy for seroma prevention and surgical incision treatment in spinal fracture care. *Int Wound J* 2016; 13:1176–1179.

Speaker Biography

Konilov Artyom Victorovich has completed his PhD at the age of 30 years from Vitebsk State Medical University, Belarus. He is the assistant professor at Vitebsk State Medical University, Belarus. He has over 150 publications that have been cited over 40 times, and his publication H-index is 5.

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Issues of experimental development and prospects of using wound coatings based on chitosan for wound treatment

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Introduction: Optimizing methods of stimulating reparative processes in the treatment of soft tissue wounds is an urgent task in modern medicine. One such area is currently the use of biopolymer wound coatings with polyfunctional properties. This is prolonged action, wound healing, detoxification and antiseptic effects, and in addition, the ability to manage biodegradation and more, the ability to act as a depot or biomatrix for various pharmacological agents immobilized in their structure.

We conducted studies of the natural chitin polysaccharide and its deacetylated derivative - chitosan, having the above properties, and of interest in promising wound coating development in such indicators as: controlled biodegradability, high wound healing activity, biocompatibility, bioadhesiveness, hypoallergy, apirogenicity and sorption activity. In this work, two experimental samples of biodegradable wound coatings synthesized on the basis of chitosan in the treatment of soft tissue wounds were compared. The aim of the study is to compare the effectiveness of wound coatings developed on the basis of chitosan with different physicochemical characteristics in the treatment of soft tissue wounds in the experiment.

Materials and methods: The object of the study was two types of experimental wound coatings based on chitosan, with technological parameters calculated by the Department of Surgical Diseases of the FSBOU VO KubMU of the Ministry of Health of Russia, synthesized by the Kurchatov Institute Research Center (Moscow). Chitosan sample No. 1 had a molecular weight of 600 kDa, a porosity of 98%, isotropic pores of diameter 20-45 µm, a wall thickness range of 350-1000 nm, a modulus of elasticity of 0.749 MPa, compression deformation of 44.32% and vertical orientation of the fibers. Chitosan sample No. 2 had a molecular weight of 600 kDa, a porosity of 98%, isotropic pores with a diameter of 70-200 µm, a wall thickness range of 600-2000 nm, a modulus of elasticity of 0.369 MPa, compression deformation of 50.43% and vertical orientation of the fibers. Sample No. 1 also had a pronounced sorption effect.

The study was carried out on 18 male rabbits of the Sovetskaya

Shinshilla breed with a body weight of 3000-3700 gr., in which a soft tissue wound model was formed. The method for forming an experimental wound was based on the method developed by the department team (patent for the invention RU No. 2703709 C1 "Method for modeling an experimental soft tissue wound in rats for developing treatment tactics"). All stages of the experiment were carried out in accordance with regulatory documents: GOST 33215-2014 "Guidelines for the maintenance and care of laboratory animals. Rules for equipment of premises and organization of procedures, "GOST 33216-2014" Manual for maintenance and care of laboratory animals. Regulations for the Maintenance and Care of Laboratory Rodents and Rabbits, "Directive of the 2010/63/EU of the European Parliament and the Council of the European Union on Animal Welfare, etc. The anesthesiological manual was carried out using veterinary preparations Telazol, Zoletil, Antisedan, in dosages calculated according to conventional methods. Humane euthanasia of laboratory animals was carried out by overdose of an anesthetic and met the requirements of regulatory acts of the Russian Federation and international standards.

In accordance with the goals and objectives of the study, two experimental, and one control group, 6 animals each, were formed. The wound healing properties of the wound coating samples were studied by immersing them in a simulated soft tissue wound in laboratory animals. In the control group, traditional wound treatment was carried out: administration of 10% methyluracil ointment and treatment of the wound with a solution of chlorhexidine bigluconate 0.5%.

On the 7th, 14th, 21st day to study the histomorphological picture of wound tissue samples, two animals in each experimental and control groups were deduced from the experiment. When evaluating the results of the study, morphometric, histological, bacteriological methods were used.

The level of bacterial insemination was determined using the developed computer image analysis method. To objectify the results of the study, as well as to minimize the number

of experimental animals, we used ultrasound diagnostics of the operation zone. Ultrasound was performed immediately before and after the operative intervention in each reference period and on the 3rd day after it. Used the portable device Mindray M7 with the linear L12-4s sensor in the frequency range of 6.0-11.0 MHz and the digital medical Sony Hybrid Graphic Printer UP-X898MD printer.

When studying chitosan samples, physicochemical properties, speed and degree of biodegradation, the possibility of providing framework and drainage functions, as well as the ability to form a biomatrix-depot drug were studied.

Statistical analysis and processing of the obtained data was carried out on a personal computer with a windows operating system (Microsoft) installed, using a set of application software using the method of variation statistics.

Results and discussion: Both studied samples No. 1 and No. 2 of homogeneous wound coatings based on chitosan showed in the experiment high wound healing activity, biocompatibility, biodegradability, bioadhesiveness, hypoallergy, pyrogenicity and sorption activity. The samples had sufficient strength, density, elasticity, the ability to maintain a given shape and initial dimensions but had different periods of complete biodegradation: 6 ± 1.1 days for sample No. 2, and 12 ± 1.7 days for sample No. 1. By having a more "loose" structure with a high degree of porosity, sample No. 2 had a higher adhesion to surrounding tissues and the ability in the wound during exudate sorption to be transformed into a gel with a highly ordered internal micellar-type nanostructure, which makes it possible to use it as a biomatrix depot for drugs introduced into its structure in order to prolong the local medicament. Sample No. 1, due to the tighter structure with unidirectional pore orientation, effectively performed the framework functions, preventing contact of the wound walls and thereby ensuring adequate drainage of the pathological focus and gradual filling of the tissue defect, preventing the possibility of formation of residual cavities.

Conclusions:

1. The examined samples of wound coatings based on chitosan have a number of positive properties (high wound healing

activity, biocompatibility, biodegradability, bioadhesiveness, hypoallergy, pyrogenicity and sorption activity), which allows determining promising directions for the development of new types of wound coatings for the treatment of soft tissue wounds of various genesis.

2. Changes in the technology of synthesis of chitosan-based biopolymers make it possible to create wound coatings that differ in 3-dimensional spatial structure, pore characteristics, stiffness and rate of biodegradation, which ensures the performance of various wound coating functions. More porous materials ("loose" types) provide adhesion and are most promising as a carrier for pharmacological agents. High density samples undergo biodegradation at a later time (up to 14 days) and can act as a framework, providing a draining effect in the wound.

3. The introduction of the ultrasound diagnostic method significantly complements the traditional methods used in experimental surgery, the method is very informative, allows for continuous monitoring of the dynamics of the wound process *in vivo* in experimental animals throughout the study.

Recent publications

1. Aramwit P. Introduction to biomaterials for wound healing. *Wound Healing Biomaterials: Functional Biomaterials*. 2016;2:3-38.
2. Borda LJ, Macquhae FE, Kirsner RS. Wound Dressings: A Comprehensive Review. *Curr. Derm. Rep.* 2016; 5(4): 287–297.
3. Anjum S, Arora A, Alam M S, Gupta B. Development of antimicrobial and scar preventive chitosan hydrogel wound dressings. *International Journal of Pharmaceutics*. 2016; 508(1-2): 92–101.

Speaker Biography

DI Ushmarov graduated from the Kuban State Medical Institute with a degree in medicine, internship in surgery; The Institute of Economics and Management in Medicine and Social Affairs, specializing in economics and management at the enterprise. Medical experience since 1994, worked as a surgeon in medical institutions of the mountains. Krasnodar (Russian Federation). The main areas of work were urgent surgery, abdominal surgery, oncology, vascular surgery, military field surgery. I have been working at FSBOU VO KubMU MZ of the Russian Federation since 2010. I combine the main position of the head of the educational and production department with teaching at the department of surgical diseases. Since 2013, a member of the Russian Society for Simulation Training in Medicine (ROSOMED). I have more than 25 scientific papers, 4 patents for inventions. I have the honorary title "Honored Worker of Health of the Kuban.

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Reparation of experimental deep wound, treated with platelet-filled dermal matrix

Natalya Valerievna Borovkova, Andreev Yu V, Makarov M S, Ponomarev I N, Storzheva M V, Budaev A A and Officerov A A

N.V. Sklifosovsky Research Institute for Emergency Medicine, Russia

A deep burn model was performed in white mice by skin excision to fascia, the area of wound defect was 2% of body surface. Wound coating based on decellularized dermal matrix (DM). We used DM without platelets (control) and DM, containing platelets with granules (high quality platelets). After 3 days all animals had hyperemia and extensive scab, epithelium and dermal layer were completely absent. The wound bottom and underlying tissues were strongly infiltrated by inflammatory cells- in the control group the infiltration density was 266 ± 48 cells/mm², in the experiment- 230 ± 35 cells/mm² ($p<0,05$). In experimental animals macrophages and fibroblasts intensively migrated to the edges of the wound, what did not occur in control. After 14 days granulation tissue formed along the entire bottom of wound. The density of newly formed vessels in control was 171 ± 33 , in the experimental groups – 504 ± 27 ($p<0,05$), i.e., angiogenesis and cell proliferation significantly increased. Nevertheless, the infiltration density did not differ from 3 days ($p>0,05$). After 21 days in control group the wound area remained the scab, tightly soldered to the wound bottom, associated with high level of inflammatory cells, epithelial growth was local. In experimental group all animals had no scab on most of the wound area, followed by active epithelium growth and hair follicles formation. Thus, wound coatings, based on DM with platelets, stimulated cell migration and proliferation in the wound, reduced the degree of infiltration

by inflammatory cells, stimulated active growth of the marginal epithelium and maturation of granulation tissue.

Recent publications

1. A Y Vaza, A M Fain, N V Borovkova, et al. The First Experience of Using the Developed Modified Allogenic Bone Grafts in the Surgical Treatment of Patients With Severe Fractures of the Surgical Neck of the Humerus. Russian Sklifosovsky Journal "Emergency Medical Care" Vol 10, No 1 (2021) P.83-90.
2. AA Budaev, MS Makarov, VV Slastinin, NV Borovkova. Materials used for knee ligament grafting. Transplantologiya. The Russian Journal of Transplantation/ Vol 13, No 3 (2021) P. 280-292.
3. N V Borovkova, M S Makarov, I N Ponomarev, Yu V Andreev, A. S. Mironov. Tissue banks. World experience. The history of development and current approaches. Transplantologiya. The Russian Journal of Transplantation/ Vol 13, No 1 (2021) P. 49-62.

Speaker Biography

Natalya Valerievna Borovkova has completed her MD at the age of 43 years from N.V. Sklifosovsky Research Institute for Emergency Medicine, Moscow, Russia. She graduated from the Moscow Medical Academy I.M. Sechenov with a degree in General Medicine. In 2010 N.V. Borovkova was the head of the scientific laboratory of cell transplantation and immunotyping. In 2018 she has been the head of the scientific department of biotechnology and transfusiology. N.V. Borovkova is the author of more than 240 publications, 26 RF patents for inventions (Hirsch Index RSCI - 7, SCOPUS - 3, Web of Science - 2).

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Efficacy of skin-based grafts in burn wound treatment

Andreev Yu V, Sachkov A V, Zhirkova E A, Borisov V S, Borovkova N V, Budaev A A, Makarov M S, Ponomarev I N and Mironov A S

N.V. Sklifosovsky Research Institute for Emergency Medicine, Russia

Biological coatings with dense structure, based on allogenic skin, could be used in burn wound treatment. Efficacy and safety of skin-based grafts was studied at 50 patients with 3rd degree burns. We used lyophilized skin, cryopreserved skin (cryoprotector - 10% DMSO), cell-free dermal matrix (DM). The first dressing was performed at 1-2 days after the necrectomy, subsequent dressings were performed 1 time every 3-4 days. Lyophilized skin grafts seemed to rapid disappear and weak contact with the wound at the first dressing, after 4-6 days all grafts had intensive suppuration and were removed. On the contrast, cryopreserved skin grafts retained original structure and were tightly soldered to the underlying tissues at the first dressing. After 6-7 days most of cryopreserved skin grafts completely lyzed and removed, longer exposition (10-12 days) required graft evaluation with dermatome and complicated granulation growth. DM formed dark, dry, dense scab, well-fixed to the underlying tissues without suppuration. Complete rejection of DM occurred on average at 10-14 days, followed by granulation tissue forming. The terms of autodermoplasty, using DM, cryopreserved skin grafts and traditional treatment, did not differ, whereas lyophilized skin grafts statistically prolonged autodermoplasty. Thus, acceleration of granulation tissue growth was not observed in skin graft studies. On the other hand, in the DM and lyophilized skin treatment groups purulent complications were not observed in most

cases without antiseptics. The cryopreserved skin or DM is more preferable skin graft type for burn wound treatment.

Recent publications

1. Yu V Andreev, K K Il'yashenko, A K Evseev, et al. Features of disturbance of oxidative stress markers and venous blood cells apoptosis in the early stage of acute poisoning by corrosive substances. *Toxicological Review* №2 (2021), P. 23-32.
2. A S Mironov, N V Borovkova, M S Makarov, I N Ponomarev, Yu V Andreev. Tissue banks. World experience. The history of development and current approaches. *Transplantologiya. The Russian Journal of Transplantation/ Vol 13, No 1 (2021) P. 49-62.*
3. N V Borovkova, M S Makarov, Yu V Andreev, M V Storozheva, I N Ponomarev. Comparing of cytokine content in serum and platelet soluble preparations, produced in different ways. *Molecular Medicine/ Vol.19, №3 (2021) P. 51-57.*

Speaker Biography

Andreev Yu V has completed his dissertation at the age of 29 years from N.V. Sklifosovsky Research Institute for Emergency Medicine, Russia. He graduated from the Moscow Institute of Medical and Social Rehabilitation with a degree in General Medicine. In 2011 he was the senior researcher of the scientific laboratory of cell transplantation and immunotyping. From 2018 he has been the senior researcher of the scientific department of biotechnology and transfusiology. Andreev Yu V is the author of more than 70 publications, 6 RF patents for inventions (Hirsch Index RSCI - 1, SCOPUS - 1, Web of Science - 1).

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Biodegradable chitosan wound dressing in the treatment of skin graft donor-sites

Borisov V S, Sachkov A V, Zhirkova E A, Kaplunova M Yu, Pidchenko N E, Pavlov AV, Frolov S V, Medvedev A O and Andreev Yu V

N.V. Sklifosovsky Research Institute for Emergency Medicine of The Moscow Health Department, Russia

Objective: We compare the efficacy of new bioplastic material based on chitosan nanofibers* and atraumatic fine-mesh gauze in the treatment of skin graft donor-sites.

Materials and methods: In 30 patients with burns of II-III degree skin grafting surgery were performed. In 15 patients of group I: donor sites were closed with material based on nonwoven chitosan nanofibers*. In 15 patients of group II: donor sites were covered with dry gauze. The goal: compare the duration of healing, risks of local infection, severity of pain by visual analog scale (VAS).

Results: In group I the donor sites epithelization takes Me 8 (8;9) days. Biodegradation of bioplastic material induced the growth of collagen fibers and wound healing. In 1 patient (6,7%) local infection were observed. In group II donor site healing takes Me 10,5 (10;11) days ($p=0,001$). 4 patients (26,7%) in group II had local infection and additional treatment required. VAS for patients of group I was Me 2 (2;3) points, and more activiti were flowled in 3-4 days after surgery. But pain syndrome in group II was more significant – Me 6 (5;6) points.

Conclusions: bioplastic materials showed their high efficiency for treatment of wounds of donor sites resulting in decreasing of wound healing duration, and the level of pain reduction.

Recent publications

1. Kaplunova M Yu, Borisov V S, Ponomarev I N, Sachkov AV, Borovkova N V. A clinical case of stimulation of epithelisation of long-term non-healing wounds of donor areas by topical application of plateless-free platelete lysates. The Russian Journal Difficult patient. 2021. V. 19. No. 6. S. 45-49.
2. Borisov V S, Klychnikova E V, Vuimo T A, Kaplunova M Yu, Tazina E V, Bogdanova A S. Possibilities of laboratory diagnosis in predicting the development of venous thromboembolic complications in patients with thermal injury. Russian journal of cardiology. 2020. V. 25. No. S1. pp. 3-4.
3. Borisov V S, Sachkov A V, Kaplunova M Yu, Titova G P, Borovkova N V, Ponomarev I N, Mironov A S. Experience in using biological coatings in complex treatment of extensive burn wounds. The Russian Journal Medical alphabet. 2020. No. 13. S. 39-43

Speaker Biography

Borisov V S defended his thesis at the age of 44 at the Tver Medical Academy, Tver, Russia. Graduated from the Kalinin State Medical Institute with a degree in general medicine. I am a certified practicing surgeon. Since 2004, I have been working as a senior researcher in the burn injury department N.V. Sklifosovsky Research Institute for Emergency Medicine, Moscow, Russia. Borisov Valery is the author of more than 80 publications, 3 RF patents for inventions (Hirsch Index RSCI - 5).

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Local conservative treatment of burn wounds using biomaterials

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The development and improvement of tools that contribute to the optimization of wound healing processes remains an urgent task to date, despite the significant successes achieved by medical science. We have successfully (97 observations) used the wound coating "Chitopran", developed with the participation of specialists of our center, in the treatment of burns of II – III A degree. The coating was also used in the treatment of wounds of donor sites, long-term non-healing wounds, trophic ulcers, bedsores. The coating is characterized by improved absorption of wound discharge, atraumatic, comfortable to wear and provides an effective wound healing effect, has biocompatibility, biodegradation property. The use of biopolymer material allows to reduce the frequency of dressings, make the treatment process less painful, reduce the time of hospitalization of patients and prevent the formation of rough scars.

In our clinic, a study of the effectiveness of the use of Pantolen gel. The gel includes as an active ingredient an aqueous extract from the antlers of the Altai maral, contains a unique balanced complex of biologically active substances, including proteins, peptides, glycosaminoglycans, glycolipids, trace elements, vitamins, does not contain synthetic additives. The gel was used in 15 patients in the treatment of II-III-degree burns, and in 3 patients in the treatment of long-term non-healing wounds. Observations allowed us to state that Pantolene gel has a pronounced stimulating effect on the processes of tissue regeneration, activates marginal and insular epithelization, shortens the healing time, is convenient to use in open wound management, in particular of the face, neck, and perineum.

The arsenal of remedies for the treatment of superficial and "transitional" forms of burns, residual long-term non-healing wounds, trophic ulcers, bedsores also included a hydrogel based on the cationic salt of the chitosan biopolymer and ascorbic acid. The gel was used in the treatment of 27 patients.

It has a high antibacterial activity on gram-positive and gram-negative strains, comparable to the effect of chlorhexidine bigluconate, is convenient for application to extensive wound surfaces, does not prevent the outflow of wound discharge into the dressing, activates the processes of wound regeneration.

The use of the developed biomaterials in surgical practice makes it possible to reduce the time of hospitalization and improve the results of treatment of wounds of various etiologies.

Recent publications

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2. Budkevich LI, Mirzoyan GV, Gabitov RB, et al. Collost Bioplastic Collagen Material for the Treatment of Burns. *Sovrem Tekhnologii Med*. 2020;12(1):92-96.
3. Lukomskiy, A O, Rao N, Yan L. et al. Stem Cell-Based Tissue Engineering for the Treatment of Burn Wounds: A Systematic Review of Pre-clinical Studies. *Stem Cell Rev and Rep* (2022).

Speaker Biography

N V Ostrovsky graduated with honours from Saratov Medical Institute. Since 2003 to the present, he has been chief executive officer of the Regional Clinical Center of Combustiology. He is also professor of the operational surgery department and heads the Department of Cell Engineering, Nanostructures, and Biosystems of the Saratov State University. Professor Ostrovsky is deputy chairman of the task group "Thermal Injury" of the Scientific Council on Surgery of the Ministry of Health and Social Development of the Russian Federation, RAMS; he is a member of the Russian and International Society of Plastic, Reconstructive and Aesthetic Surgeons and Pirogov Surgical Society. He published more than 240 peer-reviewed research papers and registered 14 patents and co-authored 5 monographs. He is on editorial boards of 4 journals. Currently N.V. Ostrovsky is the head of the surgical scientific school, which is carrying out pioneering research on the problem of surgical treatment of burns.

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The new antimicrobial medication for endodontic treatment based on calcium hydroxocuprate and cooper nanoparticles

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Alveolar bone regeneration may be achieved only in 53.6% - 70.8% of apical periodontitis cases. Zones of exposed root dentin, formed during root canal cleaning, may be considered as surgical wounds. Specificity of these wounds includes a large surface area – there are 20,000-80,000 dentine tubules' apertures on each 1 mm² – and a permanently persistent bacterial biofilm, which is found in dentine at the depth of 300 – 1000 microns. It's necessary to develop new methods of prolonged antimicrobial treatment to improve the alveolar bone healing.

The aim of this study was to investigate a new nanomedicine based on calcium hydroxocuprate and copper nanoparticles and to show the dynamics of passive impregnation of the root dentin with this mixture.

Results: The formation of nanoparticle compositions was established by electron microscopy. Cooper nanoparticles, due to their small size (0.5-3 nm) and high surface energy, penetrate into calcium hydroxocuprate crystals having an average size of 287±23.4 nm. Large particles accumulate the energy of smaller cooper particles and become capable of getting into the dentin along the concentration gradient by the osmotic pressure in the capillary system of the dentine tubes. This fact is confirmed by the clinical research.

In the slices of the roots of the teeth treated with water paste of calcium hydroxocuprate cooper particles were detected in the dentine at a depth of just 10 microns. The

distribution of copper in the dentin fragment treated by calcium hydroxocuprate electrophoresis was different- copper was detected after 200 microns from the root canal wall. The calcium hydroxocuprate and cooper hydrosol mixture made it possible to achieve impregnation of the dentin to a depth of 300 to 500 microns without any electric exposure.

Antibacterial potential of this medicine is being investigated in the laboratories of Tver State Medical University using real-time PCR analysis.

Recent publications

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2. Rummyantsev VA, Frolov GA, Blinova AV, Karasenkov YaN, Bituyukova EV. Electron microscopic properties of a new antimicrobial nanodrug based on copper-calcium hydroxide compound. Vestnik Avitsenny [Avicenna Bulletin]. 2021;23(4):532-41

Speaker Biography

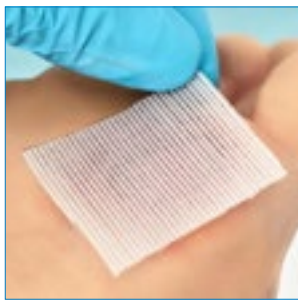
A Blinova is a post-graduate student of Tver State Medical University, Russia. She graduated from Tver State Medical University in 2020 with a degree in dentistry. She has over 40 publications and 5 patents that have been cited over 30 times (the publication H-index is 3). Her research interests include modern conceptions of endodontic treatment, the control of oral biofilms and using nanotechnologies in dentistry.

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Strengthening recovery: A burn injury-focused mobile app to improve outcomes

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In 2018, the American Burn Association reported approximately 25, 130 burn victims were admitted to verified burn centers in North America. This number is likely an under-estimation of burn cases as it does not include patient admissions from burn centers who have not been verified with the ABA. While in the burn center all of patients' needs are met by the burn care team however after discharge, families and frequently unprepared community providers are expected to assume patient care. Inadequate post-discharge wound care may result in serious complications including infection, marginalized healing, and unplanned hospital readmissions. Burn care providers are utilizing an mHealth to supplement post-discharge care for those who live outside of the vicinity of the burn center which is believed to decrease complications that lead to unplanned hospital readmission, yet there is nothing for psych-social needs which if left unattended. The *Bridge Mobile Application* (App) for burn patients is the first mobile app of its kind and is tailored specifically toward the evolving bio-psycho-social recovery needs of patients during the first 90 days after discharge from a burn center. Goals of the Bridge are to decrease unplanned hospital readmissions, improve patient quality of life, and promote resilience in short-term recovery. The Bridge mobile app provides a "bridge" between hospital and home, broadening burn-informed patient

continuity of care further into the community than ever before. Features include videos depicting hand hygiene, dressing changes, and range of motion exercises for each region of the body that are available on patients' smartphones, tablets or other electronic device 24/7. In addition, positive cognitive behavioral messages and educational content are delivered on a daily basis. The Bridge collects data reflecting exposure to the app and patient progress for pain, itch, anxiety, and mood. A pilot study for The Bridge app is currently underway at Firefighter's Burn Center in Memphis, Tennessee.

Recent publications

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2. Thereasa E Abrams, Stephen V McGarity, Psychosocial determinants of burn-related suicide: Evidence from the national violent death reporting system, *Journal of Burn Care & Research*, Volume 42, Issue 2, March/April 2021, Pages 305–310.
3. Thereasa E Abrams, Roberta J Ogletree, Dhitinut Ratnapradipa, Michael W Neumeister, Adult survivors' lived experience of burns and post-burn health: A qualitative analysis. *Burns*. 42 (2016) 152–162.

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Evaluation of LL-37 in healing of hard-to-heal venous leg ulcers: A multicentric prospective randomized placebo-controlled clinical trial

Margit Mahlapuu

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Many patients with venous leg ulcers do not reach complete healing with compression treatment alone, which is current standard care. This clinical trial HEAL LL-37 was a phase IIb double-blind, randomized, placebo-controlled study, with the aim to evaluate the efficacy and safety of a new drug LL-37 for topical administration, in combination with compression therapy, in 148 patients suffering from hard-to-heal venous leg ulcers. The study had three arms, consisting of two groups treated with LL-37 at concentrations of 0.5 or 1.6 mg/mL, and a placebo cohort. Patients had a mean age of 67.6 years, a median ulcer duration of 20.3 months, and a mean wound size at the time of randomization of 11.6 cm². Efficacy analysis performed on the full study population did not identify any significant improvement in healing in patients treated with LL-37 as compared to the placebo. In contrast, a post-hoc analysis revealed statistically significant improvement with LL-37 treatment in several interrelated healing parameters in the subgroup of patients with large target wounds (a wound area of at least 10 cm² at randomization), which is a known negative prognostic factor for healing. The study drug was well tolerated and safe in both dose strengths.

In summary, subgroup analysis in this clinical trial provided an

interesting observation that the investigated doses of LL-37 could offer a treatment benefit in patients with large ulcers, exigently warranting further clinical investigations to validate the treatment outcome in this patient group.

Recent publications

1. Mahlapuu M, Sidorowicz A, Mikosinski J, et al. Evaluation of LL-37 in healing of hard-to-heal venous leg ulcers: A multicentric prospective randomized placebocontrolled clinical trial. *Wound Repair Regeneration* (2021) 29(6):938-950.
2. Kurhe Y, Caputo M, Cansby E, Xia Y, Kumari S, Howell BW, Marschall HU, Mahlapuu M. Antagonizing STK25 signaling suppresses the development of hepatocellular carcinoma through targeting metabolic, inflammatory, and pro-oncogenic pathways. *Cellular and Molecular Gastroenterology and Hepatology* (2021). Accepted for publication.
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Advanced wound dressing for real-time pH monitoring

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Università di Bologna, Italy

The increasing demand of wearable technologies is giving rise to a strong push for the design of textile chemical sensors targeting the real-time monitoring of vital parameters for improved healthcare. Among the most challenging applications, monitoring of nonhealing wounds is a scarcely explored medical field that still lacks quantitative and minimally invasive tools for the management of the healing process. This contribution deals with the development of a smart bandage for the real-time monitoring of wound pH, which correlates with the healing stages and gives direct access to the wound status without disturbing the wound bed. The fully textile device is realized on medical bandages and relies on a newly-designed electrochemical pH sensor based on biocompatible materials and operating at low applied voltage (0.2 V). The sensing layer, including a screen-printed sensor made of semiconducting polymer and iridium oxide particles, was combined with a medical grade foam ensuring the delivery of a continuous wound exudate flow across the sensor area. The pH sensor exhibits a reversible response with a sensitivity of $(59 \pm 4) \mu\text{A pH}^{-1}$ in the medically relevant

pH range for wound monitoring (pH 6–9) and its performance was assessed and validated in terms of accuracy, selectivity against the most common chemical interferents and stability to temperature variations (from 22 to 40°C). Thanks to the robust sensing mechanism and the simple device geometry, the fully assembled smart bandage was successfully validated in flow analysis using synthetic wound exudate. Following this approach, the design of wound moisture and uric acid sensing dressings is currently under development.

Recent publications

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What is the effect of larval therapy on the debridement of venous leg ulcers? A systematic review

Elaine Greene

St. James Hospital, Ireland

Aim: To determine the impact of larval therapy on the debridement of venous leg ulcers, in comparison to other debridement methods or no debridement.

Method: Using systematic review methodology, published quantitative studies focusing on the effect of larval therapy on the debridement of venous leg ulcers were included. The search was conducted in January 2020 and updated in May 2021 using CINAHL, PubMed, Embase, and the Cochrane library, and returned 357 records, of which six studies met the inclusion criteria. Data were extracted using a predesigned extraction tool and all studies were quality appraised using the RevMan risk of bias assessment tool.

Results: Larval therapy was found to debride at a faster rate than hydrogel ($p = 0.011$, $p < 0.001$, $p = 0.0039$), have a similar effect to sharp debridement ($p=0.12$, $p=0.62$), and was a resource-effective method of debridement ($p<0.05$, $p<0.001$, $p<0.001$). When larval therapy in combination with compression therapy was compared to compression alone, larvae had a greater effect

on debridement ($p < 0.05$), however, it did not improve overall wound healing rates ($p=0.54$, $p=0.664$, $p=0.02$). Pain levels increased during larval therapy and reduced after treatment.

Conclusion: Larval therapy promotes rapid debridement of venous leg ulcers. However, further high quality randomised controlled trials, comparing larval therapy to other debridement methods for venous leg ulcers, incorporating the use of compression is required to determine the long term effects of larval therapy.

Recent publications

1. Greene E, Avsar P, Moore Z, Nugent L, O'Connor T, Patton D. What is the effect of larval therapy on the debridement of venous leg ulcers? A systematic review. *J Tissue Viability*. (2021). Aug;30(3):301-309.
2. Fan W, Yang B, Hu X, et al. Safety and efficacy of larval therapy on treating leg ulcers: a protocol for systematic review and meta-analysis. *BMJ Open* 2020;10:e039898.

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Innovative wound infection treatment using electrospun antimicrobial wound matrices

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Non-healing wounds and wound infections are a major problem for society due to increased healthcare costs and significant burden to patients. As microbial biofilms are one of the main reasons for the development of non-healing skin wound infections, novel treatment strategies are sought to fight them. We have started to design and develop antimicrobial wound matrices by electrospinning. This method allows obtaining nanofibrous wound matrices that have several advantages such as resemblance of the natural extracellular matrix, high surface area to volume ratio, tunable porosity, sufficient gas-exchange and possibility to include antimicrobial agents such as antibiotics, antimicrobial peptides (AMPs). Delivery of AMPs by electrospun fibrous matrices enables to improve their stability and lower the toxicity of AMPs, and provides a controlled delivery profile together with prolonged activity. AMPs eradicate the infections more effectively due to their mechanisms of action which is usually related to the direct damage of bacterial plasma membranes and/or penetration within the bacterial cytoplasm to access intracellular targets. Topical application of AMPs is known to promote the migration of keratinocytes and fibroblasts, and this contributes significantly to an accelerated wound healing. In this presentation, the results from two case studies will be given where wound matrices

functionalized with different antimicrobial agents have been prepared and fully characterized *in vitro* and *ex vivo* on relevant wound pathogens. Safety and biocompatibility of the matrices has been tested on eukaryotic cells. We have shown that the design, selected materials and electrospinning methods have a huge effect on the potency and efficacy of the antimicrobial matrices and further studies will determine the clinical efficacy and safety of these novel antimicrobial wound matrices.

Recent publications

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2. Ramos Celia, Lanno Georg-Marten, Laidmae Ivo, Meos Andres, Harmas Riinu, Kogermann Karin. High humidity electrospinning of porous fibers for tuning the release of drug delivery systems. *International Journal of Polymeric Materials*. (2020).
3. Lanno, Georg-Marten, Ramos, Celia, Preem, Liis, Putrinš, Marta, Laidmäe, Ivo, Tenson, Tanel, Kogermann Karin. Antibacterial porous electrospun fibers as skin scaffolds for wound healing applications. *ACS Omega*, 5 (46), 30011–30022.

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Healing of a chronic pressure injury in a patient treated with medical cannabis for pain and sleep improvement: A case report

Brenden S Rabinovitch, Patrick L Diaz, Talia M Katz, Amanda C Langleben and Evan Cole Lewis

Neurology Centre of Toronto (NCT), Canada

Background: A small body of evidence suggests medical cannabis may facilitate wound healing, but the exact mechanism of this effect is unclear.

Purpose: This case report describes a patient with a pressure injury (PI) who received cannabis oil treatment for pain management and sleep improvement.

Methods: A 37-year-old woman with multiminicore disease, scoliosis, short-chain acyl-CoA dehydrogenase deficiency, and epilepsy presented to the Neurology Centre of Toronto with chronic pain and sleep disturbance, including difficulty initiating and maintaining sleep. She also had a 5-year history of a PI between her right iliac crest and right rib cage that had progressively worsened. The patient received a medical cannabis oil protocol that used a combination of cannabidiol and tetrahydrocannabinol.

Results: Cannabis oil was effective in treating pain and sleep difficulties. Unexpectedly, during the first 2 weeks of treatment, the PI started to heal and was almost completely closed at the 2-month follow-up.

Conclusion: Although it is unknown if the observed healing of this refractory PI was indirectly or directly related to the cannabidiol and tetrahydrocannabinol treatment, the potential relationships among pain, sleep disturbance, cannabis treatment, and healing should be explored.

Recent publications

1. Diaz PL, Katz TM, Langleben AC, Rabinovitch BS, Lewis EC. Healing of a chronic pressure injury in a patient treated with medical cannabis for pain and sleep improvement: A case report. *Wound Manag Prev.* 2021 Oct;67(10):42-47.
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3. Medical Cannabis Treatment for Pediatric, Drug-resistant Epilepsy: An Overview & Summary for Those New to the Conversation (<https://centreformedicinalcannabis.substack.com/p/medical-cannabis-treatment-for-pediatric>).

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Use of cadaveric skin in the preparation of the receptor bed in lower limb ulcer

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Background and objective: Considering that chronic ulcers of the lower limbs are of torpid evolution and difficult to treat, with the presence of biofilm in the wound bed associated with a process of chronic inflammation that interrupts the development of normal healing, we propose a treatment with skin substitutes (cadaveric skin and artificial skin) to adapt the wound bed and prepare it for the definitive reconstruction with autograft.

Methods: Retrospective cohort of 22 patients who underwent reconstructive surgery for vascular or post-traumatic chronic ulcers in the lower limbs at the Hospital Alemán in Buenos Aires (Argentina) from February 2017 to December 2019. In the first surgical stage, the ulcers were debrided with immediate coverage of cadaveric skin (allograft) and in a second surgical stage, removal of the allograft and reconstruction with a split-thickness skin graft (STSG) or Integra® (Lifesciences Corp., Plainsboro, NJ, USA) and STSG.

Results: A total of 22 patients were analyzed, 15 of them women (68.18%) with an average age of 72.5 years. The average surface area of the chronic ulcers was 111.76 cm². The etiology of the ulcers was vascular in 12 patients (54.54%) and post-traumatic in 10 patients (45.45%). In 20 patients (90.9%)

the acceptance of the cadaveric skin graft was achieved; in 18 cases the graft was taken 100% and in 2 cases 50%. The allograft was applied as a temporary skin substitute for the preparation of the receptor bed. All patients showed a decrease in the inflammatory process, exudate and pain.

Conclusions: In our experience, cadaveric skin graft is a valid option for the treatment of chronic ulcers resistant to non-surgical treatment.

Recent publications

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Use of vacuum systems for early implant-associated infection after decompression and stabilization surgery for lumbar spinal stenosis

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Objective: To analyze the results of treatment of patients with implant-associated surgical site infection after decompression and stabilization surgery performed for lumbar spinal stenosis.

Material and Methods: Results of treatment of 43 patients with early (up to 90 days after the operation) suppuration of the surgical wound after decompression and stabilization operations for lumbar spinal stenosis were analyzed.

Results: A total of 4033 operations for lumbar spinal stenosis with implantation of stabilization systems were performed from 2015 to 2019. There were 43 (1.06 %) cases of early suppuration of the surgical wound with the installed instrumentation. Out of them seven (16.27 %) cases were superficial and 36 (83.78 %)—deep. The wound revision, surgical debridement and installation of a vacuum assisted closure (VAC-dressing) were performed. The treatment of superficial suppuration was accompanied by a single installation of a VAC-dressing before wound closure, and deep suppuration from 2 to 8 VAC-dressings were changed. Wound healing achieved in all patients within 14–55 days. Timely diagnosis of the complication and application of negative pressure therapy allowed arresting the inflammatory process and preserving the implants in all patients with a follow-up period of 12 months.

Conclusion: In the case of development of early suppuration of the surgical wound, the patient needs an urgent sanitizing operation. Negative pressure treatment with VAC-dressings is an effective and safe way to relieve this complication. This method combined with etiotropic antibiotic therapy makes it possible to quickly cleanse and heal the wound while preserving the implanted instrumentation.

Recent publications

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