

The Role of Plasma Rays in Critical Care Medicine

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According to the material, which is based on the achieved experience in treating gastro-intestinal bleeding, pneumonia (including ventilator-associated pneumonia), diabetic foot syndrome, purulent-septic complications and bedsores in the critically ill patients, authors have recommended a new method to prevent and treat the above-mentioned pathologies by using plasma. A lighter progress of the pathological processes, lowering of intoxication and clinical picture, trustworthy improvement of the patient's condition and lowering of the average duration of the treatment prove the advantages of the given method. Also an important economical effect is achieved by lowering the average treatment price, the cost of drugs and diagnostics. Achieved results allow us to recommend the use of plasma streams in critically ill patients. High effectiveness, simplicity, reliability and significant economical effects are the advantages of this method.

Key words: plasma streams, critical condition, ventilator-associated pneumonia, purulent-septic wounds, diabetic foot syndrome, bedsores.

Actuality.

Using the high-temperature methods on biologic tissues is very effective and well known from early ages. They are used as an electro surgical, laser or/and thermo coagulation instruments in different spheres of medicine. All of these methods, with their positive characteristics have several defects (lack of efficiency and reliability, hardness of usage, high price and many more). The most perspective between the new physical methods is the usage of plasma rays. The plasma components are compact, reliable and technically simple for use and service. The flexible construction the tube of plasma flow gives the surgeon possibility to work freely while operating practically on any zone of the wound. Plasma does not have any negative influence neither on patient – nor on surgery brigade. The energetic characteristics of plasma are several times higher than on other thermo surgical devices. The usage of plasma is a breakthrough in the sphere of physical affection on biological tissues, and its perspectives are admitted by many authors.



The indisputable dignities of the plasma medicine are:

- the possibility of stopping strong bleedings, especially when the wound is wide and big;
- the possibility to use it to stop the bleeding on rough and on the places which are hard to approach;
- the possibility to execute the organ-saving operation on the spleen;
- the effective hemostasis at the disorder of coagulation of blood;
- the hermetic defect of the lung tissues (aerostasis), the defect of parenchyma of liver (cholestasis), the defect of the lymphoid tissue (lymphostasis), the defect of parenchyma of pancreas (fermentostasis);
- high efficiency and speed of coagulation of the wounded surface;
- insignificant thermal damage of the tissues;
- decrease of the multiplication of microbes in the operated wound, bacteriostatic and bacteriocidal effect;
- sanation of the stomach and pleura cavity;
- sterility and non contact method (the sterilization of the manipulator is executed in the steam);
- the possibility to use it to destruct the tissues with the plasma stream, for example on the tumor tissues;
- analgesic effect of the plasma streams on the neural tissues;
- the positive affection on the dates of reparation and cicatrisation processes;
- simplicity, reliability and accessibility of the method for fast mastering and using.

The executed researches have shown us that plasma streams can be used for the operations on the parenchyma organs, lungs and pleura, in neurosurgery, in gastrointestinal surgery, in purulent surgery, practically on every tissue and organ.

History of the method.

The 1st experimental researches of the physical energy of plasma in surgery were executed in 60s. The reason of this was the ability to use the plasma streams locally on biological tissues. The created plasma complexes were meant to be used in surgery and they were called "the plasma scalpel". They generated a plasma stream with the power of 70 Vat, with temperature around 6700 C. In the researches, which were conducted in this period, they were saying about using plasma for cutting the muscles for laparotomy, for different operations on liver, mastectomies, amputations, lung resections and other interventions which where related to generous bleeding. The authors remarked the high hemostatic value of the plasma, the ability to provide with coagulation and dissection of the tissues.

Later, they were using plasma rays on the operations on liver, transversal laparotomy, mastectomy and amputations of limbs, for destructing tubercular hearths on the backbone, for dissection of the scorch scabs and in many other cases. These researches have confirmed the high coagulation abilities of plasma streams. By the 80s and 90s, the more powerful plasma complexes were created, and in the 90s of XX century, air-plasma devices were used in treatment and surgery. The authors, who had the experience of using plasma streams in surgery, remarked the expressed hemostatic and cholestatic effect, reliable healing of surface of the wound and bactericidal particularities of the method.

Essence of the method.

The basic principle of forming plasma ray is to form it with the help of stagnant argon air or from the flow of atmospheric air through the encirclement of electric charge. We were using the plasma device – “Ariel 21” (patent – P 2075 from 31.03.1998 “materials of treating pathological processes”), which was created by the co-workers of Regional Central Hospital and Technological Institute of Leningrad, with cooperation of Surgical Faculty of the Russian Medical-Military Academy. The apparatus of plasma were made in the city of Tbilisi; they were tested, approved its usage and they were used in the medical departments of Georgia, Russian Federation, Republic of Armenia and Republic of Belarus. The ionized air comes out through the narrow tube as a flow, which forms a fiery luminary torch in the middle of which the temperature is close to 16000 C, which gives us the possibility to form and weld the organ formed tissues. The temperature of the torch sharply decreases as you move away to the distance from its epicenter and at the edge of its fiery part, in a few millimeters, it is 30 C. The additional factors of ascendancy are the flow of ozone and the UV wisp, which are used for treating the diseased surfaces.

Last years, in our institute, they started to use plasma streams in the catastrophe and critical care medicine. Using plasma streams in critical care medicine and on patients with heavy pathologies has become actual last years, while in developed countries the plasma components were defined as one of the most prior course in the technical direction. Alongside with plasma rays, they emanated components such as UV ray, ozone and nitrous oxide.

1. Plasma for treating bedsores.

The researches executed by us and gained results give us the possibility to recommend using plasma at any stage of bed sore, any type of wound, any type of its localization, depth and volume of the damage. In the group, in which were the patients with bedsores, 150 sessions of plasma irradiation was executed, 10 patients had 5 sessions and another 10 had 10 sessions. Preliminary results of the treatment give us possibility to acknowledge that plasma irradiations brought us from the heavy course of complication to its noticeable improvement, to shortening the duration of treatment and to the improvement of general statement of patient. Also the perceptible economic effect is noticed, subsidence of 30 standard units per patient each day.

2. Plasma for treating ventilator-associated pneumonias.

In 2007-08 years, we executed some researches with the use of plasma components irradiating the projection of lungs, in those patients who were in critical condition and had broncho-pulmonary complications. This new method was approbated on 40 patients.

Total of 335 sessions of plasma irradiation were executed, 5 sessions on 13 patients and 10 sessions on 27 patients. The 2 groups were emitted:

- on 24 patients there was a suspicion that they had pneumonia before they were hospitalized, plasma irradiations were appointed as soon as they entered the department;
- on 16 patients, treatment with plasma streams was appointed after 3-5 days after hospitalization, when the signs of pneumonia formed.

On the patients who had appointments of treatment with plasma streams as soon as they were hospitalized, in 9 cases broncho-pulmonary diseases did not arise, accordingly there was no necessity of antibacterial therapy. These kinds of occasions did not take place in 2nd group.

In the patients of the research group, we saw different kinds of positive events:

- trustworthy course of pneumonia with the low degree of display of clinical signs and intoxication;
 - decrease of lethal occasions by 15% in patients in critical condition;
 - the reliable improvement of the general blood analysis and biochemical data;
- the decrease of average expenses of daybeds by 20-25 provisory units and decrease of the general prices of treatment by 15-18% which is achieved with the decrease of antibiotics, immunomodulators and decrease of daybeds.

3. Plasma for irradiating sternum.

35 patients, who had gastro-duodenal ulcer bleeding, were irradiated by plasma streams on the sternum, which (according to Zv. Kheladze's (2008) and A. Palavandishvili's (2008) scientific work) causes to activate the differentiation of tubic cells, which on the other side has a positive effect on the nourishment of the wall of the stomach and helps to normalize the raised hydrogen chloride, which was caused by stress in the patient who was in critical condition.

The method, which was used by us, is quite simple: the sternum is irradiated by plasma streams for 5-10 minutes 15 cm away from the surface, 1-2 times a day in the first week of patient's hospitalization. By using this method, the stress ulcer was healed quickly. This method didn't cause any complications or repeated hemorrhage.

The facts were confirmed by researching the stomach tissue (biopsy), which was taken by using endoscopy, and histological data, before and after the treatment. In the process of working, the method was awarded for patent (Zv. Kheladze, Z. Kheladze, S. Jaiani, B. Cuckiridze "The new use of plasma streams" #10786\01.07.07.2008).

4. Plasma for treating diabetic foot syndrome.

The patients, along with treating by plasma streams, also received conservative treatment. The method was based on irradiating the lower extremities by plasma streams 5-10 times, in the projection of the shank and foot fingers. The mode "Plasma Irradiation" was used. The method was used each day for 5-7 minutes. The temperature of the plasma stream, at the surface of the skin, was safe (36-38 C), the method didn't require preliminary preparations and didn't depend on the condition of the patient. The length of treating diabetic foot syndrome, including the use of plasma streams, lasted for 25 days.

After using the plasma streams, the amount of glucose in the blood approached to normal and glucosuria was lowering. In the patients who had angiopathy, the limping syndrome was lowering, also the dryness of the skin, cyanosis, growth of hairy surface and a.a. tibialis post. et dorsalis pedis pulsation and blood pressure was normalized.

Thus, using plasma streams alongside with the traditional methods of treatment, gives us an opportunity to achieve a highly effective treatment:

- lowering the dryness and cyanosis of the skin, also warming the foot if the ischemic form takes place;
 - relieving the pain in the damaged extremities, in 7 cases – the pain was totally gone;
 - lowering the swelling of the foot in 11 patients, in 6 cases – swelling was totally healed;
 - reduction of the demarcation zone in 15 patients;
- in 17 patients – restoration of pulsation in a.a. tibialis post. et dorsalis pedis.

The use of the mentioned method, on the patients with diabetic foot syndrome, allows us to stabilize the glycemic index and lower the hypoglycemic drug doses, or if using the same doses – lower the sugar level in the blood. The complex treatment improves hemodynamics, raises the energy aggregation level of the nerve tissue, enlarges the contracted blood vessels, has anti-inflammatory effect, and raises the subjective self-appraisal of the patient.

5. Plasma for treating purulent-septic complications.

The complex treatment of purulent-septic complication with wide damage of limbs gives us opportunity to achieve positive effect with the help of using plasma rays on damaged and purulent cavities, treatment with ozone and UV rays, radical surgery on the hearth, rational use of antibiotics, immunomodulators and other types of treatment. The duration of the treatment is reduced by 20-30%, faster processes of regeneration are occurred, these kinds of complications complicate perceptibly rarely with sepsis, the expression of the pain occurs a lot rarely after surgery, ensuring of a faster rehabilitation of the limb functions and a better course of the after surgery period. Treatment of purulent-septic complication with the new, complex treatment with the use of plasma is very effective and it gives us possibility to execute the high quality prophylactics of the surgery infection alongside with treating it.

This method, with the use of plasma rays, ozone and UV components, showed us high efficiency for treating the anaerobic infections of soft tissues, which is frequent and extremely dangerous complication of the lower limbs. While using plasma streams on the complications with anaerobic infections, it is very important to start using from the initial stage and the successively while revising the wounds with the "plasma irradiation" regime, 2-4 times per day.

The instillation of plasma streams gave us possibility to conclude the executed medical and economical efficiency estimation in the following way:

the method is available and does not need expensive and long specific preparations; while treating with plasma streams, the material expenses can be lowered by 20-25% and the general duration of the treatment decreases by 15-30%, considering different categories of patients.

Therefore, using plasma complexes in critical care medicine for improving the results of treatment is very perspective trend.

Summary.

According to the material, which is based on the achieved experience in treating gastro-intestinal bleeding, pneumonia (including ventilator-associated pneumonia), diabetic foot syndrome, purulent-septic complications and bedsores in the critically ill patients, authors have recommended a new method to prevent and treat the above-mentioned pathologies by using plasma. A lighter progress of the pathological processes, lowering of intoxication and clinical picture, trustworthy improvement of the patient's condition and lowering of the average duration of the treatment prove the advantages of the given method. Also an important economical effect is achieved by lowering the average treatment price, the cost of drugs and diagnostics. Achieved results allow us to recommend the use of plasma streams in critically ill patients. High effectiveness, simplicity, reliability and significant economical effects are the advantages of this method.

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წარმოდგენილ მასალებზე დაყრდნობით, რომელიც დაფუძნებულია გასტროინტესტინური სისხლდენების, პნევმონიების (ვენტილატორ-ასოცირებული პნევმონიის ჩათვლით), დიაბეტური ტერფის სინდრომის, ჩირქოვან-სეპტიური გართულებებისა და ნაწოლების მკურნალობის გამოცდილებაზე კრიტიკულ მდგომარეობაში მყოფ პაციენტებზე, ავტორებმა შემოგვთავაზეს და რეკომენდაცია გაუწიეს პლაზმის გამოყენებას ზემოთ ხსენებული პათოლოგიების პრევენციისა და მკურნალობისათვის. პათოლოგიური პროცესების უფრო მსუბუქი პროგრესირება, კლინიკური სურათისა და ინტოქსიკაციის შემცირება, პაციენტის ზოგადი მდგომარეობის სანდო გაუმჯობესება და მკურნალობის საშუალო ხანგრძლივობის შემცირებამ წარმოაჩინეს მოცემული მეთოდის უპირატესობები. ასევე, აღნიშნული მეთოდის გამოყენებით აღინიშნება მნიშვნელოვანი ეკონომიური ეფექტი მკურნალობის საშუალო ღირებულების, წამლებისა და გამოკვლევების გადასახადის შემცირების ხარჯზე. მიღებული შედეგები საშუალებას იძლევიან რომ რეკომენდირება გავუწიოთ პლაზმური ნაკადის კრიტიკულ მდგომარეობაში მყოფ პაციენტებზე გამოყენებას. მაღალი ეფექტურობა, სიმარტივე, სანდოობა და შესამჩნევი ეკონომიური ეფექტი წარმოადგენენ აღნიშნული მეთოდის უპირატესობებს.