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PATHOGENESIS AND TREATMENT OF HEMOTRANSFUSION SHOCK

Yuldasheva Nodira Ergashevna

Dosent of Andijan State Medical Institute

Qoraboev Ubaydullo Madaminovich

Professor of the Department of AFC, Tula State University, Medical Institute.

Annotation: Hemotransfusion shock is one of the most dangerous complications of blood transfusion, expressed in the destruction of red blood cells with the release of toxic substances into the vascular bed of the patient. It is characterized by psychoemotional arousal, painful sensations in the lumbar region, tachycardia, drop in blood pressure, jaundice. It is diagnosed on the basis of the clinical picture, a number of indicators of the general analysis and biochemical composition of the blood, an antiglobulin test. Treatment involves the immediate cessation of hemotransfusion and symptomatic therapy: elimination of erythrocyte breakdown products, partial or complete replacement of the function of target organs.

Key words: Hemotransfusion shock, blood, erythrocyte.

Hemotransfusion shock is an extreme manifestation of an incompatibility reaction. It is rare (in 7% of all blood transfusions), but dominates the structure of transfusion complications (from 50% to 61.5%). At the same time, the mortality rate, according to various sources, can reach 71.2%. It develops directly during the procedure or in the next 1-2 hours after its completion. Signs of shock usually appear within 30-45 minutes from the start of blood transfusion. Due to the danger of developing a state of shock and the occurrence of fatal consequences, transfusion is performed exclusively in a hospital by a transfusiologist or an anesthesiologist-resuscitator who has received special training.

Reasons

It is believed that the main reason for the development of the condition is the incompatibility of the blood of the donor and the patient. In this regard, the main risk factors are violation of the rules of blood transfusion, lack of sufficient qualifications from the doctor conducting the transfusion. Hemotransfusion shock develops when:

Blood group incompatibilities according to the ABO system. It is most rare, because the standards of medical care are strictly regulated and involve at least three–fold determination of the recipient's blood type and two-fold determination of the donor. Incompatibility can occur with the phenomenon of "blood chimera" (simultaneous presence of two different groups of antigens in humans).

Incompatibility of Rh factor (Rh). It is typical for patients with weakly positive rhesus, since they have fewer antigens compared to those with a pronounced positive factor. In cases of questionable Rh factor, it is recommended to treat rhesus as free of antigens and hemotransfusion

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of Rh-negative blood.

Incompatibilities of other antigens. At least 500 blood antigens are known to form 40 serological systems. There is often a violation of compatibility according to the Kell system, less often - Duffy, Lewis and Kidd, or due to the presence of undetectable rare platelet antigens, which can also lead to hemotransfusion shock. A three-time biological test is crucial in determining compatibility.

Shock phenomena can develop after transfusion of an infected medium in the event of a violation of the tightness of the hemacon, improper storage or non-compliance with the plasma quarantine period. The literature describes the potential for the development of hemotransfusion complications in severe forms of other allergic reactions, systemic diseases, and with a history of transfusion of incompatible components.

Pathogenesis

The pathogenetic mechanism of hemotransfusion shock is based on the second type of allergic reactions – cytotoxic. These reactions are characterized by a rapid release of histamine, a high rate of development (sometimes within a few minutes). When incompatible components with a volume of 0.01% or more of BCC enter the patient's bloodstream, hemolysis (destruction of transfused red blood cells) begins in the recipient's vessels. At the same time, biologically active substances are released into the blood. Unrelated hemoglobin, active thromboplastin and intraerythrocyte coagulation factors are significant.

As a result of the release of hemoglobin, its deficiency as an oxygen carrier is formed, it passes through the renal barrier, damaging the kidney – hematuria appears. All factors cause spasm and then dilation of small vessels. During the narrowing of the capillary lumen, hemosiderosis develops – a dangerous process that leads to acute renal damage due to impaired filtration. With a high release of coagulation factors, the probability of DIC syndrome is high. The permeability of the vascular endothelium increases significantly: the liquid part of the blood leaves the bed, thickening provides an increase in the concentration of electrolytes. As a result of an increase in the concentration of acid residues, acidosis increases.

Microcirculation disorders, redistribution of fluid between vessels and interstitium, hypoxia lead to multiple organ failure syndrome – the liver, kidneys, lungs, endocrine and cardiovascular systems are affected. The combination of violations entails a critical decrease in blood pressure. Hemotransfusion shock refers to redistribution shocks.

Classification

There are three degrees of hemotransfusion shock, depending on the level of decrease in systolic blood pressure: I degree – blood pressure drops to 90 mmHg; II – to 70 mmHg; III – below 70 mmHg. Periods of shock development are more indicative, the distinctive features of which are the detailed clinical picture and organ damage –targets:

The period of shock. It begins with the redistribution of fluid and microcirculation disorders. The

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main clinical aspect is a drop in blood pressure. DIC syndrome often occurs. The leading manifestations are from the cardiovascular system. Lasts from a few minutes to 24 hours.

The period of oliguria/ anuria. It is characterized by further damage to the kidneys, a violation of their filtration ability, and a decrease in reabsorption. With artificial urine drainage, hematuria and bleeding of the urethra are observed. The symptoms of shock become blurred. In case of inadequate treatment, increasing doses of sympathomimetics are required.

The recovery period. It occurs with the timely start of therapy. The filtration function of the kidneys is improving. With a prolonged second period of shock, kidney damage is irreversible, this will be indicated by proteinuria and a decrease in plasma albumin.

Reconvalescence (recovery). The period of normalization of the activity of all systems, functional defects are completely regressed, anatomical defects are compensated. There is a complete restoration of coagulation, vascular barrier, and electrolyte balance. The duration is 4-6 months. At the end of the stage, it is possible to judge chronic organ damage.

Symptoms of hemotransfusion shock

Clinical manifestations are observed already during hemotransfusion, but may occur obliterated and remain unnoticed against the background of the severity of the underlying disease. More than 70% of patients have mental agitation, vague anxiety; facial hyperemia against the background of general pallor, cyanosis or marbling; chest pains that constrain breathing; shortness of breath, a feeling of lack of air; tachycardia. Nausea or vomiting is rare. A characteristic adverse sign is lower back pain, indicating kidney damage.

With a lightning-fast course of shock, the patient may die within a few minutes from a critical drop in blood pressure, refractory to sympathomimetic agents. If the development of shock is gradual, patients experience a temporary imaginary improvement. In the future, the clinic increases: body temperature rises, jaundice of mucous membranes and skin appears, pain increases. Over time, with a large volume of hemotransfusion, edema and hematuria appear.

When a hemotransfusion complication occurs during anesthesia, the picture is always erased, many symptoms are absent. A patient in a coma or under general anesthesia cannot express concern, so timely detection of a life-threatening condition falls entirely on the transfusiologist and anesthesiologist. In the absence of consciousness, the leading signs are the appearance of urine the color of "meat slops", a jump in temperature, a drop in pressure, cyanosis and increased bleeding of the surgical wound.

Complications

Among the main complications of shock are multiple organ failure and acute renal failure. If treatment is ineffective, the acute process is chronicled and leads to disability of the patient. A large volume of hemotransfusion and late diagnosis cause the accumulation of critical concentrations of electrolytes. Hyperkalemia causes refractory life-threatening arrhythmias. Following damage to the myocardium and kidneys, blood supply to all organs and tissues is

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disrupted during hemotransfusion shock. Respiratory dysfunction develops. The lungs cannot perform an excretory function and remove toxins from the body, exacerbating intoxication and ischemia. A vicious circle and multiple organ failure are forming.

Diagnostics

The main diagnostic criterion for hemotransfusion shock is the association of hemotransfusion with symptoms. The clinical picture allows us to suspect the development of shock and differentiate it from a number of other complications of transfusion. When typical symptoms appear, laboratory diagnostics, consultation with a hematologist and a transfusiologist are carried out. The required tests are:

General and biochemical blood tests. Hypochromic anemia progresses in patients with transfusion of incompatible blood, the number of platelets is reduced, free hemoglobin appears in the plasma, hemolysis is determined. After 12-18 hours, transaminases, urea, creatinine, potassium and sodium increase. Gas analysis and blood CSF make it possible to evaluate the effectiveness of oxygenation, lung function, and the body's ability to compensate for acidosis and hyperkalemia.

The study of hemostasis. The coagulogram is characteristic of DIC syndrome. The stage of hypercoagulation is replaced by depletion of coagulating components, up to complete absence. In elderly patients taking warfarin, a thromboelastogram is advisable. Based on the data, the issue of the need for the use of coagulants, plasma transfusion and plasma factors, platelet mass is being resolved.

Antiglobulin tests. They are the standard for the examination of patients with complications of hemotransfusion and differential diagnosis. The main one is the Coombs test. A positive result means the presence of anti-Rh factor and specific antibodies-globulins, fixed on red blood cells. The Baxter test makes it possible to suspect the correct diagnosis with a high probability and begin intensive therapy until other laboratory data are ready.

Urine tests. Oliguria or anuria indicate kidney damage. Free hemoglobin, macrohematuria, and protein appear in the urine. A borderline indicator for transferring a patient to intensive care is a decrease in daily diuresis to 500 ml.

In the conditions of the intensive care unit, ECG monitoring is carried out every hour until the acute condition is relieved. Differential diagnosis is performed with acute renal injury of a different etiology and massive hemotransfusion syndrome. In the first case, the key role is played by hemotransfusion and the time of shock development, in the second – the Coombs sample and the volume of the transfused medium. Massive hemotransfusion syndrome and shock have similar pathogenesis and principles of therapy, do not require differentiation on the first day of treatment. These diagnoses are often established retrospectively.

Treatment of hemotransfusion shock

If incompatibility is suspected, hemotransfusion should be stopped immediately and infusion

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therapy should be started. Treatment is carried out in the ICU under the supervision of an intensive care specialist and with the participation of a transfusiologist. The main measures are aimed at accelerated elimination of toxic substances, maintenance of homeostasis, and, if necessary, prosthetics of vital functions. Catheterization of the central vein is mandatory. Drug therapy includes:

Drugs to increase blood pressure. In order to maintain the pressure and pumping function of the myocardium, sympathomimetics (adrenaline, norepinephrine, dopamine) are used. Infusion therapy replenishes the volume in the vascular bed, provides sufficient cardiac output. It is mandatory to use crystalloids in conjunction with colloids to reduce the effect of backflow.

Antishock drugs. Antihistamines and glucocorticosteroids reduce swelling and fluid redistribution. Calcium chloride is able to reduce the permeability of the vascular wall. NSAIDs reduce pain and swelling of tissues, stabilize the endothelium. With their inefficiency, expressed anxiety of the patient, narcotic analgesics are used.

Correction of the coagulation system. In order to reduce thrombosis in the period of hypercoagulation and to neutralize the effects of changes in microcirculation, disaggregants are used. Antioxidants are shown to improve the rheological properties of blood. Anticoagulants, thrombomass and plasma are used depending on the stage of DIC syndrome under the control of a coagulogram.

Forced diuresis. It involves the administration of diuretics in combination with a large volume of infusion. Stimulation of diuresis promotes accelerated excretion of decomposition products from the body. Timely initiated forced diuresis with a small volume of transfused incompatible components reduces the severity of kidney damage. In conditions of shock, it is necessary to strictly keep records of the water balance in order to avoid edema of the lungs and brain.

Substitution therapy is carried out strictly according to indications. Plasmapheresis is effective only in the first stage of shock, when the elimination of antigen–antibody complexes may be sufficient for kidney protection. Hemodialysis is used to eliminate toxins, correct the electrolyte composition in severe renal dysfunction. Preventive protection of other target organs consists in timely oxygen therapy – from oxygen insufflation to artificial lung ventilation, reduction of the energy needs of organs (drug coma) and symptomatic therapy.

Prognosis and prevention

The prognosis of hemotransfusion shock is unfavorable. Disability and chronic renal injury occur in more than 90% of surviving patients. However, modern methods of renal replacement therapy give many patients a chance for a decent quality of life. With timely intensive therapy, it is possible to compensate for the course of CRF for many years. Kidney transplantation may be required to increase life expectancy.

Prevention consists in strict observance of the established rules of transfusion, clear indication of absolute and relative indications for hemotransfusion, determination of the minimum sufficient volume of blood components. It is extremely important to pay attention when determining

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compatibility, and carefully collect anamnesis. A special role is played by a biological compatibility test, a visual assessment of hemacons.

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