LOW-VOLUME INFUSION THERAPY IN PATIENTS WITH MECHANICAL JAUNDICE IN THE SURGICAL PERIOD, TAKING INTO ACCOUNT HEART FAILURE

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Abstract: Pathologies occurring in elderly patients are characterized by severe complications affecting the body. The importance of perioperative monitoring of key homeostatic indicators, including colloid-osmotic pressure, plasma osmolarity, and blood coagulation potential, is emphasized. Changes in these indicators are inevitable during surgical interventions, particularly in patients with comorbidities and the elderly. Correcting volume disturbances is one of the primary tasks determining the outcome of surgical treatment. Infusion-transfusion therapy using colloid and crystalloid solutions, along with accompanying hemodilution, significantly affects homeostasis indicators. To gain a deeper understanding of the pathophysiology of these processes, this literature review was conducted.

Factors Causing Mechanical Jaundice and Infusion Therapy

Rational infusion therapy is a fundamental component of anesthesiological care and intensive therapy. This is likely related to the absence of an optimal infusion medium that can be safely administered in the required volume to maintain circulating blood volume (CBV). This is probably due to the lack of an ideal infusion medium that can be safely infused in the necessary amount to preserve circulating blood volume (CBV). Another reason for the ineffectiveness of infusion therapy is the insufficient timely monitoring of various physiological and biochemical indicators influenced by infusion solutions [1,2]. Additionally, there are challenges in their comprehensive evaluation. Analysis of the literature emphasizes the importance of monitoring and correctly interpreting hemodynamic indicators, blood

composition, osmolarity, plasma oncotic pressure, and coagulation status during infusion therapy [3,5].

The Importance of Osmolality in Infusion Therapy

Osmotic pressure is the process by which water moves through a semi-permeable membrane from an area of lower solute concentration to an area of higher concentration. Osmotic pressure is the hydrostatic pressure required to stop this osmotic flow of water. Osmolality is a measure of a solution's ability to induce osmotic movement of water, defined as the total concentration of solute particles in the actual solution (mosmol/kg water), independent of their size, shape, or electrical charge [6,9,11]. Normally, plasma osmolality is 285 ± 5 mosm/kg water, and in compensated normoosmolality, this range can expand. Osmolarity, created by substances such as inorganic ions, glucose, and proteins that cannot pass through the cell membrane, is called tonicity. The law of isoosmolality states that osmolality must be the same in all fluid compartments of the body. One of them is the mechano-osmotic stretching of the plasma membrane, its detachment from the cytoskeleton, intracellular potassium loss, and disruption of cellular bioelectric processes. Some researchers note that the distribution of fluid in the body is related to the distribution of osmotically active substances [12]. Under normal conditions, this distribution is maintained by biological barriers and ion pumps. The perioperative significance of osmometry is confirmed by studies from A.M. Mamadov. He showed that changes in osmotic indicators, combined with neuroendocrine (insulin, glucagon, cortisol, antidiuretic hormone, renin) and volumetric (CBV) indicators, can predict the development of surgical and purulent-septic complications in the first days postoperatively. Early detection of these changes allows for prophylactic corrective therapy [13].

Furthermore, the widespread use of crystalloids, despite their advantages (low cost and low reactivity), can cause certain problems. For example, the excess

chloride in "physiological saline" can lead to hyperchloremic acidosis in cases of large-volume infusions, and the hypoosmolarity of Ringer's solution also raises some questions [14]. That is, it has been confirmed that altering plasma osmolality has a positive effect on hemodynamics. Thus, osmolality regulates water movement in various fluid sectors, significantly affecting tissue perfusion and cellular functional status, and indirectly influencing the efficacy of surgical treatment [10].

Preparations Used in Infusion Therapy

One of the factors affecting blood volume is the action of opposing forces, consisting of hydrostatic and colloid-osmotic pressures, which operate both inside and outside the vessel. Colloid-osmotic pressure (or oncotic pressure) is a part of osmotic pressure created by colloid molecules that cannot pass through capillary walls. Other researchers identify statistical differences between colloid-osmotic pressure (COP) and COP calculated using the Landis and Pappenheimer formula based on total protein concentration in plasma. Liquid heparin coating the walls of syringes or cannulas can dilute the sample and lead to falsely low COP values, so cannula walls should be coated with dry heparin. In hypernatremia (as well as alkalosis, which enhances the Gibbs-Donnan effect on osmolality), COP measurements may show inflated values. In hyponatremia (and acidosis), values may be underestimated, related to the operational characteristics of the oncometer. If the sodium content in the sample is normal, but hyperosmolality is due to high levels of glucose, urea, mannitol, or other non-electrolytes, such errors are not observed.

Dextran and hydroxyethyl starch (HES) molecules are electrically neutral, and their effect on plasma colloid-osmotic pressure (COP) is not accompanied by the Gibbs-Donnan effect, as seen with albumin preparations. Measured COP values in plasma with these infusion agents should be interpreted cautiously, as a significant portion of HES molecules can pass through an oncometer membrane with a

permeability of 30,000 Da. In such cases, using a membrane with a permeability limit of 10,000 Da may be preferable. With aging, average normative COP values decrease: in those under 50 years, average values are 21.1 ± 4.8 mmHg, while in those aged 70–89, this value is 19.7 ± 3.7 mmHg. Even a few hours of strict bed rest leads to an approximate 15% decrease in COP. Daily fluctuations in COP levels in the same patient within ±10% are considered normal. According to local scientists, the plasma COP indicator is the primary factor regulating water movement between tissues and capillaries. This means that the endothelium has high permeability for inorganic ions but low permeability (under normal conditions) for polymer ions, including proteins. However, in pathology, this permeability increases [44].

Some authors emphasize the decrease in plasma osmotic pressure (COP) in patients receiving crystalloid infusions and in dogs undergoing ovariohysterectomy without any infusion [33]. The perioperative decrease in COP is associated with blood loss and its replacement with hypooncotic solutions, as well as the catabolic phase of protein metabolism, increased vascular wall permeability under conditions of tissue hypoxia and acidosis.

The glycocalyx, in addition to the endothelial cell layer, is an additional unrestricted...(truncated 1714 characters)... structure and functions of pulmonary blood flow, it is important to consider. Researchers have determined that a 50% decrease in COP significantly increases the risk of pulmonary edema, but only in the presence of left ventricular failure, if the end-diastolic pressure in the left ventricle is 10 mmHg.

Demling R.H. and colleagues, in experiments on sheep, found that in hypoproteinemia, the transcapillary filtration rate in the lungs is less dependent on low plasma oncotic pressure but clearly dependent on capillary hydrostatic pressure. On the other hand, V. Velanovich's numerous experimental models and clinical

studies showed no clear correlation between oncotic pressure and the amount of tissue water in the lungs [15].

According to O. Habler, hemotransfusions do not benefit ICU patients suffering from polytrauma and sepsis if they raise hemoglobin above 90 g/L [12]. In this state, the coagulation system is activated, erythrocytes form "rouleaux," and at 30% hematocrit, they are damaged in fibrin networks [13].

According to A. Shander, a person's response to anemia depends on their adaptation capabilities, which manifest individually in each person. Many symptoms associated with anemia may arise from inadequate restoration of circulating volume, and eliminating them requires only normalizing this physiological indicator. Despite a significant decrease in oxygen delivery, its consumption also decreases, and the load on the left heart chamber decreases more than oxygen delivery. This positive compensation occurs due to improved blood viscosity, a significant decrease in total peripheral resistance, and a decrease in filling pressure in the heart chambers [15].

A.V. Koloskov's emphasis highlights the importance of considering hemoglobin levels in patients with cardiovascular diseases, especially in the context of surgical stress. Low hemoglobin levels (less than 100 g/L) increase mortality risk in such cases. The role of myocardial ischemia, which often manifests postoperatively but is masked by anesthetics, is also emphasized, leading to delayed signaling of cardiovascular decompensation [16].

Some researchers note that red blood cells play an important role not only in gas transport but also in stabilizing hemostasis when hematocrit is 30% or higher and hemoglobin level is 100 g/L or above [12,13].

In the study by Singbartl K. and colleagues, the critical decrease in plasma fibrinogen concentration (less than 1 g/L) is emphasized as limiting hemodilution [14]. One of several explanations for changes in blood coagulation associated with

hemodilution is the imbalance between anti- and procoagulant mechanisms. Some studies have noted activation of fibrinolysis in the perioperative period. S.G. Reshetnikov attributes this to the suppression of endogenous antifibrinolytics by synthetic colloids and their incorporation into the thrombus structure, resulting in a softer thrombus that is easier to dissolve.

Conclusion: Thus, in the intensive therapy of elderly patients with mechanical jaundice, to achieve successful surgical treatment outcomes, it is necessary to eliminate adverse conditions in hematocrit and hemostasis system disturbances, which can be accomplished through rational and judicious use of infusion solutions. Literature analysis shows that this problem remains unresolved in modern clinical medicine, and the provided data allows specialists to more effectively influence and optimize infusion therapy for the primary pathology.

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