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Management of Disorders of Homeostasis With Saline Enteral Solution in Acute Poisoning With Psychopharmacological Drugs

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BACKGROUND In acute poisoning, accompanied by a violation of the parameters of homeostasis, the problem of its management by the enteral route has been insufficiently studied.

PURPOSE OF THE STUDY To assess the possibility of correcting electrolyte and volemic disorders of the body using an enteral solution (ES) in case of poisoning with psychopharmacological drugs.

MATERIAL AND METHODS The study involved 120 patients who underwent intestinal lavage (IL) with ER on the 1st day in complex therapy. In the following days, 40 of them received infusion therapy, and 80 — drank glucose enteral solution (GES), 3–4 liters per day.

RESULTS IL had a corrective effect on the electrolyte composition of the blood, volemic and hemorheological parameters, as well as on central and peripheral hemodynamics. The subsequent administration of GES had a stabilizing effect on these indicators, comparable to that of infusion therapy.

CONCLUSION In case of poisoning with psychopharmacological drugs, the use of saline enteral solution in the form of intestinal lavage and subsequent oral administration of the same solution in a daily volume of 3–4 liters, but with the addition of glucose, provides correction of impaired homeostasis indicators and may be an alternative to infusion therapy.

Keywords: acute poisoning, saline enteral solution, intestinal lavage, enteral correction of homeostasis disorders

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ABB – acid-base balance
ALT – alanine aminotransferase
AP – acute poisoning
APTT – activated partial thromboplastin time
AST – aspartate aminotransferase
AT – amitriptyline
BE – base excess
BP – blood pressure
CH – central hemodynamics
CPV – circulating plasma volume
EC – enteral correction
ESR – erythrocyte sedimentation rate
GES – glucose enteral solution
GIT – gastrointestinal tract
HR – heart rate
IL – intestinal lavage
INR – International Normalized Ratio
IT – infusion therapy
MAP – mean arterial pressure
MCV – mean erythrocyte volume
PPD – psychopharmacological drugs
RBCAr – index of aggregation of erythrocytes at rest
RBCAe – index of aggregation of erythrocytes during exercise
SES – saline enteral solution
TPT – thromboplastin time

INTRODUCTION

Severe acute poisonings (AP), accounting for about 30% of victims of chemical trauma, are accompanied by violations of vital functions and indicators of body homeostasis: water-electrolyte, acid-base, hemorheological and hemostatic with obstruction of the microcirculatory bloodstream and tissue hypoxia with the subsequent development of systemic inflammatory reaction and severe, often fatal, complications (shock, pneumonia, multiple organ failure) [1, 2].

Intoxication and hypoxia act as the trigger mechanism of the process of violations of homeostasis constants in AP [3], and the key point is imbalance in the water compartments of the body: on the one hand, hypovolemia and hemoconcentration, and on the other, tissue hyperhydration [4]. Fluid retention in tissues is caused by the accumulation of osmotically active substances of exogenous and endogenous origin, an increase in hydrostatic pressure in capillaries with a decrease in systemic blood pressure (BP) or an increase in venous pressure, as well as a decrease in colloidal osmotic blood pressure [4–6]. The consequence of the development of edematous syndrome is a violation of morphology and deterioration of the function of organs and systems. The consequence of the thickening of the alveolar-capillary membrane, an increase in the average volume, changes in the shape and aggregation capacity of erythrocytes are disorders of microcirculation, transmembrane diffusion and oxygen transport, aggravation of oxygen and energy starvation of cells with all the ensuing consequences of homeostasis impairment [4, 5, 7, 8].

Without diminishing the importance of the constantly improving technology of intravenous infusion therapy (IT), some authors consider the possibility of intensive correction of homeostasis disorders by introducing special fluids into the gastrointestinal tract (GIT) as an additional or alternative treatment [9]. At the same time, two stages are observed, which differ from each other both in technological methods and in the specifics of the composition of the corresponding enteral media, the first is urgent enteral correction (EC) of hypovolemia and metabolic disorders, and then, the second is the replenishment of the lack of energy consumption and constructive material in the body with the help of enteral power supply (EN) [9–12].

To date, the EN technology and the composition of nutritional mixtures are quite well developed: there are a lot of scientific publications, manuals and guidelines dedicated to this therapeutic area [9, 10]. We cannot say that about EC, which has absolutely been dominated by IT. Researchers still do not have a consensus on both the fundamental issues of the possibility of its use in clinical practice, and on the issues of technological methods and composition of infusion media.

At the same time, EC in comparison with IT is a simpler and safer way and, which is especially important, corresponds to the natural processes of intake and assimilation of nutrients. It should be noted that the rate of intake of nutrients from the gastrointestinal tract into the internal environment is regulated by mechanisms that ensure their entry from the gastrointestinal tract into the internal environment in an optimal manner. This makes it possible to create a reserve volume of nutrients in the gastrointestinal tract for the purpose of their gradual demand in accordance with the needs of the body [12]. M.F. Zarivchatsky (1990) found that blood loss in the amount of up to 30 ml/kg was accompanied by increased intestinal absorption, and surgical interventions on the abdominal organs initially inhibited it [12].

It is recommended to start EC urgently, immediately after, for example, gastroduodenal bleeding arrest, major surgery, as well as in concomitant injuries and other critical conditions [11-13, 15-19]. Solutions and mixtures of various compositions, including original formulations, have been suggested to perform EC [12, 14, 18]. I.B. Ershova et al. (2012) recommended to use solutions with a glucose content in a concentration of 1–2%, based on the generalization of literature data on the use of various enteral mixtures, which ensures the maximum rate of their absorption, comparable to parenteral drip administration [20]. Solutions with low osmolarity are absorbed faster than ones with high osmolarity. For EC of acute blood loss, it is recommended to use a monomeric-electrolyte, glucose-salt and multicomponent solution based on gelatinol [12]. Solutions and liquid mixtures for EC are administered orally (as a drink) or injected through a tube inserted into the stomach or into the small intestine. In order to avoid a laxative effect, the rate of administration of fluids should not exceed 30 ml/min, and the total volume may be 2.5–5.0 liters in case of blood loss and 2.5–3.0 in the immediate postoperative period [12].

According to the results of numerous studies, EC allows you to verify the deviations from the norm in the indicators of water-electrolyte balance and acid-base balance (ABB). Reducing the volume deficit of circulating blood by increasing the volume of circulating plasma (CPV) and the corresponding hemodilution contribute to the improvement of microcirculation and indicators of central hemodynamics (CH), oxygen transport function of blood, transcapillary metabolism and hemostatic potential, activation of gastrointestinal motility [12, 17, 18, 21-23]. In patients with acute surgical infection of soft tissues, EC after wound debridement had a detoxifying effect, caused activation of phagocytosis, restoration of cellular and humoral immunity, and acceleration of tissue regeneration [12].

Despite the undoubted efficiency of EC, its technical simplicity and low cost, it is far from being widely used. This is probably associated with the dominant idea of the functional failure of the intestinal absorption capacity in the early post-aggressive period on the one hand and the lack of a unified methodological approach of specialists to EC on the other hand [24, 25]. Accidental, empirically selected solutions and nutritional mixtures for enteral administration may not only be ineffective, but also hazardous to the patient's health. From the literature it follows that the most suitable for EC are chyme-like liquids [19, 22, 25]. Y.M. Galperin et al. suggested saline enteral solution (ES) and monomeric electrolyte solutions, similar in macroelement composition to chyme, for the correction of metabolic disorders in surgical patients by intra- and postoperative intra-intestinal probe administration [17, 19, 26]. In AP, the effectiveness of EC has not been sufficiently studied; there are only a few works on to this topic [27].

MATERIAL AND METHODS

We examined 120 patients, whose average age was 42 (36; 52) years. Of these, 60% were women, and 40% were men with psychopharmacological drugs (PPD) acute poisoning of severe degree Glasgow coma scale score 3-5) - amitriptyline (20 patients), barbiturates (20 patients), phenothiazine and benzodiazepine derivatives (80).

In order to detoxify all patients upon admission (on the 1st day), intestinal lavage (IL) using saline ES was included in the treatment complex. On the next day after IL, to maintain physiological constants, 80 out of the total number of patients were prescribed for fractional oral administration of saline ER, additionally containing glucose (study group). In the second group (comparison) of 40 patients on the next day after IL, IT was used to maintain homeostasis indicators. All patients were admitted to the Acute Poisoning Department of the N.V. Sklifosovsky Research Institute for Emergency Medicine.

The study of homeostasis indicators of patients was carried out upon admission to the hospital, 1, 3 and 5 days later. The effect of EC on the electrolyte, acid-base, biochemical composition, blood osmolality, hematocrit, coagulogram indices, hemorheology, as well as mean arterial pressure and heart rate was assessed. In patients with amitriptyline (AT) poisoning, an electrocardiogram was additionally recorded, a QRS value of more than 0.12 s in combination with cardiac arrhythmias was regarded as a primary cardiotoxic effect.

Clinical blood analysis was performed on an Advia 120 hematological analyzer (Bayer, Germany). The level of hematocrit, hemoglobin, the number of RBC, platelets, leukocyte formula were recorded.

The acid-base balance, blood gases and electrolytes were determined on an automatic analyzer Stat Profile CCX-1 (Nova Biomedical, USA).

The biochemical blood test was performed on an automatic analyzer Sapphire-400 (Hirose Electronic System, Japan), the following parameters were assessed: total protein and albumin, glucose, urea and creatinine in the blood, the enzyme spectrum was investigated: the activity of aminotransferases and blood β-amylase.

The effect of EC on hemorheological parameters was assessed - plasma and blood viscosity, viscoelasticity, index of red blood cells aggregation at rest (RBSAr) and during exercise (RBSAe), hemostasis - the number and aggregation of platelets, fibrinogen, prothrombin, activated partial thromboplastin time (APTT) and international ratio (INR).

The apparent viscosity of blood was determined in the mode of decreasing the shear rate (γ) from 250 to 2.5 s^{-1} with AKR-2 rotary viscometer (Russia), the viscoelasticity of blood at shear rates of 62.8, 12.6 and 2.5 s^{-1} - with Bioprofiler capillary viscometer (USA). RBC aggregation activity was measured with MA-1 aggregometer (Myrenne GmbH, Germany), collagen-induced platelet aggregation - with Chrono-log model 590 aggregometer (USA). Hematocrit and platelet count were determined with Act diff 2 Beckman Coulter hematology analyzer (USA), hemostasis parameters - plasma fibrinogen content, INR, APTT, thrombin test - with SA 1500 coagulometer (Sysmex, Japan).

Mean arterial pressure (MAP) was calculated using the Wetzler and Roger formula:

$MAP = (0.43 \times BP_{syst}) + (0.58 \times BP_{diast})$.

All patients, upon admission to the department, underwent IL according to the well-known technique using saline ES in a volume of 12–16 L [28]. On the next day, the patients of the comparison group had colloid and crystalloid solutions intravenously in a volume of 3-4 liters per day. Patients of the observed group had oral saline ES in a volume of 3-4 L per day with an additional glucose content at the rate of 3 g/L - glucose enteric solution (GES). The pH of the solution was 5.5–5.8; the osmolarity of the solution was about 260–290 mOsm/L (adjustable, depends on the volume of the solvent) [29, 30].

The solution was prepared immediately before use from concentrates mass-produced by a domestic manufacturer.

After the patients became conscious (6-12 hours after IL) and their condition was still regarded as severe, fractional (150-200 ml) oral administration of GES was started at the rate of 3-4 liters with a uniform distribution of this volume during the day. Initially, GES was administered through a nasogastric probe, and when patients could drink, they were given it orally. In this regimen, patients received GES for 3-5 days (until a satisfactory condition was achieved).

Patients in the comparison group with PPD poisoning (40 people) received standard therapy, which included IL upon admission to the hospital and IT - intravenous drip of crystalloid and colloid solutions in a volume of 3-4 liters per day for 5 days. The balance of daily volumes of injected and excreted fluid in patients of both groups was maintained by prescribing diuretics.

STATISTICAL PROCESSING OF RESULTS

Statistical processing of the data was carried out using the Microsoft Office Excel and StatSoft STATISTICA 10 software package. When the data distribution differed from normal, the Mann-Whitney test and the median test (25 and 75% percentiles) were used to compare independent samples, and Wilcoxon test was used for dependent samples (paired comparison) . Differences were considered statistically significant at $p < 0.05$.

RESULTS

Table 1 shows the indicators of water-electrolyte metabolism, ABB and blood gases in case of poisoning with AT, barbiturates and combined poisoning with PPD (derivatives of phenothiazine and benzodiazepine).

Table 1

Influence of intestinal lavage on indicators of water-electrolyte and acid-base balance of patients with poisoning with amitriptyline, barbiturates and psychopharmacological drugs

Indicators		Reference values	Stages research	Groups of patients with poisoning		
				AT (*n* = 20)	Barbiturates (*n* = 20)	PPD (*n* = 40)
Hematocrit, vol.%		35–48	Before IL	44.9 (37.8; 53.0)	48.5 (43.0; 55.0)	45.8 (40.3; 52.3)
			After IL	35.0 * (29.7; 41.1)	33.7 * (27.7; 40.3)	36.6 * (3 0.3; 43.7)
			Δ,%	-22	-30.5	-20.1
Blood plasma electrolytes, mmol/L	K^+	3.5-5.1	Before IL	3.4 (2.8; 4.0)	3.7 (3.3; 4.3)	3.6 (3.1; 3.9)
			After IL	3.7 (3.4; 4.0)	3.7 (3.4; 4.2)	3.9 (3.3; 4.1)
			Δ,%	8.8	0.0	8.3
	Na^+	135-146	Before IL	141.1 (132.4; 147.0)	143.7 (138.8; 145.8)	141.4 (134.4; 145.6)
			After IL	137.0 (134.3; 142.5)	137.9 * (136.8; 141.8)	138.3 (135.5; 143.9)
			Δ,%	-2.9	-4.0	-2.2
ABB (venous blood)	pH	7.35-7.45	Before IL	7.2 (7.2; 7.4)	7.32 (7.26; 7.40)	7.34 (7.26; 7.41)
			After IL	7.47 * (7.37; 7 , 43)	7.40 (7.35; 7.43)	7.40 (7.32; 7.46)
			Δ,%	3.7	1.1	0.8
	BE, mmol/L	(-) 2.3 - (+) 2.3	Before IL	-4.7 (-8.2; -1.2)	-4.0 (-6.8; -1.2)	-6.0 (-9.4; -2.4)
			After IL	-4.1 (-6.6; -1.6)	-2.9 (-5.7; -0.1)	-3.0 * (-5.8; -0.2)
			Δ,%	12.8	27.5	50.0

Notes: * - statistically significant differences from the baseline in groups with the same type of poisoning ($p < 0.05$ according to Wilcoxon's test). Δ,% to the initial value of indicators. ABB - acid-base balance; AT - amitriptyline; BE - base excess; IL - intestinal lavage; PPD - psychopharmacological drugs

According to the Table 1 data, upon admission, patients had sub- and compensated blood acidosis, the concentration of potassium ions was close to the lower limit of the norm. After IL, a 20–30% decrease in hematocrit was observed, and a

tendency toward a decrease in sodium content to the lower limit of the reference value and an increase in the concentration of potassium ions in plasma within the normal range was observed as well. With the initially noted metabolic acidosis of the blood, it was corrected by reducing the deficit of buffer bases (BE) by 12.8–50%.

A more detailed analysis of the research results revealed three variants of changes in the studied parameters after IL: they did not change, increased or decreased.

Table 2 shows the results of the effect of IL on the concentration of blood electrolytes, osmolality and average erythrocyte volume in the studied patients.

As can be seen from Table 2, after IL in most observations (60%), the concentration of sodium ions with the initial value of 139.9 mmol/L did not change statistically significantly, in 24.2% of cases (the initial mean value 130.2 mmol/L) it statistically significantly increased to an average level of 138.1 mmol/L, and in 15.8% of observations with an initial mean value of 140.3 mmol/L, it decreased to an average level of 131.3 mmol/L.

Table 2

Influence of intestinal lavage on the concentration of blood electrolytes, osmolality and average erythrocyte volume in case of poisoning with psychopharmacological drugs (n = 120)

Blood indicators	Reference values	The nature of the change in the values of indicators after intestinal lavage								
		Decrease			Without changes			Increase		
		Before IL	After IL	Specific weight,%	Before IL	After IL	Specific weight,%	Before IL	After IL	Specific weight,%
Sodium, mmol/L	135-146	140.3 (124.5; 153.3)	131 , 3 (119.7; 145.5)	15.8	139.9 (138.1; 141.7)	139.3 (136.9; 141.7)	60.0	130.2 (128.6; 134.4)	138.1 * (136.6; 142.4)	24.2
Potassium, mmol/L	3.5-5.1	3.7 (1.9; 5.5)	3.2 (2.9; 3.5)	9.2	3.6 (3.3; 3.9)	3.7 (3.4; 4.0)	23.3	2.9 (2.6; 3.2)	3.7 * (3.4; 4 , 0)	67.5
Calcium, mmol/L	1.0-1.15	0.98 (0.76; 1.18)	0.62 * (0.43; 0.79)	21,7	0.56 (0.36; 0.78)	0.63 (0.41; 0.83)	20.0	0.37 (0.28; 0.46)	0.7 * (0.6; 0.8)	58.3
Magnesium, mmol/L	0.45-0.6	0.49 (0.37; 0.61)	0.38 (0.17; 0.59)	17.5	0.38 (0.26; 0, 50)	0.37 (0.28; 0.46)	24.2	0.14 (0.08; 0.20)	0.38 * (0.29; 0.47)	58.3
Chlorine, mmol/L	98-106	109.8 (99.9; 117.5)	101 (93; 112)	100	-	-	-	-	-	-
Osmolality, mOsm/kg	275-296	292 (285; 294)	278 * (273; 288)	21,7	279.9 (275.6; 283.8)	281 (274; 283)	36.7	268.6 (262.2; 280.4)	282.7 * (282.4; 288.8)	41.6
MCV, fl	80–95	89 (87; 92)	86.8 * (83.0; 88.8)	28.3	84.0 (82.4; 87.2)	83.9 (82.3; 87.1)	40.0	83.0 (81.2; 86.4)	88.0 * (84.2; 90.0)	31.7

Notes: * - statistically significant difference from the baseline indicator ($p < 0.05$ according to Wilcoxon's test). IL - intestinal lavage; MCV - mean corpuscular volume

The similar picture after the IL was observed in relation to other indicators. Thus, the concentration of potassium ions did not change if its initial value was 3.6 mmol/L, which was observed in 23.3% of cases. In the prevailing number of observations (67.5%), hypokalemia was initially noted (the average value was 2.9 mmol/L), with a statistically significant normalization of this indicator after IL (3.7 mmol/L at $p < 0.05$). The concentration of calcium and magnesium ions in blood plasma in 58.3% of cases with an initial low level increased after IL with a statistically significant difference in values ($p < 0.05$). The concentration of chlorine ions in all cases after IL decreased moderately within the range of reference values.

The osmolality of blood plasma at a value of about 280 mOsm/kg, which was observed in 36.7% of cases, did not change after IL. With initially lower values (268.6 mOsm/kg in 41.8%), it increased to 282.7 mOsm/kg with a statistically significant difference in values ($p < 0.05$). In 21.7% of cases, blood plasma osmolality before IL was 292 mOsm/kg and was in the range of reference values; nevertheless, after IL it decreased to 278 mOsm/kg ($p < 0.05$).

In 40% of cases, the mean corpuscular volume (MCV) with an initial value of 84 (82.4; 87.2) fl after IL remained unchanged, in 28.3% of cases with values over 89 fl - it statistically significantly decreased to 86.8 fl ($p < 0.05$), and in 31.7% of observations the MCV with 83 fL increased statistically significantly to the size of 88.0 fl ($p < 0.05$).

Thus, our study showed that IL did not have a significant effect on the studied parameters if they initially occupied an average position in the range of reference values. At the same time, their most high or most low indices shifted after IL to the average level of this range.

Table 3 shows the values of blood counts before and after IL in AP PPD.

Table 3

Influence of intestinal lavage on the acid-base status of blood in case of poisoning with psychopharmacological drugs

Blood indicators	Reference values	The nature of the change in the values of indicators after intestinal lavage								
		Decrease			Without changes			Incresae		
		Before IL	After IL	Specific weight,%	Before IL	After IL	Specific weight,%	Before IL	After IL	Specific weight,%
pH	7.35-7.45	-	-	-	7.4 (7.3; 7.6)	7.4 (7.2; 7.5)	65.0	7.29 (7.22; 7.40)	7.42 * (7.37; 7.49)	35.0
BE, mmol/L	-2.3 - (+) 2.3	-8.8 (-12.1; -5.1)	-1.7 * (-3.4; 0.4)	28.3	-0.6 (-4.9; 3.3)	-0.6 (-6.9; 7.1)	71.7	-	-	-
HCO_3, mmol/L	21.8-27.2	30.5 (26.4; 36.6)	26.9 * (25.9; 28.5)	25.8	26.2 (24.9; 27.5)	25.9 (23.5; 27.9)	43.3	20.3 (19.2; 21.8)	26.3 * (24.8; 28.0)	30.9
Lactate, mmol/L	0.7-2.5	3.67 (2.68; 4.58)	0.96 * (0.39; 1.65)	32.5	1,2 (1, 0; 1.4)	1.16 (0.99; 1.31)	67.5	-	-	-

Notes: * - statistically significant difference from the baseline indicator ($p < 0.05$ according to Wilcoxon's test). IL - intestinal lavage; BE - base excess

In 35% of observations before IL, there was a shift in pH to the acidic zone, in 28.3% there was a deficiency of bases, in 30.9% - a lack of bicarbonate, and in 32.5% - an excess of lactate. Such indicators of CBS testified to the presence of metabolic acidosis in 1/3 of patients with AP PPD. After IL, the concentration of lactate in the blood decreased 3.8 times and became normal, the content of bicarbonate increased 1.3 times, and the base deficit decreased 5.2 times; In this case, the pH of the blood increased to normal values. These changes were statistically significant ($p < 0.05$) and indicated the elimination of metabolic acidosis.

Along with this, in 25.8% of patients, initially there was an increased content of bicarbonate in the blood. After IL, its level decreased by 11.8% ($p < 0.05$) to the normal value. In the rest of the patients, the ABB indices were within the normal range and did not change significantly after IL.

Comparative characteristics of oxygen tension in arterial and venous blood of patients with AP PPD, who were on spontaneous breathing, before and after IL are presented in Table 4.

Table 4

Dynamics of oxygen tension in arterial and venous blood of patients with poisoning with psychopharmacological drugs before and after intestinal lavage (n = 20)

Indicator and type of the blood sample		Reference values	Research stages		Δ,%	The difference in pO_2 in arterial and venous blood		Δ,%
			Before IL	After IL		Before IL	After IL	
pO_2, mm Hg	arterial	80–95	71.4 (64.7; 78.5)	133.0 * (119.9; 145.3)	86.3	46.5 (35.3; 58.3)	91.8 * (77.3; 104.5)	97.4
	venous	35–49	40.2 (36.5; 44.9)	41.9 (40.5; 43.7)	4.23			

Notes: * - statistically significant difference from the initial indicator ($p < 0.05$ according to the Mann – Whitney test); Δ,% with the initial value. IL - intestinal lavage

As can be seen from Table 4, oxygen tension in arterial blood after IL increased by 86.3%, and in venous blood by 4.23%. In this case, the difference in pO_2 of arterial and venous blood increased by 97.4%, which indicates an increase in cellular oxygen consumption.

The analysis of the state of indicators of the blood coagulation system in patients before and after IL, the which results are presented in Table 5, did not reveal significant changes in the coagulogram indices, which were within the normal range, except for the INR, which turned out to be slightly higher than the upper limit of the reference value.

Table 5

Coagulogram before and after intestinal lavage in case of poisoning with psychopharmacological drugs

Indicators	Reference values	Before IL	After IL
Fibrinogen, g/l	1.8-4.0	2.9 (2.5; 3.4)	3.1 (2.6; 5.0)
Thrombin test, s	15–20	15.4 (13.2; 18.0)	15.9 (14.0; 18.2)
APTT, s	25–35	3 1.5 (23.9; 39.7)	30.0 (27.3; 32.1)
Fibrinolytic activity of plasma, min	5-12	10.0 (8.0; 12.2)	11.4 (10.4; 12.2)
INR	0.85-1.15	1.19 (0.83; 1.53)	1.3 (1.1; 1.5)

Notes: APTT - activated partial thromboplastin time; IL - intestinal lavage; INR - international normalized ratio

The analysis of the hemorheological status in patients with PPD poisoning (Tables 6, 7) revealed signs of increased viscosity syndrome in 79% of cases, characterized by an increase in hematocrit up to 49.8 vol.%, an increase in the parameters of apparent blood viscosity up to 5.9 mPa · s (by 15.5%) at a high shear rate of 250 s^{-1} and up to 13.3 mPa· s (by 38.4%) at a low shear rate of 10 s^{-1}. The relative viscosity of the blood was 7.2 mPa · s, which exceeded the norm by 34.6%. The RBC aggregation index was 16.7. The platelet aggregation capacity was 15.1%.

Table 6

Influence of intestinal lavage on hemorheological characteristics in case of poisoning with psychopharmacological drugs

Indicators	Research stages			
	Reference values	Before IL	After IL	Δ,%
Hematocrit, vol.%	39.6-43.1	49.8 * (44.9; 53.7)	43.0 ** (40.5; 46.3)	-13.7
Apparent blood viscosity, mPa s: - shear rate 250 s^{-1} - shear rate 10 s^{-1}	 4.61-4.87 8.87-9.61	 5.9 * (5.2; 6.4) 13.3 * (11.0; 15.8)	 5.1 ** (4.6; 5.8) 10.7 ** (8.5; 12.7)	 -13.6 -19.5
Specific viscosity of blood, mPa s: - shear rate 10 s^{-1}	0.19-0.21	0.27 (0.21; 0.33)	0.21 ** (0.18; 0.24)	-22.2
Relative blood viscosity, mPa s	4.87-5.35	7.2 * (6.2; 8.0)	4.8 ** (4.5; 5.1)	-33.3
Plasma viscosity, mPa s	1.78-1.9	2.06 (1.75; 2.33)	1.81 ** (1.67; 1.91)	-12.1
RBC aggregation index	15.02-16.18	16.7 (14.0; 19.8)	15.01 ** (14.1; 16.02)	-10.1
Platelet count, 10^{9}/l	187-204	220 (160.5; 246)	168 (140.0; 239.0)	-23.6
Platelet aggregation,%.	9.9-17.1	15.1 (12.1; 18.5)	11.8 ** (9.9; 13.5)	-21.9
Blood clotting time, min	6.81-8.07	5.87 (4.46; 7.40)	9.3 ** (8.3; 10.1)	58.4

Notes: * - statistically significant difference with the norm indicator ($p < 0.05$ according to the Mann - Whitney test), ** - with the baseline indicator, ($p < 0.05$ according to the Wilcoxon test); Δ,% to the initial indicator. IL - intestinal lavage

Table 7

Indicators of hemorheology of patients in the study and the comparison group with poisoning with psychopharmacological drugs

Indicators		Norm	Research stages					
			1st day		3rd day		5th day	
			Study group	Comparison group	Study group	Comparison group	Study group	Comparison group
Hematocrit,%		40.4 (40.05; 40.76)	33.3 (30.5; 36.5) *	38.8 (32.5; 41.2) **	31.7 (29.3; 39.9) *	41.0 (35.0; 43.0) **	33.6 (31.1; 38.5) *	42.2 (29.2; 44.5) **
Apparent blood viscosity, mPa s at 250 s^{-1}		4.9 (4.84; 4.96)	4.5 (4.0; 5.0)	4.5 (4.5; 5.05)	4.75 (4.5; 5.0)	5, 4 (4.0; 5.6) **	4.80 (4.1; 5.5)	5.2 (3.8; 5.7)
Apparent viscosity of blood, mPa s at 10 s^{-1}		9.50 (5.46; 9.54)	6.85 (4.7; 9.0)	7.8 (7.1; 9.67)	6.85 (6.6; 7.1)	12.2 (8.1; 13.9) **	6.7 (5.5; 10.0)	11.4 (6.7; 14.6) **
Plasma viscosity, mPa s		1.80 (1.78 ; 1.82)	1.32 (1.25; 1.60) *	1.95 (1.8; 2.1) **	1.42 (1.41; 1.8)	2.35 (1.8; 2.5) *; **	1.74 (1.56; 2.2)	2.3 (1.67; 2.62) *; **
Blood viscosity, mPa s at shear rate	2.5 s^{-1}	5.9 (5.75; 6.05)	3.13 (2.89; 3.20) *	3.39 (2.67; 5.76) *	2.75 (2.51; 4.21) *	4.03 (3.55; 5.55) **	4.06 (2.89; 6.99)	4.0 (3.56; 6.5)
	12.6 s^{-1}	4.8 (4.68; 4.92)	2.54 (2.24; 2.68) *	3.01 (2.54; 5.2) *	2.45 (1.99; 3.74) *	3.14 (2.67; 4.46) *	3.38 (2.34; 5.35)	3.83 (3.44; 5.4)
	62.8 s^{-1}	4.1 (4.02; 4.18)	2.82 (2.19; 3.17) *	3 , 1 (2.28; 4.68) *	2.29 (1.94; 2.78) *	3.69 (3.2; 4.01) **	2.96 (2.29; 4.06)	3.63 (3.06; 4.53)
Viscoelasticity, mPa s, at shear rate	2.5 s^{-1}	3.13 (3.02; 3.24)	1.27 (1.08; 1.31) *	1.67 (1.22; 2.92) *	1.18 (0.79; 2.19) *	2.01 (1.74; 3.07) *	2.04 (1.09; 3.1)	1.99 (1.73; 4.24) *
	12.6 s^{-1}	1.55 (1.48; 1.62)	0.63 (0.50; 0.75) *	0.74 (0.05; 1.95) *	0.83 (0.48; 1.3) *	1.01 (0.64; 1.29) *	0.82 (0.66; 1.43)	0.86 (0.69; 2.04)
	62.8 s^{-1}	0.61 (0.57; 0.65)	0.24 (0.13; 0.28) *	0.60 (0.28; 0.63) **	0, 26 (0.18; 0.32) *	0.58 (0.19; 0.70) **	0.23 (0.15; 0.40) *	0.48 (0.21; 0.87) *

Notes: * - statistically significant difference from the norm; ** - intergroup difference ($p < 0.05$ according to the Mann – Whitney test)

After IL, patients showed a decrease in the hematocrit number (on average by 13.7 vol.%). The initially high parameters of blood viscosity after IL decreased, approaching the physiological level. The apparent viscosity of blood decreased on average by 13.6% at a shear rate of 250 s^{-1}, and at a shear rate of 10 s^{-1} by 19.5%. The specific viscosity of blood at a shear rate of 10 s^{-1} decreased by 22.2%, and the relative viscosity by 33.3%. Plasma viscosity decreased by an average of 12.2%. RBC aggregation tended to decrease by 12.1%, and platelet aggregation ability decreased after IL by 21.9%. The blood clotting time increased from 5.87 to 9.3 minutes. The observed dynamics of hemorheological parameters indicated the onset of hemodilution and an improvement in capillary blood flow.

One day after IL, changes in hemorheological parameters were characterized by a further decrease in hematocrit in the observed group to the level of 33.3 vol.%, And in the comparison group - to 38.8 vol.% (See Table 7). Table 7 shows that on the 3rd and 5th day the hematocrit in the observed group remained at the level of 31.7–33.6 vol.%, while in the comparison group it increased on the 3rd day on average to the level 41.0, and on the 5th day - up to 42.2 vol.%. The tendency to blood thickening in patients of the comparison group by the 3-5th day was accompanied by a recurrence of an increase in its viscosity characteristics (apparent blood viscosity at shear rates of 250 s^{-1} and 10 s^{-1}), as well as plasma viscosity, while in the observed group these indicators at all stages of the study remained within the normal range.

The index of RBC aggregation at rest (RBCAr) in both groups of patients was within the normal range during the first 3 days, and on the 5th day there was a tendency to its increase (Table 8). The index of RBC aggregation during exercise (RBCAe) exceeded the normal value at all stages of observation, starting from the 1st day. Platelet aggregation on the 1st day after IL remained at the normal level, and subsequently tended to increase. In the comparison group, this indicator exceeded the normal value at all stages of observation. The platelet count remained within the normal range.

Table 8

The state of aggregation of erythrocytes and platelets in the study and the comparison group at the stages of the study in case of poisoning with psychopharmacological drugs

Indicators	Norm	Research stages					
		1st day		3rd day		5th day	
		Study group	Comparison group	Study group	Comparison group	Study group	Comparison group
Index of RBC aggregation at rest (RBCAr)	15.6 (15.02; 16.18)	10.7 (5.60; 11.6) [2]	12.09 (11.8; 18.54)	15.2 (12.0; 22.6)	14.73 (13.1; 20.45)	16.5 (12.9; 19.3) [1]	16.1 (12.4; 22.4)
RBC aggregation index (RBCAe)	18.19 (18.17; 19.63)	19.7 (15.9; 24.2)	20.4 (19.7; 28.6)	25.2 (20.1; 35.8)	28.02 (26.0; 33.3) 2	27.7 (25.9; 31.2) [1]	30.5 (27.3; 33.5) [2; 3]
Platelet aggregation,% op.pl.	13.0 (12.6; 13.6)	13.0 (4.0; 16.0)	14.0 (5.3; 17.3)	20.0 (9.0; 24.0)	19.0 (16.5; 18.9)	14.0 (8.0; 20.0)	17.2 (14.2; 18.3)
Platelet count, 10 [9]/l	196 (187.6; 204.4)	229 (173; 278)	194 (126; 242)	235 (192.0; 276.0)	186 (129; 199)	319 (167; 567)	221 (134.5; 275.5)

Thus, IL (saline ES) and subsequent EC with the help of GES had a positive effect on the viscosity potential of blood, contributed to the correction of its hyperviscosity and a decrease in the aggregation properties of res blood cells and platelets. At the same time, the analysis of the hemorheological status of patients in the comparison group revealed signs of recurrence of the hyperviscosity syndrome on the 3rd and 5th days.

In severe AT poisoning, cardiotoxic effect was observed in 20% of patients in the period prior to the onset of IL, which was not detected after IL.

In patients of the same group with initially low blood pressure, IL was accompanied by the disappearance of pallor skin and mucous membrane of the lips, the "marble" pattern on the skin of the extremities. The skin became pink and warm. Stabilization of blood pressure was confirmed by its normal numbers. According to the nature of the initial values of the studied hemodynamic parameters and their changes after IL, the results were divided into three categories - increase/decrease or no changes.

Table 9 shows the results of recording the heart rate (HR) and MAP in 20 patients with severe AT poisoning before and after IL.

Table 9

Influence of intestinal lavage on hemodynamic disturbances in severe amitriptyline poisoning (n = 20)

Options	The changes in heart rate and systolic blood pressure after IL										
	Increase				Decrease				Stability		
	Before IL	After IL	Δ,%	Specific weight,%	Before IL	After IL	Δ,%	Specific weight,%	Before IL	After IL	Specific weight,%
Heart rate	89 (74; 103)	95.5 (86.2; 106.8)	7.3	15.0	114.0 (102.0; 123.8)	92.7 * (87.4; 99.8)	-18.7	50.0	95 (85; 106)	94.5 (84.9; 106.1)	35.0
MAP	87.8 (81.3; 92.5)	97.9 * (91.8; 106.0)	11.5	55.0	109.9 (105.6; 112)	93.4 (82.2; 106.4)	-15.0	20.0	93.5 (85.9; 100.7)	92.7 (85.2; 100.0)	25.0

Notes: SAD norm - 92.1 ± 1.5; * - statistical significance of the difference with the baseline indicator (p <0.05 according to Wilcoxon's test). IL - intestinal lavage; MAP - mean arterial pressure

According to the data obtained, 50% of these patients had tachycardia in excess of 110 beats per minute (bpm) before the onset of IL. After IL, these patients showed a decrease in heart rate by an average of 18%. In another category of patients with this pathology, which amounted to 15% of the total number, the heart rate after IL against the background of the initial tachycardia (on average 89 beats/min) increased on average to 95.5 beats/min, and in 35% of cases the initial value, averaging 95 beats/min, remained the same after IL. It should be noted that an increase in heart rate in some or a decrease in others after IL in comparison with baseline values was statistically significant (p <0.05).

Table 9 also shows that arterial hypotension was observed in 55% of cases of AT poisoning before IL. After IL in these cases, MAP increased by an average of 11.5% and reached a normal value. In another category of patients with the same poisoning, with an initial value exceeding 91 mm Hg, MAP after IL decreased by an average of 15% and stabilized within the normal range. Baseline MAP values were within 93.5 mm Hg. after IL remained the same.

As a result, heart rate in patients with severe AT poisoning, regardless of the initial value after IL, stabilized within 92.7–95.5 per minute, and MAP after IL, regardless of the initial level, was set in the range of 92.7–97.9 mmHg.

The effect of IL on the state of blood biochemical parameters is presented in Table 10.

Table 10

The influence of intestinal lavage on the biochemical parameters of the blood of patients with poisoning with psychopharmacological drugs

Indicators	Reference values	The change in indicators after intestinal lavage:							
		Decrease			No changes		Increase		
		Before IL	After IL	Specific weight,%	to IL	After IL	Before IL	After IL	Specific weight,%
Total protein, g/l	66-83	65.2 (60.4; 67.4)	61.9 * (58.1; 63.3)	85.0	-	-	43.9 (42.9; 45.3)	66.7 * (64.7; 68.3)	15.0
Urea, mmol/l	1.8-7.2	-	-	-	4.4 (3.9; 5.1)	4.6 (2.9; 6.5)	-	-	-
Creatinine, μmol/L	58–96	-	-	-	82.7 (70; 95)	83.6 (69.7; 96.7)	-	-	-
Total bilirubin, μmol/l	5.1-21	-	-	-	7.3 (5.8; 9.4)	8.5 (6.7; 10.9)	-	-	-
λ-amylase, U/L	20-100	-	-	-	47.4 (8.4; 89.0)	39.8 (17.5; 62.7)	-	-	-
ALT, U/L	5–49	-	-	-	20.4 (8.7; 31.7)	21.9 (11; 32)	-	-	-
AST, U/L	9–48	-	-	-	18.7 (11.0; 26.8)	17.8 (13.5; 21.7)	-	-	-

Notes: * - statistical significance of the difference with the baseline indicator ($p < 0.05$ according to Wilcoxon's test). ALT - alanine aminotransferase; AST - aspartate aminotransferase; IL - intestinal lavage

Table 10 shows that in 85% of cases the concentration of total protein in blood plasma was at the level of the lower limit of the reference value. After the IL, it decreased by another 5.1%. In 15% of cases, with an initially reduced concentration of total protein in blood plasma (43.9 g/l), its growth after IL to normal value was noted. In these cases, the differences in protein concentration values before and after IL were statistically significant.

In case of PPD poisoning, the indices of the content of urea, creatinine and bilirubin in the blood were within the reference values. They did not change after the IL. The initially normal values of transaminases (alanine aminotransferase - ALT and aspartate aminotransferase - AST) also remained unchanged after IL. The level of λ-amylase decreased on average by 16.3% in the range of normal values.

Table 11 shows the dynamics of peripheral blood parameters in patients with severe AP PPD before and after IL.

Table 11

Influence of intestinal lavage on peripheral blood parameters in patients with severe poisoning with psychopharmacological drugs

Indicators	Reference values	Changes in indicators after intestinal lavage								
		Decrease			No changes			Increase		
		Before IL	After IL	Specific weight,%	Before IL	After IL	Specific weight,%	Before IL	After IL	Specific weight,%
Red blood cells, 10^{12}/l	3.9-5.4	5.1 (4.9; 5.5) 4.2 (3.9; 4.5)	4.2 (3.7; 4.9) * 4.0 (3.7; 4.3)	15.8 78.3	- -	- -	- -	3.5 (3.2; 3.8) -	4.1 (3.6; 4.8) * -	5.9 -
Hemoglobin, g/l	120-165	148.6 (141.2; 156.4)	129.0 * (121.8; 135.0)	51.7	125.1 (118.2; 134.6)	123.0 (114.7; 133.1)	35.8	110.1 (98.7; 125.9)	127.1 * (115.6; 141.0)	12.5
Platelets, 10^{9}/l	180-320	-	-	-	243.2 (210.0; 275.8)	245.4 (216.4; 276.6)	60.0	175.0 (146.1; 201.7)	265.2 * (240.6; 295.6)	40.0
White blood cells, 10^{9}/l	4-9	16.2 (12.2; 20.4)	13.5 (8.6; 18.0)	20.0	11.7 (-0.1; 23.9)	13.5 (1.6; 25.0)	49.2	8.5 (5.8; 11.4)	15.1 (11.6; 18.0)	30.8
Lymphocytes,%	20-30	-	-	-	-	-	-	9.7 (6.3; 13.3)	15.7 * (11.8; 19.4)	100
ESR, mm/hour	0–20	-	-	-	-	-	-	10.0 (2.8; 16.8)	16.2 (7.4; 27.0)	100

Notes: * - statistical significance of the difference with the baseline indicator ($p < 0.05$ according to Wilcoxon's test). IL - intestinal lavage; ESR - erythrocyte sedimentation rate

As can be seen from Table 11, in 94.1% of patients after IL, the content of RBC decreased, but within the normal range. Of this number of patients, in 15.8% of observations, the number of RBC decreased by 17.7%, and in 78.3% - by 4.8% from the initial level. The decrease in the content of RBC after IL was the more noticeable, the higher its initial value was. In 5.9% of patients with an initially reduced content of erythrocytes after IL, there was an increase in it on average by 17.1% to the normal value.

The hemoglobin concentration, close to the average value of 125.1 g/l, did not practically change after IL. At higher values - 148 g/l, observed in 51.7% of cases, its concentration decreased after IL to the level of 129 g/l ($p < 0.05$). With initially low values (110.1 g/l) in 12.5% of patients, the hemoglobin concentration increased statistically significantly to a level of 127.1 g/l ($p < 0.05$).

The initially normal platelet count, which was observed in 60% of cases, did not change significantly after IL. In 40%, with initially reduced values, the platelet concentration after IL increased statistically significantly 1.5-fold to the normal level ($p < 0.05$).

The number of WBC in 30.8% of observations with initially normal values after IL increased 1.8-fold. In other cases, the content of WBC ranged from 11.7 to 16.2×10^{9}/l, which exceeded normal values. Of these, in 49.2%, the level of WBC in the blood after IL remained practically unchanged, and in 20% it decreased by 16.7%.

The relative content of lymphocytes in the observed group of patients was initially low. After IL, this indicator statistically significantly increased 1.6-fold ($p < 0.05$), but did not reach the lower limit of the reference values. In all patients, the erythrocyte sedimentation rate (ESR) after IL had a tendency to accelerate within the upper limit of the normal value.

DISCUSSION

As a result of the study, it was found that EC (IL using SES and subsequent oral administration of GES in the amount of 3-4 liters per day) with AP PPD has a multifaceted corrective effect on impaired physiological parameters, which key point is elimination of water-electrolyte and acid - the main imbalance. This result can be explained, on the one hand, by a consequence of the detoxification effect of IL - elimination of the root cause of all disorders, and, on the other hand, by the direct effect of SES on water-electrolyte metabolism through the intestinal wall according to the principle of autoregulation due to the chyme-like physicochemical characteristics of the solution. Thus, the therapeutic mechanisms of EC are based on two processes: the removal of pathological and excess chemicals from the body and the entry of a balanced amount of electrolytes and water into the bloodstream. The presence of glucose in the SES increases the absorption of sodium ions from the intestine into the blood, followed by water, which generally increases the rate of solution absorption [21, 20].

The body receives electrolytes only from the outside, and in this context, SES is a donor of all macronutrients (except nitrogen) in a ratio balanced with chyme [28]. Probably, due to this circumstance, electrolytes in its composition are physiologically included in transmembrane metabolism. This can explain the revealed certain regularity of the "tendency" of physiological indicators to a certain averaged level of values in the range of the reference interval. For example, for sodium ions, this level at AP PPD was 138–139 mmol/L in the range of the reference value 135–146 mmol/L. For potassium ions, this “stress-norm” in AP PPD was 3.6–3.7 mmol/L, and so on. A similar tendency to averaging the values after IL was also characteristic of the parameters of plasma osmolality and the average volume of erythrocytes. Obviously, the value of

osmolality changed or remained stable depending on the concentration of electrolytes and protein, while the average volume of erythrocytes depended on the value of the osmotic pressure of the plasma (see Table 2).

The process of transport of saline solution from the gastrointestinal tract to the bloodstream is associated with the mobilization of proteins and lipoproteins deposited in the intestinal wall and in the liver so that the solution enriched with these components enters the bloodstream in the form of blood plasma [11, 31]. According to K.S. Ternovoy et al. (1984), protein is deposited in the intestine and liver in an amount necessary for the formation of approximately 1 liter of plasma [32]. It is known from the literature that additional enteral support significantly increases the rate of recovery of CPV, the amount of circulating total protein and albumin [11, 12, 19]. In our observations, the concentration of protein in the blood plasma after IL decreased by 5.1% due to hemodilution, while the drop in hematocrit was up to 20–30%. Calculations showed that with such a ratio of decrease in protein concentration and hematocrit, the total amount of circulating protein increased. In other cases (15% of the total number of patients), with an initially reduced concentration of total protein in blood plasma - 43.9 (42.9; 45.3) g/L, its growth was noted after IL to the normal level of 66.7 (64 , 7; 68.3) g/l with a statistically significant difference in values ($p < 0.05$).

An increase in the colloid osmotic pressure of the blood helps to reduce tissue edema due to the return of water to the bloodstream [3, 5]. An increase in CPC, in turn, causes a thinning of the blood, an increase in its fluidity and an improvement in microcirculation, as evidenced by a decrease in hematocrit and an improvement in coagulation and hemorheological characteristics. A decrease in blood viscosity leads to an automatic increase in cardiac output and an improvement in CH parameters [33].

The mechanism of increased oxygenation of blood and tissues as a result of IL can be represented as follows: the transformation of the size of RBC after IL and an increase in the total area of their contact with the capillary endothelium, a decrease in membrane thickness (alveolar-capillary with initial interstitial pulmonary edema, cell membranes) are accompanied by an increase in velocity and volume transmembrane oxygen diffusion, which are known to be directly proportional to the area and inversely proportional to the membrane thickness [7, 34]. Increased blood flow, improved microcirculation and CH contribute to an increase in the rate and volume of blood gas transport.

The management of blood acidosis can be explained by the elimination of excess protons and lactic acid through the mucous membrane into the gastrointestinal tract with their subsequent removal by washing water, as well as due to the absorption and metabolism of acetate, which is part of the salt ES, with its subsequent biochemical transformation (enzymatic conversion) in the liver and striated muscles into bicarbonate. It is known that as a result of metabolism, one mole of bicarbonate is formed from each mole of acetate. Biochemical transformation of acetate occurs along the following path: $CH_3COO^- + CO_2 + H_2O \rightarrow CH_3COOH + HCO_3^-$. This reaction takes place with the participation of acetyl coenzyme (CoA) and adenosine-5-triphosphate (ATP). The metabolic rate of acetate is 5 mmol/min or 300 mmol/h [35]. As a result of bicarbonate formation, blood acidosis is neutralized. The results of this study have shown that acetate resorption during IL occurs selectively, namely, only during blood acidosis. This statement is based on the fact that in none of the observations after IL, metabolic alkalosis was recorded, which would be detected in the case of an excessive intake of acetate in the blood. Initially, the normal values of ABB after IL did not change.

We did not observe any clinically significant reactions and complications of the use of saline ES and GES.

CONILUSION

The results of the study showed that disorders of homeostasis such as of water-electrolyte, acid-base imbalance and an increase in blood viscosity in acute poisonings with psychopharmacological drugs can be successfully corrected by using a saline enteral solution in the form of intestinal lavage and subsequent oral administration of glucose enteral solution. The normalization of the studied parameters mainly occurred in the process of intestinal lavage. The key links in the therapeutic mechanism were the correction of the water-electrolyte balance and the acid-base balance, followed by a cascade of positive reactions and processes of restoring other indicators. Following a session of intestinal lavage, the daily intake of glucose enteral solution in a volume of 3-4 liters maintains physiological constants at the proper level. This implies, that in the complex of methods of enteral correction, the sequential administration of intestinal lavage and the oral use of glucose enteral solution are methodically justified, and in general, the complex of enteral correction may be considered as an alternative to infusion therapy in acute poisoning with psychopharmacological drugs.

FINDINGS

1. The use of saline enteral solution in the process of intestinal lavage helps reduce the hematocrit by 20-30% of the initially increased, while the concentration of sodium and potassium ions in the blood, as well as the values of osmolality and the average volume of red blood cells, initially occupying either extremely low or high positions the reference range, after intestinal lavage are shifted to its mean value.

2. Metabolic acidosis of the blood is managed after intestinal lavage due to an increase in the bicarbonate content by an average of 30% and a decrease in the concentration of lactic acid in the blood by an average of 3.8-fold as well as a decrease in the deficiency of buffer bases by 12.8–50%.

3. Initially increased blood viscosity decreases after intestinal lavage due to its dilution, as evidenced by a decrease in hematocrit, as well as due to a decrease in its viscosity characteristics at different shear rates by 12.1–33.3% and a decrease in the aggregation activity of erythrocytes on average by 10.1, and platelets by 21.9% and an increase in blood clotting time by 58.4%. Such dynamics of hemorheological parameters indicates hemodilution with an improvement in capillary blood flow.

4. Oral intake of saline enteral solution in a daily volume of 3-4 liters helps maintain the hematocrit and viscosity potential of blood at a level close to the lower limit of the norm, while in standard infusion therapy, a relapse of an increase in viscosity is observed by the 3-5th day.

5. In severe amitriptyline poisoning, after intestinal lavage, the number of heart contractions, regardless of the initial values, stabilizes at the level of 92.7–95.5 beats per minute, and the mean arterial pressure is within 92.7–97.9 mm Hg.

6. In case of poisoning with psychopharmacological drugs, the normal values of the studied physiological parameters after intestinal lavage do not change, but initially disturbed ones become normal. Daily oral intake of glucose enteral solution in a volume of 3-4 liters ensures the stability of physiological constants in the period after intestinal lavage.

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