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PERIOPERATIVE WATER BALANCE IN PATIENTS WITH ACUTE ABDOMINAL PATHOLOGY IN A LIBERAL REGIME OF INFUSION THERAPY

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Ключевые слова*: ургентная хирургия, инфузионная терапия, либеральный режим, водный баланс, водные сектора организма*
Ключові слова: *ургентна хірургія, інфузійна терапія, ліберальний режим, водний баланс, водні сектори організму*

Abstract. Perioperative water balance in patients with acute abdominal pathology in a liberal regime of infusion therapy. Kravets O.V. *In order to evaluate the effectiveness of the liberal regime of infusion therapy, we examined 50 patients with acute abdominal pathology considering the state of the water sectors of the body. We established that liberal regime of infusion causes hypervolemia and hyperhydration of peripheral tissues during the first 6 hours of the perioperative period, it retains a moderate deficit of hypovolemia and dehydratation from 1 to 14 day of observation and forms an increase in interstanial volume, causing its maximum edema from the 3d to 7th day of observation. These changes are combined with positive daily and cumulative water balances, which is reflected in a critical increase in the percentage of excess fluid from the 5th day of postoperative period.*

Реферат. Періопераційний водяний баланс хворих із гострою абдомінальною патологією при ліберальному режимі інфузійної терапії. Кравець О.В. *З метою оцінки ефективності ліберального режиму інфузійної терапії ми обстежили 50 хворих з гострою абдомінальною патологією на стан водних секторів організму. Нами встановлено, що ліберальний режим інфузійної терапії викликає гіперволемію і гіпергідратацію периферичних тканин перші 6 годин періопративного періоду, зберігає помірний дефіцит об'єму циркулюючої крові і дегідратацію з 1 по14 добу спостереження та формує збільшення обсягу інтерстицію, викликаючи його максимальний набряк з 3 по 7 добу спостереження. Ці зміни поєднується з позитивними добовим і кумулятивним водними балансами, що відбивається в критичному збільшенні відсотка надлишкової рідини з 5 доби післяопераційного періоду.*

Acute pathology of the abdominal organs is accompanied by the development of hypovolemia of varying severity [1,2]. Replacement of hypovolemia is carried out with infusion agents [4]. Both insufficient and excessive volume of infusion therapy is combined with the development of adverse outcomes [4].

The purpose of the study is to evaluate the effectiveness of the liberal regimen of infusion therapy in patients with emergency pathology of the abdominal cavity.

MATERIALS AND METHODS OF RESEARCH

After the approval by the Ethical Commission of the SE "DMA" of the Health Ministry of Ukraine, 50 patients with a mean age of 49 [Me - 45:60] years, of whom 34 (68%) men and 16 (34%) women were examined. All patients underwent urgent laparotomy due to the urgent pathology of the abdominal organs.

Inclusion criteria: urgent laparotomy; age over 45 and less than 75 years; degree of anesthetic risk by ASA – III; medium degree of surgical risk – (the predicted percentage of postoperative complications and lethality is 10-50% by the P-POSSUM scale); degree of volume depletion – 20% [1, 3], the informed consent of the patient to participate in the study.

Exclusion criteria: elective surgical interventions, age less than 45 and more than 75 years; degree of anesthetic risk by ASA I-II-IV; mild degree of surgical risk, high (the predicted percentage of postoperative complications and lethality is less than 10% or higher than 50% by the P-POSSUM scale); gastrointestinal bleeding; the volume of intraoperative blood loss above level I according to Bryusov; the degree of volume depletion is less than 10% and more than 30%, the patient's refusal to participate in the study.

Preoperative infusion therapy was performed after assessing the degree of volumetric depletion, at the initial stage coinciding with the degree of dehydration according to PG Shelestyuk, according to the normogram (Table 1) with balanced crystalloid solutions [1].

Table 1

Calculation of infusion therapy by the liberal regime of infusion therapy

Hypovolemia degree	Time of papula resolution (min)	Amount of fluid (ml/kg*/daily)	Amount of fluid daily (ml/kg/hour)
2	15-20	80-120	3,5-5,0

Note. kg* - ideal body mass in patients with obesity.

A quarter (25%) of the calculated infusion volume was administered in the first hour of treatment at a rate of 20-30 ml/kg/hour, 25% – in the following two hours of treatment at a rate of 10-15 ml/kg/hour (including intraoperatively taking into account intraoperative losses). Full restoration of the

circulating blood volume deficit (the remaining 50% of the calculated infusion volume) was carried out before the end of the first day of treatment at a rate of 3.5-5.0 ml/kg/hour. From the 2nd day of treatment, the daily fluid volume was calculated taking into account the hourly requirement ((body m+40)×1 ml/kg/h), pathological (vomiting, hyperthermia released through drains, dressings) and physiological (perspiration (14.5 ml/kg/day), diuresis and stool) losses. The transformation of the route of fluid administration to enteral (through the gastric tube) started from the 2nd day of treatment.

Surgical intervention with an average duration of 80.6±20.3 minutes was performed using total intravenous anesthesia against the background of total myoplegia with atracurium besylate with APV according to the standard scheme in all patients.

We studied the clinical findings of systemic hemodynamics: arterial pressure (AP), mean arterial pressure (MAP), heart rate (HR), diuresis, and routine clinical laboratory tests (complete blood count and urine analysis, coagulogram, biochemical blood test). The daily water balance was estimated as the difference between the amount of injected and withdrawn fluid per day. The cumulative water balance was calculated according to the observation period by the difference between the amount of injected and withdrawn fluid over the period under study [2]. The percentage of excess fluid was determined by the formula [2]:

$$\frac{\text{total amount of fluid} - \text{total amount of fluid losses}}{\text{body mass}} \times 100\%$$

Using the method of non-invasive bioelectric rheography, the device "Diamant" determined the indicators of the water sectors of the body as extracellular fluid volume (ECV), intracellular fluid volume (ICV), total body fluid (TBF), plasma volume (PV), intravascular fluid volume (IVFV), interstitial fluid volume (IFV) was determined by the difference between the extracellular fluid and intravascular fluid volume [5].

Control points: before surgery, after preoperative preparation, after 6 hours, on day 1, 2, 3, 5, 6, 7 and 10-14 days of the postoperative period.

Statistical analysis of the results was carried out using the MS Excel 2007, Statistica 6 package. The results were presented by M±m. the level of $p<0.05$ was taken as statistically significant.

RESULTS AND DISCUSSION

An analysis of the initial state of the water sectors in patients with urgent pathology of the abdominal organs established the presence of moderate volumetric depletion – hypovolemia (decrease of IVFV by 15.8% of the norm ($p<0.05$)) caused by a decrease in plasma volume by 17% of the norm ($p<0.05$) and leading to the development of deficiency of extracellular fluid in 18.4% ($p<0.05$) (Table 2). This was combined with dehydration (ICV was 91.5% of the norm ($p<0.05$)) and formed a decrease in TBF by 12% of the norm ($p<0.05$).

Table 2

Indicators of water sectors of body (M±m)

Indicator	Norm (n=40)	Initially (n=50)	6 hours (n=50)	1 day (n=50)	2 day (n=50)	3 day (n=50)	5 day (n=50)	7 day (n=50)	10-14 day (n=49)
ECV (l)	14,1	11,4*±0,4	14,0†±0,3	16,0†*±0,5	17,8*±0,3	19,4*†±0,4	17,2*†±0,3	18,6*†±0,2	17,1*±0,3
ICV (l)	24,9	23,8*±0,8	26,9*†±0,7	22,6*†±1,3	22,1±0,5	21,5*±0,9	24†±0,7	21,8*†±0,4	22,9*±0,3
TBF (l)	39	35,3*±1,3	40,9*†±1,4	38,6±1,1	39,9±1,1	40,9±1,3	41,2±0,9	40,4±1,3	40,0±1,0
PV (l)	2,7	2,3*±0,2	2,8†±0,2	2,8*†±0,1	2,5±0,1	2,5*±0,1	3,0†±0,1	2,2*†±0,1	2,3*±0,1
IVFV (l)	4,9	4,1*±0,3	5,2†±0,3	4,6*†±0,2	4,4±0,2	4,5*±0,1	5,4†±0,3	3,9*†±0,1	4,1*±0,1
IFV (l)	9,2	7,3±0,3	8,8±0,3	11,4±0,2	13,4±0,3	14,9±0,4	11,8±0,3	14,7±0,4	13,0±0,3

N o t e : * $p<0.05$ compared with norm, † $p<0.05$ compared with previous stage of observation

In the first 6 hours of the postoperative period, after the preoperative infusion preparation and intraoperative replenishment in the liberal regime, the patients achieved moderate hypervolemia (OWV values were 104% of the norm). This ensured the restoration of TBF and the extracellular sector to the norm, with a significant increase in ICV (by 8% of the norm ($p<0.05$), by 16% of the initial level ($p<0.05$)). By the end of day 1 of the postoperative period, the pattern of fluid metabolism changed. So, against the background of the restored TBF to the norm, we observed a statistically significant increase in ECV by 13% of the norm ($p<0.05$) in the intravascular deficit associated with a decrease in PV (CBV values were 80% of the norm ($p<0.05$), PV – 87% ($p<0.05$)), and signs of dehydration (ICV accounted for 90% of the norm ($p<0.05$)). We evaluated such an increase in the extracellular space against the background of a reduced intravascular volume, as interstitial edema. Indeed, the latter reached maximum values on day 3 and 7 of the postoperative period accounting for 137%-139% of the norm ($p<0.05$), corresponding to days it coincided with a decrease in diuresis up to 0.52 ml/kg/h and required drugs correction. At the same time, lack of circulating blood volume and the phenomenon of dehydration required additional infusion load. The indicated redistribution between the water sectors was noted throughout the entire observation period and coincided with the positive daily water balance of the patients (Table 3).

Table 3

Water balance of patients in liberal regime of infusion therapy (M±m)

Indicator/day of observation	1 day (n=50)	2 day (n=50)	3day (n=50)	4 day (n=50)	5 day (n=50)	6 day (n=50)	7 day (n=50)	10-14 days (n=49)
Water balance per day (l)	4,57±0,3	2,5†±0,4	2,8±0,2	2,3†±0,3	2,3±0,5	2,5±0,2	2,1†±0,4	2,4†±0,3
Cumulative water balance (l)	4,57±0,3	7,07†±0,3 (for 2 days)	9,87†±0,3 (for 3 days)	12,17†±0,3 (for 4 days)	14,47†±0,3 (for 5 days)	14,9†±0,3 (for 6 days)	16,47†±0,3 (for 7 days)	19,3†±0,3 (for 14 days)
Percentage of excess fluid (%)	6.5±0,3	10,1†±0,3 (for 2 days)	14,1†±0,3 (for 3 days)	17,4†±0,3 (for 4 days)	20,7†±0,3 (for 5 days)	21,3±0,3 (for 6 days)	23,5†±0,3 (for 7 days)	27,5†±0,3 (for 14 days)

N o t e : † $p<0,05$ compared with previous stage of observation.

The liberal regime of infusion therapy throughout the postoperative period coincided with a positive daily water balance. The maximum values of the latter was on day 1 day of treatment. The progressive growth of cumulative water balance and the percentage of excess fluid was observed during the first 5 days of the postoperative period and coincided with the time of patients' staying in the intensive care unit. The percentage of excess fluid on day 5 of postoperative treatment reached critically dangerous values and was 20.7%.

CONCLUSIONS

Carrying out infusion therapy in a liberal regime in patients with urgent pathology of the abdominal organs:

1. Causes hypervolemia and hyperhydration of peripheral tissues during the first 6 hours of the perioperative period.

2. Keeps a moderate deficit of circulating blood volume and dehydration from day 1 to day 14 of observation.

3. Generates an increase in the volume of the interstitium, causing its maximum edema from day 3 to day 7 of observation.

4. It is combined with positive daily and cumulative water balances, which is reflected in a critical increase in the percentage of excess fluid from the day 5 of the postoperative period.

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