The study includes the results of perioperative examination and treatment of 75 surgical patients with burns. It was determined that the terms of severe burns surgical treatment (ST) are influenced by the presence of comorbidity, flame burn (93.3%), with simultaneous respiratory tract injuries (53.3%). It was established that a complicated course of the burn disease (BD) was associated with an increase of a deep burn area > 20% (p = 0.001), the volume of infusion therapy on the 1st day (p = 0.005) and on the 2nd day (p = 0.005) of the burn shock with the need to increase the rate of intravenous crystalloids administration to achieve the target diuresis rate of > 0.5 ml / kg / h during the first 24 hours after the burn (p = 0.001). The expediency of observing the tactics of “Damage Control Resuscitation”, which is aimed at performing surgical treatment of burns, taking into account the stabilization of the patient’s condition and the possibility of the body’s adaptive capabilities, is substantiated. This necessitated the development and use of a perioperative management scheme for patients, which contributes to the restoration of homeostasis indices against the background of staged surgical interventions with severe burns.

Key words: burn disease, intensive care, metabolic response, systemic inflammatory response syndrome, perioperative medicine.

The present study is a fragment of the research project “Improvement of emergency and immediate care, intensive care and anesthetic methods in patients of different age categories at treatment stages”, state registration №01160006507.

Frequency and severity of burns, duration of hospital stay and mortality after burns have decreased, especially in countries with high and average incomes, and one of the major reasons for such dynamics is the achievement and possibility of providing adequate intensive care (adequate volemic resuscitation, respiratory therapy, nutritive support and antibiotic therapy) in combination with the possibility of early necrectomy [4, 8, 9].
Early surgical intervention (with a burn area less than 60%) is associated with reduced blood loss, infection and the sepsis developing probability [2, 5], reducing the inflammation mediators release. With this strategy of treatment a decrease in the length of hospital stay, reducing mortality, improving the autodermoplastics results are observed [3].

Early excision of necrotic tissues and plasty, performed during the first 48-72 hours, can reduce the metabolic rate by 40%. Early necrectomy reduces the level of procalcitonin and reduces the risk of developing bacterial complications and, consequently, the mortality level [7]. But according to L. K. Macri et al. (2016), only an isolated immediate excision of the eschar does not mitigate the effects of injury, does not reduce the formation of scar tissue [6].

According to Anderson T.A. et al. (2016), the need for perioperative anesthetic management exists in patients with a percentage of burn exceeding 10%-15% of the body surface [8]. With anesthesiological support an acute period of the burn disease (BD), an anesthesiologist may reveal systemic disorders at different phases of the BD. Therefore, in order to ensure the possibility of starting active surgical treatment of burns, it is necessary to have adequate intensive care that can restore the adaptive mechanisms in the patient.

Therefore, the topicality of the present study is due to the problem of maintaining high in-hospital mortality in patients with severe burns and one of the most important reasons for such dynamics is the debatableness of the perioperative intensive care adequacy in severe burns for the safe start of early surgical burn treatment.

The purpose of the study was improvement of the severe burns treatment results by optimizing perioperative intensive care based on the study of pathophysiological changes in homeostasis, dynamics of the systemic inflammatory response syndrome and polyorganic dysfunction, depending on the terms of the severe burns stage surgical treatment beginning.

Materials and methods. The total of 75 patients with a thermal trauma undergoing the in-hospital treatment at the burn center were examined and analyzed for the period of 2012-2016. Patients stratification was carried out in accordance with the severity of the thermal injury based on the assessment of the burn area and severity index (BASI) and the need for the stage surgical treatment of burns. Patients were divided into the study groups:
- study group 1 (n = 46) - patients with BASI of 61 to 90 points, when severe burn injury is diagnosed. Patients of group 1 had BASI of 67.7 ± 1.44 points, total burn area (TBA) - 27.7 ± 0.9%, deep burn area (DBA) - 16.8 ± 1.0%. The patients’ average age was 47.4 ± 1.81 years.
- study group 2 (n = 29) - patients with BASI of 91 points, when critically severe burn shock is diagnosed. Patients of group 2 had BASI of 134 ± 6.31 points, the TBA - 57.3 ± 3.6% with DBA - 22.3 ± 2.6%. The patients’ average age was 41.4 ± 2.4 years.

Depending on the terms of the first surgical intervention, patients of groups 1 and 2 were divided into subgroups:
- 1.1 and 2.1, where the first surgical intervention was performed up to the 5th day of BD;
- 1.2 and 2.2, where the first surgical intervention was performed after the 5th day of BD.

A group of regional norms was examined to compare the laboratory indices. Control points were: 1, 3, 5, 7, 14, 21, 28 and 35 days.

After the thermal trauma was received, all patients underwent assessment of their burns severity, formulation of the diagnosis, the sepsis developing probability, reducing the inflammation mediators release. The study of blood serum CRP levels was performed by the Stat Fax 303+ immunoassay analyzer (Awareness Technology GmbH®, Germany).

The IL-6 level study was performed with the Stat Fax 303+ immunoassay analyzer (Awareness Technology, USA), using the “Interleukin-6-IFA-Best” kit (Vector-Best, Russia). The blood serum cortisol level was determined by the Stat Fax 303+ immunoassay analyzer (Awareness Technology, USA) at different stages of the study.

All the patients at hospitalization underwent the assessment of the burns severity, formulation of the diagnosis, were subjected to the diagnostics and treatment program, in compliance with the MOH of Ukraine Order No. 691 dated November 7, 2007 and No. 838 dated September 30, 2013.
Along with the main vital functions monitoring, the issue of the possibility and volume of early and progressive necrectomy with autodermic or xenoplasty was considered.

Operational activity was accompanied by the implementation of general and regional anesthesia techniques.

The statistical processing of the research materials was carried out using the biostatistics methods implemented using the STATISTICA v.6.1 software package (Statsoft Inc., USA) (license number AGAR909 E415822FA). Descriptive data statistics results were used to describe the primary data array. For quantitative data verification of the hypothesis about the normal law of random variables distribution was carried out according to the Kolmogorov-Smirnov and Shapiro-Wilk criteria.

The correlation analysis was performed to calculate the Spearman rank correlation coefficients (r) and canonical correlation (Rc) to detect the relationship between subsets of data as a whole, as well as the method of logistic regression with the odds ratio indices calculation with the confidence interval of 95% (95% CI).

**Results of the study and their discussion.** As a result of the performed study analysis, it was determined that the growth of the preoperative intensive care duration was influenced by the presence of concomitant diseases (R = 0.455; p = 0.002), in particular those of the cardiovascular (27.3%) and the respiratory (9.1%) systems, in patients with severe burns, against the background of alcohol intoxication in 45.5% of cases (χ² = 26.55, p < 0.001). Patients recorded a higher BASI level (R = 0.547; p = 0.001) due to the prevalence of deep burns area (DBA) (R = 0.359, p = 0.014). In patients with extremely severe burns, the delayed operative treatment terms were influenced by the etiologic factor (R = 0.425; p = 0.027), in particular, the presence of the flame burn (93.3%) with simultaneous respiratory tract injuries (R = 0.411; p = 0.027) in 53.3% of the patients (χ² = 4.89, p = 0.027).

It has been established that in patients with severe burns with the delayed operative treatment (OT) of burns the individual volume of liquid resuscitation and its total duration (U = 92.0; p = 0.001) had increased to reach the level of diuresis exceeding 0.5 ml / kg / h for the 1st and the 2nd days of the BD (R = 0.523; p = 0.001 and R = 0.477; p = 0.001, respectively). When comparing the efficiency of restoring aqueous balance in patients with extremely severe burns, it was determined that the total resuscitation volume within the 1st day after burning did not significantly differ between the subgroups and was efficient in the rate of hourly diuresis (0.9 ml / kg / hour and 1.2 ml / kg / h, respectively). But the need for general terms of infusion therapy in patients with extremely severe burns with delayed OT onset (U = 40.0; p = 0.002) was reliably growing. In patients with severe and critically severe burns, the mean blood pressure values did not differ from the norm (> 70 mm Hg) at all stages of the examination and there was no need for vasopressor support of hemodynamic indices.

It was proved that a thermal trauma on the 1st day of observation was accompanied by the development of hypermetabolic syndrome in the patients of observation groups 1, 2 and 3, which was manifested with a significant increase of cortisol levels, which mean values exceeded the norm by 15.6 and 10.3 times, respectively (p < 0.001). From the first day of the thermal trauma, stressed-induced hyperglycemia was recorded, when the blood glucose levels in the patients of observation groups 1 and 2 exceeded the regional norm by 19.0% and 36.0%, respectively. The metabolic response severity, due to the increased blood cortisol level and to the development of stress-induced hyperglycemia, differed in patients with varying severity of burn injury.

The cortisol level reduction was observed on the 3d day after burning. But against the background of early surgical treatment in severe and critically severe burns, the repeated increase of blood cortisol levels was recorded, respectively, by 27% and 82% on the 7th day of the OT. It is assumed that the early surgical burns treatment was accompanied by further activation of the sympathetic-adrenal system, which required the choice of rational analgesia in the perioperative period (p = 0.001) and providing of adequate nutritional support (p = 0.029). At the same time, the early operative treatment of severe and critically severe burns was accompanied by faster normalization of blood glucose levels on the 5th and the 7th days of BD (p = 0.037 to the previous stage, respectively). It was determined that in patients with an early onset of the burns OT, an early enteral nutrition was carried out, reaching the calculated calorage up to the 3d-4th days of BD (R = -0.322; p = 0.029).

It was determined that from the 1st day after burn, there was a tendency towards hypoproteinemia, more pronounced in patients with critically severe burns. Further reduction of blood total protein (TP) to 55.0 ± 2.1 g / l or by 14.0%, compared to the previous stage, was recorded in patients of subgroup 1.1 against the background of early surgical burn treatment onset (p = 0.01) requiring substitution therapy with albumin. The correlation analysis confirmed the probable relationship between the blood serum TP level in subgroup 1.1 and the early onset of severe burns OT (R = -0.349, p = 0.043). On the 5th day after burn, blood serum TP level in subgroups 1.1 and 1.2 increased up to 61.6 ± 2.13 g / l (p = 0.205) and 60.1 ± 1.6
It was determined that in patients with critically severe burns, on the 1st day after burn, a reduction of the TP level in subgroups 2.1 and 2.2 was recorded up 63.5 ± 3.1 g / l and 57.1 ± 2.3 g / l, respectively. The mean TP values continued to reduce up to 52.9 ± 2.8 g / l (p = 0.001) and 49.8 ± 2.4 g / l (p = 0.002), respectively, on the 3d day of BD. In patients with critically severe burns, the TP blood serum levels were lower than normal ones within the acute BD period and probably did not differ between subgroups, regardless of the surgical treatment terms.

It was revealed that leukocytosis was determined against the background of a thermal trauma on the 1st day of BD in patients of groups 1, 2 and 3 (mean values exceeded the norm by 2.5, 2.8 and 2.0 times, respectively), neutrophilosis (level of stab neutrophils was exceeding the norm by 5.8, 7.5 and 4.2 times) and the development of lymphopenia (the values of blood lymphocytes being less by 1.8, 2.3 and 1.7 times, respectively). The level of CRP in patients of the observed groups 1, 2 and 3 exceeded the norm by 18.4, 14.4 and 11.7 times. The mean values of blood serum IL-6 in patients of groups 1, 2 and 3 exceeded the norm by 12.3, 13.6 and 10.9 times, respectively. The level of IL-6 correlated with higher values the total burn percentage (R = 0.359, p = 0.014), the deep burn area (R = 0.562, p <0.001) and BASI (R = 0.572, p <0.001).

On the 3d day after the burn, further reliable increase in IL-6 levels in the CRP mean values was recorded in all patients of the studied subgroups, which was most pronounced in patients of subgroups 1.2 and 2.2, who were undergoing delayed OT of burns (p = 0.021 and p = 0.015 before the previous stage, respectively). Carrying out the intensive therapy against the background of early OT of severe and critically severe burns was accompanied by the IL-6 level reduction by 1.6 times (p = 0.057) on the 7th day of BD. The increase in the level of lymphocytes in patients of subgroups 1.1 and 2.1 on the 14th day of BD (p = 0.002 and p = 0.001, respectively) was confirmed by a reliable correlation between the onset of the burns OT and the level of lymphocytes (R = -0.436, p = 0.048).

The delayed start of OT in patients with severe burns correlated with maintaining high IL-6 level (R = 0.760, p = 0.001), leukocytosis (R = 0.318, p = 0.067), neutrophilosis (R = -0.807, p <0.001), the blood serum fibrinogen level (R = 0.472, p = 0.024). In the patients with critically severe thermal trauma, a reverse correlation between the surgical intervention term, the blood IL-6 level (R = -0.742, p = 0.004) and the blood serum CRP (R = -0.536, p = 0.059) was recorded.

A comparative characteristic of the variable indices dynamics characterizing the possible formation of multiple organ dysfunction syndrome (MODS) and sepsis using the SOFA scale, depending on the terms of the surgical burn treatment onset, was carried out. All patients were in consciousness throughout the observation period.

Comparing the mean values of StO2 values on the 1st day after the burn in subgroups 1.1 and 1.2, it is possible to note a slightly less StO2 value in patients of subgroup 1.2 - 97.7%, compared to the StO2 values in the affected patients of the studied subgroup 1.1 - 98.6%. Perhaps these values were due to the diagnosed respiratory tract burn (RTB) in 9.8% of patients in subgroup 1.2. In the patients of subgroups 2.1 and 2.2, the StO2 level was 98.0% and 95.7%, respectively. This was due to the presence of RTB in the 53.3% of patients in the subgroup 2.2. On the 3d day at the stage of burn shock, there were no differences between the StO2 values in all groups and the upper limit of normal (ULN).

When observing the dynamics of SBP, patients in the studied groups did not report deviations from the generally accepted norms (> 70 mm Hg) at all stages of the observation and there was no need for vasopressor support for hemodynamic indices.

Although the mean blood platelet count differed slightly between the studied subgroups, however, they did not exceed the physiological norm (200-320x10^9 / l) at all stages of the study.

For patients with severe burns on the 3d day after the burn, a reliable correlation between the onset of surgical intervention (SI) and blood urea level was detected (R = -0.445, p = 0.034) in the patients in the subgroup 1.1, the above correlation with the creatinine dynamics was detected both in patients of subgroup 1.1 (R = -0.466, p = 0.016), and in subgroup 1.2 (R = 0.435; p = 0.034). In patients of subgroup 2.2 with the delayed OT of critically severe burns, on the 3d day of BD, a reliable correlation was detected between the blood serum bilirubin levels and the term of OT (R = 0.577, p = 0.005). Regardless of the burns OT onset term, the mean index of organ dysfunction did not differ reliably at the treatment stages, indicating the efficacy of perioperative intensive care during the acute BD period.

In determining the best terms of preoperative preparation in patients with severe and critically severe burns, it is necessary to reasonably observe the principles of the “Damage Control Resuscitation” tactic, which is aimed at performing delayed surgical treatment of burns, taking into account the stabilization of the patient’s condition. Namely, the ability of the body’s adaptive capacities, which manifest themselves in the compensation of hematological indices should be taken into account: maintaining the blood hemoglobin level
not less than 120 g/l, total blood protein of not less than 60 g/l, restoration and prevention of satisfactory renal function due to normalizing the creatinine and blood serum urea indices as well as to smoothing the metabolic response aggressiveness (glycemia level up to 5.5-6.0 mmol/l). The correlation between the shorter length of hospitalization and the onset terms of early surgical treatment in patients with severe and critically severe burns (p = 0.078 and p = 0.019, respectively) was determined, which caused the necessity of developing and using the scheme of perioperative management in the acute period of burn disease. With an early OT onset in severe and critically severe burns, the number of patients with complicated BD course reduced by 10.8% and 40.6%, respectively, compared to patients with the delayed terms of the first surgical intervention.

Conclusion

The pronounced deficiency of the skin cover with burns leads to increasing of pathological changes in vital systems and organs, which requires a sufficient and individualized intensive care within the short time period to ensure the possibility of early onset of severe burns OT. The scheme of perioperative management is justified in patients with severe burns, where the perioperative period includes the preoperative preparation time interval, intraoperative time and postoperative course with further assessment of the therapeutic measures efficacy.

References


Реферати

ПЕРИОПЕРАЦІЙНА МЕДІЦИНА – НОВИЙ НАПРАВЛІННЯ ЛІКУВАННЯ ТЯЖКОЇ ОПІКОВОЇ ТРАВМИ
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У дослідженні включені результати періоперативного обслуговування і лікування 75 постраждалих з ожогами. Визначено, що на відтінківання початку ОЛ тяжких ожогів впливає наявність супутньої патології, опіку полум’ям (93,3%) з одночасним ураженням дихальних шляхів (53,3%). Встановлено, що ускладнення перевір ОХ асоціювалося зi збільшенням площі глобокого опіку >20% (p<0,001), об’ємом інфузійної терапії на 1 добу (p<0,001) і 2 добу (p=0,005) опікова шоку, із необхідністю збільшення темпу внутрішньовенового введення кристалолідів для досягнення цільового темпу діурезу >0,5 мл/кг/год. протягом першої доби після опіку (p<0,001). Обґрунтовано доцільність дотримання тактики «Damage Control Resuscitation», що спрямована на використання оперативного лікування опіків з урахуванням стабілізації стану постраждалих та спроможності адаптаційних можливостей організму. Це обумовило необхідність розробки та використання схеми періоперативного ведення постраждалих, що спрямовується на нормалізацію гомеостазу на тлі проведення етанових оперативних втручань тяжких опіків.

Ключові слова: опікова хвороба, інтенсивна терапія, метаболічна відповідь, синдром системної запальної відповіді, пері операційна медіцина.

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