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Research Article

Violation of the Volume of Circulating Blood and Coating System during a Burning Shock

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Abstract: The burn-injured patient presents special challenges regarding resuscitation requirements, metabolic stress and determinants of outcome. The object of the study was 95 patients with deep burns from 10 to 35% of the body surface who received a burn shock at the burn department of Samarkand branch of RSCUMA during 2016-2018 years. With deep burns in the vast majority of patients, there is a moderate degree of blood loss, which manifests itself with a VCB deficit of up to 30%, a violation of the volume of circulating plasma protein, a decrease in the globular blood volume. Conducting adequate preoperative measures allows the improvement of indicators of both VCB and coagulation systems in patients with mild and moderate plasma losses.

Keywords: metabolic stress, blood volume, Shock

INTRODUCTION

Burn trauma remains one of the real problems of modern medicine, because of its long clinical course, the high mortality rate and sometimes the unacceptable results of treatment. The burn-injured patient presents special challenges regarding resuscitation requirements, metabolic stress and determinants of outcome (Latenser, B. A. 2009).

In recent years, there has been an increase in the number of patients with extensive deep skin burns, which causes a significant proportion of deaths in the period of burn shock, reaching 25-35% (Alexeev, A.A. *et al.*, 2010). In spite of great success achieved in burn treatment, a lethal outcome among severely burnt patients remains high even in specialized hospitals (Herndon, D.N. 2001; Edwards-Jones V. *et al.*, 2003 Jun).

Aims to study of the state of the structure of the circulating blood volume and coagulation system in patients with burn shock.

MATERIAL AND METHODS

The object of the study was 95 patients with deep burns from 10 to 35% of the body surface who entered a burn shock state in the burn department of Samarkand branch of RSCUMA during 2016-2018 years. The age of patients ranged from 18 to 77 years, the average age was 54.3 ± 0.7 years. There were 71 men (74.73%), women - 24 (25.27%).

To assess the patient's condition during admission and during treatment, we studied the shock index of Algower. Volume of Circulation Blood **(**VCB) and its components in 84 patients when admitted to hospital were determined by the method of A.I. Gorbashko (1974). For this, a 6% solution of polyglucine, 20% solution of trichloroacetic acid and 96% ethanol were used. For the determination of polyglucin in plasma, FEK-56M photocalorimeter was used, working as a red light filter and in 10-mm cuvettes.

The coagulation system and blood fibrinolytic activity were studied in 95 patients. For an objective judgment of the state of the coagulation blood system, the following parameters were investigated: protrombin index according to Kvik, Rutberg fibrinogen, thrombotest according to Fuonte-Ita, plasma tolerance to heparin according to Poller, Howell recalcification time, retraction of the blood clot and fibrinogen, retraction of Houell, retraction of the blood clot and fibrinosis (Krilov K.M. *et al.*, 2006; Gorbashko, A.I. 1974).

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Table-1.Distribution of patients with deep burns by the degree of plasma loss

Degree of plasma loss	Number of patients	
	.	%
I degree	49	51.58
II degree	29	30.53
III degree	17	17.89
Total	95	100%

Table-2.Changes in the structure of the VCB in patients with burn shock

Graduations VCB	Upon enrolment				After necrotomu and ADP			
	Counter.	I-degree	II-degree	III-degree	Counter.	I-degree	II-degree	III-degree
VCB, ml/kg	74.1± 0.3	67.5± 0.4*	61.5± 0.5*	53.9± 0.4*	77.1± 0.3	72.0± 0.2	70.4± 0.42*	66.2± 0.4*
VCB, deflciency %	5.2± 0.1	10.9± 0.4*	22.0± 0.3*	32.9± 0.7*	4.4± 0.5	4.3± 0.1	10.2± 0.3*	12.7± 0.3*
CVP, ml/kg	40.4± 0.5	36.2± 0.2*	33.1± 0.2*	27.4± 0.2*	42.3± 0.3	38.3± 0.2	37.9± 0.1*	34.7± 0.2*
GO, ml/kg	33.,7± 0.2	31.3± 0.3*	28.4± 0.2*	26.5± 0.3*	34.8± 0.2	33.7± 0.3*	32.1± 0.4*	31.5± 0.2*
RUB, g/l	3.3± 0.1	2.83± 0.16*	2.54± 0.02*	2.28± 0.04*	3.7± 0.05	3.0± 0.01*	2.92± 0.2*	2.79± 0.01*
JTG, g/l	10.4± 0.2	9.8± 0.1*	8.3± 0.1*	6.9± 0.1*	12.3± 0.1	10.1± 0.09*	9.7± 0.05*	8.9± 0.04*

Note: * - the degree of reliability of the results of P <0.05

Table-3.Disorders of the blood coagulation system in patients with deep burns when admitted to hospital

Coagulogram indicators	Main group (but shock levtls)			Control group
	I degree	II degree	III degree	
PTI, %	92.3±1.5*	94.6±3.8	87.6±3.1	90.2±1.0
Fibrinogtn, g/l	2.68±0.3*	2.92±0.29*	2.15±0.25*	3.4±0.2
Trombotest, st.	4.34±0.14*	4.4±0.2*	4.06±1.1	5.0±0.1
Hematocrit	40.9±1.1*	33.1±1.4*	19.4±2.1	44.0±0.8
Recallation time,s.	82.1±2.9*	87.4±3.8*	89.4±3.2*	74.0±3.2
Tolerance to heparin, s.	283.8±8.8*	256.3±11.8	253.4±21.3	290±7.4
Fibrinolysis,%	10.7±0.27*	8.09±0.42*	6.58±0.69*	15.4±0.6

Note: * - the degree of reliability of the results of P <0.05

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Table- 4. Disorders of the blood coagulation system in patients with deep burns in the postoperative period

Coagulogram indicators	Main group			Control group
	I degree	II degree	III degree	
PTI, %	91.6±3.9	91.0±1.0*	95.6±12.1	90.2±1.0
Fibrinogtn, g/l	2.3±0.3*	2.92±0.29*	2.15±0.25*	3.4±0.2
Trombotest, st.	5.0±0.14*	4.4±0.2*	4.06±1.1	5.0±0.1
Hematocrit	36.0±3.9	33.1±1.4*	19.4±2.1*	44.0±0.8
Recallation time,s.	92.6±2.6*	97.3±3.0	85.0±5.6	74.0±3.2
Tolerance to heparin, s.	252.3±32.3	215.6±8.4*	282.3±6.1*	290±7.4
Fibrinolysis,%	20.1±0.45*	7.7±0.45*	7.4±1.9	15.4±0.6

Note: * - the degree of reliability of the results of P <0.05

RESULTS AND DISCUSSION

Upon admission to the hospital, we differed 3 degrees of burn shock due to the deficiency of VCB (Table-1). The vast majority of patients had a BCC deficiency from 20 to 30% of the initial significance, which corresponded to the II-degree burn shock. In contrast, in 29 (30.52%) patients the I-degree was established, in 17 (17.89%) - the III degree of burn shock (Table-1).

In addition to the VCB deficiency, upon admission to the hospital, the Algovera index was studied, which was directly dependent on the severity of plasma loss. According to the data obtained, the severe degree of blood loss was characterized by an increase in

the Algovera index from 0.54 with a 1 - degree to 1.45 in patients with a 3 - degree of plasma loss. Therefore, these data indicate deeper changes in the system of homeostasis in patients with severe burn shock.

On this basis, we studied the changes in the structure of the VCB (Table-2). At the same time, in order to adequately judge the true changes and possibilities of corrective therapy, the VCB data were analyzed when the patient was admitted to the hospital at the stage of burn shock. The results were evaluated in a comparative aspect with the results of the control group.

A study of the state of the VCB and its components showed that the severity of the changes is directly proportional to the degree of burn shock. Upon admission to the hospital, patients with deep burns showed a statistically significant decrease in the overall VCB of 67.5±0.4 ml / kg to 53.9±0.5 ml / kg, respectively, I- and III-degrees of shock. The BCC deficiency also varied according to the severity of burn shock, amounting to 10.9±0.4% with I-degree, 22.0±0.3% with II- and 32.9±0.7% with III - degree. Structural indices of bcc in patients with shock grade I did not significantly differ from those in the control group, although there is a statistical difference between them. These changes were most clearly expressed in the group of patients with moderate and severe shock. This is evidenced by a decrease in the OCP and GO, respectively, to 28.4±0.2 ml/kg and 26.5±0.3 ml/kg in patients with a W-grade shock. Along with this, there was a decrease in CBS from 3.3±0.1 g/l to 2.28±0.04 g / l ($P<0.05$).

It should be noted that after treatment tactics, aimed both at correcting disturbances of homeostasis and of complex anti-shock therapy, significant changes were observed in the direction of improving VCB performance. This favorable trend was the most characteristic patient with mild and moderate burn shock. There was a decrease in the bcc deficiency in patients with grade I and II, respectively, to 4.3±0.1% and 10.2±0.3% ($P<0.05$). The positive trend was mainly based on an increase in the rates of ORP and GO, which amounted to 38.3±0.2 ml / kg and 33.7± 0.3 ml/kg respectively, 37.9±0.1 ml / kg and 32.1±0.4 ml / kg with an average degree of shock. However, despite the positive dynamics of indicators, in the group of patients with a severe degree of shock, even after the measures taken, the worst BCC indicators remained. So the BCC deficiency in this group of patients was 12.7±0.3% in the shock period. Along with this, statistically significant low rates of OTSP (34.7±0.2md / kg, $p<0.05$), OGG (8.9±0.04 g / l, $P<0.05$) and GO (31,5±0.2 ml /kg, $P<0.5$).

Changes in the blood coagulation system and fibrinolytic activity were studied depending on the severity of burn shock (Table-3).

Upon admission to the clinic of patients with deep burns of 20-25% of the body surface, there is a slight activation of the blood coagulation system, which is expressed in the lengthening of PTI to 92.2±1.5% ($P<0.05$), VRK to 82.1±2,9 sec. Also, there is a slight decrease in the hematocrit and suppression of blood fibrinolytic activity from 15.4±0.6 to 10.7±0.27% ($P<0.05$) in the study group. In contrast, in patients with shock grade II, admission to the clinic showed an increase in blood coagulation, along with continued inhibition of fibrinolytic activity. This is evidenced by the elongation of PTI to 94.6±3.8% ($P<0.05$) and a decrease in plasma tolerance to heparin to 256.3±11.8 seconds ($P<0.05$). Fibrinolysis is statistically significantly reduced to 8.09±0.42% ($P<0.05$), and hematocrit to 33.1±1.4 due to intensive loss of the formed part of the blood and hemoconcentration.

The same changes were mainly observed in cases of severe shock in patients with deep burns over 30% of the body surface. However, due to the higher volume of plasma loss, the changes were more profound. There was a slight increase in blood coagulation (tolerance to heparin was 253.4±21.3 s, thrombotest - 4.06±0.2 degree), and PTI decreased to 87.6 ± 3.1% ($P<0.05$). A deep inhibition of fibrinolytic activity was also observed, which is 6.58±0.69% ($P<0.05$). A critical decrease in the hematocrit to 19.1±2.1% ($P<0.05$) was noted.

Considering the above, upon admission to the hospital, all patients underwent a complex of anti-shock measures aimed at improving the water-salt balance, acid-base balance and disturbances of homeostasis.

After a comprehensive anti-shock therapy, various surgical interventions were performed: necrotomy in 27, early necrectomy in 43 patients, and autodermoplasty in 49 patients with deep burns, 11-15% of the body surface. The analysis of the coagulation system and the fibrinolytic activity of the blood after performing surgical interventions showed a tendency to normalize all indicators (Table- 4).

Due to adequate preoperative therapy in the postoperative period, a tendency towards normalization of all indicators of the coagulogram in patients with plasma grade I was revealed. At the same time, PTI statistically significantly amounted to 91.6±3.9%, fibrinogen 2.3±0.3 g/l, trombotest 5.0±0.14 degrees ($P<0.05$). However, a slight inhibition of fibrinolytic activity persisted even at discharge of patients from the hospital, amounting to 20.1±0.45% ($P<0.05$). With a moderate severity of plasma loss, there was also a significant improvement in the indicators for discharge. This is evidenced by the normalization of PTI, fibrinogen and hematocrit. However, inhibition of fibrinolysis persists.

In contrast to the indicators in patients with I- and II-degrees of plasma loss, with a severe degree of plasma loss in the coagulation system of the blood, even after treatment measures, violations of the coagulogram indices remain. Increased indices of PTI, recalcification time and thrombotest are evidence of still persisting hypercoagulation with suppressed fibrinolysis ($P < 0.05$).

CONCLUSIONS

- With deep burns in the vast majority of patients, there is a moderate degree of blood loss, which manifests itself with a VCB deficit of up to 30%, a violation of the volume of circulating plasma protein, a decrease in the globular blood volume.
- When plasma losses in patients with extensive deep burns, there is a violation of blood coagulation and suppression of fibrinolytic activity, which correlates with the degree of burn shock.
- Conducting adequate preoperative measures allows the improvement of indicators of both VCB and coagulation systems in patients with mild and moderate plasma losses.

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