

Dynamics of the circadian rhythm of diastolic blood pressure in the acute period of combined severe traumatic brain injury

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Abstract

During the acute period of CSTBI, the correction of hemodynamics (hypotensive, according to indications of vasopressor therapy) ensured the stability of the indicator within the generally accepted standard values. All injured patients retained a tendency to instability of the vascular vasopressor response, which turned out to be the most significant in group 3 in patients over 61 years of age. The most pronounced daily changes in peripheral vascular tone were found in patients of group 3. The adaptive capabilities of peripheral vessels were comparatively more active in patients of group 1 up to 40 years old from 9 to 17 days of the acute period of CSTBI.

Keywords: combined severe traumatic brain injury, circadian rhythm, diastolic blood pressure

Relevance. The most important goal of intensive care for patients with severe traumatic brain injury (TBI) is "... to maintain an optimal flow of oxygen-rich blood to the brain." Among the measures of intensive therapy, which are of great importance for the prevention of secondary ischemic attacks, there are primarily the provision of external respiration function and the relief of hemodynamic disorders. Systemic BP is a critical factor in compensating for cerebral ischemia in severe TBI. The value of this factor is most pronounced in the first few days after TBI and in the immediate postoperative period. According to the authors, the decrease in cerebral perfusion pressure that occurred during antihypertensive therapy posed a real threat of cerebral ischemia. On this basis, many researchers have given up on lowering BP with TBI treatment. Moreover, recently, sympathomimetics (epinephrine, dopamine, norepinephrine) have been widely used to increase BP. It is believed that they contribute to an increase in cerebral perfusion pressure without significantly affecting ICP [1-5]. Due to the lack of information, we made an attempt to study and assess the dynamics of the circadian rhythm of diastolic blood pressure (DBP) in the acute period of combined severe traumatic brain injury (CSTBI).

Purpose of the work: to study and assess the adaptive changes in the phase structures of the circadian rhythm of diastolic blood pressure in combined severe traumatic brain injury.

Material and research methods. The indicators of a comprehensive examination of 30 patients with concomitant severe traumatic brain injury (CSTBI) who were admitted to the ICU of the neurosurgical department of RSCEMA in the first hours after an accident - 28, catatrauma of 2 patients were studied. According to the testimony of 29 patients, on admission, invasive mechanical respiratory support (MRP) was started. Monitoring was carried out by complex hourly registration of parameters of body temperature, hemodynamics, respiration. Mechanical respiratory support was started with artificial lung ventilation (ALV) for a short time, followed by transfer to SIMV. The severity of the condition was assessed by scoring methods according to the scales for assessing the severity of combined injuries - the CRAMS scale, the assessment of the severity of injuries according to the ISS scale. On admission, impaired consciousness in 29 injured patients was assessed on the Glasgow Coma Scale (GS) of 8 points or less. Patients were considered in three age groups: group 1, 19-40 years old (13), group 2 - 41-60 years old (9), 3 - 61-84 years old (8 patients). Complex intensive therapy consisted in identifying and timely correction of deviations: MRP, after removing from shock anesthetic, anti-inflammatory, antibacterial, infusion therapy, correction of protein and water-electrolyte balance disorders, surgical, to the extent possible, early correction, syndromic, symptomatic therapy.

Results and discussion.

Table 1

Assessment of the severity of the condition by age

Parameters	group 1	group 2	group 3
age in years	29.5±4.3	51.6±4.8	72.3±9.1
CRAMS, points	4.5±0.6	4.4±0.8	4.8±0.6
ISS, points	50.2±5.6	43.3±7.1	46.2±9.1
GS, points	7.3±0.5	7.9±1.3	7.8±1.5

It was found that with the most severe injuries in patients of group 1 (50.2±5.6 points), the severity of the condition and impaired consciousness did not differ significantly from those in groups 2 and 3 (tab. 1).

Table 2

Dynamics of the mesor of the circadian rhythm of diastolic blood pressure

Days	group 1	group 2	group 3
1	75.3±3.1	75.3±7.1	78.0±5.0
2	70.5±1.9	79.5±3.5	75.6±2.5
3	72.0±2.2	77.2±2.4	73.3±2.6

4	77.6±2.3	78.4±3.0	77.5±2.9
5	76.3±1.8	77.0±2.7	79.1±3.5
6	76.7±1.7	76.8±2.0	77.2±2.6
7	76.7±1.7	77.6±2.6	74.3±2.8
8	77.4±2.2	74.9±2.1	73.2±3.9
9	75.1±2.8	74.1±3.0	74.0±2.8
10	78.9±3.0	75.6±2.2	75.8±3.7
11	74.8±2.1	74.6±2.5	73.5±2.7
12	75.0±2.1	73.3±2.1	72.6±3.2
13	72.7±2.8	72.2±2.2	68.5±2.9
14	74.8±2.5	73.0±1.9	76.0±2.7
15	74.6±2.2	73.0±2.4	72.4±3.0
16	73.8±1.9	72.3±2.2	76.4±2.9
17	72.4±3.1	70.1±2.5	75.7±3.9
18	75.3±3.0	79.8±5.2	68.4±3.2
19	72.9±2.4	76.7±4.0	72.6±3.7
20	71.5±2.6	75.5±4.9	74.5±2.9
21	73.0±2.3	72.5±5.0	76.3±5.2
22	74.2±4.2	78.2±4.5	74.5±6.6
23	71.3±2.5	73.9±3.5	70.1±4.4
24	71.2±2.7	75.0±3.5	79.4±6.9
25	72.9±3.6	80.9±5.6	75.8±5.8

As shown in tab. 2, the index of the mesor of the circadian rhythm DBP did not differ from the normative values established in the studied age groups. During the acute period of CSTBI, the correction of hemodynamics (hypotensive, according to indications of vasopressor therapy) ensured the stability of the indicator within the generally accepted standard values.

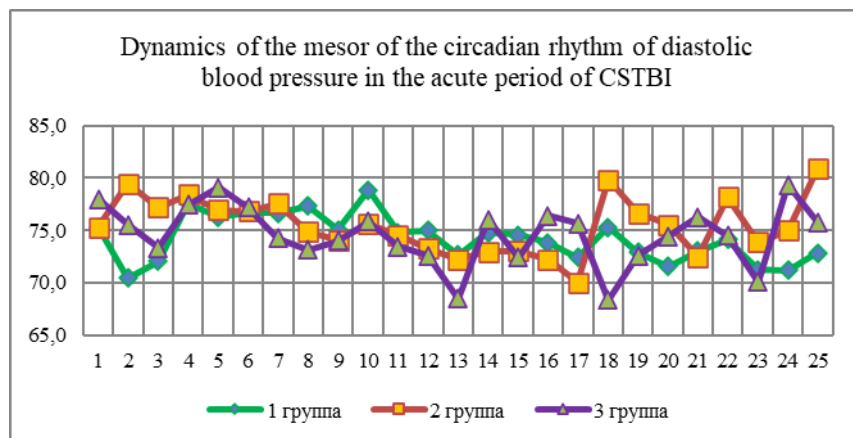


Fig.1

During the acute period of CSTBI, the minimum value of the mesor of the circadian rhythm DBP was detected on day 2, amounting to 70 mmHg, the maximum on day 10 - 79 mmHg. We paid attention to 4-5 day periods of fluctuations. In group 2, the minimum value was noted on the 17th day - 70 mmHg, the maximum on the 25th day - 81 mmHg, fluctuations in the mesor of the circadian rhythm DBP are also represented by 4-5 day periods of fluctuations. In group 3, the minimum DBP level - 68 mmHg was detected on the 13th and 18th days, the maximum on the 5th and 24th days - 79 mmHg, respectively. Fluctuations were represented mainly by 5-day

waves. It should be noted that the most significant vasoactive therapy was carried out in patients of group 3 with the introduction of both antihypertensive and vasopressors.

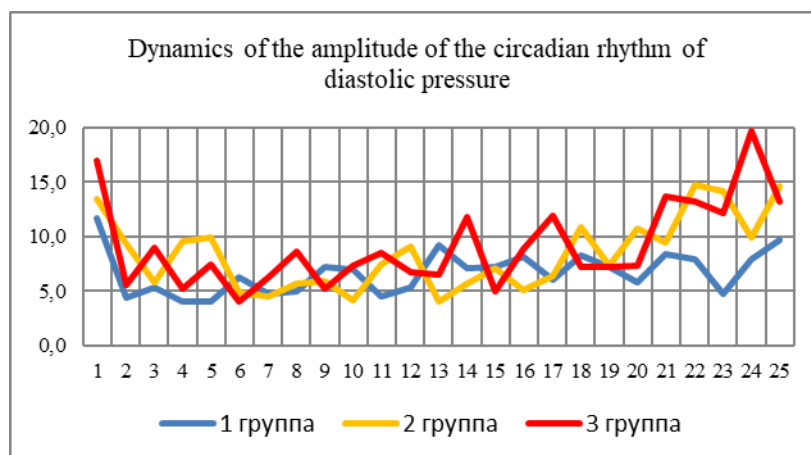


Fig.2

Pronounced deviations from the mesor in the circadian rhythm of DBP were found in all injured patients on day 1. In group 1, the amplitude of daily fluctuations was 12 mmHg, in group 2 - 13 mmHg, and in group 3 - 18 mmHg. Taking into account that the increase in the amplitude of daily fluctuations characterizes the stress response of the indicator, it can be imagined that on the 24th day (20 mmHg), all the injured retained a tendency to instability of the vascular vasopressor response, which turned out to be most significant in group 3 in patients over 61 years old. The severity of daily fluctuations in DBP characterizes the instability of the peripheral vascular tone immediately after injury, the tendency to stabilize the DBP index on days 2-20 with intensive stress-limiting therapy and the progression of instability on the 25th day, despite MRP and vasoactive therapy, correction of volemic parameters, and other parameters of homeostasis. In group 1, waves with a period of fluctuations of 5-4 days prevailed, in group 2 - 4 daily periods, in group 3 - 3-4 day periods (fig. 2).

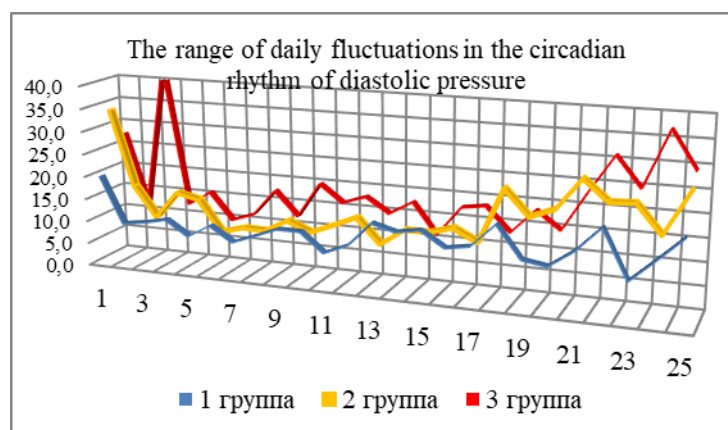


Fig.3

Of all the age groups studied, the most pronounced daily changes in peripheral vascular tone were found in patients of group 3 on day 1 - 26 mmHg, on day 3 - 40 mmHg, 24 - 36 mmHg (fig. 3). The least pronounced DBP fluctuations were noted in the injured group 1 on day 1 17 mmHg, on day 26 - 13 mmHg (fig. 3).

During the first week of the acute period of CSTBI, the mean values of circadian rhythms for the first 8 days in the 1st group characterized the tendency to spasm of peripheral vessels at 5 o'clock (78 mmHg), and the most significant decrease in peripheral vascular tone per day at 9-11 o'clock in the morning (73 mmHg). In group 2, the DBP was 81 mmHg at 8 am, decreased at 12 noon to 75 mmHg. In group 3, the highest DBP values of 78 mmHg were observed at 13 hours, the minimum at 24 hours was 73 mmHg (fig. 4). The greatest displacements of the acrophases of the circadian rhythm DBP were noted in group 1.

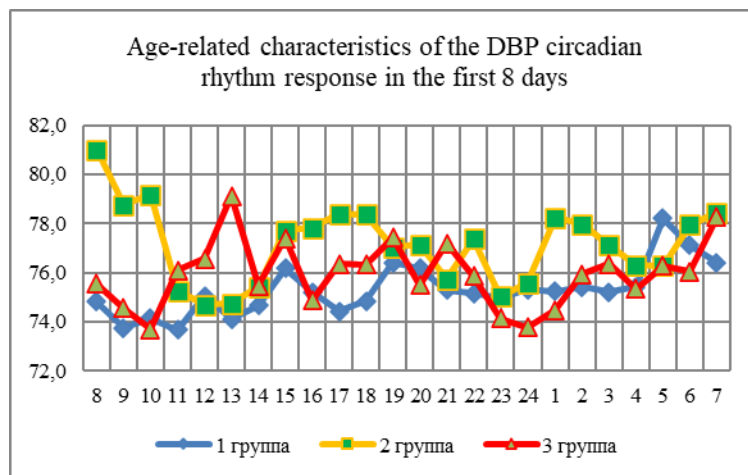


Fig.4

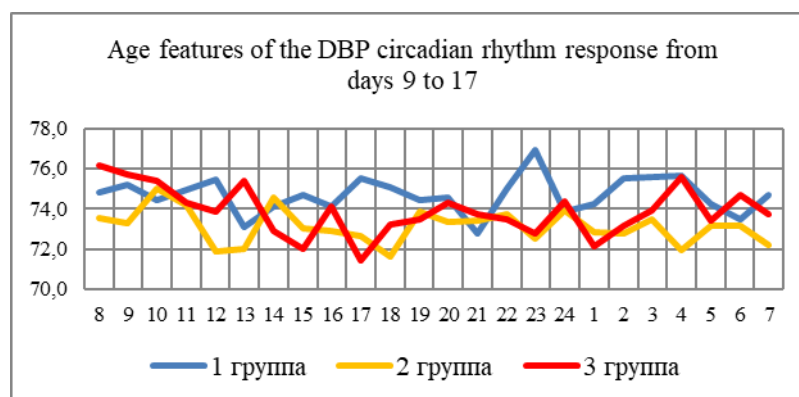


Fig.5

9-17 days of the acute period of CSTBI were characterized by the projection of the acrophase of the circadian rhythm DBP in group 1 at 23 hours (77 mmHg), in group 2 at 10 am (75 mmHg), at 8 am (76 mmHg) in patients of group 3. During the second week of the acute period of CSTBI,

the most pronounced displacement of acrophase at night was revealed in group 1 (inversion of the DBP circadian rhythm) (fig. 5). Thus, the most active were the adaptive capabilities of circadian biorhythms of peripheral vessels in patients of group 1 from 9 to 17 days of the acute period.

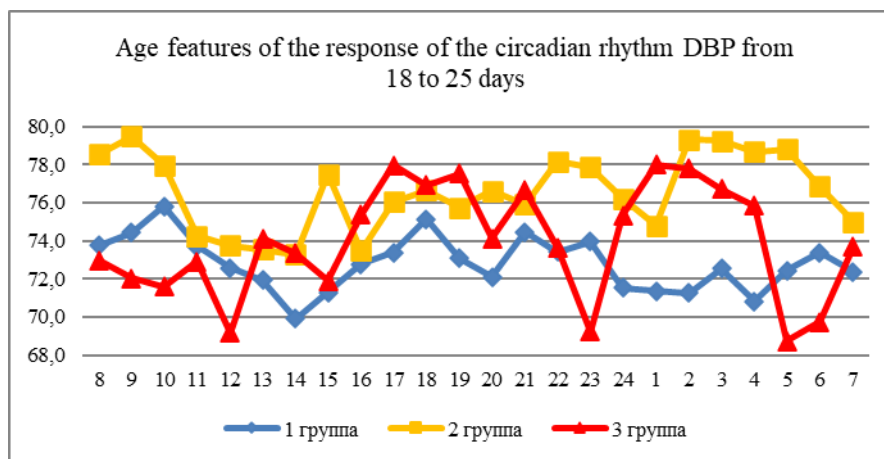


Fig.6

From 18 to 25 days, acrophase DBP appeared at 10 am (76 mmHg), in group 2 at 9 and 2 am (79 mmHg), in group 3 at 18 and 1 am (78 mmHg) (fig. 6). Vasopressor tendency was most pronounced in patients of group 2 and the least significant in group 1. The revealed features indicate the most unfavorable changes in DBP, possibly due to the compensatory direction of the changes.

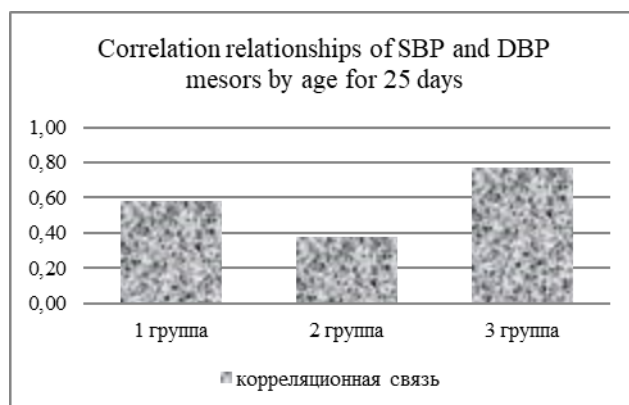


Fig.7

In the acute period of CSTBI, a reliably direct correlation between SBP and DBP was found in patients of group 3 (0.78), in group 1, 0.59, and in group 2, insignificant (0.38). The revealed features are possibly due to the effect of the prevailing vasopressor therapy, the most unfavorable condition, when an increase in cardiac output occurs only with an increase in vascular tone, that is, the effect of "centralization of blood circulation" was observed in group 3 (fig. 7).

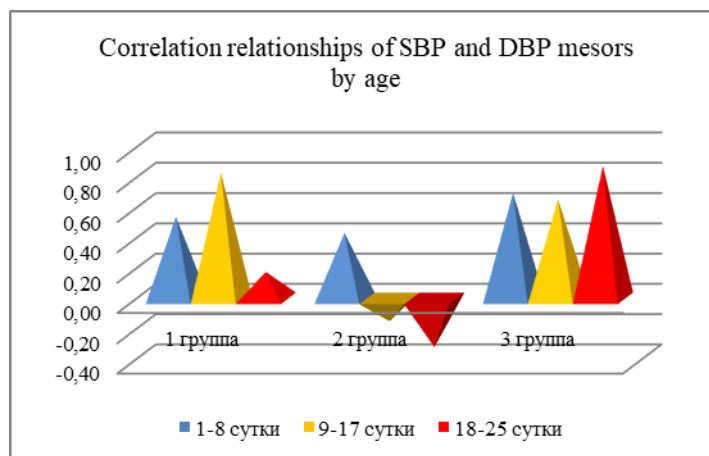


Fig.8

In group 1, the direct correlation between SBP and DBP was moderate in the first week, became significantly significant on days 9-17 and significantly decreased on days 18-25. In group 2, a weak direct correlation in the first week completely disappeared on days 9-17, a negative weak correlation appeared on days 18-25. In patients of group 3, a strong direct relationship between SBP and DBP parameters was observed throughout the acute period (fig. 8).

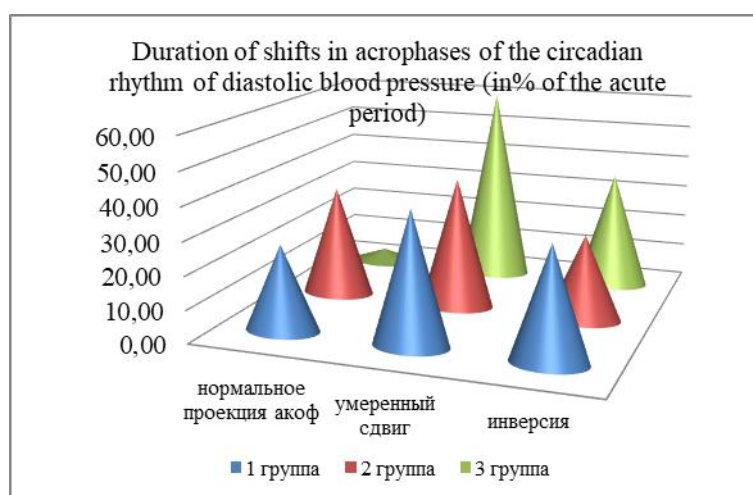


Fig.9

As can be seen from fig. 9, during most of the acute period of CSTBI, a moderate shift in acrophase prevailed, with a shift in the peak within daytime hours. Inversion (the most significant shift at 12 hours) was detected in groups 1, 2, 3 during 34%, 26%, 36% of intensive therapy time, respectively.

Conclusions. In the acute period of CSTBI, hemodynamic correction (hypotensive, as indicated by vasopressor therapy) ensured the stability of the mesor of the circadian rhythm DBP within the generally accepted standard values. All injured patients retained a tendency to instability of the vascular vasopressor response, which turned out to be the most significant in group 3 in

patients over 61 years of age. The most pronounced daily changes in peripheral vascular tone were found in patients of group 3. The adaptive capabilities of peripheral vessels were comparatively more active in patients of group 1 up to 40 years old from 9 to 17 days of the acute period of CSTBI.

References:

- 1) <http://www.stm-journal.ru/en/numbers/2010/4/685/pdf>
- 2) <https://newday-clinic.ru/posledstviya-cherepno-mozgovojev-travmy>
- 3) <https://www.mediasphera.ru/issues/zhurnal-nevrologii-i-psikhiatrii-im-s-s-korsakova/2018/11/1199772982018111093>
- 4) <https://diseases.medelement.com/disease>
- 5) <http://symona.ru/shkola-professionala/monitoring-i-terapiya/narusheniya-gemodinamiki-i-dyxaniya-chmt/>