DYSFUNCTIONS OF THE CARDIOVASCULAR SYSTEM IN HEMORRHAGIC STROKE IN NEWBORS

Dilmuradova Klara Ravshanovna, Mamatkulov Timur abdimuradovich, Ahmedova Mahbuba Maxmudovna

1 D.Sc. Docent. Head of the Course of Neonatology. Faculty of Postgraduate Education. Samarkand Medical Institute. Samarkand. Uzbekistan. E-mail: vmofneonatologiya.km@mail.ru.
2 Assistant. Course of Neonatology. Faculty of Postgraduate Education. Samarkand Medical Institute. Samarkand. Uzbekistan. E-mail: tima_med@mail.ru
3 PhD. Docent. Department of Pediatria. Faculty of Postgraduate Education. Samarkand Medical Institute. Samarkand. Uzbekistan. E-mail: Zuxratilykova@gmail.com

ABSTRACT

Author presented evaluation data of the computer brain neurosonography results and hemodynamic monitoring of the 56 newborns with hemorrhagic insult. At newborns with hemorrhagic insult were identified significant changes of the hemodynamic not only in the brain, but also of the whole organism, which is not always manifested in the clinical symptoms. It must be taken into account when treating newborns with hemorrhagic insult, especially during surgical interventions.

I. INTRODUCTION

Acute dysfunction of brain circulation is one of the important medical-social dilemmas [1,6,15,18,20]. The apoplexy in infant years gaining actuality in a relationship with increasing its spreading, high number of mortality and difficult neurological incomes leading to an early child neurological disability [10,13,16,19]. Results of epidemic research in recent years including the frequency of apoplexy in infant years are different, but mostly works consist of 2-3/100 000 in a year. According to date of literature, most authors believe that haemorrhagic apoplexy of children in early years carries polyetiological character[5,8,12,14]. So, the main problem of neonatology prophylaxis haemorrhagic apoplexy complication needs mobilization experts’ hard work several hachures (neonatologist, neurosurgeon, haematologist, paediatrician, optometrist, obstetrician - gynecologist, neuropathologist, infectious disease specialist). The problem remaining acute is maintenance pre-surgery conduct with non-traumatic extravasation in brain- deleting hematomas by surgery [3,4,7,11,17]

The classical symptoms of apoplexy in infants are highly various, its diagnostics much difficult because of absence of clear identification and description about the ill people feelings. Description in literature which is about symptoms and signs of apoplexy is not enough for detecting apoplexy in infant. In the result of this, the apoplexy in infants in most cases are being diagnosed late or can’t be find, the clinic features are being explained with other reasons. The clinic-treating prophylaxis help in many cases delays, as the result irreversible incomes and increasing the number of disables in childhood increase despite the fact that it can be avoidable. [2,9]

II. MATERIALS AND METHODS

The research was done with 56 infants with haemorrhagic apoplexy: boys -32, girls-24. In group which didn’t got surgery (one group) include children who got traditional therapy (8 children), including compensation deficit hemo-plasma transfusion, decongestant, anti-inflammatory correction. In infants of this group found small volume of hematoma which was not required deleting by surgery or difficult localization of extravasation, noted positive dynamic in carrying traditional therapy. In these infants was found insignificant deviations in homeostasis. After enhancement condition 42 infants discharged, 8 of them without surgery interference, before (14 the ills – 2 groups) and after surgery hematoma deleted (20 children- 3 groups). Passed away 8 ill infants (4 groups), with 4- ( in first 24 hour, with 1 ill child to 2,3 and 9 days after surgery, was done in 2 days after arrival
to clinic, 1 child passed away in 160 days artificial ventilation after two surgeries which were done in first and third days of arrival to clinic. The 4 infant groups were different from their arrivals with serious condition.

The diagnose confirmed with the method of computer tomography (CT). Concomitant infection: herpes, cytomegalovirus, chlamydia, pneumonia revealed in 25 infants, in 25 negative result of research, remaining 6 to subject TORCH infected wasn’t revealed.

The condition of central hemodynamic was evaluated by monitoring the next indexes: minute blood volume (MBV), stroke volume (SV), indicators of systolic (SBP), pulse (PAP), mean (MAP), diastolic (DBP) blood pressure, total peripheral vascular resistance (OPSR), heart rate (HR), an indicator of myocardial oxygen consumption. The dynamics of sympathetic tone was assessed by the index of the minute blood volume (QVm). The method for calculating the minute volume of blood circulation (MCV) and total peripheral vascular resistance (OPSR) was borrowed from the materials of clinical and functional results of studies of adult cardiologists [127]. Monitoring workable with machines 1- Nihon Kohden (Japan), Datex Ohmedia (Spain), Oxypal Neo(Japan). The statistic processing obtained results conducted in computer with the help of Microsoft Excel program. For comparison of average volumes used criteria of Student-t. For contrasting ratings of results and detection of alternative interconnected events applied method of couple correlations.

### III. RESULTS.

In first days of treatment average index indicators of systolic (SBP) in infants of 1 group was raised till 23 % at normal level of diastolic blood pressure. It means, revealed hyper dynamic type of blood circulation which was expressed by increasing pulse (PAP), tendencies at development of average blood pressure till 58.8±6.2 mm.hg caused an increase in myocardial oxygen consumption by 20% (p <0.05), an increase in the minute volume of blood circulation by 78%, with a normal average daily heart rate, oxygen saturation indicator (table 1).

**Table 1.** Average daily hemodynamic parameters of non-operated new-borns (group 1)

<table>
<thead>
<tr>
<th>Treatment days</th>
<th>SBP mm. Hg ±1</th>
<th>DBP mm. Hg ±1</th>
<th>PAP mm. Hg ±1</th>
<th>MAP mm. Hg ±1</th>
<th>HR beat/min ±1</th>
<th>SpO₂ % ±1</th>
<th>Post-operative O₂ ±1</th>
<th>MCV l/min ±1</th>
<th>QVm, ml ±1</th>
<th>SV ml ±1</th>
<th>OPCR din<em>s</em>sm⁻⁵ m ±1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>86.6 ±6.7</td>
<td>44.9 ±6.2</td>
<td>42.3 ±3.1</td>
<td>58.8 ±6.2</td>
<td>138.6 ±12.3</td>
<td>97.8 ±1.2</td>
<td>120.0 ±0.8</td>
<td>892.0 ±58.3</td>
<td>±0.01</td>
<td>6.4 ±0.8</td>
<td>777 ±191</td>
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<tr>
<td>2</td>
<td>82.7 ±6.1</td>
<td>42.3 ±5.3</td>
<td>41.8 ±6.3</td>
<td>53.9 ±6.3</td>
<td>143.3 ±6.7</td>
<td>97.0 ±1.3</td>
<td>118.5 ±0.4</td>
<td>957.9 ±52</td>
<td>±0.01</td>
<td>6.7 ±0.8</td>
<td>690 ±93</td>
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<td>3</td>
<td>80.6 ±7.0</td>
<td>42.9 ±3.8</td>
<td>40.3 ±6.9</td>
<td>54.9 ±4.7</td>
<td>141.7 ±5.8</td>
<td>97.3 ±1.0</td>
<td>114.2 ±0.4</td>
<td>926.0 ±92</td>
<td>±0.01</td>
<td>6.5 ±0.6</td>
<td>696 ±60</td>
</tr>
<tr>
<td>4</td>
<td>83.9 ±5.7</td>
<td>43.2 ±4.1</td>
<td>37.7 ±5.8</td>
<td>55.3 ±5.1</td>
<td>133.1 ±1.2</td>
<td>96.9 ±1.2</td>
<td>111.6 ±0.3</td>
<td>790.1 ±32.7</td>
<td>±0.01</td>
<td>5.9 ±0.5</td>
<td>849 ±139</td>
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<td>86.8 ±3.3</td>
<td>44.3 ±4.7</td>
<td>40.7 ±1.6</td>
<td>57.1 ±4.5</td>
<td>134.2 ±5.9</td>
<td>97.4 ±0.5</td>
<td>116.5 ±0.3</td>
<td>833.0 ±23.5</td>
<td>±0.01</td>
<td>6.2 ±0.4</td>
<td>834 ±112</td>
</tr>
<tr>
<td>6</td>
<td>86.9 ±3.2</td>
<td>45.7 ±3.3</td>
<td>41.0 ±1.9</td>
<td>59.7 ±4.6</td>
<td>132.1 ±0.7</td>
<td>97.3 ±1.4</td>
<td>114.8 ±0.1</td>
<td>816.9 ±27.3</td>
<td>±0.01</td>
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<td>7</td>
<td>88.3 ±3.1</td>
<td>45.6 ±2.1</td>
<td>41.5 ±1.6</td>
<td>58.1 ±2.3</td>
<td>129.5 ±2.8</td>
<td>97.5 ±0.8</td>
<td>114.4 ±0.1</td>
<td>803.2 ±17.8</td>
<td>±0.01</td>
<td>6.2 ±0.3</td>
<td>880 ±87</td>
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<tr>
<td>8</td>
<td>88.2 ±4.8</td>
<td>46.1 ±3.7</td>
<td>41.7 ±1.8</td>
<td>59.6 ±4.5</td>
<td>136.1 ±0.5</td>
<td>97.4 ±0.4</td>
<td>120.0 ±0.3</td>
<td>846.1 ±18.1</td>
<td>±0.01</td>
<td>6.2 ±0.2</td>
<td>834 ±112</td>
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<tr>
<td>9</td>
<td>90.2 ±3.4</td>
<td>47.4 ±2.4</td>
<td>42.3 ±0.8</td>
<td>61.0 ±0.2</td>
<td>130.1 ±0.3</td>
<td>97.7 ±0.2</td>
<td>117.4 ±0.4</td>
<td>800.0 ±13.5</td>
<td>±0.01</td>
<td>6.2 ±0.8</td>
<td>902 ±87</td>
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<td>10</td>
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<td>42.3 ±1.8</td>
<td>44.6 ±1.3</td>
<td>56.5 ±2.9</td>
<td>125.9 ±6.5</td>
<td>97.5 ±0.5</td>
<td>110.2 ±0.0</td>
<td>865.4 ±46.0</td>
<td>±0.01</td>
<td>6.9 ±0.7</td>
<td>809 ±68</td>
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<td>89.7 ±1.6</td>
<td>43.4 ±0.5</td>
<td>46.3 ±0.8</td>
<td>58.9 ±1.1</td>
<td>131.4 ±0.3</td>
<td>97.7 ±0.3</td>
<td>117.9 ±0.2</td>
<td>914.1 ±145.1</td>
<td>±0.01</td>
<td>7.0 ±0.3</td>
<td>785 ±88</td>
</tr>
<tr>
<td>12</td>
<td>86.7 ±4.0</td>
<td>44.0 ±2.7</td>
<td>42.7 ±5.8</td>
<td>58.3 ±7.0</td>
<td>127.6 ±11.8</td>
<td>98.0 ±0.5</td>
<td>110.6 ±0.3</td>
<td>832.4 ±6.5</td>
<td>±0.01</td>
<td>6.5 ±6.5</td>
<td>833 ±88</td>
</tr>
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The compensational feature hyperdynamic type of hemodynamic during the whole period of treatment confirmed to be stable level on average index of oxygen saturation. The index of myocardium oxygen consuming remained raised according to the norms during the whole observation with the tendency of decreasing to 10% at 10,12,13 days.

Before the surgery hemodynamic characteristics of 14 infants (2 groups) were studied, after the healing preparation all of them were operated. In post-surgery period, 8 of them transferred to neurosurgery department for two days after the operation, remained 6 for the 4-6 days after the surgery.

In the post-operation period average index of hemodynamic MAP, CVP, RR, oxygen saturation situated on the bound of normal physiological significance. On the first day revealed increase of consuming myocardium oxygen at the level of 11%, raising IOK at the level of 70% on the circumstances of absent symptoms for hypersympathicotonia (QVm=1.05±0.01).

The tendency of the functional activity of hemodynamic to hyperdynamia in group 2 was the result of not only intracerebral haemorrhage, but also the reaction of the cardiovascular system to blood transfusion, carried out in all new-borns during the period of preparation for surgery. Compensation for the BCC deficiency determined the stability of the average daily hemodynamic parameters in both groups; neurological symptoms on admission corresponded to the underlying disease. The introduction of erythrocyte mass and FFP upon admission restored not only the BCC, gas transport function, oxygen capacity of the blood, but also onotic pressure, rheological properties, compensation for the deficiency of coagulation factors, haemostasis.

On the first day after surgery in patients of group 3 (Table 2.) body temperature, SBP, DBP, AVP, CVP, HR, RR, oxygen saturation index, sympathetic tone index were within normal limits. However, at the same time, myocardial oxygen consumption was increased by 17%, IOC - by 70% (p <0.05). On days 2-4 of the postoperative period, the tendency to increase the temperature to sub febrile numbers (37.2 ± 0.16 °) caused an increase in the effect of sympathetic tone on the heart rate by 21% on day 2, without increasing myocardial oxygen consumption, IOC (table 2).

Table 1. Average daily hemodynamic indicators of new-borns after the operation (3 group)

<table>
<thead>
<tr>
<th>Days</th>
<th>SBP mm. Hg</th>
<th>DBP mm. Hg</th>
<th>PAP mm. Hg</th>
<th>MAP mm. Hg</th>
<th>CVP mm. Hg</th>
<th>RR In min</th>
<th>HR In min</th>
<th>SpO₂ %</th>
<th>Post-op mioc</th>
<th>IOK l/min</th>
<th>QM</th>
<th>SV ml</th>
<th>OP CR din</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>81.8 ±4.7</td>
<td>44.4 ±3.5</td>
<td>35.9 ±2.5</td>
<td>46.4 ±4.2</td>
<td>54.9 ±2.5</td>
<td>36.5 ±3.3</td>
<td>143.4 ±5.8</td>
<td>98.7 ±0.6</td>
<td>117.4 ±0.3</td>
<td>817.4 ±36.1</td>
<td>1.09 ±0.0</td>
<td>5.7 ±0.2</td>
<td>801 ±10.5</td>
</tr>
<tr>
<td>2</td>
<td>81.5 ±4.7</td>
<td>41.8 ±3.2</td>
<td>39.3 ±4.8</td>
<td>42.4 ±5.8</td>
<td>58.6 ±3.8</td>
<td>41.1 ±6.3</td>
<td>145.2 ±10.2</td>
<td>98.0 ±1.1</td>
<td>118.4 ±0.5</td>
<td>927.8 ±124.3</td>
<td>1.2 ±0.0</td>
<td>6.4 ±0.2</td>
<td>703 ±12.0</td>
</tr>
<tr>
<td>3</td>
<td>84.1 ±6.0</td>
<td>42.7 ±3.5</td>
<td>38.6 ±3.2</td>
<td>45.9 ±3.8</td>
<td>48.8 ±3.4</td>
<td>40.0 ±5.7</td>
<td>140.4 ±6.9</td>
<td>97.9 ±1.0</td>
<td>118.1 ±0.4</td>
<td>855.7 ±47.9</td>
<td>1.19 ±0.0</td>
<td>6.1 ±0.9</td>
<td>786 ±99.9</td>
</tr>
<tr>
<td>4</td>
<td>85.9 ±2.8</td>
<td>46.0 ±6.5</td>
<td>34.3 ±4.8</td>
<td>44.7 ±6.1</td>
<td>56.5 ±6.5</td>
<td>39.1 ±11.4</td>
<td>139.6 ±11.4</td>
<td>97.5 ±0.9</td>
<td>120.0 ±0.3</td>
<td>726.9 ±267.7</td>
<td>1.01 ±0.0</td>
<td>5.2 ±0.4</td>
<td>945 ±82.4</td>
</tr>
<tr>
<td>5</td>
<td>84.1 ±6.1</td>
<td>45.2 ±3.2</td>
<td>38.1 ±2.4</td>
<td>51.7 ±5.3</td>
<td>46.1 ±2.5</td>
<td>41.1 ±11.5</td>
<td>138.8 ±11.5</td>
<td>97.1 ±1.1</td>
<td>116.8 ±0.7</td>
<td>817.8 ±71.4</td>
<td>1.10 ±0.0</td>
<td>5.9 ±0.2</td>
<td>823 ±92.1</td>
</tr>
</tbody>
</table>

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Noteworthy is the high SBP (95.3 ± 1.4 mm Hg) on the day of admission to the clinic, which was increased by 28% (p <0.05), with a tendency to decrease to 78.6 ± 9 mm Hg for 10 days. DBP in the first 9 days did not differ significantly from the norm, on the 10th day it decreased by 30% (p <0.05), despite the vasopressor support of hemodynamic in the 4th group of new-borns.

The average daily level of pulse and mean arterial pressure in children of group 4 was characterized by an increase throughout the observation period. The average daily CVP was closer to the upper limit of the permissible values. The oxygen saturation index against the permissible norm, starting from the second day, amounted to 70-80 cm of water at st. The dynamics of the average daily heart rate level occurred within the permissible values. The oxygen saturation index against the background of constant oxygen insufflation tended to decrease. At the same time, the average daily rate of oxygen consumption by the myocardium, an increase of 31% on the first day, remained increased up to 8 days in the following days. Moderate hypersympathotonia (1.18 ± 0.01) in the first two days began to increase to 1.25 ± 0.01, in the following days it showed a tendency to a slight decrease to 1.14 ± 0.02 units for 10 days.

The seriousness of the patient’s condition for 4 group depended on big size of extravasation for 2 with dislocation of the brain in 1-1.5 cm, accompanying with infection – pneumonia in 3 new-borns. In other days of observation dependable, various indexes were not found, proving the efficiency of hemodynamic correction. However, serious brain damage, weight of accompanying factors caused negative outcome. The compensatory value of the activity of the respiratory system (tachypnea) during hyperthermia is known, aimed at an adequate increase in heat transfer under conditions of hypermetabolism with a systemic inflammatory response of the body. The average daily body temperature in patients of group 4 on the first day was significantly lower than in the first. That is, in group 1, a sub febrile level of body temperature was revealed, and in group 4, with a comparatively more severe stress state, the average daily body temperature turned out to be "normal". In group 1, the average daily body temperature gradually decreased to normal on the 5th day, remaining at this level on the following days of observation. While in patients of group 4 on 8 and subsequent days, the average daily temperature level increased to sub febrile figures (37.1 ± 0.1 °) against the background of an increase in clinical and laboratory signs of the inflammatory response of the new-born’s body. Initial sub febrile condition in group 1 at admission was most likely associated with a stress response of the body to an intracerebral hematoma.

IV. DISCUSSION.

The revealed changes in hemodynamic in the group of non-operated new-borns characterize the formation of a hyper dynamic type of blood circulation caused by a stress hypersympathotonic response to cerebral haemorrhage. Confirmation is an increase in the level of sympathetic tone in 1 day by 20% under conditions of normal body temperature. The steadily increased cardiac output was due to hypersympathotonia. The hyper dynamic type of blood circulation found in this group of newborns was most likely of an adaptive nature and the restructuring of hemodynamic was aimed at maintaining the required level of intracranial blood circulation in response to cerebral haemorrhage in new-borns. However, the vasoactive effect of drug correction (barbiturates, lidocaine, magnesium sulphate), as evidenced by the tendency to decrease total peripheral vascular resistance throughout the observation period, exerted a stress-limiting effect, reducing tissue oxygen demand, improving tissue perfusion in the ischemic brain area, anti-edema effect.
The increased consumption of oxygen by the myocardium, revealed in the examined group 2, in the absence of signs of hypersympathicotonia, apparently has compensatory developmental mechanisms, which, under conditions of blood transfusion therapy (increase in IOC), allow maintaining stable indicators of SBP, DBP, MAP, CVP.

The comparatively smaller number of hemo- and plasma transfusions in the postoperative period (group 3) is due to the fact that children went to the operation with already recovered BCC during preoperative preparation. In new-borns after surgery, there was a tendency to stress mobilization of hemodynamic, characteristic of the adaptive mobilization of compensatory mechanisms in the postoperative period.

Dramatic consequences in the examined group 4 were associated with severe brain damage and the severity of associated factors.

V. CONCLUSION.

In the group of non-operated new-borns, a hyper dynamic type of blood circulation of an adaptive nature and signs of hemodynamic restructuring aimed at maintaining the required level of intracranial blood circulation in response to cerebral haemorrhage in new-borns were revealed.

In order to stabilize the achieved results of surgical treatment, it is advisable to increase the duration of drug correction by 2-3 days (up to 10 days after the operation). With haemorrhagic stroke in new-borns, pronounced disturbances in the activity of the cardiovascular system are noted. This must be taken into account when carrying out intensive care of new-borns with haemorrhagic stroke, especially during surgical interventions.

REFERENCE LIST


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