THE ASSESSMENT OF HEMODYNAMICS AND FLUID BALANCE DISORDERS OF THE PREGNANT WOMEN WITH THE GESTOSIS DURING THE CESAREAN SECTION

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ABSTRACT

This research work is carried out in the Department of Anesthesiology, Intensive Care and Critical Care, Obstetrics and Gynecology in the Perinatal Centre of the National Centre of Medicine, Yakutsk, the Russian Federation. A prospective study in one hundred and forty women from 2010 to 2012 has been made. All study patients are divided into two groups: Group I - control group, comprising 79 healthy patients; II group – the main group, including 61 patients with gestosis.

The research of the central hemodynamic parameters and water balance was performed non-invasively using the cardio-respiratory device KM-AP-01 "DIAMANT" (City of St. - Petersburg) in the integral reography and impedansometry mode. As the above presented table shows, Group I is characterized by normal hemodynamic performance of the central and peripheral hemodynamics in the preoperative period but after the intraspinal anesthesiathere is a slight increase in the heart rate an average of 93,9 ± 15,67 beats / min, against the background of the decline in the total peripheral resistance an average of 1114,67 ± 409,66 din * s * cm-5. At the time of the fetus extraction, there is some increase in indicators such as TPVR, CO, SV, but at the end of the surgery they are normalized. In group II, comprising the obstetric patients with gestosis, attention is to be drawn to the increased level of the total peripheral vascular resistance at all stages of the research, which peaks at the time of the fetus extraction, as TPVR averagely increases 2725, 07 ± 1591, 47 din * s * cm-5, CO 7, 03 ± 3, 26 l * min-1.This is due to the sharp changes in pre-and after load on the left heart and circulatory centralization. Volume of fluid and extracellular fluid, on the background of the lowered parameters of the intracellular liquid.

In group II, comprising the patients with gestosis, the TVF, INTRA figures have decreased on the background of the increased volume of blood and plasma.In the postoperative period in group I the increased figures of EXTRA, BV, PV, INTRA TVF during the cesarean decrease. In group II there is also an increase of EXTRA, BV, PV, but on the background of the decreased figures of INTRA and TVF. In general, in group I originally, at the end of the third trimester of pregnancy there is a relative hypovolemia. At the time of the operative delivery on the background of the infusion therapy, the blood output from the depot and the increase of the blood flow redistribution there is an increase of EXTRA, BV, PV, TVF indicators. However, in the postoperative period, these figures are slightly lower. In group II, comprising the patients with gestosis, there is hypervolemia due to the extracellular and total body fluid on the background of the intracellular fluid deficiency.

During the c-section there is a slight hypovolemia caused by the blood loss and the fluid redistribution by sectors. In the postoperative period, the volume of extracellular fluid, the volume of blood and the volume of plasma increase due to the compensatory mechanisms of the body and the continuing gestosis.

Keywords: Anesthesiology, gestosis, extracellular liquid, hemodynamic.

INTRODUCTION

The gestosis belongs to the most complicated part of the obstetrical pathology. Over the past five years its occurrence has increased and varies between 14 and 21%. The violation of the vascular permeability plays the main role in the pathogenesis of gestosis and as a result of it, there is a paradoxical combination, that is hypovolemia against the background of large amounts of water in the interstitium, which leads to reducing the adequacy of hemodynamics. [1,2].

Let us have a closer look at the development mechanism of the water-sectoral violation, happening to the pregnant women with the gestosis.

The development basis of hyperhydration is the damage of the vascular endothelial cells, which perform a wide range of the most important functions, including keeping on the certain level the filling the organism water systems. It is the damage of vascular endothelial cells that is the reason for the capillary leak in the severe forms of gestosis.

The swelling of the interstitial space occurs when the fluid is filtered through the microcirculatory channel faster than removed by the lymphatic system. In this case the fluid transportation through the vascular endothelium into the interstitial space is determined by the values of hydrostatic and oncotic pressure on both sides of the capillary wall, and is described by Starling equation. [3,4,5].

The introduction of the noninvasive assessment methods to assess the central hemodynamics and water - sectoral balance into the clinical medicine raises the quality of understanding the woman in labour condition to a higher level and it allows the anesthesiologist to manage and monitor the violations of hemodynamic parameters and water balance.

The aim of the research is to assess the extent of the hemodynamic parameters and water balance violations during the surgical delivery under the intraspinal anesthesia of the obstetric patients with the accompanying gestosis.

THE MATERIAL AND METHODS OF THE RESEARCH

This research work is carried out in the Department of Anesthesiology, Intensive Care and Critical Care, Obstetrics and Gynecology in the Perinatal Centre of the National Centre of Medicine, Yakutsk, the Russian Federation. A prospective study in one hundred and forty women from 2010 to 2012 has been made.

All study patients are divided into two groups: Group I - control group, comprising 79 healthy patients; II group – the main group, including 61 patients with gestosis.

The main indications for the operative delivery in the first group were: uterine scar – 51 (64,5%), the untrained birth canals – 19 (24%), the premature rupture of membranes– 9 (11,3%).

The main indications for the operative delivery in the second group in most cases were the progression of gestosis with the ineffectiveness of conservative treatment – 52 (85,2%), the threatening fetal asphyxia - 5 (8,1%), preeclampsia – 4 (6,5%).

The methodology of the research was to give the dynamic assessment of the main vital systems functional state in which the maternal bodies were before surgery, at the key stages of the surgical delivery and in the postoperative period.

The research of the central hemodynamic parameters and water balance was performed non-invasively using the cardio-respiratory device KM-AP-01 “DIAMANT” (City of St. - Petersburg) in the integral reography and impedansometry mode.

The following hemodynamic parameters were measured: HR - heart rate (beats / min); MAP - mean arterial pressure (mm Hg);; CI-cardiac index (l * min-1 * m-2); SV-stroke volume (ml);SI-stroke index (ml * m-2);CO- cardiac output (l * min-1);TPVR- total peripheral vascular resistance (dyne * s * cm-5); IGTV-integral gain tonicity vessels (standard units);RR reserve ratio (%).As indicators of water balance: TVF-the total volume of fluid - litres, EXTRA- extracellular fluid in litres, INTRA-intracellular fluid in litres, PV-plasma volume in litres, BV - blood volume in litres.

All patients had the following premedication: atropine 0.5 -0.7 mg, 2 mg of diphenhydramine, dormikum 2 to 3 mg intravenously. In group I infusion therapy was in the amount of 5 to 7 ml / kg, in Group II it was 3 - 5 ml / kg Stabizol solution.

The intraspinal anesthesia was performed in the left lateral position under the local anesthesia at the level of L4-L5 using needles with a diameter G 20 -27. For the anesthesia the isobaric bupivacaine 0.5% was used in a dose of 10 - 15 mg.

THE RESULTS

The research produced the following results.

As the above presented table shows, Group I is characterized by normal hemodynamic

performance of the central and peripheral hemodynamics in the preoperative period but after the intraspinal anesthesiathere is a slight increase in the heart rate an average of 93,9 ± 15,67 beats / min, against the background of the decline in the total peripheral resistance an average of 1114,67 ± 409,66 din * s * cm-5. At the time of the fetus extraction, there is some increase in indicators such as TPVR, CO, SV, but at the end of the surgery they are normalized. In group II, comprising the obstetric patients with gestosis, attention is to be drawn to the increased level of the total peripheral vascular resistance at all stages of the research, which peaks at the time of the fetus extraction, as TPVR averagely increases 2725,07 ± 1591,47 din * s * cm-5, CO 7,03 ± 3,26 l * min-1.This is due to the sharp changes in pre-and afterload on the left heart and circulatory centralization.

In the postoperative period, the obstetric women with the severe gestosis have the vasospasm that remains up to 2 - 3 days.

The baseline characteristics of the water balance in Group I - TVF, EXTRA, INTRA, PV, BV are all reduced, including the actual performance.

In group II there is an increase of all parameters of the water balance at the expense of the total volume of fluid and extracellular fluid, on the background of the lowered parameters of the intracellular fluid.

At the stage of the cesarean in group I the actual figures at all stages of the surgical intervention remain at the same level.

According to the indicators of deviations from the norm and % to a proper indicator the TVF, EXTRA, BV, PV figures have increased and the INTRA figures remain in short supply.

In group II, comprising the patients with gestosis, the TVF, INTRA figures have decreased on the background of the increased volume of blood and plasma.

In the postoperative period in group I the increased figures of EXTRA, BV, PV, INTRA TVF during the cesarean decrease. In group II there is also an increase of EXTRA, BV, PV, but on the background of the decreased figures of INTRA and TVF.

In general, in group I originally, at the end of the third trimester of pregnancy there is a relative hypovolemia.

At the time of the operative delivery on the background of the infusion therapy, the blood output from the depot and the increase of the blood flow redistribution there is an increase of EXTRA, BV, PV, TVF indicators. However, in the postoperative period, these figures are slightly lower.

In group II, comprising the patients with gestosis, there is hypervolemia due to the extracellular and total body fluid on the background of the intracellular fluid deficiency.

During the caesarean section there is a slight hypovolemia caused by the blood loss and the fluid redistribution by sectors.

In the postoperative period, the volume of extracellular fluid, the volume of blood and the volume of plasma increase due to the compensatory mechanisms of the body and the continuing gestosis.

THE RELATIONSHIP OF HEMODYNAMICS AND FLUID BALANCE

In Group I, on the background of the original hypovolemia the spinal anesthetic management leads to the development of hypotension, which requires correction by the volemic load.

At the stage of the cesarean, due to the infusion therapy and compensatory mechanisms of the body there is an increase in fluid more due to the volume of blood, the volume of plasma, the volume of total fluid and the extracellular fluid. At this stage, the hemodynamics is stable.

In the postoperative period, due to the return of algesthesia, the hemodynamics is characterized by an increase in the heart rate, cardiac output, cardiac index on the background of the fluid balance normalization. In Group II there is originally hypervolemia on the background of the increased figures in the peripheral vascular resistance, cardiac output, cardiac index. In this connection, the load on the heart is significant. The infusion therapy requires a precise control of the quality and quantity. After the spinal anesthetic management unlike group I there is no significant

reduction of the pressure and the peripheral vascular resistance. This is certainly connected to the total vasospasm due to gestosis. At the stage of the fetus extraction there is the highest load on the heart caused by the mechanical pressure and a sharp increase in the blood flow. There is also a significant increase in pre-and after load on the heart. It is at this stage when the stagnation of blood occurs in the lungs and it can cause the pulmonary edema. However, on the background of the spinal anesthesia, unlike the other types of anesthesia, such as the general and epidural anesthesia, the risk of the acute left ventricular failure is minimal because it is the subarachnoid block that causes the greatest decrease in total peripheral vascular resistance and reduces the preload on the heart. Thus it eliminates the blood stagnation development in the pulmonary circulation, even in patients with severe gestosis. As for the water balance due to the redistribution of blood and fluid as well as the blood loss there are reductions in the total volume of fluid and extracellular fluid, on the background of the blood volume and plasma volume increased figures. This can be explained by the inclusion of compensatory mechanisms of the body - the ejection of blood from the depot. . In the postoperative period the women in labour with gestosis still have the hyperkinetic circulatory disorder which in severe cases may last up to 3 - 5 days. The water - sectoral balance in the early postoperative period is characterized by the hypervolemia, which is reduced in parallel with the stabilization of the hemodynamics.

CONCLUSIONS:

1. In pregnant women without concomitant gestosis during cesarean section under ISA, the initial decrease in systemic vascular resistance is replaced by a 1.3-fold increase in the initial data at the higher SV and the CO and the CI (1.3 times) and CR (1.4 times). Water balance in this group of women is characterized by an increase in all liquid sectors (TVF, EXTRA, INRTA, PV, and BV. Shifts of hemodynamics and water balance are normalized during the first hours after the operation.
2. For pregnant women with gestosis increase in the initial TPVR and the CO is marked, which at the time of extraction of the fetus increases in 1.6 and 1.3 times, respectively. Water balance in this group of women is characterized by the initial increase in all liquid sectors, primarily due to its extracellular portion, the amount of which increases in 1.3 times. During cesarean section the liquid decrease in all water sectors is observed. These disorders remained the same for 3-4 days after surgery.
3. Perioperative assessment of central and peripheral hemodynamics and water- sectoral balance of the women in labor provides control and justification of infusion therapy. In severe forms of gestosis infusion therapy must be based on hemodynamic monitoring data.

THE PRACTICAL RECOMMENDATIONS

The evaluation of the initial central and peripheral hemodynamics of the water - sectoral balance is necessary for the proper selection and the volume of the infusion therapy and possible inotropic support.

The preoperative preparation of the pregnant women during the intraspinal anesthesia with the isobaric solution of the marcaine spinala is required. It must include the infusion therapy in 5 - 7 mL / kg starch solution, an average of 60 drops per minute.

The preoperative preparation of the pregnant women with gestosis also requires the infusion therapy but in the minimal dosages, 3 - 5 ml / kg starch solutions.The intraspinal anesthesia requires the precise control of the spinal block level.

The intraoperative assessment of the central sector of the hemodynamics and water sectoral balance is required because it gives an opportunity to identify the most dangerous and critical periods of surgery.Therefore, it helps to begin the necessary measures. Thus, the most dangerous period in Group I is conducting the intraspinal anesthesia because of a reduction in the vascular tone on the background of the relative hypovolemia. In both groups, the critical period is the time of the

fetus extraction. This is due to the mechanical pressure made by the obstetricians and the pathological total vasospasm which women in labour with gestosis have. This period requires the correction of the hemodynamics parameters, as there is a high risk of the pulmonary edema. This correction can be done with the use of such medications as the calcium channel blockers (veropamil) and others, sedation (dormikum, relanium) as well as the oxygen supplementation via a nasal catheter. In the postoperative period, the women in labour with gestosis still have the high indices of the central and peripheral hemodynamics and the state of the hypervolemia, and therefore the treatment of gestosis continues till the above figures are stabilized.

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Table 1

Characteristics of the study groups

Indicators	I group	II group
Age	29,47±4,45	32,3±5,63
Weight	70,11±8	79,3±9,85
Growth	163,71±5,61	165±7,02
The period of gestation	39,23±0,95	36,85±1,2
ASA	I, II	II, III

Table 2

Dynamics of hemodynamic parameters during research

The group	Before the operation	After SA	Removing the fetus operations	After the End of Operations	End of Operations
Heart rate (beats/min)					
I group	81,1±11,3	93,9±15,7	86,6±23,9	92,0±26,2	71,5±12,6
II group	81,1±11,3	86,8±17,1	87,3±20,4	91,1±22,2	71,1±12,6
Blood pressure мм Hg					
I group	76,3±8,6	61,3±14,0	87,5±6,8	84,5±5,9	83,1±7,8
II group	89,5±26,0	110,8±13,2	101,6±18,6	100,2±19,5	103,2±11,8
cardiac index ($l*m^{-1}*m^{-2}$)					
I group	3,9±1,1	4,7±1,3*	4,6±1,8*	5,1±1,5*	4,0±1,3
II group	3,8±1,3	4,1±2,6	4,2±1,9	4,2±1,9	3,4±1,1
stroke volume of blood (ml)					

I group	62,3±16,0	68,3±17,5	84,8±19,0	80,2±19,8	74,9±17,3
II group	69,3±14,5	69,6±22,8	76,3±29,1	72,5±26,3	73,1±20,1
Stroke index(ml*m^{-2})					
I group	48,9±14,8	44,8±10,0	56,4±19,2	56,0±15,7	54,8±12,8
II group	47,5±13,3	45,8±20,2	49,8±25,9	43,4±12,2	48,8±13,1
the minute volume of circulatory (l*min^{-1})					
I group	5,1±1,2	5,6±1,7	6,9±2,1	7,5±2,4	5,3±1,3
II group	5,5±1,2	6,0±2,1	7,0±3,3	6,3±2,7	5,8±1,7
total peripheral resistance of blood (din*s*cm^{-5})					
I group	1247,9±436,4	1114,7±409,7	1413,5±682,9	1100,1±483,1	1225,0±348,8
II group	1687,6±839,8	2568,5±1054,7	2725,0±1591,4	1888,7±982,9	3307,0±1170,0
the coefficient of the integral tonical vessels (conventional units)					
I group	71,5±5,2	68,1±12,2	71,5±8,2	69,8±5,9	75,2±10,3
II group	76,6±5,56	75,0±5,6	71,9±7,8	69,9±5,5	71,6±3,5
The ratio of allowance (%)					
I group	104,4±40,1	124,3±43,2	152,0±49,0	147,3±51,0	122,5±28,4
II group	124,9±22,6	131,6±33,9	136,8±47,3	139,2±48,0	130,7±35,8

Note: * - indicator significantly differ from the original (p< 0,05).
** - indicator is significantly different from the values 1 group (p <0,05).

Table 3

The dynamics of the water balance on the stages of the research

The group	Before the operation	After SA	Removing the fetus operations	After the End of Operations	End of Operations
Total body fluids (L)					
I group	27,48±3,01	30,92±3,05	30,91±3,26	30,61±3,05	28,44±3,69
II group	30,68±4,53	29,26±5,43	29,17±5,50	29,17±5,48	30,93±4,27
Extra cellular fluid (L)					
I group	9,41±0,82	10,60±1,32	10,65±1,61	10,24±1,74	9,25±2,60
II group	10,36±1,72	9,78±2,21	9,43±1,8	7,85±2,08	10,41±1,6

Intra cellular fluid (L)					
I group	18,98±2,15	20,13±1,96	20,53±2,63	20,27±2,21	18,72±2,40
II group	20,09±2,86	19,65±4,09	19,87±4,02	19,8±3,91	20,54±3,0
the volume of plasma (L)					
I group	2,12±0,18	2,36±0,29	2,34±0,37	2,36±0,38	2,23±0,42
II group	2,39±0,43	2,26±0,51	2,18±0,42	2,14±0,42	1,82±0,87
the volume of blood (L)					
I group	3,39±0,53	4,02±0,53	3,98±0,63	4,0±0,68	3,96±0,61
II group	3,97±0,63	3,72±0,86	3,59±0,68	3,57±0,7	3,89±0,67

Note: * - indicator significantly differ from the original ($p< 0,05$).
** - indicator is significantly different from the values 1 group ($p <0,05$).