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Influence of Propofol on Hemodynamics During Cesarean Section

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Abstract: The article presents the results of assessing the degree of influence of propofol anesthesia on the cardiovascular system of parturient women during surgical delivery in 98 pregnant women. The CH of parturient women undergoes significant changes at various stages of anesthesia. During induction of anesthesia, there is a tendency towards a decrease in cardiac output and minute performance, a decrease in systemic arterial tone, which was accompanied by a tendency to arterial hypotension and compensatory tachycardia. These changes were transient in nature and did not lead to gross hemodynamic changes, by the time the surgical intervention is completed, all the main CH indicators return to their original values.
Conclusions: Propofol in standard dosages does not have a pronounced effect on systemic and central hemodynamics in parturient women. Propofol anesthesia during cesarean section is effective and safe.
Key words: caesarean section, propofol, central hemodynamics

There are special requirements for anesthesia during caesarean section (CS) - it must protect the mother's body from surgical trauma and at the same time not have a pronounced negative effect on the newborn. All narcotic and analytical drugs used in anesthesiology penetrate the placenta, and changes in the circulatory system that occur in the body of a pregnant woman often cause the development of various reactions to the administration of certain drugs [1, 6, 7]

Since maternal blood pressure is a major determinant of fetal perfusion, it is important to avoid maternal hypotension. Maintaining adequate maternal oxygenation to prevent fetal hypoxemia is also fundamental when administering general anesthesia to a pregnant patient. Regional anesthesia, which has a high safety profile, is the most common method of anesthesia for women in labor. However, for a small percentage of women, general anesthesia is the only option. [11, 16]

To date, there is no consensus on which drug is "ideal" for induction of anesthesia. According to modern concepts, all drugs easily and quickly penetrate the placental barrier and are found in the fetal blood in significant quantities [2-6, 9, 10] Like other intravenous anesthetics, propofol readily crosses the placenta and enters the fetal circulation [8,12,10,16]. However, the concentration of the drug reaching the fetus is comparable to that when using other anesthetics. A number of properties of propofol open up the possibility of widespread use of the drug in obstetric patients. [3,4,15,16]

Unfortunately, numerous studies conducted in this area are extremely contradictory. In the literature, opinions are expressed about its depressive effect on newborns [12,14], but such data are rare. Most scientists believe that propofol does not have a negative effect on the fetus and newborn [8, 11, 13, 15]. There is also no clear opinion on the effect of the drug on maternal hemodynamics [2, 5-7]. Published data indicate insufficient knowledge of the dynamics of blood pressure and systemic arterial tone in patients. All of the above determined the nature of our research.

Purpose of the study: To assess the degree of influence of propofol anesthesia on the cardiovascular system of parturient women during the process of surgical delivery.

Material and research methods.

The prospective case-control study included 98 pregnant women who delivered surgically in the maternity complex of the multidisciplinary clinic of the Tashkent Medical Academy. The age of women giving birth ranged from 17 to 36 years, averaging 26.5±7.5 years. The operations were performed both planned (90%) and emergency (10%). On average, the surgical intervention lasted 58±7.5 minutes. The duration of anesthesia was, accordingly, 3-5 minutes longer.

Indications for surgical delivery were: morpho-functional incompetence of the uterus - 55, clinically and anatomically narrow pelvis - 18, severe preeclampsia - 12, partial abruption of a normally located placenta - 7, breech presentation of the fetus - 6, high myopia - 2.

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Anesthesia technique: 3-5 minutes after standard intravenous premedication, induction was performed with a bolus injection of propofol at a dose of 2.5-2.75 mg/kg body weight. Then muscle relaxation was carried out with a solution of dithiline at a dose of 2 mg/kg, followed by short-term mask ventilation with an oxygen-air mixture. After the onset of myoplegia, tracheal intubation was performed and the parturients were transferred to artificial ventilation. Anesthesia was maintained by infusion of propofol (4-5 mg/kg per hour) and narcotic analgesics after fetal extraction. The time from the beginning of induction into anesthesia to the extraction of the fetus averaged 10 ± 3.1 minutes, lengthening in technically difficult cases to 15.3 ± 3.6 minutes.

Studies of CG indicators were carried out at 5 stages: Stage I - upon admission to the obstetric clinic; II - on the operating table after premedication; III - after induction of anesthesia; IV - at the moment of fetal extraction; V - at the end of the surgical intervention.

The obtained data were expressed in mean values ± standard deviation from the mean. The Kruskal - Wallis test was used to perform statistical analysis . A p value < 0.05 was considered significantly significant.

Results of the study and their discussion: All 98 women in labor had anemia of varying severity upon admission, hemoglobin ranged from 87 g/l to 110 g/l, the average values were 90.7 ± 6.3 g/l. The hematocrit was in the range of 32-34%, averaging 32.4±2.5%. Studies of acid-base status (ALS) indicated the presence of metabolic acidosis of varying severity in the majority of women in labor; it was subcompensated (Ph 7.31 ±0.007; pCO_2 35.53±0.93 mm Hg ; pO_2 74.7±0.89 mmHg ; BE -4.92±0.33 mmol /l) (p< 0.05).

All women in labor showed pronounced changes in CG indicators upon admission. We regarded these changes as a result of the presence of anemia and gppoproteinemia in the majority of women in labor . The noted values of the shock index (SI), according to the probabilistic assessment of one-time performance, indicate severe heart failure. In turn, the indicated decrease in the reserve coefficient (FR) in women in labor upon admission indicated the presence of moderate circulatory failure.

The increase in heart rate (HR) (92±3.2) that we found in women in labor upon admission is quite logical to consider as a compensatory reaction aimed at maintaining the required level of blood circulation in conditions of reduced cardiac output and strain on the mechanisms of mobilization of venous return.

Summarizing the obtained data from the examination of women in labor upon admission, it can be noted that the majority of them were characterized by: anemia, hypoproteinemia, moderate hypovolemia, compensated metabolic acidosis, disorders of the main indicators of CH, indicating a decrease in one-time and minute cardiac output with the development of moderate centralization of blood circulation and compensatory increasing the intensity of the functioning of the external respiration apparatus.

The study of the CH immediately after induction of anesthesia revealed a decrease in the main hemodynamic parameters, which is reflected in the following table 1.

Table 1

Dynamics of the main indicators of CH at the stages of anesthesia (general trends)

Indicators	**Research stages**			
	Admission	**Induction**	**Extraction**	**Ending**
MAP mmHg . _	78.3-86.7	73.3-86.7	83.3-93.7	83.3-96.7
Heart rate /min	89-102	88-106	90-104	86-92
SV, ml	38.5-92.3	38.1-63.7	47.2-80.2	40.7-58.1
SI, ml/m	23.8-50.0	21.8-39.4	26.9-48.6	23.2-32.0
CI, ml/m min	2.08-4.5	2.39-3.9	3.07-4.02	2.45-3.8
CIT	77.4-81.6	75.2-77.0	74.8-79.3	77.1-80.2
CR	0.92-1.2	0.92-1.05	0.64-0.95	0.94-1.01
PB	0.64-1.32	0.7-1.11	0.6-1.13	0.98-1.08

Note: BP – blood pressure, HR – heart rate, SV – stroke volume, SI – stroke index, CI – cardiac index, CIT – coefficient of integral tonicity, CR – reserve coefficient, PB – balance indicator .

It is easy to notice that during induction of anesthesia, single and minute cardiac output decreased by 15.8 - 16.1% and 4.4 - 5.7%, respectively. A decrease in stroke volume of the heart led to a compensatory increase in heart rate from 85.2 ± 2.28 to 112.3 ± 5.7 beats/min. In parallel, a decrease in systemic arterial tone was

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noted (the coefficient of integral tonicity (CIT) decreased to 76.7 - 75.2), which confirmed the moderate vasoplegic effect of propofol.

There was a clear trend towards a decrease in blood pressure (BP) in the majority of parturients. Blood pressure, compared to initial values, decreased by 10-15%. In 5.7% of women in labor, blood pressure fluctuations were insignificant. Hypotension was transient and did not require additional correction.

A study of acid-base balance and blood gas composition showed that the vast majority of patients retained compensated metabolic acidosis after induction of anesthesia.

Thus, the introduction of anesthesia in women in labor with initial moderate anemia and hypovolemia is accompanied by a decrease in cardiac output, a decrease in systemic arterial tone, and moderate arterial hypotension. The decrease in minute volume of blood circulation compared to the stroke volume of the heart was not so pronounced, which was due to a compensatory increase in heart rate.

Our data are consistent with the results of studies by a number of authors who describe a decrease in cardiac stroke volume and blood pressure, respectively, by 10-20% and 20-30% during induction with propofol in somatically healthy patients.

Starting from the stage of fetal extraction, the CH indicators undergo changes again. There was a tendency to increase blood pressure, which increased on average by 3.3-10.1% compared to the initial values. Compared to the previous stage of the study, heart rate increased by 5.4 -7%, which was due to additional blood flow as a result of the cessation of the functioning of the uteroplacental circulation. At this stage of the surgical intervention, there was an increase in one-time and minute cardiac output by 10.5 - 18.2% and 8.5 -12.2%, respectively.

After the fetus is removed, a clear improvement in CH indicators can be noted in the vast majority of patients: the single and minute performance of the heart increased, and blood volume indicators increased.

Hemodynamic studies carried out at the end of the surgical intervention showed that in conditions of new blood circulation due to the shutdown of the uteroplacental circulation, the CH indicators again undergo certain changes. There is a tendency towards a decrease in cardiac output and cardiac output, which return almost to the initial values in the preoperative period. In response to a decrease in systemic circulation parameters, an increase in systemic arterial tone was noted, which also approached the initial values. In addition, the heart rate also returns to its original values.

Thus, during the process of anesthesia with propofol in parturients who delivered by abdominal CS, the CH undergoes significant changes at various stages of anesthesia and surgery. Already during induction of anesthesia, there is a clear tendency towards a decrease in one-time and minute cardiac output, a decrease in blood volume parameters, in parallel, a decrease in systemic arterial tone was noted, which was accompanied by a tendency to arterial hypotension and compensatory tachycardia. These changes were transient in nature and did not lead to gross hemodynamic changes. Subsequently, after the fetus is removed, there is a clear improvement in CH indicators due to additional blood flow caused by the shutdown of the uteroplacental circulation. By the time the surgical intervention is completed, all the main indicators of the CH practically return to their original values.

Conclusions: Propofol in standard dosages does not have a pronounced effect on systemic and central hemodynamics in parturient women. Propofol anesthesia during cesarean section is effective and safe.

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