DOI: https://doi.org/10.17816/JOWD71083

Evaluation of the diagnostic possibility of hemorrhagic risk in pregnant women with severe preeclampsia by rotational thromboelastography

© Ilya S. Peretyatko[1], Elena V. Mozgovaya[1, 2]

[1] The Research Institute of Obstetrics, Gynecology, and Reproductology named after D.O. Ott, Saint Petersburg, Russia;
[2] Saint Petersburg State University, Saint Petersburg, Russia

AIM: The aim of this study was to determine the risk of hemorrhagic complications in pregnant women with severe preeclampsia using rotational thromboelastometry (ROTEM) in two screening tests — EXTEM and INTEM.

MATERIALS AND METHODS: We examined 30 pregnant women with severe preeclampsia, who were observed in the intensive care unit, the Department of Obstetrics and Perinatology, the Research Institute of Obstetrics, Gynecology, and Reproductology named after D.O. Ott, Saint Petersburg. The control group consisted of 10 patients with normal pregnancy, delivered by caesarean section for reasons not related to obstetric complications.

RESULTS: When interpreting the ROTEM results, the reference intervals for pregnant women in the third trimester were used, as determined in the study by J. Lee et al. (2019). According to the analysis of thromboelastograms of pregnant women with severe preeclampsia, 9 (30%) of them had a tendency towards hypocoagulation. Of these, 3 thromboelastograms had deviations via the intrinsic coagulation pathway (in the INTEM tests), 3 thromboelastograms via the extrinsic coagulation pathway (in the EXTEM tests), and the rest combined both options. Two patients with severe preeclampsia developed a complication in the form of HELLP syndrome, and the phenomena of hypocoagulation, according to the results of ROTEM performed before delivery, were observed in only one patient. A comparative analysis of ROTEM parameters among pregnant women with severe preeclampsia and normal pregnancy did not reveal statistically significant differences.

CONCLUSIONS: The use of the ROTEM method with the main screening tests (EXTEM and INTEM) did not show diagnostic value in assessing the risk of hemorrhagic complications of severe preeclampsia.

Keywords: preeclampsia; rotational thromboelastometry; hemostasis; pregnancy.

To cite this article:
Peretyatko IS, Mozgovaya EV. Evaluation of the diagnostic possibility of hemorrhagic risk in pregnant women with severe preeclampsia by rotational thromboelastography. *Journal of Obstetrics and Women's Diseases.* 2021;70(2):37–44. DOI: https://doi.org/10.17816/JOWD71083

Received: 16.03.2021 **Accepted:** 05.04.2021 **Published:** 30.04.2021

УДК 618.3-06:616.8-009.24-036.3]-07
DOI: https://doi.org/10.17816/JOWD71083

Оценка возможности диагностики риска геморрагических осложнений у беременных с тяжелой формой преэклампсии методом ротационной тромбоэластографии

© И.С. Перетятько[1], Е.В. Мозговая[1, 2]

[1] Научно-исследовательский институт акушерства, гинекологии и репродуктологии им. Д.О. Отта, Санкт-Петербург, Россия;
[2] Санкт-Петербургский государственный университет, Санкт-Петербург, Россия

Цель — выявить риск геморрагических осложнений у беременных с тяжелой преэклампсией методом ротационной тромбоэластометрии (ROTEM) в двух скрининговых тестах EXTEM и INTEM.

Материалы и методы. Нами было обследовано 30 беременных с тяжелой формой преэклампсии, наблюдавшихся в палате интенсивной терапии акушерского отделения ФГБУ «НИИ АГиР им. Д.О. Отта». Группу контроля составили десять пациенток с физиологически протекающей беременностью, родоразрешенных путем операции кесарева сечения в плановом порядке по причинам, не связанным с акушерскими осложнениями.

Результаты. При интерпретации результатов ROTEM-анализа применяли референсные интервалы для беременных в III триместре, определенные в исследовании J. Lee et al. (2019). По данным анализа тромбоэластограмм беременных с тяжелой преэклампсией у девяти (30 %) пациенток были отклонения в сторону гипокоагуляции. Из них три тромбоэластограммы выполнены по внутреннему пути свертывания (в тестах INTEM), три — по внешнем пути свертывания (в тестах EXTEM) и три при сочетании обоих вариантов. У двух пациенток с тяжелой преэклампсией развилось осложнение в виде HELLP-синдрома, причем явления гипокоагуляции по результатам ROTEM-анализа, выполненного до родоразрешения, наблюдались только у одной пациентки. При сравнительном анализе показателей ROTEM между беременными с тяжелой преэклампсией и физиологически протекающей беременностью статистически значимых различий не выявлено.

Заключение. Метод ROTEM с основными скрининговыми тестами (EXTEM и INTEM) не имел диагностического значения в оценке риска возникновения геморрагических осложнений тяжелой преэклампсии.

Ключевые слова: преэклампсия; ротационная тромбоэластометрия; гемостаз; беременность.

Как цитировать:
Перетятько И.С., Мозговая Е.В. Оценка возможности диагностики риска геморрагических осложнений у беременных с тяжелой формой преэклампсии методом ротационной тромбоэластографии // Журнал акушерства и женских болезней. 2021. Т. 70. № 2. С. 37–44. DOI: https://doi.org/10.17816/JOWD71083

Рукопись получена: 16.03.2021 **Рукопись одобрена:** 05.04.2021 **Опубликована:** 30.04.2021

BACKGROUND

A progression in pregnancy is associated with changes in all stages of hemostasis, which aim to prepare a woman for childbirth. The risks of venous thrombotic complications (VTC) in pregnant women are about five times higher than in non-pregnant women [1]. The probability of VTCs is 1.9 cases per 1,000 pregnancies. Notably, women in the first 6 weeks of the postpartum period are more likely to develop VTCs than pregnant women [2].

Pregnancy is associated with physiological changes in the blood coagulation system, which correlate with placentation. These changes in pregnant women lead to an approximately two-fold increase in the coagulation activity of the blood system compared with that in non-pregnant women; this state in pregnant women is called physiological hypercoagulation [3]. In conjunction with other risk factors, VTC is associated with a high risk of miscarriage itself and the development of thrombosis in the mother during the postpartum period. In contrast, although pregnancy is a state of hypercoagulation, pregnant women are at a high risk of massive bleeding, primarily because of premature detachment and previa or ingrowth of the placenta, as well as preeclampsia [4, 5]. Currently, standard clotting assessments are most often used to assess the hemostasis system; these include measurement of activated partial thromboplastin time, prothrombin time, thrombin time, fibrinogen level, and platelet count. These tests were not initially intended to monitor coagulopathies but were developed to detect the deficiency of certain coagulation factors or to monitor the efficiency of anticoagulant therapy [4, 5]. They do not help assess the function of natural anticoagulants, the fibrinolysis system, and the functional activity of platelets. The true potential of the hemostasis system can be determined only by testing all the primary mechanisms of blood coagulation in aggregate. As a result, recently, tests for determining the viscoelastic properties of the forming clot are being increasingly requested [6]. Tests such as rotational thromboelastometry (ROTEM) allow quick assessment of the hemostatic system and help initiate appropriate therapy [7, 8]. ROTEM has shown high efficacy in the treatment of massive blood loss and is included in most clinical guidelines for the care of patients with obstetric bleeding [9, 10].

The study aimed to determine the standard ROTEM parameters in pregnant women with severe preeclampsia.

MATERIALS AND METHODS

We enrolled 30 pregnant women with severe preeclampsia who were being monitored in the intensive care unit of the obstetric department of the D.O. Ott Research Institute of Obstetrics, Gynecology, and Reproductology. The control group comprised 10 patients with physiologically proceeding pregnancy, with delivery scheduled via caesarean section for reasons not related to obstetric complications.

All pregnant women underwent a full clinical and laboratory examination in compliance with the Ministry of Health No. 572n.

The viscoelastic properties of the forming clot were assessed using a ROTEM® Delta device (Germany) using reagent kits (Pentapharm GmbH). Blood samples were obtained before surgery via peripheral vein puncture of the cubital vein and were collected into standard 3.5-ml Vacutainer tubes containing 3.2% sodium citrate. ROTEM analysis was performed within 2 h after receiving the samples. The primary screening tests were performed, and the parameters of whole blood coagulation were assessed during the initiation of thrombogenesis by factors of the extrinsic pathway (recombinant tissue factor), EXTEM test, and intrinsic pathway (contact activation with ellagic acid), INTEM test. Parameters assessed using ROTEM were the following (Figure 1): time of clot formation onset, time of clot formation, clotting dynamics, maximum clot firmness, and A10 and A20 (amplitude of the formed clot after 10 and 20 min, respectively).

The plasma component of the hemostasis system was assessed using an automatic coagulometer ACL Elite pro by determining the activated partial thromboplastin time, prothrombin index, prothrombin time, international normalized ratio, and fibrinogen level.

The obtained data were statistically analyzed using Microsoft Excel 2007 and Statistica 10.0 software. The mean and standard deviation were calculated. Correlation analysis was performed using Spearman's correlation coefficient. Student's *t*-test was used to test the statistical significance of differences in mean values.

RESULTS

The age of pregnant women with severe preeclampsia ranged from 19 to 43 years (mean age: 32.8 ± 6.06 years). Examination of the obstetric history of patients revealed early reproductive losses, induced abortions, and a complicated course of previous pregnancies. Two thirds of the women were primiparous. One third of pregnancies occurred with the use of in vitro fertilization. A burdened somatic history was registered in 80% of pregnant women with severe preeclampsia. In addition, 70% of pregnant women had carbohydrate metabolism disorders, which were combined with chronic arterial hypertension in 40% women and chronic pyelonephritis in 9.5% women. Pure preeclampsia was registered in 20% pregnant women.

The main clinical manifestations of severe preeclampsia were arterial hypertension (systolic blood pressure: 158 ± 13.7 mmHg, diastolic blood pressure: 97 ± 6.8 mmHg),

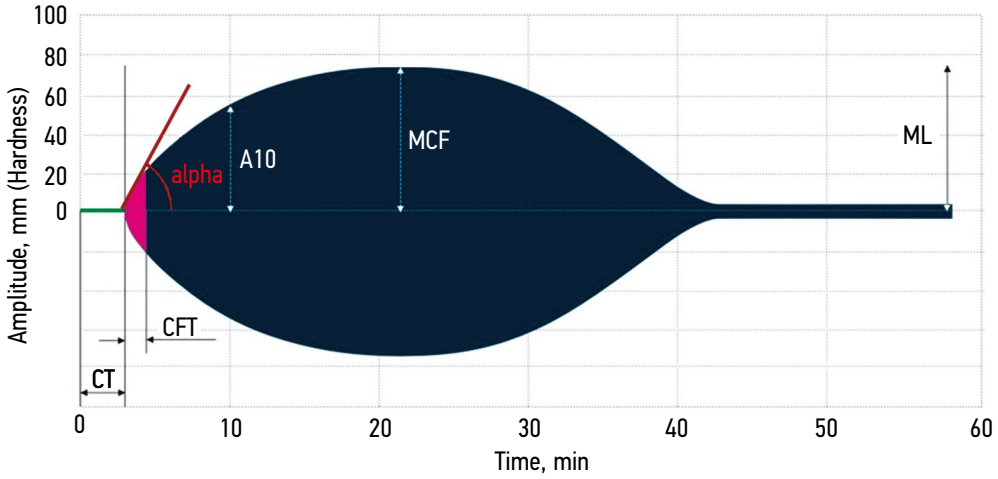

Figure. ROTEM standard parameters. CT — time of clot formation onset; CFT — clot formation time; alpha angle — coagulation dynamics; MCF — maximum clot firmness; A10 and A20 — amplitude of the formed clot after 10 and 20 min; ML — maximum lysis

proteinuria (1.64 ± 1.9 g/l), and swelling in 90% subjects as well as grade III swelling and negative diuresis in 26% subjects. Neurological symptoms in the form of headaches, less often nausea and vomiting, were noted in 56.7% subjects. Blood testing revealed thrombocytopenia in 30% of subjects. Biochemical analysis revealed a significantly increased activity of lactate dehydrogenase (35%) and hypoproteinemia (77%).

In most patients who were examined, coagulogram indices indicated hypercoagulation. All patients received magnesia therapy at the initial stage according to the current recommendations. Antihypertensive therapy with clonidine was prescribed to 40% of pregnant women, and the remaining 60% received methyldopa in combination with calcium channel blockers. All pregnant women with severe preeclampsia underwent delivery by caesarean section. The delivery term was 26 to 41 weeks (35.8 ± 3.3). The average volume of intraoperative blood loss was 670 ± 108 ml, the average weight of all newborns was 3017.5 ± 867 g, and the Apgar score was 7.2 ± 1 points. Two patients developed a complication of HELLP syndrome. All puerperas were discharged in a satisfactory condition on day 8.2 ± 2.

The comparison group comprised 10 pregnant women who had delivery by caesarean section in a scheduled manner. Their average age was 28.8 ± 3.4 years, and their average delivery term was 38.8 ± 1.8 weeks. The control subjects had an uneventful thrombohemorrhagic history. The indications for scheduled abdominal delivery were a scar on the uterus after a caesarean section (30%), a coxalgic pelvis (10%), a contracted pelvis (30%), *vasa previa* (10%), and a neurologist's opinion (20%).

Table 1 shows the average values of coagulogram indices as well as results of clinical blood test in pregnant women with severe preeclampsia and with physiological course of pregnancy. Hypercoagulation were noted both in women with severe preeclampsia (60%) and those with a physiological course of pregnancy (40%). Patients with severe preeclampsia tended to have higher fibrinogen and prothrombin index indices as well as lower activated partial thromboplastin time, but the differences were insignificant.

When interpreting the ROTEM results, reference intervals for pregnant women in III trimester, reported by a study of international colleagues, were used [11]. Table 2 presents the mean and statistical deviation values of the ROTEM test scores. Analysis of 9 (30%) thromboelastograms (TEGs) of pregnant women with severe preeclampsia revealed hypocoagulation, with 3 TEGs each revealing hypocoagulation along the intrinsic coagulation pathway, extrinsic coagulation pathway, and both pathways. Prolonged clotting time and clot formation time indicated decreased dynamics of stable clot formation through activated platelets and fibrin, which most likely could be caused by impaired platelet function, low platelet count, or abnormal fibrin polymerization. In subjects with hypocoagulation along both the intrinsic and extrinsic pathways, there was a tendency to insufficient amplitude and, therefore, the firmness of the forming clot 10 min after the start of the study, which returned to normal level only by the 20th min of induced coagulation.

In pregnant women with hypocoagulation, delivery occurred from 28 to 38 (35.8 ± 3.07) weeks. Increased intraoperative bleeding was noted in three patients, for which tranexamic acid was intravenously administered. In general, surgeries were technically uneventful. The average blood loss was 660 ± 100 ml. One postpartum woman developed HELLP syndrome on postoperative day 1; the postpartum period was uneventful in rest of the patients. Table 2 presents the indicators of clinical and laboratory examination before surgery.

Two patients with severe preeclampsia developed HEELP syndrome: one developed the syndrome before delivery and another after delivery. Table 3 shows the results of a clinical

Table 1. Mean and statistical deviation values of coagulogram indices and clinical blood test results of pregnant women with severe preeclampsia and those with physiological course of pregnancy

Indicator	Pregnant women with severe preeclampsia, *n* = 30	Women with physiological course of pregnancy, *n* = 10
Clinical blood test values		
Leukocytes, $\times 10^9$/l	9.9 ± 2.9	8.5 ± 2.3
Erythrocytes, $\times 10^{12}$/l	4.07 ± 0.46	3.88 ± 0.3
Hemoglobin, g/l	119.7 ± 11.33	129.5 ± 9.73
Platelets, $\times 10^9$/l	197.53 ± 60.51	229.6 ± 44.85
Coagulogram		
Prothrombin time, s	10.35 ± 0.77	10.55 ± 0.94
Prothrombin index, %	138.90 ± 28.28	129.95 ± 24.25
International normalized ratio	0.92 ± 0.07	0.93 ± 0.08
Fibrinogen, g/l	5.30 ± 0.80	4.29 ± 0.63
Activated partial thromboplastin time (ind.), s	0.89 ± 0.09	0.93 ± 0.07
Thrombin time, s	14.81 ± 1.14	15.93 ± 0.89

Table 2. Indicators of clinical and laboratory examination of patients with hypocoagulation

Indicators	Pregnant women with hypocoagulation before surgery, *n* = 9	
Clinical blood test values		
Leukocytes, $\times 10^9$/l	9.06 ± 2.42	
Erythrocytes, $\times 10^{12}$/l	4.14 ± 0.3	
Hemoglobin, g/l	119.11 ± 10.23	
Platelets, $\times 10^9$/l	188.11 ± 52.24	
Coagulogram		
Prothrombin time, s	10.11 ± 0.63	
Prothrombin index, %	146.78 ± 31.6	
International normalized ratio	0.91 ± 0.06	
Fibrinogen, g/l	5.16 ± 0.73	
Activated partial thromboplastin time (ind.), s	0.86 ± 0.12	
Thrombin time, s	14.47 ± 0.83	
	EXTEM	**INTEM**
CT, s	73.8 ± 22.5	247.4 ± 112.3
CFT, s	119.1 ± 53.3	138.3 ± 81.8
Alpha angle, deg.	69.3 ± 8.9	66.7 ± 11.4
A10, mm	53.9 ± 9.5	54.8 ± 10.7
A20, mm	62.7 ± 7.38	64.9 ± 6.4
MCF, mm	66.2 ± 6.1	68.4 ± 6.3

Note. CT — time of clot formation onset; CFT — clot formation time; alpha angle — coagulation dynamics; A10 and A20 — amplitude of the formed clot after 10 and 20 min, respectively; MCF — maximum clot firmness; EXTEM — thrombus formation via extrinsic coagulation pathway factors; INTEM — thrombus formation via intrinsic coagulation pathway factors.

and laboratory study of these two women. According to TEG performed before surgery, in one pregnant woman with postpartum HELLP syndrome, both EXTEM and INTEM tests revealed signs of hypocoagulation, characterized by increased time of clot formation, insufficiency of clot formation at 10 and 20 mins and reduced maximum clot firmness. Subsequently, this patient underwent fresh frozen plasma transfusion intraoperatively. In the postpartum period, TEG revealed persistent hypocoagulation, with aggravated anemia and thrombocytopenia; therefore, repeated transfusion of both fresh frozen plasma and erythrocyte and platelet suspensions was performed.

Table 3. Results of clinical and laboratory studies of pregnant women with early and late HELLP syndrome before delivery and in the postoperative period

Indicators	Before delivery		After delivery	
	HELLP syndrome, *n* = 1	Severe preeclampsia, *n* = 28	HELLP syndrome, *n* = 1	Severe preeclampsia, *n* = 28
Clinical blood test values				
Leukocytes, $\times 10^9$/l	19.6	6.5	12.2	13.8
Erythrocytes, $\times 10^{12}$/l	4.03	4.47	3.23	3.47
Hemoglobin, g/l	115	144	93	117
Platelets, $\times 10^9$/l	79	121	47	70
Biochemical blood test values				
Alanine aminotransferase, U/L	153	9.8	179	13
Aspartate aminotransferase, U/L	161	28.4	250	74
Lactate dehydrogenase, U/L	1063	1280	823.1	2052.4
Total protein, g/l	68	54.47	66.3	53.7
Coagulogram indices				
Prothrombin time, s	9	8.9	9.7	9.5
Prothrombin index, %	205	213	156.8	157
International normalized ratio	0.8	0.79	0.86	0.87
Fibrinogen, g/l	5.6	5.89	3.97	2.97
Activated partial thromboplastin time (ind.), s	1.1	1.04	0.88	0.92
Thrombin time, s	15	14.4	17.8	21.7
ROTEM indices				
	EXTEM / INTEM	EXTEM / INTEM	EXTEM / INTEM	EXTEM / INTEM
CT, s	57 / 140	56 / 198	62 / 164	47 / 178
CFT, s	105 / 94	172 / 181	108 / 102	196 / 202
Alpha angle, deg.	75 / 73	74 / 68	70 / 72	76 / 70
A10, mm	51 / 51	41 / 40	44 / 46	36 / 37
A20, mm	59 / 58	50 / 57	50 / 55	44 / 46
MCF, mm	62 / 62	56 / 56	60 / 59	50 / 51
Urinary test values				
Protein	5.3	0.08	2.88	2.14

Note. CT — time of clot formation onset; alpha angle — coagulation dynamics; MCF — maximum clot firmness; A10 and A20 — amplitude of the formed clot after 10 and 20 mins, respectively; CFT — clot formation time; EXTEM — thrombus formation via extrinsic coagulation pathway factors; INTEM — thrombus formation via intrinsic coagulation pathway factors.

Table 4. Mean and statistical deviation values of ROTEM test scores in pregnant women with severe preeclampsia and those with physiological pregnancy course

ROTEM indicators	EXTEM		INTEM	
	Severe preeclampsia, *n* = 30	Physiological pregnancy, *n* = 10	Severe preeclampsia, *n* = 30	Physiological pregnancy, *n* = 10
CT, s	61.37 ± 15.13	57.6 ± 7.46	196.53 ± 71.55	164.50 ± 13.53
CFT, s	84.60 ± 38.22	76.8 ± 11.89	89 ± 55.85	67.80 ± 3.23
Alpha angle, deg.	74.47 ± 6.19	73.7 ± 2.79	73.37 ± 7.92	67.80 ± 12.93
A10, mm	60.03 ± 7.82	67.2 ± 2.99	59.90 ± 8	73.70 ± 5.29
A20, mm	66.87 ± 6.12	61.9 ± 3.54	67.50 ± 5.53	60.50 ± 4.43
MCF, mm	69.47 ± 5.16	69.4 ± 2.37	70.33 ± 5.12	71 ± 3.06

Note. CT — time of clot formation onset; CFT — clot formation time; alpha angle — coagulation dynamics; MCF — maximum clot firmness; A10 and A20 — amplitude of the formed clot after 10 and 20 mins, respectively; EXTEM — thrombus formation via extrinsic coagulation pathway factors; INTEM — thrombus formation via intrinsic coagulation pathway factors.

A pregnant woman with HELLP syndrome, which developed even before delivery, despite significant changes in laboratory parameters, had no hypocoagulation disorders according to TEG data. As a result, the patient underwent intraoperative transfusion of fresh frozen plasma. In the postoperative period, TEG analysis showed insufficient firmness of the forming clot after 10 and 20 mins at normal maximum clot firmness. On day 2 of the postoperative period, owing to an increase in signs of multiple organ failure, the puerpera was transferred to a multidisciplinary hospital.

Comparative analysis of ROTEM indicators between pregnant women with severe preeclampsia and pregnant women with physiological pregnancy course (Table 4) did not reveal statistically significant differences.

The correlation analysis of the ROTEM indices and coagulation system indices revealed an average direct correlation between platelet count and the amplitude of forming clot after 10 min (0.46; 0.41), 20 min (0.41; 0.43); and the maximum clot firmness (0.45; 0.39) in tests of thrombogenesis initiation by factors of the extrinsic (EXTEM) and intrinsic (INTEM) pathways, as well as the mean inverse correlation (–0.52) between the count of platelets and the time of clot formation in the EXTEM test.

Considering these data, it can be concluded that rotational thromboelastography with the main screening tests EXTEM and INTEM did not have a significant diagnostic value in assessing the risk of hemorrhagic complications in pregnant women with severe preeclampsia.

ADDITIONAL INFORMATION

Conflict of interest. The authors declare no conflict of interest.
Author contributions. *E.V. Mozgovaya* and *I.S. Peretyatko* conceptualized and designed the study; *I.S. Peretyatko* collected and processed the material, performed statistical data processing, and wrote the text; *E.V. Mozgovaya* edited the text.

REFERENCES

1. Alshawabkeh L, Economy KE, Valente AM. Anticoagulation during pregnancy: Evolving strategies with a focus on mechanical valves. *J Am Coll Cardiol*. 2016;68(16):1804–1813. DOI: 10.1016/j.jacc.2016.06.076
2. Bates SM, Greer IA, Middeldorp S, et al. VTE, thrombophilia, antithrombotic therapy, and pregnancy: Antithrombotic therapy and prevention of thrombosis, 9th ed: American College of chest physicians evidence-based clinical practice guidelines. *Chest.* 2012;141(2 Suppl):e691S-e736S. DOI: 10.1378/chest.11-2300
3. Katz D, Beilin Y. Disorders of coagulation in pregnancy. *Br J Anaesth.* 2015;115 Suppl 2:ii75-ii88. DOI: 10.1093/bja/aev374
4. Trikha A, Singh PM. Management of major obstetric haemorrhage. *Indian J Anaesth.* 2018;62(9):698–703. DOI: 10.4103/ija.IJA_448_18
5. Shifman EM, Kulikov AV, Ronenson AM, et al. Prevention, the algorithm of reference, anesthesia and intensive care for postpartum hemorrhage. *Guidelines. Annals of Critical Care.* 2019;3:9–33. (In Russ.). DOI: 10.21320/1818-474X-2019-3-9-33
6. Curry NS, Davenport R, Pavord S, et al. The use of viscoelastic haemostatic assays in the management of major bleeding: A British Society for Haematology Guideline. *Br J Haematol.* 2018;182(6):789–806. DOI: 10.1111/bjh.15524
7. Anderson L, Quasim I, Steven M, et al. Interoperator and intraoperator variability of whole blood coagulation assays: a comparison of thromboelastography and rotational thromboelastometry. *J Cardiothorac Vasc Anesth.* 2014;28(6):1550–1557. DOI: 10.1053/j.jvca.2014.05.023
8. Abuelkasem E, Lu S, Tanaka K, et al. Comparison between thrombelastography and thromboelastometry in hyperfibrinolysis detection during adult liver transplantation. *Br J Anaesth.* 2016;116(4):507–512. DOI: 10.1093/bja/aew023
9. Rossaint R, Bouillon B, Cerny V, et al. The European guideline on management of major bleeding and coagulopathy following trauma: fourth edition. *Crit Care.* 2016;20:100. DOI: 10.1186/s13054-016-1265-x
10. McNamara H, Kenyon C, Smith R, et al. Four years' experience of a ROTEM®-guided algorithm for treatment of coagulopathy in obstetric haemorrhage. *Anaesthesia.* 2019;74(8):984–991. DOI: 10.1111/anae.14628
11. Lee J, Eley VA, Wyssusek KH, et al. Baseline parameters for rotational thromboelastometry (ROTEM®) in healthy women undergoing elective caesarean delivery: a prospective observational study in Australia. *Int J Obstet Anesth.* 2019;38:10–18. DOI: 10.1016/j.ijoa.2019.01.008

СПИСОК ЛИТЕРАТУРЫ

1. Alshawabkeh L., Economy K.E., Valente A.M. Anticoagulation during pregnancy: Evolving strategies with a focus on mechanical valves // J. Am. Coll. Cardiol. 2016. Vol. 68. No. 16. P. 1804–1813. DOI: 10.1016/j.jacc.2016.06.076
2. Bates S.M., Greer I.A., Middeldorp S. et al. VTE, thrombophilia, antithrombotic therapy, and pregnancy: Antithrombotic therapy and prevention of thrombosis, 9th ed: American College of chest physicians evidence-based clinical practice guidelines // Chest. 2012. Vol. 141. No. 2. Suppl. P. e691S–e736S. DOI: 10.1378/chest.11-2300
3. Katz D., Beilin Y. Disorders of coagulation in pregnancy // Br. J. Anaesth. 2015. Vol. 115. Suppl 2. P. ii75–ii88. DOI: 10.1093/bja/aev374
4. Trikha A., Singh P.M. Management of major obstetric haemorrhage // Indian J Anaesth. 2018. Vol. 62. No. 9. P. 698–703. DOI: 10.4103/ija.IJA_448_18
5. Шифман Е.М., Куликов А.В., Ронензон А.М. и др. Профилактика, алгоритм ведения, анестезия и интенсивная терапия при послеродовых кровотечениях. Клинические рекомендации // Вестник интенсивной терапии имени А.И. Салтанова. 2019. № 3. С. 9–33. DOI: 10.21320/1818-474X-2019-3-9-33

6. Curry N.S., Davenport R., Pavord S. et al. The use of viscoelastic haemostatic assays in the management of major bleeding: A British Society for Haematology Guideline // Br. J. Haematol. 2018. Vol. 182. No. 6. P. 789–806. DOI: 10.1111/bjh.15524

7. Anderson L., Quasim I., Steven M. et al. Interoperator and intraoperator variability of whole blood coagulation assays: a comparison of thromboelastography and rotational thromboelastometry // J. Cardiothorac. Vasc. Anesth. 2014. Vol. 28. No. 6. P. 1550–1557. DOI: 10.1053/j.jvca.2014.05.023

8. Abuelkasem E., Lu S., Tanaka K. et al. Comparison between thrombelastography and thromboelastometry in hyperfibrinolysis detection during adult liver transplantation // Br. J. Anaesth. 2016. Vol. 116. No. 4. P. 507–512. DOI: 10.1093/bja/aew023

9. Rossaint R., Bouillon B., Cerny V. et al. The European guideline on management of major bleeding and coagulopathy following trauma: fourth edition // Crit. Care. 2016. Vol. 20. P. 100. DOI: 10.1186/s13054-016-1265-x

10. McNamara H., Kenyon C., Smith R. et al. Four years' experience of a ROTEM®-guided algorithm for treatment of coagulopathy in obstetric haemorrhage // Anaesthesia. 2019. Vol. 74. No. 8. P. 984–991. DOI: 10.1111/anae.14628

11. Lee J., Eley V.A., Wyssusek K.H. et al. Baseline parameters for rotational thromboelastometry (ROTEM®) in healthy women undergoing elective caesarean delivery: a prospective observational study in Australia // Int. J. Obstet. Anesth. 2019. Vol. 38. P. 10–18. DOI: 10.1016/j.ijoa.2019.01.008

AUTHORS INFO

***Ilya S. Peretyatko**, MD;
address: 3 Mendeleevskaya line,
Saint Petersburg, 199034, Russia;
e-mail: doc.pere@yandex.ru

Elena V. Mozgovaya, MD, PhD, DSci (Medicine);
ORCID: https://orcid.org/0000-0002-6460-6816;
eLibrary SPIN: 5622-5674; e-mail: elmozg@mail.ru

ОБ АВТОРАХ

***Илья Сергеевич Перетятько**;
адрес: Россия, 199034, Санкт-Петербург,
Менделеевская линия, д. 3;
e-mail: doc.pere@yandex.ru

Елена Витальевна Мозговая, д-р мед. наук;
ORCID: https://orcid.org/0000-0002-6460-6816;
eLibrary SPIN: 5622-5674; e-mail: elmozg@mail.ru