https://doi.org/10.15360/1813-9779-2026-3-2668



# Use of VA-ECMO in the Prenatal Period in a Patient with Acute Myocardial Infarction Complicated by Cardiogenic Shock: Case Report

Evgeniy S. Dumanyan[1,2*], Yuri N. Markov[1], Marat F. Mukhamadeev[1], Radik R. Khafizov[1], Bulat I. Zagidullin[1], Ainagul Zh. Bayalieva[2,3], Veronica R. Davydova[2,3], Nigina A. Nigmatullina[3], Gulnara M. Khairutdinova[1], Liliya A. Shakirzyanova[1], Antonina A. Panina[1]

[1] R.S. Akchurin Emergency Hospital,
18 Naberezhnochelninsky Ave.,423803, Naberezhnye Chelny, Republic of Tatarstan, Russia
[2] Kazan State Medical University, Ministry of Health of Russia,
49 Butlerova Str., 420012 Kazan, Russia
[3] Republican Clinical Hospital, Ministry of Health of the Republic of Tatarstan,
138 Orenburgsky Trakt, 420064 Kazan, Russia

**For citation:** *Evgeniy S. Dumanyan, Yuri N. Markov, Marat F. Mukhamadeev, Radik R. Khafizov, Bulat I. Zagidullin, Ainagul Zh. Bayalieva, Veronica R. Davydova, Nigina A. Nigmatullina, Gulnara M. Khairutdinova, Liliya A. Shakirzyanova, Antonina A. Panina.* Use of VA-ECMO in the Prenatal Period in a Patient with Acute Myocardial Infarction Complicated by Cardiogenic Shock: Case Report. *Obshchaya Reanimatologiya = General Reanimatology.* 2026; 22 (3): 48–54. https://doi.org/10.15360/1813-9779-2026-3-2668 [In Russ. and Engl.]

***Correspondence to:** Evgeniy S. Dumanyan, pro_medol@mail.ru

## Summary

**The aim** is to demonstrate the successful use of veno-arterial extracorporeal membrane oxygenation (VA-ECMO) in a patient developing acute myocardial infarction (AMI) and cardiogenic shock due to spontaneous coronary artery dissection in the third trimester of pregnancy.

**Patient and investigative techniques.** We analyzed laboratory and hemodynamic parameters, mechanical ventilation settings and ECMO circuit parameters in a 32-week pregnant woman with acute myocardial infarction and cardiogenic shock caused by spontaneous coronary artery dissection. We reviewed all stages of patient's management from hospital admission, including initiation of ECMO, performing of cesarean section under extracorporeal support, and patient's transportation to tertiary center for heart transplantation.

**Results.** The use of VA-ECMO in a patient with AMI at 32 weeks of gestation provided biventricular circulatory support, which allowed to stabilize severe cardiogenic shock and safely place coronary stents, providing sufficient placental blood flow to preserve the life of the fetus. A cesarean section (CS) was performed under VA-ECMO support resulting in delivery of a live baby-girl weighing 1.8 kg with an Apgar score of 5/6. The mother was transported after CS to the V. I. Shumakov National Medical Research Center for Transplantation and Artificial Organs, Ministry of Health of the Russian Federation, where emergency orthotopic heart transplantation (OHT) was performed.

**Conclusion.** We present a case report of spontaneous coronary artery dissection leading to AMI and cardiogenic shock and requiring life-saving circulatory support with VA-ECMO. The case demonstrates the urgent need of both treatment arms including established protocol of coronary angiography with percutaneous coronary intervention, and timely employed individual approach, that include VA-ECMO, intra-aortic balloon pump, and left ventricular decompression. The use of high-tech methods and a professionally employed multidisciplinary approach saved the lives of both the mother and the child.

***Keywords: extracorporeal membrane oxygenation; pregnancy; acute myocardial infarction; cardiogenic shock; spontaneous coronary artery dissection; caesarean section***

**Conflict of interest.** The authors declare no conflict of interest.

**Information about the authors:**
Evgeniy S. Dumanyan: https://orcid.org/0000-0003-0937-4060
Yuri N. Markov: https://orcid.org/0000-0002-8211-5981
Bulat I. Zagidullin: https://orcid.org/0000-0001-5294-7288
Marat F. Mukhamadeev: https://orcid.org/0000-0003-4371-7151
Radik R. Khafizov: https://orcid.org/0000-0003-4345-1234
Ainagul Zh. Bayalieva: https://orcid.org/0000-0001-7577-3284
Veronica R. Davydova: https://orcid.org/0000-0003-4718-5076
Nigina A. Nigmatullina: https://orcid.org/0000-0003-4441-8858
Gulnara M. Khairutdinova: https://orcid.org/0000-0002-8152-8514
Liliya A. Shakirzyanova: https://orcid.org/0009-0004-2696-0330
Antonina A. Panina: https://orcid.org/0000-0003-4399-8723

## Introduction

According to the US Center for Disease Control and Prevention, in 2023, «other cardiovascular causes» accounted for 10.4% of all maternal deaths, with bleeding accounting for 18.1%. These statistics included all deaths during pregnancy and within 1 year after childbirth [1]. The incidence of acute coronary syndrome (ACS) during pregnancy ranges from 3 to 6 cases per 100,000 pregnancies. Maternal mortality from ACS ranges from 5 to 10% [2]. The common causes of ACS in pregnant women include atherosclerosis [3, 4] and spontaneous coronary artery dissection (SCAD) [5]. SCAD, which can develop before and after childbirth, is the cause of acute myocardial infarction (AMI) in pregnant women in 27–43% of cases. The mortality rate for AMI in pregnant women is currently 5–11% [6].

SCAD is a spontaneous, non-traumatic, and non-iatrogenic dissection of the coronary artery (CA) wall with the formation of a false lumen [7]. Only 43% of SCAD cases occur during the peripartum period. Two pathohistological theories of its development are described in a publication by Sharonne N. Hayes and colleagues [7]. It is hypothesized that hormonal shifts (changes in the sensitivity of estrogen and progesterone receptors) associated with pregnancy lead to alterations in arterial architecture. SCAD is rarely associated with inflammatory diseases.

According to a multicenter prospective study, cardiovascular diseases account for the majority of maternal morbidity and are responsible for more than 25% of maternal deaths in the United States [8]. There are several diseases that can lead to cardiovascular complications during pregnancy. They include arterial hypertension, arrhythmias and cardiomyopathies, congenital or acquired valve defects, coronary artery disease (a leading cause of SCAD), pulmonary hypertension, and venous thromboembolism or amniotic fluid embolism. Cardiomyopathy and/or heart failure account for more than 50% of cardiovascular disorders during pregnancy. Cardiogenic shock (CS) during pregnancy caused by severe myocardial damage leads to reduced cardiac output, hypoperfusion of target organs, and hypoxia in the mother and fetus. Cardiogenic shock carries a poor prognosis, with in-hospital mortality rates of 30–50% and long-term mortality of about 50%. Temporary or long-term mechanical circulatory support (MCS) is used in management of cardiogenic shock caused by cardiomyopathy or SCAD [8]. Veno-arterial extracorporeal membrane oxygenation (VA-ECMO) as one of MCS modalities addresses the problem of tissue hypoperfusion, but creates a risk of bleeding, along with the risk of placental abruption, which directly threatens fetal life [8].

In publications on the use of ECMO in obstetric patients, both veno-venous extracorporeal membrane oxygenation (VV-ECMO), used for indications such as pulmonary embolism, viral pneumonias, and sepsis, and VA-ECMO [9], [10] are reported. Reports of VA-ECMO use in the peripartum period are extremely rare and are usually limited to isolated case reports. Thus, in a literature review by A. M. Sarah et al. [10], 45 cases of ECMO use in the antenatal period were reviewed: 41 VV-ECMO cases and 4 VA-ECMO cases. Overall maternal survival was 77.8% and fetal survival was 65%. According to a systematic review by Emily E. Naoum et al. [11], among 358 women who received MCS in the peripartum period, ECMO was used antenatally in 22.6% of patients, VA-ECMO in 40.5% of cases, and overall maternal survival was 74.3%. Of the 358 pregnant women included in the study, only 3 patients had SCAD as the cause of the life-threatening condition.

In the Russian Federation, the use of ECMO has increased markedly over the past 15 years [12–15]. In obstetrics, ECMO is most often used in the postpartum period. The first reported experience of a cesarean delivery in a patient on VV-ECMO was described by a team of authors from Krasnodar [16].

The purpose of this case report was to demonstrate the successful use of VA-ECMO in a patient at 32 weeks of gestation with a confirmed diagnosis of spontaneous coronary artery dissection and ST-elevation myocardial infarction complicated by cardiogenic shock.

## Case Report

**On Day 1** (07/04/25) at 08:40, a 31-year-old female patient was brought by an ambulance crew to the emergency department of the R.S. Akchurin Emergency Hospital (R.S. Akchurin Emergency Hospital, Republic of Tatarstan, Naberezhnye Chelny) with a diagnosis of «ST-elevation acute myocardial infarction of anterolateral localization. Spontaneous coronary artery dissection (?). Cardiogenic shock, SCAI C [17]. Pregnancy, 31–32 weeks». According to the updated SCAI (Society for Cardiac Angiography and Interventions) classification of cardiogenic shock stages, the patient's CS on admission corresponded to stage C, progressing to stage D. Complaints upon admission include general weakness, occasional chest burning equal to 2–3 scores on a 10-score VAS for the past 5–6 days, and maximum pain intensity on the morning of hospitalization. Objectively, the patient was conscious, and her hemodynamic parameters were stable with vasopressor support (noradrenaline at a dose of 0.25 μg/kg/min). BP 105–110/75 mm Hg, HR 67–72/min, $SpO_2$ 98%. ECG: sinus rhythm, HR 67/min, QS in V2–V3 leads, qR in V4 lead, ST-segment elevation in I, aVL, and V2–V6 leads. ST-segment depression in III and aVF leads. Blood troponin level: 367 pg/mL.

To determine the extent of coronary artery involvement, coronary angiography (CAG) was per-

formed. Particular attention was paid to positioning the patient on the operating table and protecting the fetus from X-ray radiation. CAG findings were as follows: coronary circulation type — right-dominant. Left main coronary artery — occlusion in the distal third (dissection of the LAD, LCx). LAD — occluded. TIMI 0 flow. LCx — occluded. TIMI 0 flow. RCA — no stenoses detected. TIMI 3 flow.

Left common femoral artery and vein cannulation was performed. VA-ECMO was initiated. Indirect stenting of the left main coronary artery and the LAD (segments 5 and 6) was performed using Calypso (R-Vascular) drug-eluting coronary stents, 3.0×33 mm and 3.5×33 mm, respectively. Balloon angioplasty of the circumflex artery. Intravascular ultrasonography (IVUS).

After percutaneous coronary intervention (PCI), the patient was transferred to the cardiac intensive care unit. BP 98/89–120/87 mm Hg, CVP 14–10 mm Hg, pulmonary artery pressure 42/15 mm Hg, PCWP 25–29 mm Hg, heart rate 104–112 beats/min. ECG showed sinus rhythm. Norepinephrine 0.05 μg/kg/min, dobutamine 3 μg/kg/min. Urine output was 0.8–1.2 mL/kg/h. Arterial blood lactate: 2.1–1.8 mmol/L. Echocardiography: LVEF 33%, LVOT VTI 8 cm. EDV 136 mL, LV ESV 91 mL. Continuous fetal heart rate monitoring showed fetal heart rate varying from 138 to 152 beats/min.

The ECMO lines and oxygenator were primed with 0.9% NaCl solution, and 5,000 units of heparin were added to the solution. Before cannulation and connection, the circuit was placed on circulation and warmed to 37.0°C, with $FiO_2$ of 100% and a fresh gas flow of 3 L/min. Ultrasound scanning of the inguinal vessels was performed beforehand to determine their diameter and identify any anatomical variants or anomalies. Vascular cannulation was performed using a percutaneous dilatational technique under X-ray guidance, with local infiltration anesthesia using 40 mL of 1% lidocaine solution, potentiated with fentanyl — 50 μg intravenously. The ECMO device used was the MEDOS DELTASTREAM III (Medos Medizintechnik AG, Germany); the arterial cannula was 15 Fr, 31 cm, and the venous cannula was 21 Fr, 60 cm, with multilevel fenestrations. The «door-to-VA-ECMO initiation» time was 80 minutes. Blood flow through the ECMO circuit was 3.5 L/min at 8,400 rpm, oxygen flow was 3.5 L/min, and $FiO_2$ was 100%. Heparin anticoagulation was administered at 10–17 U/kg/h with a target aPTT of 60–70 seconds, along with dual antiplatelet therapy: aspirin 125 mg and clopidogrel 75 mg.

After 14.5 hours, the patient reported recurrence of retrosternal pain and worsening shortness of breath. Subsequent angiography revealed a dissection of the LAD distal to the stented segment. Stenting of the dissection segment and coronary arteries IVUS were performed. An intra-aortic balloon pump catheter was inserted via the right common femoral artery into the aorta to unload the left ventricle in view of reduced LV contractility. The device was operating in 1:1 mode. Decreased LV myocardial contractility persisted, LVEF declined from 33% to 28%.

**On Day 2** (07/05/25), further progression of heart failure manifested by a decrease in left ventricular myocardial contractility (LVEF 25–28%, LVOT VTI 6–7 cm, LVEDV 155 mL, LVESV 116 mL) (Fig.) and worsening respiratory failure due to recurrent pulmonary edema. Respiratory support was also provided, alternating high-flow nasal oxygen therapy ($FiO_2$ 60–65%) with noninvasive mask ventilation ($FiO_2$ 60–65%).

**On Day 3** (07/06/25), due to a marked reduction in LVEF, worsening cardiovascular insufficiency, and decreased uteroplacental blood flow, a decision was made to proceed with delivery by cesarean section while on VA-ECMO. Given the high risk of postoperative uterine hemorrhage, a supply of packed red blood cells, platelet concentrate, cryoprecipitate, and fresh frozen plasma was prepared, and heparin infusion was discontinued 2 hours before surgery.

The procedure was performed in the catheterization lab. After induction of anesthesia (propofol 1.5 mg/kg, fentanyl 1.5 μg/kg, rocuronium 50 mg), the trachea was intubated using videolaryngoscope. At the time of intubation, ECMO circuit blood flow was increased by 0.7 L/min, and fresh gas flow by 0.5 L/min. The ventilator settings were: $FiO_2$ 40–50%,

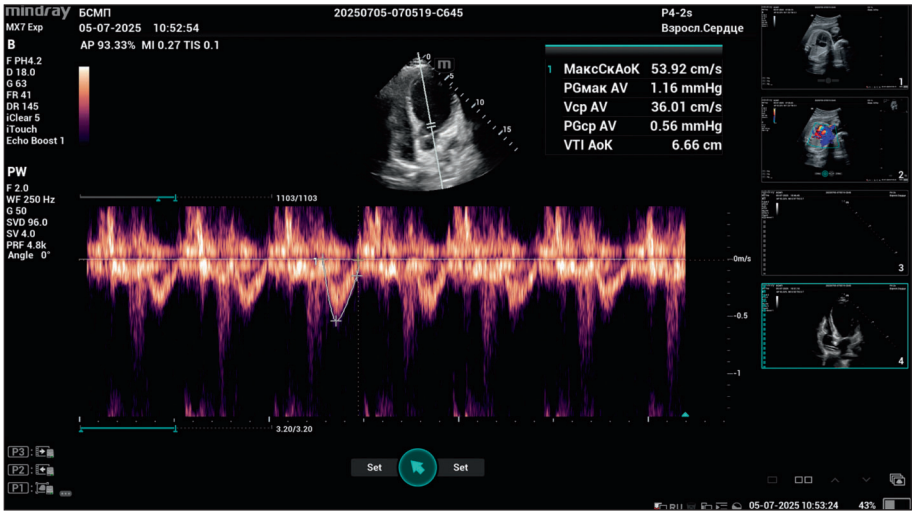


**Fig. Parameters of cardiac contractile function (day 2).**

respiratory rate (f) 10–12 breaths/min, tidal volume 5 mL/kg, PEEP 5–6 cm $H_2O$, and inspiratory pressure (Pinsp) 13 cm $H_2O$. After transition to mechanical ventilation, the VA-ECMO settings were: ECMO circuit blood flow 3.5–3.7 L/min, pump speed 8,400–8,700 rpm, oxygen flow 2.5–2.0 L/min, and $FiO_2$ 70%. Before fetal extraction, guide catheters were advanced via the radial artery introducers to the ostia of the uterine arteries. The fetus was delivered. After delivery, balloon occlusion and embolization of the uterine arteries were performed. The uterus was sutured. A baby girl was born, weighing 1.8 kg, with an Apgar score of 8. The newborn was put on a ventilator and transported by ground ambulance to the Republican Pediatric Clinical Hospital in Kazan, Republic of Tatarstan.

Anesthesia was total intravenous: fentanyl at a dose of 2 μg/kg, propofol at a dose of 2 mg/kg/hour, and muscle relaxation with rocuronium bromide 50 mg. Intraoperative blood loss was 400 mL. The volume of postoperative blood loss over the following 24 hours was approximately 70–90 mL. Heparin infusion was resumed 8 hours after surgery at a rate of 8 U/kg/hour.

**On Day 4 (**07/07/25), echocardiography showed that the cardiac pumping function remained extremely poor (a spherical-shaped LV, spontaneous echo contrast, LVEF 10–15%), creating a risk of intracavitary thrombus formation. Atrial septal puncture was performed to decompress the LV. An additional 21 Fr cannula was advanced through the right common femoral vein into the left atrial cavity. The mechanical support setup was as follows: blood from the LA, RA, and IVC was drained into the ECMO circuit and returned via a cannula in the left common femoral artery, with an IABP catheter in the aorta.

The right common femoral vein was used as vascular access for cannulation of the left atrium. During catheterization, angiography revealed thrombosis of the common iliac vein. Thromboaspiration and balloon angioplasty of the right common iliac vein were performed. After that, it became possible to advance the cannula into the left atrium through the interatrial septum.

**On Day 5** (07/08/25) ultrasonography revealed a 4×6 cm retroperitoneal hematoma in the area of the right iliac vein, which required relaparotomy. The source of the bleeding was not identified.

After relaparotomy, the patient was conscious. Mechanical ventilation was continued via an orotracheal tube in SIMV-PC mode: $FiO_2$ 45%, rate 10/min, Vt 5 mL/kg, PEEP 6 cm $H_2O$, Pinsp 13–12 cm $H_2O$. Hemodynamic parameters: BP 128/68–121/72 mmHg, PAP 32/15 mmHg, HR 125–122/min, $SpO_2$ 98–99%. ECMO parameters: 3.5–3.7 L/min, 8,400–8,700 rpm, oxygen flow 2.0 L/min, $FiO_2$ 70%, heparin infusion 8 units/kg/hour, aPTT 55–85 sec.

**On Day 6** (07/09/25), the patient was transported from Naberezhnye Chelny to Moscow by a combined mode of transport: 40 km from the

**Table. Surgical procedures and associated complications.**

| Stages of treatment, date | Medical interventions | | Complications, sequelae |
|---|---|---|---|
| | Procedure | Details | |
| Day 1, 04.07.2025 | Cannulation of femoral vessels for VA-ECMO | The left common femoral artery and the left common femoral vein are cannulated | No |
| | LAD CAG/PCI, IVUS | | No |
| | LAD CAG/PCI, IABP | PCI in the distal segments of LAD artery. Catheterization of the right common femoral artery for IABP | No |
| Day 2, 05.07.2026 | Continuation of intensive therapy, consultations, and a medical council | | |
| Day 3, 06.07.2025 | Cesarean section, uterine arteries embolization | | Blood-loss 400 mL |
| Day 4, 07.07.2025 | CAG, interatrial septal puncture, insertion of additional cannula in the left atrium | Common iliac vein thrombosis, balloon angioplastya | Hemorrhagic shock retroperitoneal hematoma |
| Day 5, 08.07.2025 | Re-laparotomy | Hematoma 4×6 cm in size, soft, 100–150 ml in volume in the projection of the right iliac vein. | No |
| Day 6, 09.07.2025 | Medical evacuation by car + airplane | MV, VA-ECMO, IABP | No |
| | Transported to the V.I. Shumakov NMRC for Transplantation and Artificial Organs, MoH | | No |
| Day 8, 11.07.2025 | Re-laparotomy | | No |
| | Orthotopic heart transplantation | | No |
| Day 9, 07.12.2025 | Weaning from VA-ECMO, IABP | | No |

R. S. Akchurin Emergency Hospital to Begishevo Airport (Nizhnekamsk), then about 900 km by plane to Zhukovsky Airport (Moscow), and then 60 km from Zhukovsky Airport to the Shumakov National Medical Research Center for Transplantology and Artificial Organs, Ministry of Health of the Russian Federation. The total medical evacuation time was approximately 5 hours.

All treatment stages and surgical procedures are presented in the table.

## Discussion

Management of pregnant women with AMI during pregnancy and the postpartum period involves multiple objectives: treating cardiogenic shock and the myocardial infarction itself, preserving fetal viability, and preparing the patient for delivery, including an anticoagulation strategy required by the AMI treatment regimen and ECMO, as well as a hemostatic strategy for the delivery period. Administration of certain medications during pregnancy such as furosemide and sedatives (dexmedetomidine, propofol) poses an additional challenge, as they have strict restrictions for use during pregnancy, but still must be used when clinically indicated, e. g., for the treatment of pulmonary edema. These factors, along with many others, make effective management of cardiogenic shock during pregnancy really challenging.

This clinical case highlights the need to employ standard treatment protocols, and make rapid and timely decisions. The strong interest in SCAD in pregnant women is due, above all, to the limited amount of empirical data that would make it possible to develop a structured diagnostic and treatment protocol for the SCAD. As for the epidemiology, it is important to note that the overwhelming majority of SCAD patients are young women with low standard cardiovascular risk scores; however, it is difficult to assess the true prevalence of this condition because of under-diagnosis and the specific features of its clinical presentation [18].

The preparation of the patient and equipment required for ground and air transportation is not described, as this is a different topic worthy of a separate publication.

## Conclusion

We presented a case report of SCAD in a pregnant woman, which resulted in AMI and CS, necessitating MCS with VA-ECMO. We showed that a combination of standard of care approaches, such as coronary angiography with percutaneous coronary intervention, and a timely individualized approach, including VA-ECMO, intra-aortic balloon pump, and left ventricular decompression, is required to manage such conditions. The use of advanced technologies and a professional multidisciplinary approach made it possible to save both the mother and the child.

## References


1. The Centers for Disease Control and Prevention (CDC). Maternal Mortality Review Infor-mation Application («Maria»): The Centers for Disease Control and Prevention (CDC), 2023. https://www.cdc.gov/maternal-mortality/php/data-research/mmria-methods/index.html
2. Диагностика и лечение сердечно-сосудистых заболеваний при беременности 2018. Национальные рекомендации *Российский кардиологический журнал*. 2018 (3): 91–134. Diagnosis and treatment of cardiovascular diseases during pregnancy 2018. National guidelines *Russian Journal of Cardiology= Rossiyskiy Kardiologichesky Zhurnal*. 2018 (3): 91–134. (in Russ.). DOI: 10.15829/1560-4071-2018-3-91-134.
3. *Кочергин Н.А., Ганюков В.И., Тарасов Р.С., Барбараш О.Л.* Инфаркт миокарда с элевацией сегмента ST. *Эндоваскулярная хирургия*. 2015 (2): 95–98. *Kochergin N.A., Ganyukov V.I., Tarasov R.S., Barbarash O.L.* Myocardial infarction with ST segment elevation. *Russian Journal of Endovascular Surgery = Endovaskulyarnaya Khirurgiya*. 2015 (2): 95–98. (in Russ.).
4. *Шахова О.Б., Кузьмина И.И, Гвинджилия Т.Р., Дамиров М.М., Мурадян Н.А., Пархоменко М.В.* Инфаркт миокарда в послеродовом периоде. *Журнал им. Н.В. Склифосовского «Неотложная медицинская помощь»*. 2022; 11 (2): 368–373. *Shakhova O.B., Kuzmina I.I., Gvindzhiliya T.R., Damirov M.M., Muradyan N.A., Parkhomenko M.V.* Myocardial infarction in the postpartum period. *Russian Sklifosovsky Journal «Emergency Medical Care» = Zhurnal im. N.V. Sklifosovskogo «Neotlozhnaya Meditsinskaya Pomoshch»*. 2022; 11 (2): 368–373. (in Russ.). DOI: 10.23934/2223-9022-2022-11-2-368-373.
5. *Кузнецов А.А., Намитоков А.М., Сажнева А.В., Некрасов А.С., Космачёва Е.Д.* Клинический случай спонтанной диссекции левой коронарной артерии в послеродовом периоде. *Российский кардиологический журнал*. 2022: 46–56. *Kuznetsov A.A., Namitokov A.M., Sazhneva A.V., Nekrasov A.S., Kosmacheva E.D.* Spontaneous left coronary artery dissection in the postpartum period: a case report. *Russian Journal of Cardiology=Rossiyskiy Kardiologichesky Zhurnal*. 2022: 46–56. (in Russ.). DOI: 10.15829/1560-4071-2022-5059.
6. *Pierce T., Hovnanian M., Hedgire S., Ghoshhajra B.* Imaging of cardiovascular disease in pregnancy and the peripartum period. *Curr Treat Options Cardiovasc Med*. 2017; 19 (12): 94. DOI: 10.1007/s11936-017-0593-8. PMID: 29134367.
7. *Hayes S.N., Kim E.S.H., Saw J., Adlam D., Arsianian-Engoren S.,Economy K.E., Ganesh S.K., et al.* Spontaneous coronary artery dissection: current state of the science: s scientific statement from the American Heart Association. *Circulation*. 2018; 137 (19): e523-e557. DOI: 10.1161/CIR.0000000000000564. PMID: 29472380.
8. *Elad B., Karas M., Changhee L., Oren D., Fried J., Raikhelkar J., Clerkin K., et al.* Mechanical circulatory support for cardiogenic shock during the peripartum period. *Artif Organs*. 2025; 49 (2): 276–280. DOI: 10.1111/aor.14870. PMID:39345176.
9. *Webster C.M., Smith K.A., Manuck T.A.* Extracorporeal membrane oxygenation in pregnant and postpartum women: a ten-year case series. *Am J Obstet Gynecol MFM*. 2020; 2(2): 100108. DOI: 10.1016/j.ajogmf.2020.100108. PMID: 32835205.
10. *Moore S.A., Dietl C.A., Coleman D.M.* Extracorporeal life support during pregnancy. *J Thorac Cardiovasc Surg*. 2016; 151 (4): 1154–60. DOI: 10.1016/j.jtcvs.2015.12.027. PMID: 26825433.
11. *Naoum E.E., Chalupka A., Haft J., MacEachern M., Vandeven C.J.M., Easter S.R., Maile M., et al.* Extracorporeal life support in pregnancy: a systematic review. *J Am Heart Assoc*. 2020; 9 (13): e016072. DOI: 10.1161/JAHA.119.016072. PMID: 32578471.
12. *Скопец А.А.* Опыт применения экстракорпоральной мембранной оксигенации в акушерстве и гинекологии. *Инновационная медицина Кубани*. 2019; (4): 6–11. *Skopets A.A.* Experience of extracorporeal membrane oxygenation in obstetrics and gynecology. *Innovative Medicine of Kuban= Innovatsionnaya Meditsina Kubani*. 2019; (4): 6–11. (in Russ.). DOI: 10.35401/2500-0268-2019-16-4-6-11.
13. *Золотухин К.Н., Фаткуллина И.Б., Лазарева А.Ю., Поляков И.В., Быстрова Ю.Р., Мухаметкулова А.Р., Клявлин С.В.* Опыт применения экстракорпоральной мембранной оксигенации у родильницы с тяжелой преэклампсией. *Уральский медицинский журнал*. 2022; 21 (5): 88–93. *Zolotukhin K.N., Fatkullina I.B., Lazareva A.Yu., Polyakov I.V., Bystrova Yu.R., Mukhametkulova A.R., Klyavlin S.V.* Experience of extracorporeal membrane oxygenation in a woman with severe preeclampsia. *Ural Medical Journal = Uralskiy Meditsinskiy Zhurnal*. 2022; 21 (5): 88–93. (in Russ.). DOI: 10.52420/2071-5943-2022-21-5-88-93.
14. *Шелухин Д.А., Павлов А.И., Кузнецов С.В.* Первый в России успешный опыт применения продленной экстракорпоральной мембранной оксигенации у родильницы с синдромом Такоцубо. *Акушерство и гинекология*. 2019; 7: 131–136. *Shelukhin D.A., Pavlov A.I., Kuznetsov S.V.* The first successful

experience in Russia of using prolonged extracorporeal membrane oxygenation in a woman with Takotsubo syndrome. *Obstetrics and Gynecology = Akusherstvo i Ginecologiya*. 2019; 7: 131–136. (in Russ.).
DOI: 10.18565/aig.2019.7.131-136.

15. *Шилова А.С., Кецкало М.В., Площенков Е.В., Раимов М.Б., Вачнадзе Д.И., Троицкий Д.А., Самострол Н.Т. с соавт.* Тромбоэмболия высокого риска при беременности. *Акушерство и гинекология*. 2025; 1: 118–126. *Shilova A.S., Ketskalo M.V., Ploshchenkov E.V., Raimov M.B., Vachnadze D.I., Troitsky D.A., Samostrol N.T., et al.* High-risk thromboembolism in pregnancy. *Obstetrics and Gynecology = Akusherstvo i Ginecologiya*. 2025; 1: 118–126. (in Russ.). DOI: 10.18565/aig.2024.239.
16. *Скопец А.А., Жаров А.С., Потапов С.И., Афонин Е.С., Андреева М.Д., Галдина Т.В., Шульженко Л.В., с соавт.* Первый случай кесарева сечения у беременной во время экстракорпоральной мембранной оксигенации в Российской Федерации. *Вестник интенсивной терапии имени А.И. Салтанова*. 2019; (3): 90–97. *Skopets A.A., Zharov A.S., Potapov S.I., Afonin E.S., Andreeva M.D., Galdina T.V., Shulzhenko L.V., et al.* The first case of Cesarean section in a pregnant woman during extracorporeal membrane oxygenation (ECMO) in Russia. *Ann Crit Care = Vestnik Intensivnoy Terapii im A.I. Saltanova*. 2019; (3): 90–97. (in Russ.). DOI: 10.21320/1818-474X-2019-3-90-97.
17. *Kapur N.K., Kanwar M., Sinha S.S., Thayer K.L., Garan A.R., Hernandez-MontfortJ., Zhang Y., et al.* Criteria for defining stages of cardiogenic shock severity. *J Am Coll Cardiol*. 2022; 80 (3): 185–198.
DOI: 10.1016/j.jacc.2022.04.049.
PMID: 35835491.
18. *Ткачева О.Н., Шарашкина Н.В.* Инфаркт миокарда беременность. *Проблемы женского здоровья*. 2008; 3 (3): 25–30. *Tkacheva O.N., Sharashkina N.V.* Myocardial infarction and pregnancy. *Women's Health Issues = Problemy Zhenskogo Zdorovya*. 2008; 3 (3): 25–30. (in Russ.).

**Received 27.01.2026**
**Accepted 13.05.2026**
**Online First 16.06.2026**