



# Mechanical thrombectomy for acute ischemic stroke with large vessel occlusion in pregnancy with mechanical heart valves : A case report

Renwei Zhang<sup>a,1</sup>, Li Peng<sup>b,1</sup>, Yao Xu<sup>a</sup>, Yumin Liu<sup>a,\*</sup>

<sup>a</sup> Department of Neurology, Zhongnan Hospital of Wuhan University, Wuhan, China

<sup>b</sup> Department of Cardiology, Zhongnan Hospital of Wuhan University, Wuhan, China

## ARTICLE INFO

### Keywords:

Mechanical heart valves  
Pregnant woman  
Mechanical thrombectomy  
Acute ischemic stroke  
Anticoagulation

## ABSTRACT

**Background:** The management of anticoagulation for mechanical heart valves (MHVs) during pregnancy posed a special challenge. Mechanical thrombectomy (MT) was the standard treatment for acute ischemic stroke (AIS) in anterior circulation with large vessel occlusion. However, the efficacy and safety of MT in the treatment of acute ischemic stroke in pregnancy were unknown. **Case presentation:** A 29-year-old woman with MHVs in her first pregnancy at 7 weeks' gestation underwent MT because of a large occlusive thrombus in the end of the internal carotid artery despite therapeutic anticoagulation with low-molecular-weight heparin. This pregnant woman recovered well after MT with a modified rank score (mRS) of 0 at 90 days. **Conclusion:** At present, there was no standard protocol of anticoagulation therapy for pregnant women with MHVs. Acute ischemic stroke with large vessel occlusion in pregnancy was rare, but could bring devastating consequences for both mother and infant. Our case report demonstrated that MT could be safe and effective in pregnancy.

## 1. Introduction

Pregnant women with MHVs were at significant risk of morbidity and mortality, due to both thrombotic and hemorrhagic complications. Mortality related to AIS during pregnancy was almost 385 times higher than that of pregnant women without AIS [1]. MT was the standard treatment for AIS in anterior circulation with large vessel occlusion. However, the efficacy and safety of MT in the treatment of AIS during pregnancy were unknown [2]. The management of anticoagulation for MHVs during pregnancy posed a special challenge. At present, there was no optimal anticoagulation strategy for MHVs in pregnancy, each option was a balance between maternal and fetal risks [3]. In this case report, we present a rare case of a patient with MHVs in pregnancy that underwent MT.

## 2. Case description

A 29-year-old-woman of 7 weeks' gestation presented with right facial paresis, hemiparesis, and partial motor aphasia for 2h, who got replacement of mitral valve when she was 16. The admission National Institute of Health Stroke Scale score (NIHSS) was 15. She

\* Corresponding author.

E-mail address: [wb001792@whu.edu.cn](mailto:wb001792@whu.edu.cn) (Y. Liu).

<sup>1</sup> Renwei Zhang and Li Peng contributed equally to this work.

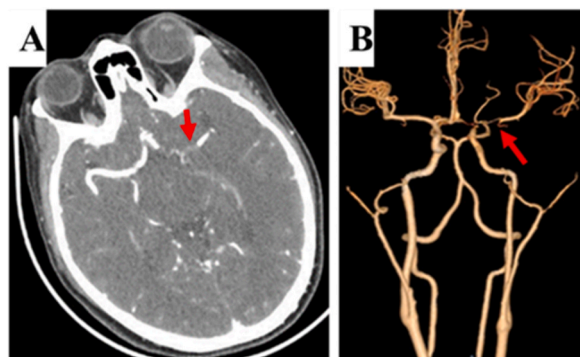
got brain computed tomography (CT) which showed hyper-dense sign in the left middle cerebral artery (Fig. 3A), and the CT-Angiogram (CTA) showed a large occlusive thrombus in the end of the internal carotid artery and the M1 of the middle cerebral artery (MCA) and A1 of the anterior cerebral artery (Fig. 1A–B). Biochemical tests showed that blood test, liver and kidney function, levels of serum electrolytes, blood glucose and lipids were all normal. There was contraindication about administering rt-PA due to the usage of low molecular weight heparin (LMWH) after MHVs. Therefore, MT was recommended as the preferred treatment. However, the efficacy and safety of MT in the treatment of AIS during pregnancy were unknown. Other concern was the risk of exposure to radiation and contrast agents to the mother and fetus during MT. Iodinated contrast agents could cross the placenta and enter the fetal circulation or pass directly into the amniotic fluid. The patient's relatives requested that all efforts should be made to save the pregnant woman. Emergent MT was conducted through thrombus aspiration by 5F intermediate catheter. The recanalization of internal carotid artery and the middle cerebral artery and the anterior cerebral artery were achieved within 100mins (from puncture to recanalization) (Fig. 2A–D) and the thrombus were bright red and very tough (Fig. 4). We performed echocardiography twice (on admission and at discharge) and found MHV was normal. The etiology of AIS in this patient was classified as cardio-embolic stroke according to TOAST classification. For secondary prevention of cardio-embolic stroke, anticoagulation therapy was recommended. Low molecular weight heparin (Dalteparin Sodium Injection, 5000 iu, SC, bid) was given after MT. 24h after MT, no obvious cerebral hemorrhage was observed in the brain CT (Fig. 3B). Cardiac ultrasound showed mechanical mitral valve replacement status and the cardiac structure and function were normal. The patient was discharged one week after MT with normal right limb strength and a mRS of 0 at 90day. We were so sorry to hear that the pregnant patient chose to abortion 1 month after discharge. Although we repeatedly told the patient that the contrast media and radiation doses were relatively little and safe for the fetus, they insisted on an abortion. Timeline of the medical diagnosis and treatment process had been shown in Fig. 5.

### 3. Discussion

In this case report, we presented a rare case of a patient with MHVs in pregnancy that underwent MT. Patients with MHVs needed life-long anticoagulation to prevent thromboembolic complications. However, anticoagulation in pregnant women with MHVs was a complex challenge. Even the rate of MHVs in pregnancy was approximately 4.07% [4]. MHVs in pregnant women was associated with high incidence of maternal complications (such as thromboembolic complications, heart failure, arrhythmia and bleeding) and fetal complications (such as fetal loss, premature delivery, low birth weight and teratogenicity) [5]. At present, there was no standard protocol of anticoagulation therapy for pregnant women with MHVs. It was previously believed that oral warfarin in early pregnancy could cause spontaneous abortion, embryo abortion and characteristic fetal malformations [6]. Warfarin had been recommended for women with MHVs in the second and third trimesters and their use in the first trimester was to be considered if the daily dose was  $\leq 5$  mg [7]. Because LMWHs did not cross the placental barrier, so there are no drug-related fetal adverse events in women using LMWHs. However, the risk of valve thrombosis is higher with LMWHs than with warfarin therapy [8]. Present study [9] found that there was no difference in adverse fetal outcomes between pregnant women taking warfarin ( $\leq 5$  mg daily) and LMWHs regimen. Whether to use LMWH or warfarin in the pregnancy should be based on the patient's condition and full discussion with the patient and her family.

In our case, the young pregnant woman started using LMWH instead of warfarin (3 mg daily) when she was pregnant, because she and her family thought the increased fetal risks associated with warfarin may not be acceptable.

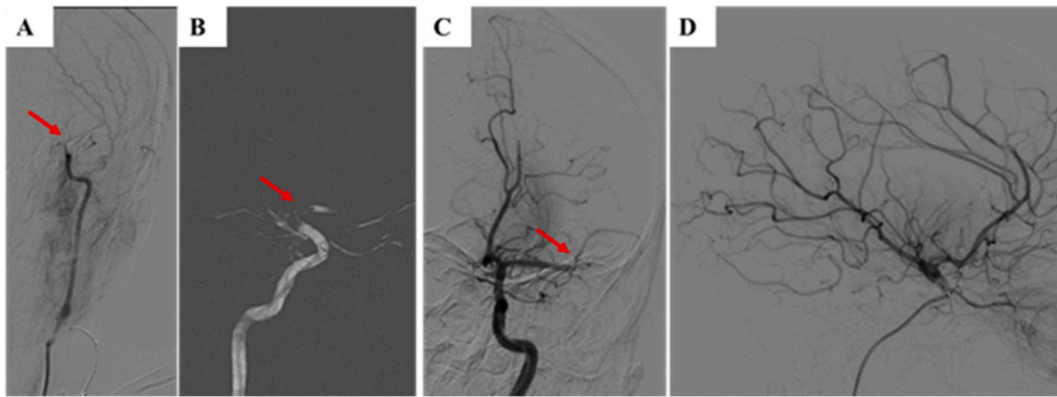
Pregnancy increased the risk of ischemic and hemorrhagic stroke, which was three times higher than in women who are not pregnant [10]. The blood in pregnant women was hypercoagulable because of the increasing coagulation factors and decreasing anticoagulation factors, especially in late gestation, which was prone to thromboembolism complications. Furthermore, high-intensity anticoagulation therapy could reduce the thrombosis and embolism complications, but could increase the risk of abortion, stillbirth, premature delivery and placental abruption. However, thrombosis and embolism may occur even after proper anticoagulant therapy. Despite advances in stroke treatment, mortality was reported to be 20%, while survivors may also suffer from disability or require



**Fig. 1.** Brain CT angiography on admission.

A Thin-slice raw images of CTA showed filling-defect in left MCA (red arrowhead).

B Volume rendering for CTA showed occlusion in the end of the internal carotid artery and the M1 of the middle cerebral artery and A1 of the anterior cerebral artery (red arrowhead).



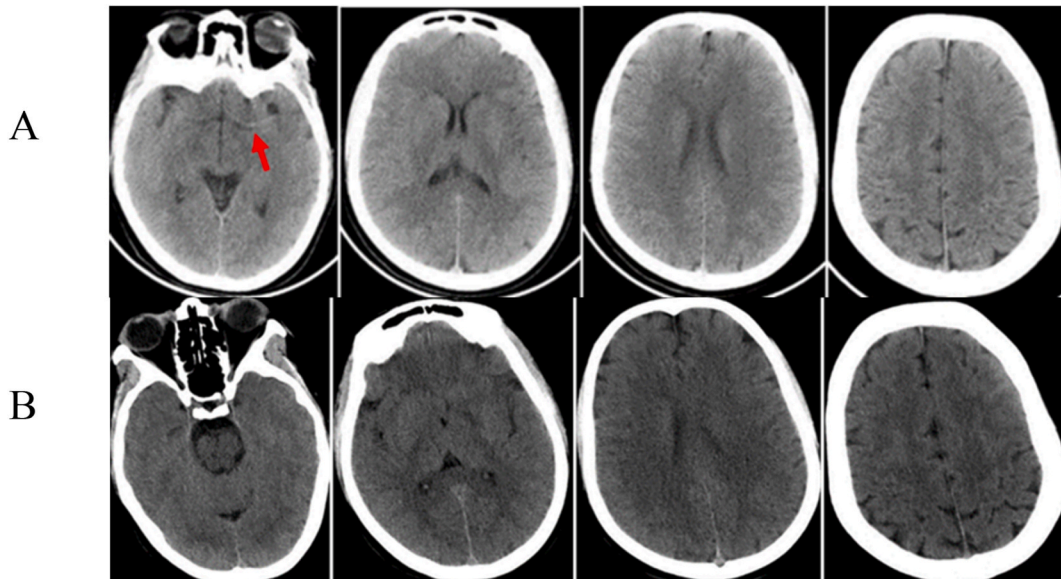
**Fig. 2.** Images during MT

A The right carotid artery angiography showed the occlusion in the end of the internal carotid artery.

B Road map showed the thrombus in the end of the internal carotid artery and the M1 of the middle cerebral artery and A1 of the anterior cerebral artery.

C After aspiration by 5F intermediate-catheter, DSA showed the migration of thrombus in the MCA.

D the recanalization of MCA was achieved, after several attempts of aspiration by intermediate-catheter.



**Fig. 3.** Brain CT on admission and 24h after MT.

A Brain CT showed no obvious abnormalities, except a suspicious hyper-dense sign of the left MCA (red arrowhead).

B Brain CT showed some low-density lesions in the basal ganglia 24h after MT.



**Fig. 4.** Thrombus from 5F intermediate-catheter.

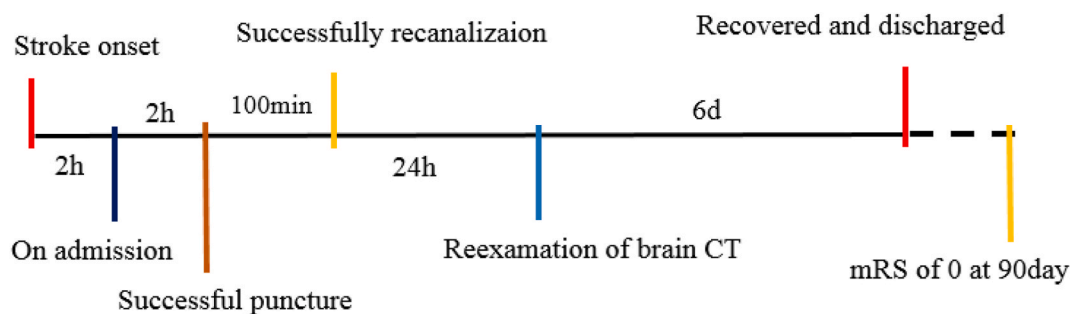


Fig. 5. Timeline of the medical diagnosis and treatment process.

rehabilitation [11]. Therefore, early recognition and management of stroke in pregnancy was essential to initiate urgent and effective treatment. Intravenous thrombolysis (IVT) administration with or without MT has been proved to be an effective treatment for AIS patients. However, the safety and feasibility of reperfusion treatment in pregnancy has not been extensively evaluated. A study [12] showed EVT was a safe and effective treatment for acute stroke secondary to LVO in pregnant patients. The expert consensus statement in European Stroke Organization guidelines [13] suggested that in pregnant women with AIS related to large vessel occlusion, MT alone should be preferred over IVT or bridging therapy (IVT + MT).

In our case, the young pregnant woman with AIS related to large vessel occlusion had a short onset time on admission and was within the thrombolytic time window. However, she took anticoagulant drugs (warfarin 3mg/d) for a long time after MHV, and then changed to use LMWH (5000 iu, SC, BID) in pregnancy. Therefore, IVT cannot be used because of contraindications. Considering the young pregnant woman may probably suffer disability or even death without MT, we conducted MT after the agreement of her relatives. But at the same time, the teratogenic risk to the fetus during MT should also be considered. Some studies have reported that contrast media during MT has no or little influence on the fetus. Radiation dose less than 2.8mGy during interventional procedure was relatively safe for fetus [14]. Some study [15] showed that foetal outcome was healthy after MT in the first trimester of pregnancy. Unfortunately, no guidelines for continuation of pregnancy in the first trimester after MT were published at present. Fortunately, the young pregnant woman with AIS recovered very well after MT with mRS of 0 at 90day. Management of MHV related embolic events in pregnant patients was comparable with non-pregnant patients. Anticoagulation with warfarin is recommended for patients with MHV, with INR of 3.0 (range, 2.5–3.5) (Class 1). 2021 AHA/ASA guideline showed that with recurrent stroke or TIA during anticoagulation, intensified warfarin should be considered for secondary prevention after assessing and ruling out non-valvular causes, and assessing bleeding risk (Class 2B) [16]. 2018 ESC guideline did not recommend adding a low dose of acetylsalicylic acid (ASA) to the VKAs or heparin treatments to prevent the valve thrombosis during pregnancy [17]. While 2020 ACC/AHA guideline recommended a low-dose aspirin (75 mg–100 mg) as an addition to VKA therapy during second and third trimesters for patients at a higher risk for embolic events [18].

In conclusion, there was no standard protocol of anticoagulation therapy for pregnant women with MHVs at present. Acute ischemic stroke with large vessel occlusion in pregnancy was rare, but could bring devastating consequences for both mother and infant. Our case report demonstrated that MT could be safe and effective in pregnancy.

The safest anticoagulation treatment for pregnant woman with MHV was indisputably VKA, with lower rates of thromboembolic complications compared with LMWH, however, the increased teratogenic risks associated with VKA should be considered as well. LMWH in the first trimester might increase the risk of thrombotic complications and we would suggest to cardiologist and cardiovascular surgeon throughout pregnancy, including during the first trimester, warfarin (<5 mg orally daily) would be an appropriate option.

#### Ethics statement

Written informed consent was obtained from the individual for the publication. The study was approved by the ethics committee of Zhongnan hospital of Wuhan University.

#### Author contribution statement

All authors listed have significantly contributed to the investigation, development and writing of this article.

#### Data availability statement

Data will be made available on request.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to

influence the work reported in this paper.

## References

- [1] I.Y. Elgendy, M.M. Gad, A.N. Mahmoud, E.C. Keeley, C.J. Pepine, Acute stroke during pregnancy and puerperium, *J. Am. Coll. Cardiol.* 75 (2) (2020) 180–190, <https://doi.org/10.1016/j.jacc.2019.10.056>.
- [2] M. Cauldwell, A. Rudd, C. Nelson-Piercy, Management of stroke and pregnancy, *Eur Stroke J* 3 (3) (2018) 227–236, <https://doi.org/10.1177/2396987318769547>.
- [3] J. Windram, J. Grewal, N. Bottega, M. Sermer, D. Spears, L. Swan, et al., Canadian cardiovascular society: clinical practice update on cardiovascular management of the pregnant patient, *Can. J. Cardiol.* 37 (12) (2021) 1886–1901, <https://doi.org/10.1016/j.cjca.2021.06.021>.
- [4] I.M. van Hagen, J.W. Roos-Hesselink, T.P. Ruys, W.M. Merz, S. Golland, H. Gabriel, et al., Pregnancy in women with a mechanical heart valve: data of the European society of cardiology registry of pregnancy and cardiac disease (ROPAC), *Circulation* 132 (2) (2015) 132–142, <https://doi.org/10.1161/CIRCULATIONAHA.115.015242>.
- [5] U. Elkayam, Anticoagulation therapy for pregnant women with mechanical prosthetic heart valves: how to improve safety? *J. Am. Coll. Cardiol.* 69 (22) (2017) 2692–2695, <https://doi.org/10.1016/j.jacc.2017.04.034>.
- [6] M.M. Daughety, J. Zilberman-Rudenko, J.J. Shatzel, O.J.T. McCarty, V. Raghunathan, T.G. DeLoughery, Management of anticoagulation in pregnant women with mechanical heart valves, *Obstet. Gynecol. Surv.* 75 (3) (2020) 190–198, <https://doi.org/10.1097/OGX.0000000000000751>.
- [7] R.A. Nishimura, C.M. Otto, R.O. Bonow, B.A. Carabello, J.P. Erwin 3rd, R.A. Guyton, et al., 2014 AHA/ACC guideline for the management of patients with valvular heart disease: a report of the American college of cardiology/American heart association task force on practice guidelines, *Circulation* 129 (23) (2014) e521–e643, <https://doi.org/10.1161/CIR.0000000000000031>.
- [8] R. D'Souza, J. Ostro, P.S. Shah, C.K. Silversides, A. Malinowski, K.E. Murphy, et al., Anticoagulation for pregnant women with mechanical heart valves: a systematic review and meta-analysis, *Eur. Heart J.* 38 (19) (2017) 1509–1516, <https://doi.org/10.1093/eurheartj/ehx032>.
- [9] Z.L. Steinberg, C.P. Dominguez-Islas, C.M. Otto, K.K. Stout, E.V. Krieger, Maternal and fetal outcomes of anticoagulation in pregnant women with mechanical heart valves, *J. Am. Coll. Cardiol.* 69 (22) (2017) 2681–2691, <https://doi.org/10.1016/j.jacc.2017.03.605>.
- [10] E.C. Camargo, A.B. Singhal, Stroke in pregnancy: a multidisciplinary approach, *Obstet. Gynecol. Clin. N. Am.* 48 (1) (2021) 75–96, <https://doi.org/10.1016/j.ogc.2020.11.004>.
- [11] C.A. Scott, S. Bewley, A. Rudd, P. Spark, J.J. Kurinczuk, P. Brocklehurst, et al., Incidence, risk factors, management, and outcomes of stroke in pregnancy, *Obstet. Gynecol.* 120 (2 Pt 1) (2012) 318–324, <https://doi.org/10.1097/AOG.0b013e31825f287c>.
- [12] K. Limaye, A. Van de Walle Jones, A. Shaban, S. Desai, S. Al Kasab, E. Almallouhi, et al., Endovascular management of acute large vessel occlusion stroke in pregnancy is safe and feasible, *J. Neurointerventional Surg.* 12 (6) (2020) 552–556, <https://doi.org/10.1136/neurintsurg-2019-015578>.
- [13] C. Kremer, Z. Gdovinova, Y. Bejot, M.R. Heldner, S. Zuurbier, S. Walter, et al., European Stroke Organisation guidelines on stroke in women: management of menopause, pregnancy and postpartum, *Eur Stroke J* 7 (2) (2022) 1–XIX, <https://doi.org/10.1177/23969873221078696>.
- [14] A. Ishii, S. Miyamoto, Endovascular treatment in pregnancy, *Neurol. Med.-Chir.* 53 (8) (2013) 541–548, <https://doi.org/10.2176/nmc.53.541>.
- [15] M. Wiącek, R. Kaczorowski, A. Oboz-Adaś, K. Kuźniar, H. Bartosik-Psujek, Acute ischemic stroke in a third trimester of pregnancy - cesarean section followed by mechanical thrombectomy, *Int. J. Neurosci.* 130 (7) (2020) 739–742, <https://doi.org/10.1080/00207454.2019.1702539>.
- [16] D.O. Kleindorfer, A. Towfighi, S. Chaturvedi, K.M. Cockroft, J. Gutierrez, D. Lombardi-Hill, et al., 2021 guideline for the prevention of stroke in patients with stroke and transient ischemic attack: a guideline from the American heart association/American stroke association, *Stroke* 52 (7) (2021) e364–e467, <https://doi.org/10.1161/STR.0000000000000375>.
- [17] V. Regitz-Zagrosek, J.W. Roos-Hesselink, J. Bauersachs, C. Blomström-Lundqvist, R. Cifková, M. De Bonis, et al., 2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy, *Eur. Heart J.* 39 (34) (2018) 3165–3241, <https://doi.org/10.1093/eurheartj/ehy340>.
- [18] C.M. Otto, R.A. Nishimura, R.O. Bonow, B.A. Carabello, J.P. Erwin 3rd, F. Gentile, H. Jneid, et al., 2020 ACC/AHA guideline for the management of patients with valvular heart disease: a report of the American college of cardiology/American heart association joint committee on clinical practice guidelines, *Circulation* 143 (5) (2021) e72–e227, <https://doi.org/10.1161/CIR.0000000000000923>.