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Successful treatment of massive pulmonary embolism in pregnancy with catheter-directed embolectomy

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Abstract:

Pulmonary embolism (PE) is associated with approximately 10.5% of maternal deaths in the United States. Despite heightened awareness of its mortality potential, there is little data available to guide its management in pregnancy. We present the case of a massive PE during gestation successfully treated with catheter-directed embolectomy.

A 37-year-old G2P1001 presented with a syncopal episode preceded by dyspnea and chest pain. Upon presentation, she was hypotensive, tachycardiac, and hypoxic. Imaging showed an occlusive bilateral PE, right heart strain, and a possible intrauterine pregnancy. Beta-hCG was positive. She was taken emergently for catheter-directed embolectomy. Her condition immediately improved afterwards. Post-procedure pelvic ultrasound confirmed a viable intrauterine pregnancy at 10 weeks gestation. She was discharged with therapeutic enoxaparin and gave birth to a healthy infant at 38 weeks gestation.

Despite being the gold standard for PE treatment in non-pregnant adults, systemic thrombolysis is relatively contraindicated in pregnancy due to concern for maternal or fetal hemorrhage. Surgical or catheter-based thrombectomies are rarely recommended. Limited alternative options forces their consideration, particularly in a hemodynamically unstable patient. Catheter-directed embolectomy can possibly bypass such complications. Our case exemplifies the consideration of catheter-directed embolectomy as the initial treatment modality of a hemodynamically unstable gestational PE.

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Abstract

Pulmonary embolism (PE) is associated with approximately 10.5% of maternal deaths in the United States. Despite heightened awareness of its mortality potential, there is little data available to guide its management in pregnancy. We present the case of a massive PE during gestation successfully treated with catheter-directed embolectomy.

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Despite being the gold standard for PE treatment in non-pregnant adults, systemic thrombolysis is relatively contraindicated in pregnancy due to concern for maternal or fetal hemorrhage. Surgical or catheter-based thrombectomies are rarely recommended. Limited alternative options forces their consideration, particularly in a hemodynamically unstable patient. Catheter-directed embolectomy can possibly bypass such complications. Our case

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Keywords: thrombectomy, embolectomy, thrombolytic therapy, pregnancy, pulmonary embolism

Introduction

Venous thromboembolism (VTE), which includes pulmonary embolism (PE) and deep vein thrombosis (DVT) is a life threatening complication of pregnancy that occurs in approximately 5.7 in 10,000 deliveries.¹ Although the incidence of DVT in pregnancy has decreased in recent years, the incidence of PE remains largely unchanged.¹ In the United States, pregnancy-associated emboli are associated with up to approximately 10.5% of maternal deaths from 2017 – 2019.² Accurate diagnosis of an acute PE in a pregnant woman therefore becomes extremely important, as it can be difficult to distinguish the signs of a PE from the typical physiologic changes of pregnancy.

An acute PE is categorized as massive when the patient presents with arterial hypotension and cardiogenic shock.³ When this occurs in pregnancy, management becomes extremely challenging with little data available to guide treatment options.⁴ In the non-pregnant population, massive PE can be treated by a combination of anticoagulation, systemic thrombolysis, surgical embolectomy, or catheter-directed techniques.⁵ However, in the pregnant population, potential risks of s maternal, placental or fetal hemorrhage, teratogenicity, and fetal loss lead to a limitation of alternative techniques being studied to treat PE.⁶ We present a case of massive PE during pregnancy successfully managed by

percutaneous catheter-directed embolectomy by entrapment. This case hopes to allow further discussion on using this technique as a first-line therapy for massive PE in pregnancy.

Case Presentation

A 37-year-old, gravida 1 para 1, presented to our emergency department (ED) with a one-day onset of a syncopal episode after suffering dyspnea and chest pain. At the time of presentation, the patient confirmed chest pains, palpitations, and dyspnea. She denied fever, chills, nausea, vomiting, abdominal pain, and leg swelling. Her past medical history was notable for hyperlipidemia, bipolar disorder, morbid obesity, chronic microcytic anemia, and endometriosis. Surgical history included a previous uncomplicated caesarean section. Medications included venlafaxine, ziprasidone, and trazodone. Family and social history were unremarkable.

Emergency medical services reported on arrival that the patient's oxygen saturation was 70% on room air and her initial blood pressure (BP) reading was 80/60 mmHg. She received 100 mL of intravenous fluid (IVF) on her way to the hospital. On presentation in the ED, the patient was afebrile, tachycardic at 120 beats per minute, tachypneic at 31 breaths per minute, BP of 94/73 mmHg which improved to 122/72 mmHg after IVF resuscitation, and oxygen saturation of 88% on nonrebreather mask. Physical exam was notable for a diaphoretic woman with obesity in acute respiratory distress. She was placed on BiPAP with her oxygen saturation improving to 100%.

A computed tomography angiogram (CTA) (Fig. 1) was significant for an occlusive bilateral PE beginning at the first bifurcation of the bilateral pulmonary arteries extending to all lobes of the lung, associated significant right heart strain, and a possible intrauterine pregnancy.

Therapeutic anticoagulation with unfractionated heparin drip was started and the patient was admitted to the critical care medicine service for further evaluation and monitoring. At this time, laboratory workup incidentally showed beta-hCG at 34,003 mIU/mL (normal < 5 mIU/mL) and severe lactic acidosis of 6.9 mmol/L (normal 0.5 – 2.2 mmol/L). The patient was taken emergently for catheter-directed embolectomy by entrapment (Fig. 2).

Initial survey of the pulmonary vasculature showed significant clot burden in the bilateral main pulmonary arteries, bilateral lower lobes, and the right upper lobe. Her thrombus was aspirated without complication (Fig. 3).

Post-procedure, the patient's condition improved immediately with heartrate decreasing from 135 to 99 bpm and her oxygen requirements decreasing to 2L/min nasal cannula. The patient underwent hypercoagulable workup which was negative. She continued anticoagulation with heparin drip. A pelvic ultrasound confirmed a viable intrauterine pregnancy estimated at 10 weeks gestation. She was discharged on hospital day 4 with therapeutic low-molecular weight heparin and instructions for close follow-up with maternal-fetal medicine and hematology.

The patient did not have any further coagulation issues throughout her pregnancy and remained compliant on her low-molecular weight heparin (LMWH). She underwent uncomplicated repeat cesarean section and had a female infant weighing 7 lb and 5.8 oz at 38 weeks gestation.

Discussion

Our patient met the criteria of a massive PE due to her initial BP of 80/60 requiring IVF resuscitation and her associated syncopal episode.³ Her hemodynamic instability necessitated the consideration of thrombolysis. There is limited data on the efficacy and safety of thrombolysis in pregnancy. Pregnancy is considered a relative contraindication for thrombolysis due to concerns about potential harm to the mother or fetus.⁴ However, limited alternative options warrants its consideration, particularly in the setting of a hemodynamically unstable patient. Guidelines specifying the suggested treatment of acute PE with life-threatening hemodynamic instability in pregnancy are detailed below (Table 1):

The most common thrombolytic treatment for PE in pregnancy is catheter-directed thrombolysis, a technique involving the delivery of fibrinolytic drugs through a catheter embedded within a thrombus.¹² Several cases report on the safety and efficacy of pharmacologic thrombolysis to treat massive DVT and PE in pregnancy, but this is considered only when the patient's life or limbs are at risk by many prominent medical professional societies.⁷⁻¹¹ There are also several adverse events associated with pharmacologic thrombolysis in pregnancy, such as major bleeding, uterine or placental hemorrhages, and traumatic hematomas.¹³ tPA has also been shown to take several hours before appreciable clinical improvement, whereas a patient who underwent percutaneous catheter-directed embolectomy such as ours showed rapid improvement afterwards.¹⁴ Surgical thrombectomies during pregnancy have been associated with major bleeding episodes (7/35; 95% CI 8-37) and fetal death (2/10; 95% CI 3-56).¹² Percutaneous mechanical thrombectomy notably has a reported maternal survival rate of 100% (7/7' 95% CI 59-100).¹² This may be due to the technique utilizing a less invasive and targeted approach to remove the patient's clot, thus bypassing the risks of maternal or fetal hemorrhage through surgical injury or movement of fibrinolytic medication into the systemic circulation.

There have been several reported cases of using catheter-directed embolectomy as the first-line option to treat severe PE in pregnancy prior to delivery.^{6,12,14-18} In two cases, the patients developed complications such as acute kidney injury, spontaneous abortion, and maternal decompensation requiring further treatment with surgical embolectomy.^{16,18} In one case, the patient underwent an emergent cesarean section prior to the thrombectomy.⁶ Two cases utilized rheolytic thrombectomy where high-pressured jet streams disrupt the thrombus which is aspirated into the catheter.^{12,18,19}

Our review of literature also yielded two similar cases of catheter-directed embolectomy by entrapment in a peripartum patient: one published by Yarusi et. al and one presented by Nemani et. al at a meeting.¹⁴ However, the patient in both cases had to be placed emergently on venoarterial extracorporeal membrane oxygenation (VA-ECMO) due to cardiac arrest, which we were able to avoid with our patient.¹⁴ This discrepancy could be due to our patient presenting during the first trimester of her pregnancy and her initial hemodynamic instability leading to a rapid decision to treat with catheter-directed embolectomy. The other two patients were initially hemodynamically stable despite their PE and had spontaneous vaginal deliveries soon after their admissions.¹⁴ However, both patients had cardiac arrests post-partum, necessitating VA-ECMO and later catheter-directed embolectomy.¹⁴ Both patients recovered soon after the procedure and were discharged home on therapeutic LMWH, similar to our patient.¹⁴ The successful outcomes of these three cases indicate there is potential for catheter-directed embolectomy to be considered as a first-line treatment for hemodynamically unstable peripartum and post-partum patients with acute PE.

Complications associated with catheter-directed embolectomy include clot dislocation, damage to the heart or vasculature, acute kidney injury, and pulmonary artery dissection.²⁰ Despite these risks, catheter-directed embolectomy can be considered as an initial treatment option in pregnancy where thrombolytics and surgical thrombectomy place significant risk and complications for both the mother and fetus because it can avoid potentially introducing fibrinolytic medications to the systemic circulation and injury or infection related to surgery. Further discussions and research should attempt to create evidence based guidelines, involving the input of specialists in obstetrics, cardiology, and critical care medicine. However, this case introduces the possibility of adding catheter-directed embolectomy to the treatment algorithm of massive PE in pregnancy.

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Fig 1. Computed tomography angiography of the chest. (A and B) Frontal view showing massive bilateral pulmonary embolism. **(C and D)** Possible intrauterine pregnancy (yellow circle).

Fig. 2 Selective right and left pulmonary artery angiography. (A) Pre-intervention impaired perfusion to the right lower lobe. **(B)** Post-intervention improvement in perfusion to the right lower lobe. **(C)** Pre-intervention impaired perfusion to the left lower lobe. **(D)** Post-intervention improvement in perfusion to the left lower.

Fig. 3 Image of the gross specimen removed after catheter-directed embolectomy by entrapment.

Table 1. Summary of recommendations regarding use of systemic thrombolysis or catheter-guided techniques in pregnancy

Organization	Year	Systemic Thrombolysis	Cather-guided Techniques
American College of	2018	Thrombolysis indicated for	No discussion

Obstetricians and Gynecologists (ACOG) ⁷		life-threatening or limb-threatening thromboembolism	
American College of Chest Physicians (ACCP) ⁸	2012	Thrombolytic therapy is best reserved for life-threatening maternal thromboembolism	No discussion
American Society of Hematology (ASH) ⁹	2018	If patient has acute PE and life-threatening hemodynamic instability, administer systemic thrombolysis alongside anticoagulant therapy	More data is required on the effectiveness of catheter-directed thrombolysis in the pregnant population, including patients with limb-threatening ischemia
European Society of Cardiology (ESC) ¹⁰	2018	Thrombolysis only in patients with severe hypotension or shock	No discussion
Royal College of Obstetricians and Gynaecologists (RCOG) ¹¹	2015	Patients in shock should be assessed by a multi-disciplinary team including the on-call consultant obstetrician and managed on an individual basis regarding IV unfractionated heparin,	No discussion

		thrombolytic therapy, or thoracotomy and surgical embolectomy	







