Novel approach of rigid bronchoscopy concurrent with cesarean section and bronchial arterial embolism for patients with massive hemoptysis during pregnancy: case reports and literature review

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Abstract: Massive hemoptysis can be life-threatening and is frequently encountered in clinical practice, but rare during pregnancy. There have been limited case reports of massive hemoptysis in pregnancy in patients with conditions such as Takayasu's arteritis, bronchiectasis, bronchial carcinoid tumor, and tuberculosis. The most important management is early control of the hemorrhage and airway protection. We report on 2 patients at 33 and 27 gestational weeks who were admitted to the emergency department because of massive hemoptysis. Therapeutic rigid bronchoscopy with the application of high-frequency jet ventilation was performed under general anesthesia during cesarean section to control potential bleeding and stabilize the airway; this was then followed by bronchial artery embolization (BAE) postsurgically. The lives of both mothers and infants were saved. At the 16- and 11-month follow-ups, the patients showed no symptoms. To our knowledge, this is the first report on the application of therapeutic rigid bronchoscopy concurrent with cesarean section in order to protect the airway and reduce the side effects of the subsequent treatment for both mother and fetus in hemoptysis cases. By reporting these cases and conducting a literature review, we present a novel treatment method for massive hemoptysis in pregnant patients that may improve patients' outcomes.

Keywords: Massive hemoptysis; pregnancy; rigid bronchoscopy; bronchial artery embolization (BAE); case reports

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Introduction

Massive hemoptysis is a life-threatening emergency. There is currently no consensus on a uniform volume threshold for hemoptysis to be considered massive, with suggestions ranging from 100 mL/24 hours to more than 1,000 mL per 24 hours (1,2). The unreliable estimation of volume and differences in cardiopulmonary function reserve have led to differing definitions of massive hemoptysis that depend on the amount of expectorated blood, which refers to hemoptysis that causes airway obstruction and asphyxia (1,3). There have been limited case reports of massive hemoptysis in pregnant patients with conditions such as Takayasu's arteritis (4), bronchiectasis (5), bronchial carcinoid tumor (6), and tuberculosis (7). The disruption of the high-pressure bronchial circulation or the explosion of pulmonary circulation, leading to the pathologically high pressures of the bronchial vasculature, accounts for most of the adverse circumstances arising during pregnancy from changes in intravascular volume (8). During pregnancy, massive hemoptysis may impair gas exchange, causing

hypoxia in the mother and the fetus, and may cause maternal hemodynamic instability due to blood loss. The ability to identify the etiology of hemoptysis and the effectiveness of controlling the hemorrhage and airway with multidisciplinary efforts are key to successfully managing this life-threatening condition.

In this article, we present 2 cases of massive hemoptysis that occurred during pregnancy, which were treated with multidisciplinary therapy. The combination of simultaneous therapeutic rigid bronchoscopy and cesarean section under general anesthesia, followed by bronchial artery embolization (BAE) after surgery is reported here for the first time. We also provide a literature review and suggest a new management solution suitable for patients with cryptogenic massive hemoptysis that can be undertaken with a planned cesarean section. We present the following case in accordance with the CARE reporting checklist (available at http://dx.doi.org/10.21037/atm-20-2502) (9).

Case presentation

Case 1

A 29-year-old woman was admitted to the maternity department of our hospital with massive hemoptysis at 33 weeks' gestation on September 21, 2018. The amount of blood loss was estimated at approximately 100 mL within 1 hour before admission. She denied coughing, night sweats, or fever and had been previously well. She was a preschool teacher, did not smoke cigarettes, and had no known tuberculosis contact. On physical examination at admission, she was anxious, and except for tachycardia, her blood pressure (BP) was 110/60 mmHg with a pulse rate of 114 beats per minute (BPM). Her admission laboratory data are presented in *Table 1*. In addition, there was no serological evidence of respiratory infection. An echocardiogram was normal. An electron-nasopharyngolaryngoscope test confirmed no active bleeding of the upper airway.

On the second day of admission, she had another episode of hemoptysis and developed breathlessness. On examination, she was alert, her BP dropped to 96/56 mmHg, and her pulse was 78 BPM. Physical examination revealed a relatively diminished breath-sound in the right chest. Arterial blood gas (ABG, with supplemental oxygen via a nasal catheter of 5 L/ min) analysis showed a pH of 7.47, PCO_2 29 mmHg, PO_2 60 mmHg, HCO_3^- 23.2 mmol/L, lactate 1.0 mmol/L, and SaO_2 92%. In addition, her hemoglobin dropped from 100 to 82 g/L. The mediastinal window of the chest computed tomography (CT) showed a thrombus obstructing the bronchus intermedius, the right middle lobe bronchus, and the right lower lobe bronchus (*Figure 1*). Considering the hemodynamic instability of the patient, she was transferred from the maternity ward to the intensive care unit (ICU) , but hemoptysis persisted. We initiated the administration of high-flow nasal cannula oxygen therapy with 65% oxygen at a flow rate of 40 L/min at a temperature of 34 ℃. Other medications included tranexamic acid (2.5 g within 24 hours) and dexamethasone to promote fetal lung maturation. A multidisciplinary team (MDT) including personnel from the ICU, interventional surgery, anesthesiology, respiratory intervention, and maternal-fetal medicine departments met with the patient's family. Therapeutic rigid bronchoscopy and cesarean section under intravenous general anesthesia were performed simultaneously. A healthy baby girl weighing 2,390 g with APGAR (appearance, pulse, grimace, activity, and respiration) scores of 2 and 7 at 1 and 5 minutes, respectively, was delivered. An 8.5 Storz rigid bronchoscope was placed with high-frequency jet ventilation (HFJV) during the cesarean which revealed evidence of blood clots in both the anterior and posterior segments of the right upper lobe bronchus as well as the bronchus intermedius (*Figure 2A,B,C*). These were extracted by a cryoprobe and occluded with gauze. After grasping the gauze, a bronchial tamponade was performed with a gelatin sponge, and after no ongoing persistent bleeding was ensured, a double-lumen endobronchial tube (DLT) was intubated to protect the airway from potential bleeding (*Figure 2*). The patient then underwent emergency bronchial arteriography with a 5F Cobra catheter (Terumo, Tokyo, Japan). Selective angiograms of the bronchial artery demonstrated multiple areas of contrast staining in the right lower lobe and a distal connection featuring a bronchial–pulmonary arterial fistula (*Figure 3A*). The right lower lobe bronchial arterial branches were then embolized with 560–710 μm of gelatin sponge particles, and a postembolization right bronchial arterial angiography confirmed satisfactory occlusion of the treated vessels (*Figure 3B*). After the procedure, the patient was immediately returned to the ICU. Given her stable situation, the DLT was removed and replaced with a single-lumen endotracheal tube on the first postpartum day. Rigid bronchoscopy was repeated on the fourth day, and both large blood clots and the gelatin sponge were removed from the bronchi with cryoprobes. However, slow but persistent bleeding was noted from the distal to the proximal portions of the B6-10 lung segments while the clots were removed. Local hemostatic therapy using iced

Table 1 Laboratory data on admission

Characteristics	Reference range	Case 1	Case 2
White cell count (×10^9/L)	3.5–9.5	9.81	11.57
Hemoglobin (g/dL)	11.5–15	10.0	11.6
Platelets (×10^9/L)	125–350	141	174
Mean corpuscular volume (fl)	82–100	95.8	91.2
Alanine aminotransferase (IU/L)	7–40	14	11
Aspartate aminotransferase (IU/L)	13–35	19	17
Serum creatinine (μmol/L)	44–133	60.7	46.7
B-type natriuretic peptide (pg/mL)	<100	47	16
Prothrombin time (s)	10.1–12.6	10.5	11.8
Activated partial thromboplastin time (s)	26.9–37.6	24.4	26.3
International normalized ratio	0.88–1.10	0.91	1.03
D-dimer (mg/L)	<0.24	2.72	0.13
Procalcitonin (ng/mL)	<0.05	0.03	<0.02
C-reactive protein (mg/L)	<8	9	7
Erythrocyte sedimentation rate (mm/h)	0–20	37	31
Anti-nuclear Antibody	<1:100	Negative	1:100
Anti-double-stranded DNA antibody	<1:100	Negative	Negative
Anti-Smith antibody	<25	1	0
Anti-nRNP antibody	<25	3	1
Anti-SS-A antibody	<25	1	1
Antineutrophil cytoplasmic antibody	Negative	Negative	Negative
Antiphospholipid antibodies	Negative	(–)	Negative
Anti-glomerular basement membrane antibody	<20	<2.0	<20

saline and thrombin (500 IU) failed, so we then performed subsequent gelatin sponge filling.

Based on suggestions from the multidisciplinary consultation, the patient accepted repeated therapeutic bronchoscopy with interventional surgery on stand-by. Cryotherapy was repeated successfully on the sixth day to extract the gelatin sponge and blood clots of the right lower lobe (*Figure 2D,E,F*). The patient was on low doses of propofol, dexmedetomidine, and remifentanil hydrochloride for sedation and analgesia while undergoing intubation. Management to prevent further atelectasis included chest physiotherapy and administration of ambroxol. The tracheal tube was pulled out on the seventh postpartum day, and the patient was then transferred to the maternity ward. She was observed for the subsequent 8 days with no further episodes of hemoptysis and was then discharged. The patient was doing well at 16 months after the treatment, and the infant's development was normal.

Case 2

A 37-year-old woman at 27 weeks' gestation with a history of untreated pulmonary hypertension (PH) had experienced several weeks of hemoptysis and dyspnea in the third trimester of pregnancy when admitted on March 10, 2019. An initial episode had occurred 8 years earlier when she was pregnant at 16 gestational weeks, and at that time, she underwent an abortion. A subsequent right heart

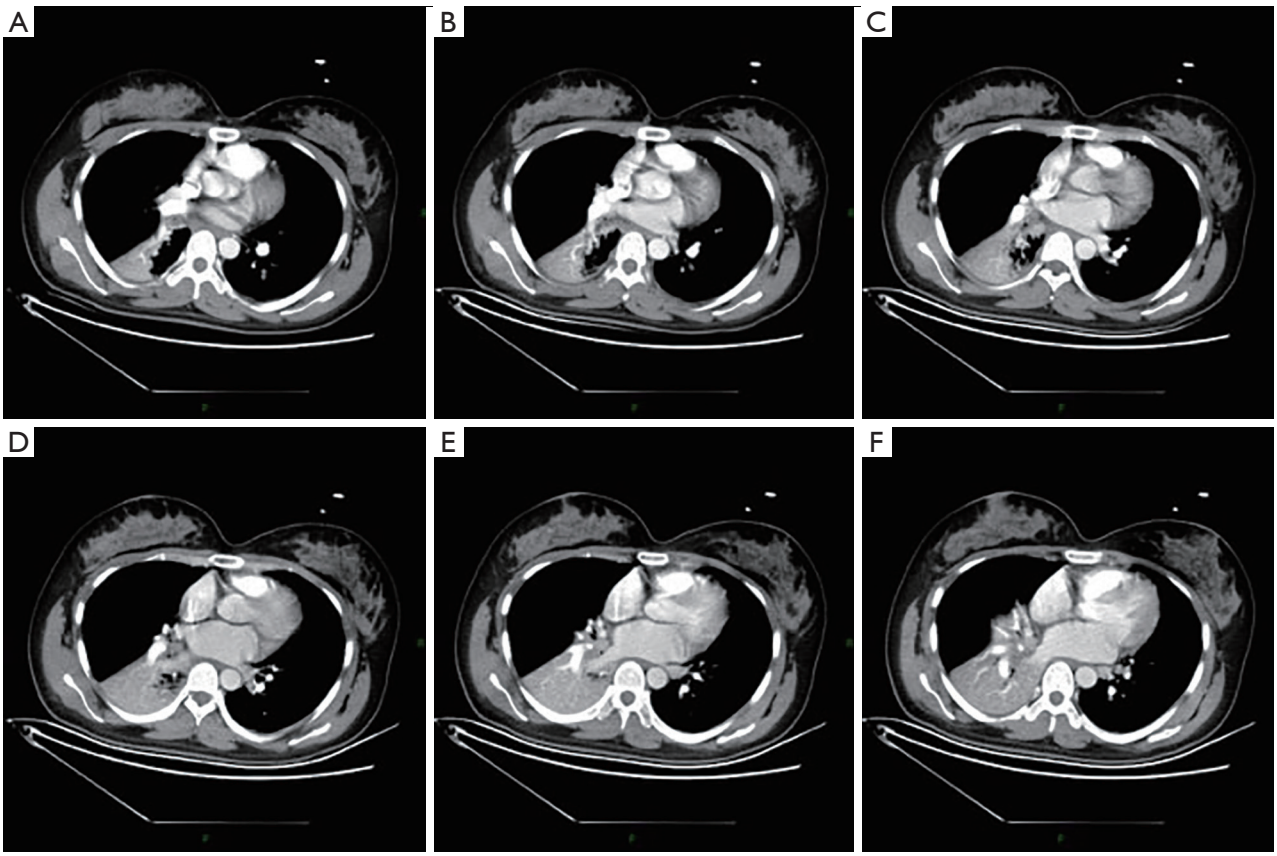

Figure 1 On mediastinal window images, chest computed tomography demonstrates a thrombus obstructing the bronchus intermedius, along with the right middle lobe bronchus and the right lower lobe bronchus being associated atelectasis of the right middle lobe and the right lower lobe

catheterization (RHC) was performed at the outpatient clinic of Peking Union Medical College Hospital that demonstrated elevated pulmonary artery pressure (PAP); however, the report was lost and we did not know the exact PAP measurement. Her sister died at 32 years from cyanosis and hemoptysis. The patient denied receiving any medications and reported no hemoptysis occurrence since her initial episode. One month earlier, she had an untreated episode of scant hemoptysis, and 1 day before the admission, she had coughed up more than an estimated 100 mL of blood over several hours. A physical examination at the time of the patient's presentation revealed a gravid female in no acute distress. Her vital signs were stable. Her laboratory tests are presented in *Table 1*. An echocardiogram showed a severely dilated right ventricle (RV) with an elevated RV pressure (75.3 mmHg) resulting in a D-shaped left ventricle (LV; *Figure 4A*). The LV ejection fraction was 77.3%. A transthoracic echocardiogram with an agitated saline "bubble study" demonstrated evidence of a right-to-left shunt suggesting pulmonary arteriovenous malformation (PAVM) (*Figure 4B*).

Intravenous tranexamic acid was initiated, and the amount of hemoptysis decreased. However, on the sixth day, the patient once again coughed up an estimated 100 ml of blood. A cesarean section concurrent with rigid bronchoscopy with HFJV under intravenous general anesthesia was then performed, and a male baby with APGAR scores of 6 and 8 at 1 and 5 minutes, respectively, was delivered. The rigid bronchoscopy revealed blood clots in the opening of the bilateral lower lobe bronchus and in the right middle lobe bronchus which were removed with cryoprobes (*Figure 5*). The extracted blood clots revealed a bronchial cast (*Figure 6*). Ice saline and thrombin (500 IU) were used for local hemostasis after the clots were removed. An endotracheal tube was inserted after assuring no active bleeding. Further bronchial arteriography demonstrated enlargement and

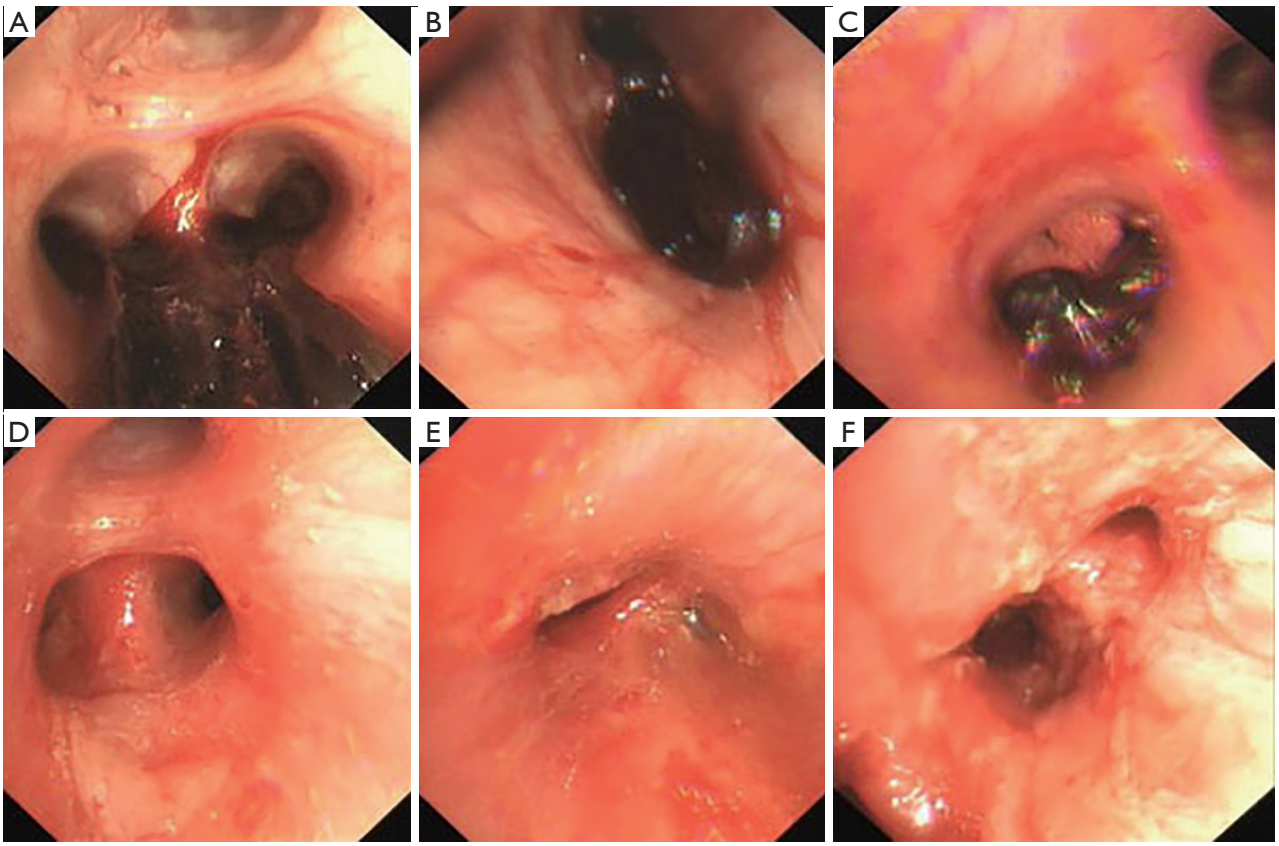

Figure 2 Rigid bronchoscopy images before and after surgery. Blood clots in the right upper lobe bronchus (A) and the bronchus intermedius (B) were each frozen and packed with a gelatin sponge (C). View of the bronchus after cryotherapy and thrombectomy to remove the gelatin sponge and blood clots (D,E,F).

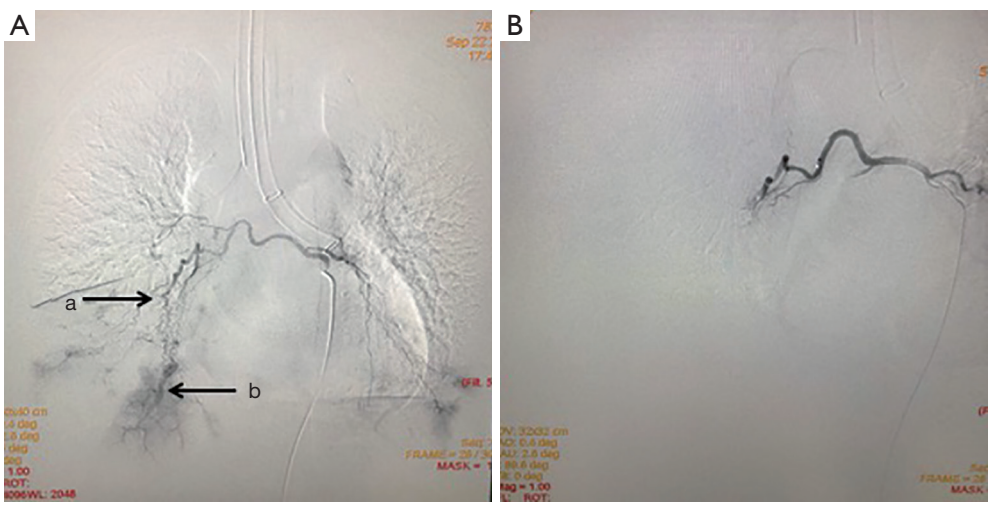

Figure 3 Selective angiograms of the bronchial artery before and after embolization. (A) Pre-embolization: Selective angiograms of the bronchial artery demonstrate a descending branch (a) supplying the bronchial tree, and faint opacification of a bronchial-to-pulmonary artery shunt featuring a bronchia-pulmonary arterial fistula (b). (B) Post-embolization: Selective catheterization of the bilateral bronchial arteries shows complete occlusion of the connection with no flow to the pulmonary artery.

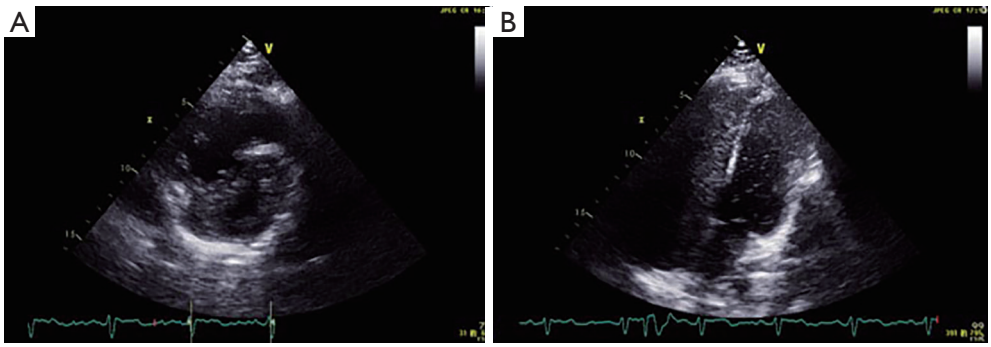

Figure 4 Echocardiography of the patient. (A) Echocardiography shows a compressed left ventricle forming a D-shape. (B) Agitated saline contrast transthoracic echocardiography demonstrates bubbles appearing in the left ventricle after their presence in the right atrium.

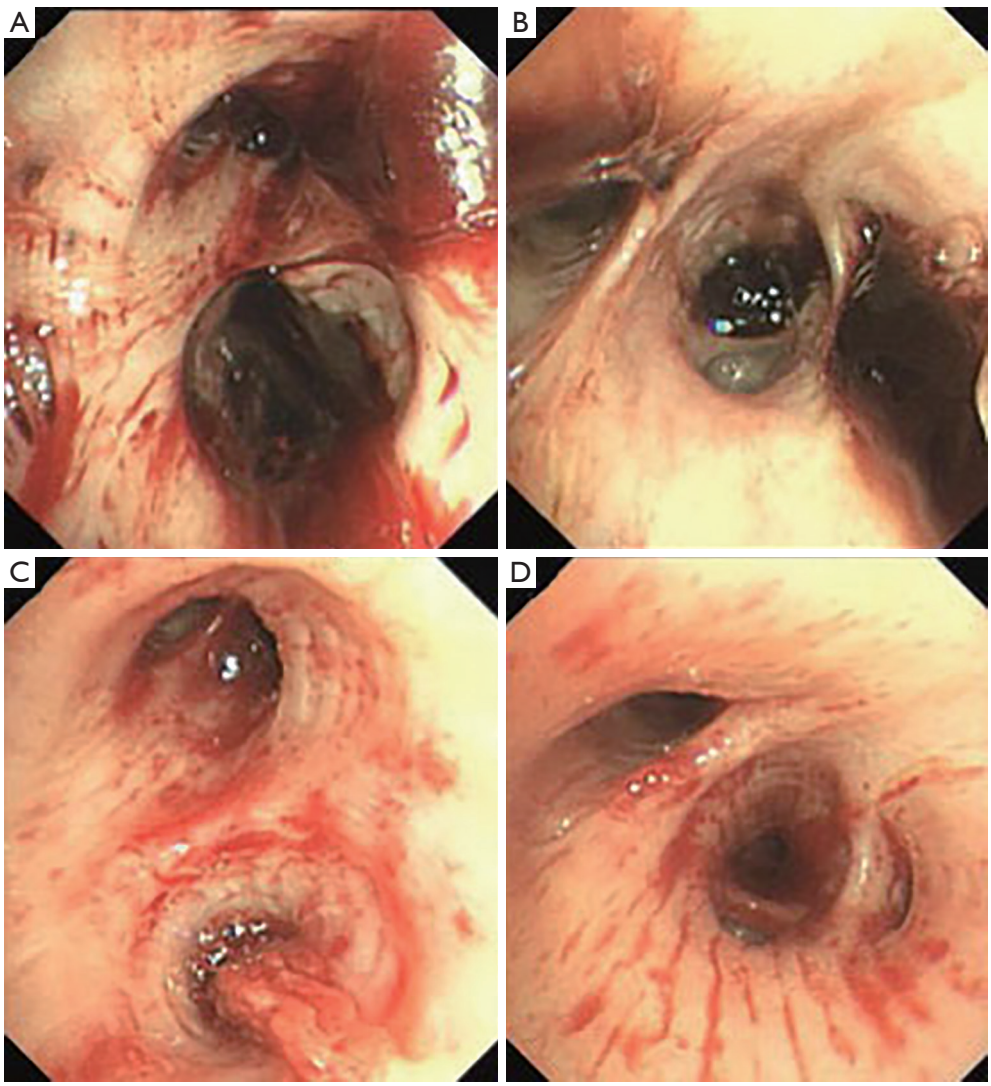

Figure 5 Rigid bronchoscopy images of the patient. Rigid bronchoscope view showing blood clots in the left lower lobe bronchus (A) and the bronchus intermedius. (B) View of the bronchus after clots were removed with cryoprobes and intermittent suctioning (C, D).

Figure 6 The blood clot extracted with cryoprobes reveal a bronchial cast.

tortuosity of the bilateral bronchial arteries. Distal to these, patchy staining and a disordered vascular mass were observed (*Figure 7A*). The endobronchial bleeding was localized, and the artery was embolized with gelatin sponge particles (350–560 μm) (*Figure 6B*). After embolization, the bleeding stopped (*Figure 7B*), and endotracheal extubation was achieved on the second postpartum day after bedside bronchoscopy confirmed no active bleeding; the patient was then transferred from the ICU to the maternity ward on the third postpartum day. Additionally, the cardiologist recommended 25 mg of oral sildenafil 3 times daily to decrease pulmonary vascular resistance. The patient was discharged home on the 10th postpartum day. Eleven months following the procedure, this patient had experienced no further episodes of hemoptysis.

The timelines for the 2 cases are provided in *Figures 8* and *9*.

Ethical statement

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from both patients.

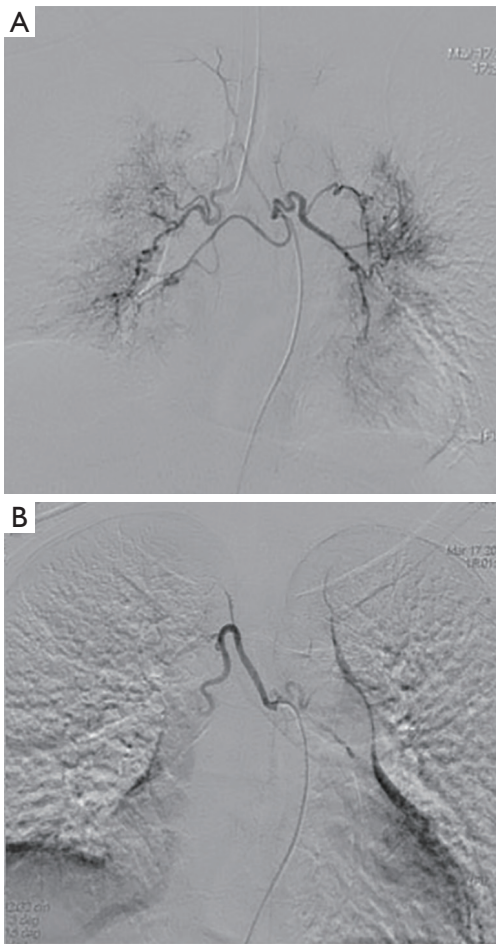

Figure 7 Selective angiograms of the bronchial artery before and after embolization. (A) Pre-embolization: Selective catheterization of the bronchial arteries shows enlargement and tortuosity of bilateral bronchial arteries; distal to this, patchy staining and disordered vascular mass were revealed. (B) Post-embolization: Selective catheterization of the bronchial arteries shows the absence of patchy staining.

Discussion

The manifestations of case 1 indicated a diagnosis of bronchial-to-pulmonary artery malformation (BPAM), which features multiple vascular communications between the bronchial and pulmonary circulations (10). Case 1 denied previous lung disease, although the white blood count was slightly elevated while the procalcitonin (PCT) was negative; thus, this case may fit the criteria for the congenital type of hemoptysis. It is well documented that maternal blood volume increases sharply during pregnancy due to increased cardiac output, sodium retention, and hormonally related

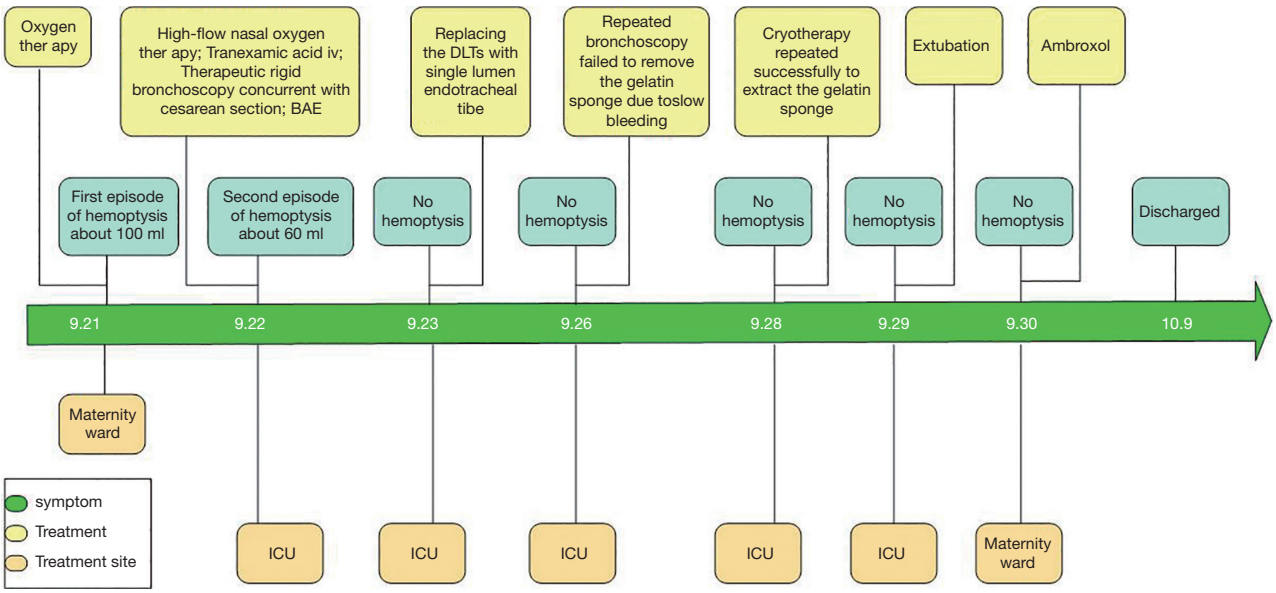

Figure 8 Timeline of case 1.

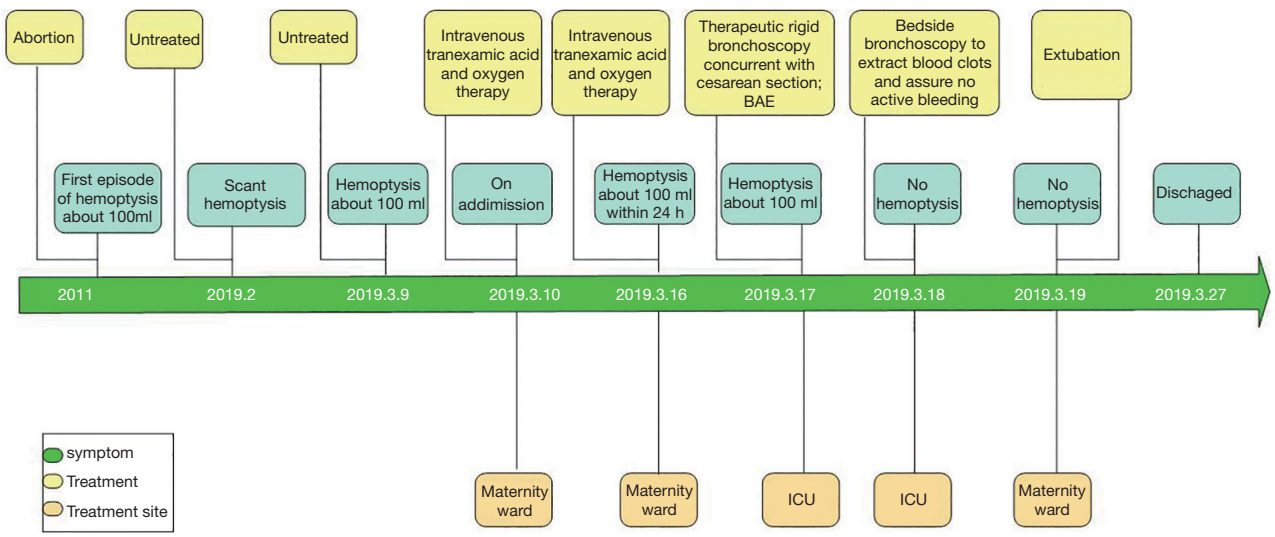

Figure 9 Timeline of case 2.

vascular change. More specifically, the plasma volume can increase to an average of 1,100–1,600 mL, which is 30–50% above the normal level, plateauing for the last 8 weeks of pregnancy (11). Significantly increased blood flow during pregnancy can lead to vasodilation and collateral circulation, resulting in increased pressure in the aberrant focal lesion, which ruptures and bleeds, causing hemoptysis.

Hemoptysis is a severe and rare complication of pulmonary arterial hypertension (PAH) and is associated with a poor prognosis and a high mortality rate, even in hemodynamically stable patients (12). There was no indication for the diagnosis of chronic thromboembolic pulmonary hypertension (CTEPH) for our patient presented in case 2, as she did not have a history of venous thromboembolism and had a reasonable level of D-dimer. Meanwhile, the evidence for secondary etiologies of PAH including anti-nuclear antibody (ANA), endonuclear antibody (ENA) panel, antineutrophil cytoplasm antibody

(ANCA), C3, C4, lupus anticoagulant, HIV, and hepatic virus antibodies were all negative. Furthermore, since the case 2 patient presented with evidence of PAVM and had a family history of hemoptysis, we considered a diagnosis of hereditary hemorrhagic telangiectasia accompanied by pulmonary arterial hypertension. Thus, a further contrast-enhanced CT and a gene mutation test were recommended. However, the patient refused the tests for financial reasons. Notably, since physiological changes during pregnancy put considerable strain on the right ventricle and can lead to right ventricular failure, patients with PAH should be advised at the time of their diagnosis that pregnancy is not recommended due to the high maternal and fetal risks (13).

The initial approach in the management of massive hemoptysis is early control of the hemorrhage and simultaneous airway protection. Immediate lateralization performed with the bleeding side down is the first step to preventing the aspiration of blood to the contralateral lung (1). Reviewing the literature, we noticed that 21 cases of massive hemoptysis during pregnancy had been reported (Table S1). Their age ranged from 19 to 35 years with the second and third trimester predominating (90.4%), which is consistent with the hemodynamic changes in pregnancy. The most common etiologies of these patients were infection (23.8%), tumor (23.8%), autoimmune disease (14.3%), and idiopathic hemoptysis probably with a hormonal role (19.0%). Flexible bronchoscopy was used in 15 (71.4%) patients, and a combination of rigid and flexible bronchoscopy was used in 3 patients (20%). Rigid bronchoscopy was used in 6 patients (28.6%), and a subsequent BAE was used in two patients (33.3%) prenatally. Three cases resulted in termination of the pregnancy. Pregnancy outcomes revealed two maternal deaths and three cases of fetal death. Of the patients with accessible follow-up information, spanning 1–96 months, none reported further hemoptysis, and all of the infants were reportedly well.

Based on the literature review, we could not find any case managed by concurrent cesarean section and therapeutic rigid bronchoscopy followed by BAE after surgery. These are the highlights of our cases. For our patients, medications such as phentolamine are not recommended for low blood pressure, and pituitrin is forbidden for use in contracting the uterine smooth muscle. Although BAE was recommended as the first-line therapy based on its effectiveness in both finding the source of bleeding and controlling hemoptysis (14), the contrast media can cross the human placenta and harm the fetus; thus, cesarean section under general anesthesia was performed first, followed by planned BAE. Early visualization with a flexible bronchoscope can be helpful in selective intubation, bronchial blocker placement, or for therapeutic purposes. However, the size of the suction port with a flexible bronchoscopy is inadequate. Rigid bronchoscopy is a more effective tool for the isolation of the mainstem bronchus while ensuring ventilation, for localization of the source of bleeding, and for maintaining an open airway to assist in the application of the interventional bronchoscopy methods (15) in order to prevent potential massive hemoptysis during the cesarean section. For these reasons, we chose to perform therapeutic rigid bronchoscopy simultaneously with the cesarean section. BAE is also recommended to urgently treat patients with massive cryptogenic hemorrhage that does not respond to endobronchial management. To minimize the adverse effects of the contrast media on the fetus, we performed BAE after the cesarean section. Furthermore, to prevent another episode of hemoptysis, our patients were intubated with a DLT before the embolization, allowing for the isolation and ventilation of the normal lung and preventing aspiration from the potential bleeding side. After 24-hour observation to ensure there was no persistent bleeding, the DLTs were replaced with a single-lumen endotracheal for ventilation.

There are certain risks of performing bronchoscopy during massive hemoptysis that are related to sedation, including hypoventilation, airway vulnerability, and aspiration (16). However, bronchoscopic management is required to localize the site of bleeding, guide angiography, and perform embolization and bronchoscopic interventions (17). As the fetus is sensitive to maternal hypoxia and hypotension, close monitoring of pregnant patients is necessary. This involves an initial assessment of the patient's medical history, continuous monitoring of intermittent sphygmomanometry, cardiac rhythm and rate, and pulse oximetry (18).

The detailed descriptions of these 2 cases are the strengths of this report, but an obvious limitation is the lack of specific RHC information in case 2. Since there is no evidence of secondary PH, we concluded that our case 2 patient can be classified as group 1 PH.

The highlights of our cases are the successful control of hemorrhage and airway management of massive hemoptysis through rigid bronchoscopy with HFJV under intravenous general anesthesia during cesarean section, as well as the combination of BAE, the use of DLTs prior to ETTs, and flexible bronchoscopy and HFNC in the perioperative period. Patients should be monitored in the ICU to provide them with comprehensive and effective life support,

while active allowing cooperation with other specialists to jointly treat critically ill patients should be pursued. Cross-specialty and multidisciplinary efforts are also the keys to the successful management of massive hemoptysis.

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/atm-20-2502). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient.

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Supplementary

Summary of the reported cases with hemoptysis during pregnancy

[Ref]	First author	Patient no.	Age (year)	Gestational age	Symptoms	Massive hemoptysis	Diagnosis	Treatment					Mode of delivery	Time of delivery	Ventilation		Prognosis and follow-up			
								Conservative therapy	Flexible bronchocopy	Rigid bronchoscopy	BAE	Other			Endotracheal intubation	Intubation time	Mother	Fetus	Hospitalization time (ICU)	Follow-up
[1]	Stiff A	1	31	26 weeks and 5 days	Hemoptysis Shortness of breath	Yes	Pertussis	Antibiotics	Yes	No	No	VV-ECOM	Cesarean delivery	27 weeks and 4 days due to worsening blood pressure	Yes	18 days	No further hemoptysis	Healthy	NM (18 days)	NM
[2]	Blitz MJ	2	23	17 weeks	Cough with hemoptysis, shortness of breath, seizure	No	Active SLE	Antibiotics methylprednisolone Therapeutic plasma exchange	Yes	No	No	None	Termination of pregnancy	17 weeks	Yes	NM	No further hemoptysis, Continued seizure and	None	Intermittent hospitalization	NM
[3]	Li X	3	30	34 weeks	Wheezing, hemoptysis	No	Tracheal inflammatory myofibroblastic tumor	None	Yes	No	No	None	Emergent cesarean section	35 weeks	No	None	No further hemoptysis, negative for local recurrence and metastasis	NM	NM	1 year
[4]	Hanick AL	4	23	20, 26 weeks respectively	Throat pain,hemo	No	Pyogenic granuloma of the larynx	None	No	No	No	Neoplasm removed after delivery	Cesarean section	36 weeks	No	None	No further hemoptysis	NM	NM	NM
[5]	Choi Y	5	33	Third trimester of pregnancy	Hemoptysis	No	Unilateral pulmonary artery agenesis	Yes	No	No	No	NM	NM	NM	No	None	No further hemoptysis	NM	NM	NM
[6]	Ng VV	6	33	32 weeks	Impending eclampsia, frontal headache, epigastric pain, and hypertension.He moptysis during the cesarean	Yes	DAH with SLE	Fresh frozen plasma, pooled platelets, prednisolone, hydroxychloroquine	Yes	No	No	Chest physiotherapy, right lateral positioning, ETT suctioning	Cesarean section	32 weeks	Yes	1 day	No further hemoptysis	NM	NM (3 days)	NM
[7]	LH	7	33	7 weeks	Hemoptysis	Yes	Coccidioidomycosis	Fluconazole	Yes	No	Yes	NM	NM	None	No	None	No further hemoptysis	Spontaneous abortion	NM	8 years
[8]	Kesrouani A	8	35	27 weeks	Hemoptysis and s	Yes	Tracheal Mucoepidermoid Carcinoma	None	Yes	Yes	No	Argon-Plasma Coagulation under rigid bronchoscopy	Cesarean section	39 weeks	Yes	NM	No further hemoptysis	Healthy	NM	5 years
[9]	Nguyen P	9	30	19 weeks	Sore throat, rhinorrhea and hemoptysis	Yes	Influenza A	Oseltamivir	Yes	Yes	No	Right lower lobectomy	NM	40 weeks	Yes	24 h	No further hemoptysis	Healthy	NM	NM
[10]	Gwinyai Ma	10	33	18 weeks	Shortness of breath and hemoptysis	Yes	Tuberculosis	Anti-tuberculosis treatment	No	Yes	No	None	Spontaneous labor	41 weeks	No	None	No further hemoptysis	Healthy	NM	10 months
[11]	Binesh F	11	28	34 weeks	Hemoptysis and chronic cough with blood-tinged sputum	Yes	Pulmonary carcinoid	None	Yes	No	No	Surgical resection after delivery	Cesarean section	38 weeks	No	None	No further hemoptysis	Healthy	NM	6 months
[12]	Desgranges	12	21	22 weeks	Hemoptysis and preeclampsia	Yes	Idiopathic haemoptysis probably with a hormonal role	None	Yes	No	Yes	None	Cesarean section	36 weeks	Yes	NM	No further hemoptysis	Healthy	NM	1 month
[13]	Venkatram S	13	24	33 weeks	Dyspnea	No	Metastatic pulmonary choriocarcinoma	Antibiotics	Yes	No	No	None	Cesarean section	33 weeks	Yes	12 days	Died on day 13	Alive	13 days	None
[14]	Martines F	14	32	23.2 weeks	Hemoptysis	Yes	Arteriovenous malformation of the base of tongue	None	No	No	No	Tracheostomy, ligation of the external carotid artery	Induction of labour	26 weeks	No	None	No further haem	NM	NM	NM
[15]	Tao H	15	31	36 weeks	Hemoptysis	Yes	Mucoepidermoid ca	None	Yes	No	No	Sleeve resection of the left main bronchus, lymph node dissection	Emergency caesarean section	36 weeks	No	None	No further haemoptysis	Healthy	NM	3 years
[16]	Peyrat E	16	32	17weeks	Hemoptysis	Yes	Idiopathic haemoptysis probably with a hormonal role	Oral tranexamic acid, terlipressin infusion, epinephrine nebulization	No	Yes	Yes	None	NM	Full-term	No	None	No further haemoptysis	Healthy	NM	2 years
		17	19	16weeks	Hemoptysis	Yes		None	No	Yes	Yes	None	NM	NM	Yes	12h	No further haemoptysis	Healthy	NM	6 months
		18	27	24weeks	Hemoptysis	Yes		None	Yes	No	Yes	None	NM	NM	No	None	No further haemoptysis	Healthy	NM	10 months
[17]	Kang AY	19	25	First trimester of pregnancy	Dyspnea and cou	No	PTU associated ANCA positive vasculitis resulting DAH	Ceftriaxone azithromycin, discontinue PTU, high dose intravenous corticosteroid therapy	Yes	No	No	None	NM	NM	Yes NM	NM	No further haemoptysis	NM	NM	6 months
[18]	Shafaque	20	29	20 weeks	Hemoptysis	No	Spontaneous lung vascular dissections	conservative treatmen	No	No	No	Right lower lobectomy	Caesarean section	NM	No	None	No further haemoptysis	Healthy	NM	6 months
[19]	Edward S	21	20	18 weeks	Cough, sore throat, and hemoptysis	No	Wegener's granulom	prednisone, cyclophosphamide	No	No	No	None	Vaginal delivery	36 weeks	No	None	No further haemoptysis	Healthy	NM	18 weeks
[20]	Downs TW	22	26	19 weeks	Hemoptysis	Yes	Infective endocarditi	Intravenous antibiotics	Yes	No	Yes	None	Vaginal delivery	39 weeks	No	None	No further haemoptysis	Healthy	NM	6 weeks
[21]	Rocha MP	23	26	28 weeks	Hemoptysis	Yes	Takayasu's Arteritis	Prednisone	Yes	No	No	Carotid surgery, thoracic aortic aneurysm resection	Vaginal delivery	35 weeks	No	None	Died due to postoperative complications	Healthy	7 weeks	NM
[22]	Salamat	24	23	28 weeks	Hemoptysis and d	Yes	Pulmonary artery sa	Heparin	Yes	No	No	None	Emergency cesarean delivery due to loss of fetal heart tones	30 weeks	No	None	Died 12 hours postpartum	Stillborn	12 days	None
[23]	Liaw YS	25	24	22 weeks	Dyspnea and hem	Yes	Choriocarcinoma	Chemotherapy	No	No	No	Hysterectomy	Termination of pregnancy	None	No	None	No further hemo	Intrauterine death	NM	NM
[24]	J Nabers	26	36	27 weeks	Hemoptysis	No	Choriocarcinoma	Intravenous MTX	Yes	No	No	Open lung biopsy	Vaginal delivery	34 weeks	No	None	No further hemo	Healthy	NM	2 years
[25]	DePace	27	27	37 weeks	Hemoptysis	Yes	Bronchiectasis.	Dexamethasone	Yes	Yes	No	Advanced CPR, left pneumonecto	Cesarean delivery	37 weeks	Yes	NM	No further hemo	Healthy	NM	20 months
[26]	FULTON	28	19	4 months	Hemoptysis	Yes	Mitral stenosis.	Blood transfusion, penicilin	No	No	No	Mitral commissuroto	Vaginal delivery	Full-term	No	None	Yes	NM	NM	NM
[27]	Wispelaere	29	31	10 weeks	Hemoptysis, transient loss of consciousness, tachycardia	Yes	Osler-Weber-Rendu syndrome	NM	Yes	No	No	Right lower lobectomy	Termination of pregnancy	None	No	None	NM	Termination of pregnan	NM	NM

NM: Not mentioned

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