Amniotic Fluid Embolism

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AFE (ASP)
Educational Objectives

- To understand the unexpected, sudden and severe nature of AFE.
- To review the differential diagnosis during sudden maternal collapse during labor or shortly after delivery.
- To present the optimal options for resuscitation for sudden maternal collapse.

Today

- Case Presentation
- Pathophysiology
- Clinical course
- Supportive treatment
- Optimal CPR

Case Presentation

- 41 yo G2P1, 38 weeks of gestation
- Type A2 gestational diabetes on Lantus 6 units QHS
- BP 145/88 Pulse 103
- In spontaneous labor
- 2240-2250 Loss of contact, FHR deceleration
- 2255 Unresponsive, maternal seizure (arms and wrists flexed, eyes rolling, small jerks of arms)
- BP 140/120 Pulse 62
- 2256 OB Emergency Team (Team Blue) called. Anesthesiologist arrived.
- 2259 Ativan given, chin lift performed, MgSO4 bolus started, patient moving and responding

- 2300 Patient unconscious
- BP 156/109, 136/115, Pulse 56, O2 sat 89%
- 2307 RRT called, MgSO4 bolus finished
- 2311 Shallow breathing, taken to OR
- 2312-2316 Intubated, ECG no rhythm, Epinephrine given, Incision made, Delivery of baby, Chest compressions begun, Cardiac Arrest Team called
- Cardiac rhythm restored, transfer to MICU
- Loss of pulse during transport to MICU
- Code continued
- Massive fluid, blood and factors for resuscitation
- Declared dead 0059—79 minutes after initial asystole

AFE (ASP)

- Rare
- Sudden, catastrophic
- Often fatal
- Incidence 1 in 12,953 up to 1 in 50,000
- In the population of women who die after unexpected cardiovascular collapse during labor, AFE is statistically the most likely diagnosis

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Shamshiraz Obstet Gynecol Clin N Am 2016;43:779-90

AFE (ASP)

- Hard to figure out:
- The clinical definition of AFE varies across reports.
- The signs and symptoms of AFE overlap with other more common obstetric complications such as hemorrhagic shock caused by postpartum hemorrhage.
- Many of the population-based studies relying on hospital discharge diagnostic codes do not ascertain the clinical diagnosis of AFE from the medical record.
- There is not a gold standard test for the diagnosis of AFE.
- The diagnosis of AFE is often a diagnosis of exclusion.

Statistics

- Incidence: 1 in 40,000 deliveries; 1.9/100,000-6.1/100,000 births
- Mortality rate of 20-60%

AFE (ASP) Risk Factors

- Cesarean delivery
- Instrumental delivery
- Cervical trauma
- Placenta previa
- Placental abruption
- Advanced maternal age
- Parity
- Male fetus
- Eclampsia
- Polyhydramnios
- Multifetal gestations

Clark SL. Obstet Gynecol 2014;123(2 Pt 1):337–48

Amniotic Fluid Embolism

- Also called Anaphylactoid Syndrome of Pregnancy (ASP)
- First named as an entity in 1941 by pathologists Steiner and Luschbaugh
  - They reported 32 cases of obstetrical patients dying in shock. In 8 of these cases, autopsy revealed fetal squamous cells or other debris in the maternal pulmonary arterial circulation
  - They concluded “pulmonary embolism by amniotic fluid”

Meyer J. Embolia pulmonary amniocaseosa. Bras Med 1926;2:301–3.
Steiner PE, Lushbaugh CC. Landmark article, Oct. 1941: Maternal pulmonary embolism by amniotic fluid as a cause of obstetric shock and unexpected deaths in obstetrics. By Paul E. Steiner and C. C. Lushbaugh. JAMA 1986;255(16):2187–203.

Early presumptions of pathophysiology

- Early studies assumed a naïve mechanical mechanism of injury: amniotic fluid is forced into the maternal circulation, resulting in obstruction of pulmonary arterial blood flow, subsequently leading to hypoxia, right heart failure and death

Clark SL. Obstet Gynecol 2014;123(2 Pt 1):337–48

AFE (ASP)

- Pulmonary artery catheter introduced
- Examinations of pulmonary artery histologic specimens during life became possible.
- Several reports in the 1980s documented
  - Identical pulmonary pathologic findings in pregnant women with a variety of conditions unrelated to AFE
- These findings cast doubt on the validity of cases reported between 1941 and 1985 in which the diagnosis of AFE was based on pathologic findings alone

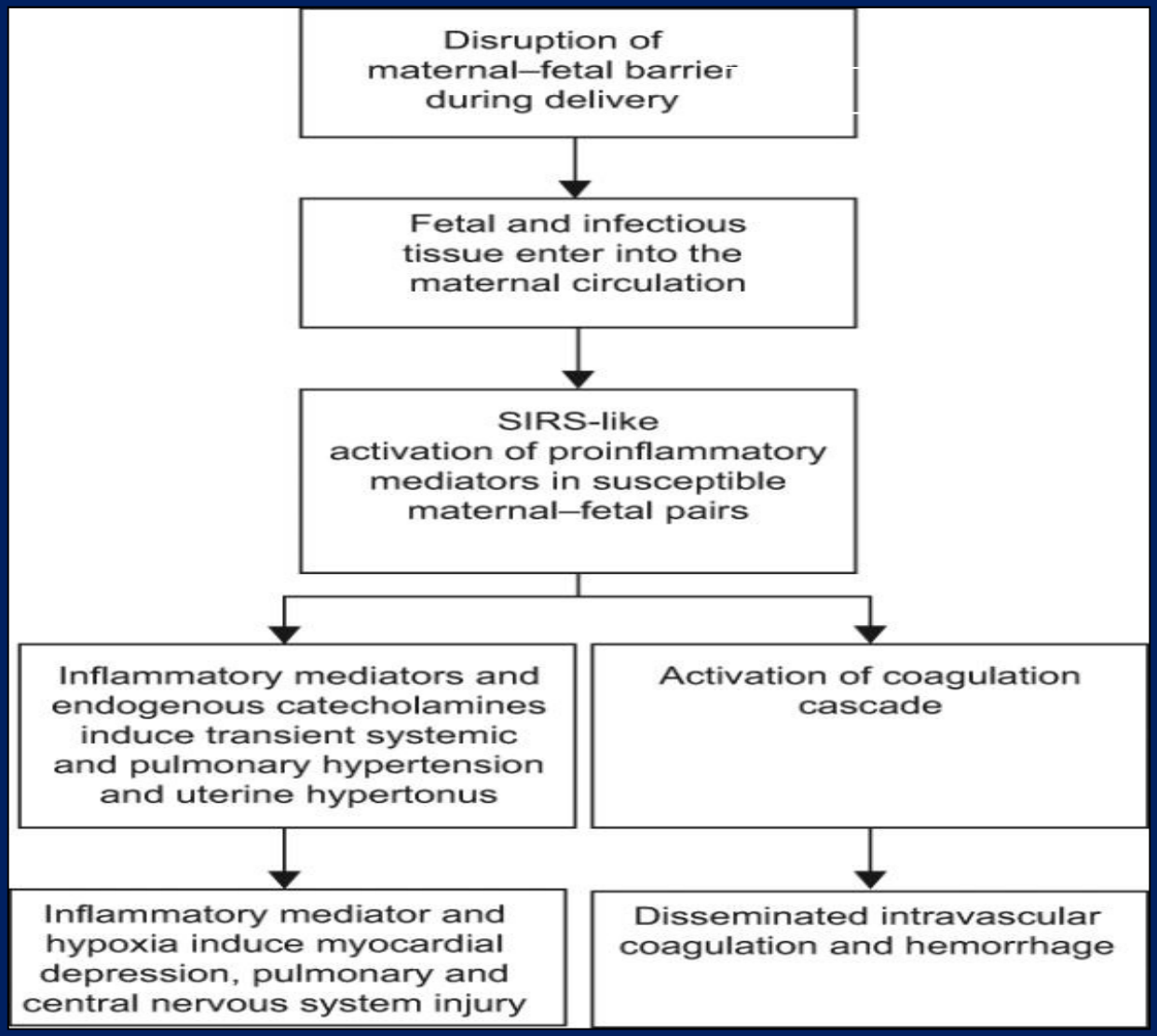
Clark SL et al. Am J Obstet Gynecol 1995;172(4 Pt 1):1158-67
Clark SL et al. Am J Obstet Gynecol 1985;151(5):617–21.

Modern Pathophysiology

- Complex sequence of pathophysiologic reactions stemming from abnormal activation of proinflammatory mediator systems, similar in theory to SIRS, following the entry of fetal antigens into the maternal circulation during parturition

Clark SL et al. Am J Obstet Gynecol 1995;172(4 Pt 1):1158-67

Proposed mechanism of amniotic fluid embolism. SIRS, systemic inflammatory response syndrome.



Proposed mechanism of amniotic fluid embolism. SIRS, systemic inflammatory response syndrome. Fig. 1. Clark. Amniotic Fluid Embolism. Obstet Gynecol 2014.

Proposed pathophysiology

- Initial period of transient pulmonary and systemic hypertension with right heart failure
- Followed by profound depression of LV function with normal PA pressures
- Then coagulopathy develops—incompletely understood but in in vitro studies, amniotic fluid shortens clotting time and induces platelet aggregation. Activates Factor X and the complement cascade

Proposed mechanism of amniotic fluid embolism. SIRS, systemic inflammatory response syndrome. Fig. 1. Clark. Amniotic Fluid Embolism. Obstet Gynecol 2014.

AFE (ASP)

- Association of induction of labor and AFE is inconsistently reported
- Abnormalities of uterine tone are described commonly in cases of AFE.
- As early as 1976, investigations into maternal–fetal oxygen transport during uterine contractions found a complete cessation of uteroplacental exchange as intrauterine pressures exceed 40 mm Hg.
- Thus, a contraction, especially a hypertonic contraction, is least likely event during all of labor to induce entrance of amniotic fluid and fetal tissue into the maternal circulation.

Clark SL et al. Am J Obstet Gynecol 1995;172(4 Pt 1):1158–67 [discussion:1167–69].

Similarities of AFE to Endotoxin mediated Shock

- Abnormal host response rather than intrinsic antigen creates response
- Tissue factor and tissue factor pathway inhibitor are higher in amniotic fluid
- Maternal plasma endothelial factor concentrations increased with exposure to amniotic fluid in the systemic vasculature
- Complement factors C3 C4 increased in patients with AFE

Kaur K. Amniotic Fluid Embolism. J Anesthes Clinical Pharmacol 32(2)April-June 2016

Clinical manifestations

- Hypotension
- Dyspnea
- Cyanosis
- Frothing
- Fetal heart rate deceleration
- LOC
- Cardiac arrest
- Bleeding from uterus, incision or IV sites
- Uterine atony
- Seizure like activity

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Clinical presentation

- Classic presentation: acute dyspnea in labor or shortly after delivery, with desaturation, or dyspnea and desaturation together, followed by sudden cardiovascular collapse, followed by cardiac arrest and coagulopathy
- Cardiac arrest can be characterized by asystole, vent fib, or PEA reflecting different mechanisms of cardiac injury

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Frequency of Signs and Symptoms

Table 2
Signs and symptoms noted in patients with amniotic fluid embolism

Sign or Symptom	Number	%
Hypotension	43	100
Fetal distress	30	100
Pulmonary edema or ARDS	28	93
Cardiopulmonary arrest	40	87
Cyanosis	38	83
Coagulopathy	38	83
Dyspnea	22	49
Seizure	22	48
Atony	11	23
Bronchospasm	7	15
Transient hypertension	5	11
Cough	3	7
Headache	3	7
Chest pain	1	2

From Clark SL, Hankings GD, Dudley DA, et al. Amniotic fluid embolism: analysis of a national registry. Am J Obstet Gynecol 1995;172:1158–69; with permission.

Differential Diagnosis to Maintain

- Pulmonary Embolism
- Hemorrhage
- Transfusion Reaction
- Anaphylaxis
- High Spinal
- Placental Abruption
- Air Embolism
- Peripartum Cardiomyopathy
- Myocardial Infarction
- Eclampsia
- Septic Shock
- Uterine Rupture
- Cardiac asystole

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Initial Diagnostic Testing

- Complete Blood Count with Platelets
- Blood Type and Screen
- Serum Electrolytes
- ABG
- Cardiac Enzymes
- Coagulation Profile
- CXR
- EKG/ Echo

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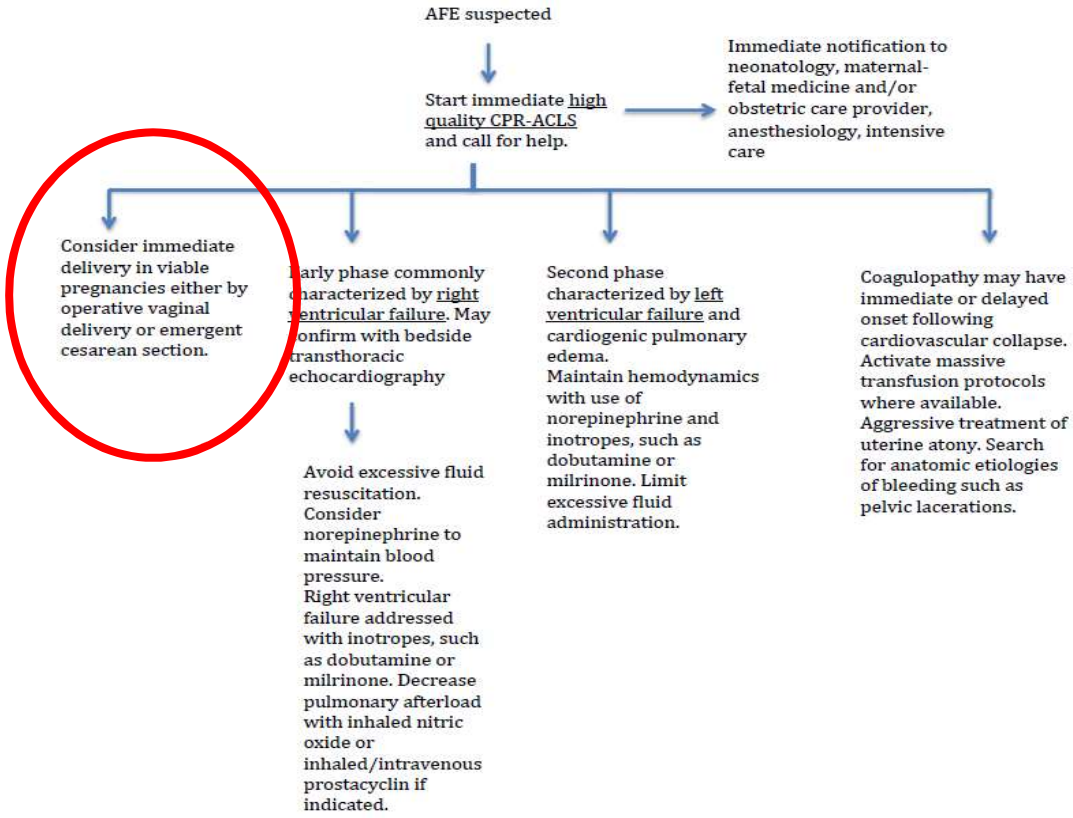
Immediate Supportive Care for suspected AFE

FIGURE 2
Immediate supportive treatment in suspected cases of amniotic fluid embolism



CPR, cardiopulmonary resuscitation; *ACLS*, advanced cardiac life support; *AFE*, amniotic fluid embolism.

SMFM. Amniotic fluid embolism: diagnosis and management. Am J Obstet Gynecol 2016.

SMFM. Amniotic fluid embolism: diagnosis and management. Am J Obstet Gynecol 2016

High-Quality CPR in Pregnancy

TABLE 1
Components of high-quality cardiopulmonary resuscitation in pregnancy

Components
Rapid chest compressions (100 × minute)
Perform hard compressions, achieving a depth of at least 2 inches
Assure adequate chest recoil between compressions
Minimize interruptions of chest compressions
Avoid prolonged pulse checks (no more than 5–10 seconds)
Resume chest compressions immediately after defibrillating
Switch provider of compressions every 2 minutes to avoid fatigue
Lateral displacement of uterus during resuscitation

SMFM. Amniotic fluid embolism: diagnosis and management. Am J Obstet Gynecol 2016.

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Summary of Recommendations

Number	Recommendations	GRADE
1	We recommend consideration of AFE in the differential diagnosis of sudden cardiorespiratory collapse in the laboring or recently delivered woman.	1C Strong recommendation Weak-quality evidence
2	We do not recommend the use of any specific diagnostic laboratory test to either confirm or refute the diagnosis of AFE; at the present time, AFE remains a clinical diagnosis.	1C Strong recommendation Weak-quality evidence
3	We recommend the provision of immediate high-quality cardiopulmonary resuscitation with standard BCLS and ACLS protocols in patients who develop cardiac arrest associated with AFE.	1C Strong recommendation Weak-quality evidence
4	We recommend that a multidisciplinary team including anesthesia, respiratory therapy, critical care, and maternal-fetal medicine should be involved in ongoing care of women with AFE.	Best practice
5	Following cardiac arrest with AFE, we recommend immediate delivery in the presence of a fetus $\geq$23 weeks of gestation.	2C Weak recommendation Weak-quality evidence
6	We recommend the provision of adequate oxygenation and ventilation and, when indicated by hemodynamic status, the use of vasopressors and inotropic agents in the initial management of AFE. Excessive fluid administration should be avoided.	1 C Strong recommendation, Weak-quality evidence
7	Because coagulopathy may follow cardiovascular collapse with AFE, we recommend early assessment of clotting status and early aggressive management of clinical bleeding with standard massive transfusion protocols.	1C Strong recommendation, Weak-quality evidence

ACLS, advanced cardiac life support; *AFE*, amniotic fluid embolism; *BCLS*, basic cardiac life support; *GRADE*, Grading of Recommendations Assessment, Development, and Evaluation.

SMFM. Amniotic fluid embolism: diagnosis and management. Am J Obstet Gynecol 2016.

TABLE 2
Recommended doses for agents commonly used in cases of acute right ventricular failure

Agent	Dose
Sildenafil	20 mg tid PO or through nasogastric/orogastric tube
Dobutamine	2.5—5.0 μg/kg per minute. Higher doses may compromise right ventricular filling time caused by tachycardia.
Milrinone	0.25—0.75 μg/kg per minute. Most common side effect is systemic hypotension.
Inhaled nitric oxide	5—40 ppm. Follow methemoglobin levels every 6 h, and avoid abrupt discontinuation.
Inhaled prostacyclin	10—50 ng/kg per minute
Intravenous prostacyclin	Start at 1—2 ng/kg per minute through a central line and titrate to desired effect. Side effects include systemic hypotension, nausea, vomiting, headache, jaw pain, and diarrhea.
Norepinephrine	0.05—3.3 μg/kg per minute

PO, per os; *tid*, twice a day.

SMFM. Amniotic fluid embolism: diagnosis and management. Am J Obstet Gynecol 2016.