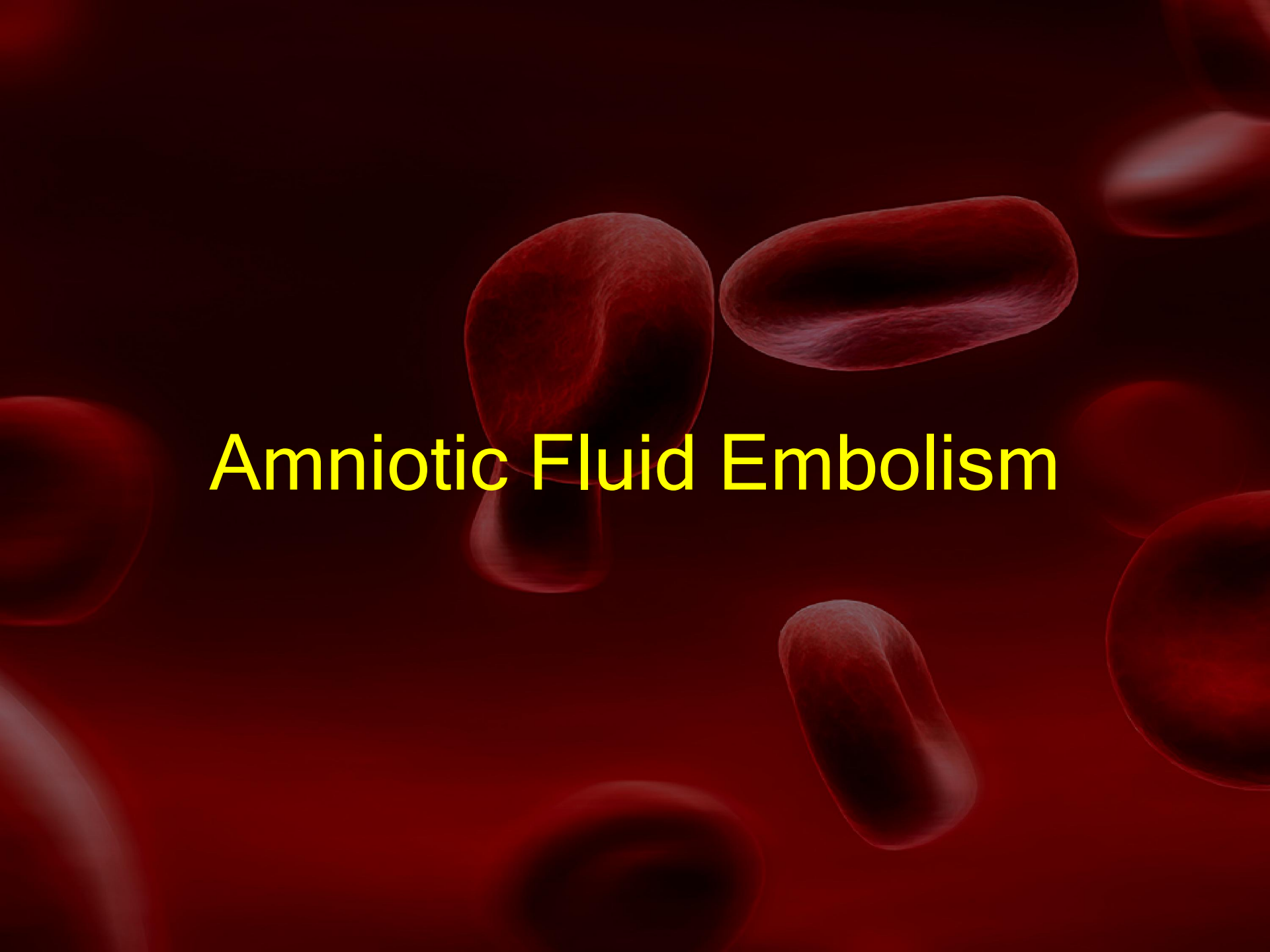
Amniotic Fluid Embolism

Amniotic Fluid Embolism (AFE)

- Rare and devastating
  - 1 in 20,000-30,000

Clark SL, Hankins GD, Dudley DA, Dildy GA, Porter TF. Amniotic fluid embolism: analysis of the national registry. Am J Obstet Gynecol 1995;172:1158–67

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  - 12% of maternal deaths

Kaunitz AM, Hughes JW, Grimes DA, et al. Causes of maternal death in the United States. Obstet Gynecol 1985, 65:605-12

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  - 2/3 of deaths within 5 hours

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  - 1 in 20,000-30,000
  - Mortality 25-80%
  - 12% of maternal deaths
  - 2/3 of deaths within 5 hours
  - 15-25% of survivors remain neurologically intact

Clark SL, Hankins GD, Dudley DA, Dildy GA, Porter TF. Amniotic fluid embolism: analysis of the national registry. Am J Obstet Gynecol 1995;172:1158–67

(AFE) Clinical Presentation

- Not limited to the time of delivery
  - Occurs in all 3 trimesters and post-partum (8 ± 8 minutes following delivery)

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(AFE) Clinical Presentation

- Not limited to the time of delivery
  - Occurs in all 3 trimesters and post-partum (8 ± 8 minutes following delivery)
  - Seen during:
    - Vaginal or cesarean delivery
    - elective terminations
    - Amniocentesis
    - Amnioinfusion
    - blunt abdominal or surgical trauma

Clark SL, Hankins GD, Dudley DA, Dildy GA, Porter TF. Amniotic fluid embolism: analysis of the national registry. Am J Obstet Gynecol 1995;172:1158–67

(AFE) Clinical Presentation

Signs or symptoms	Frequency
Hypotension	100%
Fetal distress	100%
Pulmonary edema or ARDS	93%
Cardiopulmonary arrest	87%
Cyanosis	83%
Coagulopathy	83%
Dyspnea	49%
Seizure	48%
Uterine atony	23%
Bronchospasm	15%
Transient hypertension	11%
Cough	7%
Headache	7%
Chest pain	2%

ARDS = adult respiratory distress syndrome.

Adapted from Clark SL, Hankins GD, Dudley DA, Dildy GA, Porter TF. Amniotic fluid embolism: analysis of the national registry. Am J Obstet Gynecol 1995;172:1158–67.

(AFE) Pathophysiology

- Embolic mechanism
  - Little correlation between presence of particulate matter in lung and severity of symptoms

Steiner PE, Lushbaugh C. Maternal pulmonary embolism byamniotic fluid as a cause of obstetric shock and unexplained death in obstetrics. JAMA 1941;117:1245–54

(AFE) Pathophysiology

- Embolic mechanism
  - Little correlation between presence of particulate matter in lung and severity of symptoms
- Arachidonic acid metabolites (leukotrienes)

Clark SC. Arachidonic acid metabolites and the pathophysiology of amniotic fluid embolism. Semin Reprod Endocrinol 1985;3:253-7

(AFE) Pathophysiology

- Embolic mechanism
  - Little correlation between presence of particulate matter in lung and severity of symptoms
- Arachidonic acid metabolites (leukotrienes)
- Immune mediated phenomenon with massive complement activation
  - *"anaphylactoid syndrome of pregnancy"*

Benson D. A hypothesis regarding complement activation and amniotic fluid embolism. Med Hypotheses 2007;68:1019–25

(AFE) Pathophysiology

- Biphasic hemodynamic response
  - *Early phase*:
    - right sided failure due to pulmonary vasospasm
    - Less than 30 minutes

Clark SL. New concepts of amniotic fluid embolism: a review. Obstet Gynecol Surv 1990;45:360–8

(AFE) Pathophysiology

- Biphasic hemodynamic response
  - *Early phase*:
    - right sided failure due to pulmonary vasospasm
    - Less than 30 minutes
  - *Second phase*:
    - Left ventricular failure
    - Pulmonary edema

Clark SL. New concepts of amniotic fluid embolism: a review. Obstet Gynecol Surv 1990;45:360–8

(AFE) Pathophysiology

- Etiology of Coagulopathy
  - Amniotic fluid procoagulant (Factor X activator)

Lockwood CJ, Bach R, Guha A, Zhou XD, Miller WA, Nemerson Y. Amniotic fluid contains tissue factor, a potent initiator of coagulation. Am J Obstet Gynecol 1991;165:1335–41

(AFE) Pathophysiology

- Etiology of Coagulopathy
  - Amniotic fluid procoagulant (Factor X activator)
  - Amniotic fluid plasminogen activation inhibitor 1

Estelles A, Gilabert J, Andres C, Espana F, Aznar J. Plasminogen activator inhibitor type 1 and type 2 in amniotic fluid during pregnancy. Thromb Haemost 1990;64:281–5

(AFE) Pathophysiology

- Etiology of Coagulopathy
  - Amniotic fluid procoagulant (Factor X activator)
  - Amniotic fluid plasminogen activation inhibitor 1
  - Circulating trophoblast

Clark SL. New concepts of amniotic fluid embolism: a review. Obstet Gynecol Surv 1990;45:360–8

(AFE) Pathophysiology

- Etiology of Coagulopathy
  - Amniotic fluid procoagulant (Factor X activator)
  - Amniotic fluid plasminogen activation inhibitor 1
  - Circulating trophoblast
  - Simply massive hemorrhage due to uterine atony

Lockwood CJ, Bach R, Guha A, Zhou XD, Miller WA, Nemerson Y. Amniotic fluid contains tissue factor, a potent initiator of coagulation. Am J Obstet Gynecol 1991;165:1335–41

(AFE) Diagnosis

Table 2. Differential Diagnosis of Amniotic Fluid Embolism

Obstetric causes
Acute hemorrhage
Placental abruption
Uterine rupture
Uterine atony
Eclampsia
Peripartum cardiomyopathy
Anesthetic causes
High spinal anesthesia
Aspiration
Local anesthetic toxicity
Nonobstetric causes
Pulmonary embolism
Air embolism
Anaphylaxis
Sepsis/septic shock

Karetsky M, Ramirez M. Acute respiratory failure in pregnancy: an analysis of 19 cases. Medicine (Baltimore) 1998;77:41–9

(AFE) Diagnosis

- Diagnosis of exclusion
- Serum tryptase

Fineschi V, Gambassi R, Gherardi M, Turillazzi . The diagnosis of amniotic fluid embolism: an immunohistochemical study for the quantification of pulmonary mast cell tryptase. Int J Legal Med 1998;111:238–43

(AFE) Management

- OXYGENATION
- CIRCULATION
- COAGULATION
- DISPO

(AFE) Management

- OXYGENATION
  - Tracheal intubation (promptly)
  - 100% O_2
  - Positive pressure ventilation

(AFE) Management

- OXYGENATION
- CIRCULATION
  - Large bore intravenous access
  - Intra-arterial catheter
  - Pulmonary artery catheter
  - Vasopressor/Inotrope support
  - Volume support with crystalloid and colloid
  - Expeditious fetal delivery (if undelivered)

Clark SL, Hankins GD, Dudley DA, Dildy GA, Porter TF. Amniotic fluid embolism: analysis of the national registry. Am J Obstet Gynecol 1995;172:1158–67

(AFE) Management

- OXYGENATION
- CIRCULATION (cont)
  - TEE monitoring?

RD, Iverson LI, Daugherty TM, Lovett SM, Terry C, Blumenstrock E. Amniotic fluid embolism causing catastrophic pulmonary vasoconstriction: diagnosis by trans-esophageal echocardiogram and treatment by cardiopulmonary bypass. Obstet Gynecol 2003;102:496–8

(AFE) Management

- OXYGENATION
- CIRCULATION (cont)
  - TEE monitoring?
  - Nitric oxide?

McDonnell NJ, Chan BO, Frengley RW. Rapid reversal of critical haemodynamic compromise with nitric oxide in a patient with amniotic fluid embolism. Int J Obstet Anesth 2007;16:269–73

(AFE) Management

- OXYGENATION
- CIRCULATION (cont)
  - TEE monitoring?
  - Nitric oxide?
  - Cardiopulmonary bypass/ECMO

Hsieh YY, Chang CC, Li PC, Tsai HD, Tsai CH. Successful application of extracorporeal membrane oxygenation and intraaortic counterpulsation as lifesaving therapy for a patient with amniotic fluid embolism. Am J Obstet Gynecol 2000;183:496–7

(AFE) Management

- OXYGENATION
- CIRCULATION (cont)
  - TEE monitoring?
  - Nitric oxide?
  - Cardiopulmonary bypass/ECMO
  - VAD

Nagarsheth NP, Pinney S, Bassily-Marcus A, Anyanwu A, Friedman L, Beilin Y. Successful placement of a right ventricular assist device for treatment of a presumed amniotic fluid embolism. Anesth Analg 2008;107:962–4

(AFE) Management

- OXYGENATION
- CIRCULATION
- COAGULATION
  - FFP, platelets, cryoprecipitate

Gist RS, Stafford IP, Leibowitz AB, Beilin Y. Amniotic Fluid Embolism. Anesth Analg 2009;108:1599–602

(AFE) Management

- OXYGENATION
- CIRCULATION
- COAGULATION
  - FFP, platelets, cryoprecipitate
  - rFVIIa? Aprotinin?
  - Aminocaproic/tranexamic acid?

Gist RS, Stafford IP, Leibowitz AB, Beilin Y. Amniotic Fluid Embolism. Anesth Analg 2009;108:1599–602

(AFE) Management

- OXYGENATION
- CIRCULATION
- COAGULATION
- DISPO
  - ICU management
  - Epidural catheter?

Sprung J, Cheng EY, Patel S, et al. Understanding and management of amniotic fluid embolism. J Clin Anesth 1992; 4:235-40