Amniotic fluid embolism: a leading cause of maternal death yet still a medical conundrum

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Introduction

• AFE is unique to pregnancy
• One of the most feared complications of pregnancy
  – Potentially catastrophic
  – Can strike in any birth setting
  – Poorly understood
  – Leading cause of direct maternal death in Australia/NZ
• Classic “triad”
  – Cardiac, pulmonary and coagulation changes
A very difficult condition to study

• No reliable animal model of the condition

• Rare nature of the condition means:
  – Publication of case reports is vital
    • New insights into pathophysiology
    • New treatment options
  – The use of case registries (eg UKOSS, AMOSS) are essential
Aims
Provide a **current** overview of AFE

- History
- Evolution of theories around pathogenesis
- Incidence
- Mortality
- Neonatal Outcomes
- Presentation
- Management
- Diagnosis
“It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so.”

- Keep an open mind to new knowledge
- Understanding of conditions such as AFE is constantly evolving
- With AFE-many lost opportunities
The term “amniotic fluid embolism” coined in 1941 by Steiner and Lushbaugh

- 32 cases of women dying of “obstetrical shock”
- 8 women had fetal material in maternal pulmonary circulation
- Women died as a result of “pulmonary embolism by amniotic fluid”
**Initial theory of AFE**

Amniotic fluid forced into maternal circulation

Obstruction of pulmonary arterial blood flow from cellular debris

Obstruction leads to hypoxia, right heart failure and death
History

• Assumptions from 1941 went largely unchallenged for decades
  – Women with similar pulmonary post mortem findings were diagnosed with AFE
    • Despite wide variety of presentations
  – Animal and human studies were showing no ill effects of infusion of amniotic fluid, even in large volumes

• 1980s: collapse of theories built on presence of fetal squames in maternal pulmonary circulation
  – Evolution of maternal critical care
  – Increasing use of PA catheters

• Critical review of the 8 index cases from 1941
  – 7 of 8 likely to be other causes (sepsis, haemorrhage)

Clark SL Obstet Gynecol Survey 1990
“Let us be careful not to make the diagnosis of amniotic fluid embolism a waste basket for cases of unexplained death during labour” Eastman 1948
Current Thinking: Pathophysiology

- Passage of amniotic fluid into maternal circulation
- Abnormal maternal response to fetal antigenic material
- Immune mediated response “Immunologic Storm”
What happened to the term “anaphylactoid syndrome of pregnancy”

• Suggested by Clark in 1995

“Amniotic fluid embolism” seems to roll off the tongue easier

“Amniotic fluid embolism seems too deeply embedded in the language of medicine to be changed” (Clark 2014)
Haemodynamic changes

• Complex and variable
• Initially: pulmonary and systemic hypertension
• Subsequent: profound LV dysfunction
  – Contributing factors:
    • Myocardial ischaemia
      – Coronary artery vasospasm
    • RV failure
    • Pulmonary injury/hypertension
CASE REPORT

Rapid reversal of critical haemodynamic compromise with nitric oxide in a parturient with amniotic fluid embolism

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Echocardiography findings

McDonnell et al IJOA 2007
Pulmonary Changes: “ARDS” picture

- Initial shunting & V/Q mismatch
- Inflammatory changes from presumed capillary damage
- Superimposed pulmonary oedema
Coagulation changes

- Can be initial presenting feature
- Nearly universal
  - AMOSS: 85% needed blood/blood products
- Similar appearance to massive placental abruption
  - ? mechanisms
- Appears to be consumptive in nature
  - Role of tissue factor?
- Can occur rapidly
  - Prepare to manage ASAP
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McDonnell et al IJOA 2013
Take Home Message Number 2

Use available resources to help guide appropriate management. Volume of tasks can be overwhelming so seek help early.

KEEP CALM AND CALL THE INTENSIVIST
UK Obstetric Surveillance System (UKOSS)

A national system to study rare disorders of pregnancy

The Australasian Maternity Outcomes Surveillance System (AMOSS) known as 'AMOSS' is a national surveillance mechanism designed to study a variety of rare or serious conditions in pregnancy, childbirth and the postnatal phase. Through translating the findings from these studies into reliable evidence-based practice, the aim of AMOSS is to improve the safety and quality of maternity care in Australia and New Zealand.
Incidence

- Traditionally described as “rare”
  - Exact incidence difficult to determine
    - Depends on method of data collection
    - More cases are being described—likely higher awareness
  - Recent reports suggest 1:16,000 to 1:50,000 deliveries
- Leading cause of direct maternal mortality in Aust/NZ
  - Consistently ranked in top 5 in most developed countries
Risk Factors for AFE

- Age >35
- Multiple gestation
- Placenta praevia
- Placental abruption
- Polyhydramnios
- Ethnic minority

Take home message number 3
“No demographic or clinical risk factor has been identified that justifies any prospective alteration of standard obstetric practice to reduce the risk of AFE”
Clark 2014

• Polyhydramnios
• Ethnic minority

Knight et al Pregnancy BMC 2012
Outcomes

- No longer universally poor outcomes
  - Less severe cases included in data collection
  - Better maternal resuscitation
  - Better ICU care

- BUT: women may still die despite best possible care
  - 13 deaths 2006-08 CMACE report

McDonnell et al IJOA 2013
Take Home Message Number 4

Women will still die from AFE

BUT: Have we given them the opportunity to survive?
AFE becoming a more prominent cause of maternal mortality

Maternal deaths due to AFE, China, 1996-2013, n=640

Figure 1 1996-2013 Maternal mortality and proportion of MD due to AFE
Neonatal Outcomes

• Outcome dependent on timing of presentation and delivery
  – Traditionally reported as 50% mortality

• AMOSS data:
  – 1 death from 36 babies
  – Intrapartum versus postpartum AFE
    • 5 min APGAR <7: 67% vs 0%
    • NICU admission: 100% vs 53%
    • Intubation: 50% vs 6%
Presentation

• A variety of potential presenting signs/symptoms
  – Premonitory symptoms, shortness of breath, hypotension, fetal compromise, maternal haemorrhage
  – Cardiac arrest does not mean certain death
    • AMOSS: 5 deaths, but 14 women who arrested

• When?
  – Majority occur around the time of delivery
    • Australian AMOSS data:
      – 48% occurred 5 min before or after birth
      – Longest delay in presentation 125 min post birth
  – Any time when there is disruption of the utero-placental interface
    • Amniocentesis, terminations, ectopic pregnancies, trauma
Management

• Good initial resuscitation care
  – Basic and Advanced Life Support-ABCs
  – Uterine displacement
  – Urgent delivery/perimortem caesarean
Management

• Anticipate deterioration in ABCs
  – Need for intubation, vasopressors, 100% oxygen

• Anticipate coagulopathy
  – Prepare RBCs, cryoprecipitate, fresh frozen plasma
  – rVIIa may be detrimental
    • Leighton 2011: Risk Ratio for death/permanent disability 2.2
    (95% CI 1.4-3.7)
    • Use only if coagulopathy unresponsive to traditional factor replacement
Take home message number 5

- ECMO/bypass
- Intra-aortic balloon counterpulsation
- Continuous haemofiltration
- RV assist devices
- Nitric oxide

Use available technology depending on clinical state
Diagnosis

• Remains a clinical diagnosis
  – Number of markers only at research stage
  – In addition to routine tests:
    • Tryptase to rule out anaphylaxis

• Registry entry criteria:
  – In the absence of an alternative explanation:
    • Acute onset hypoxia, hypotension, coagulopathy

• Post mortem findings-interpret with care
Don’t forget about the welfare of yourself, and the staff involved

- Welfare issues are paramount
- Second victim phenomena are well described
Summary

- AFE remains a potentially devastating complication unique to pregnancy
- Current evidence supports some form of immune mediated/initiated trigger
- Use the technology you have available to help guide care
- Management can quickly overwhelm available resources
- Death is unfortunately still a reality for some women