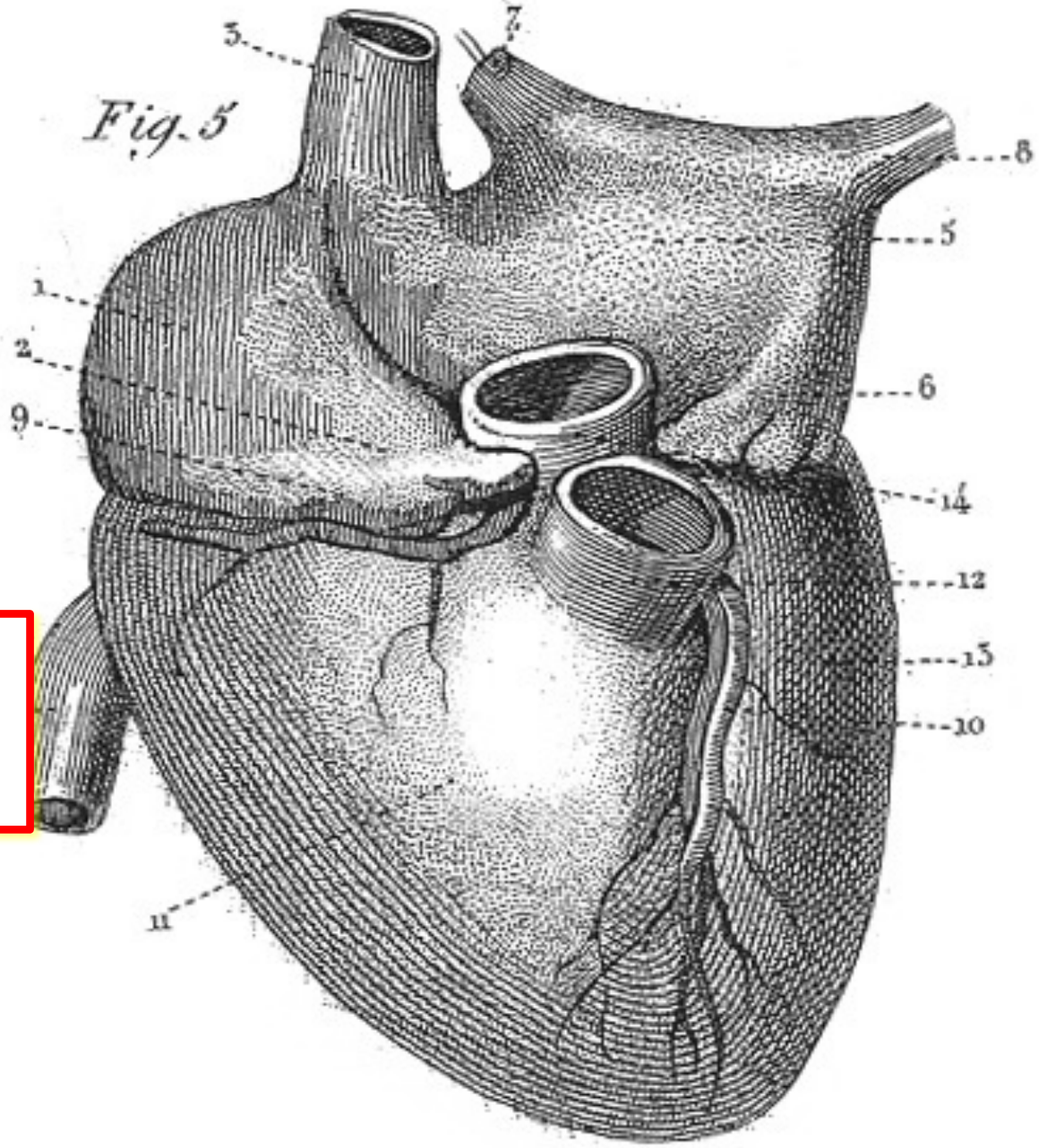
Plötsligt medvetslös

Maternell kollaps

Ove Karlsson, MD PhD docent
Sahlgrenska Universitetssjukhuset



Maternell kollaps

- Patientfall x flera
- Statistik
- MBRRACE mm
- Fysiologi
- Vetenskap
- PM/Rutin
- Att fundera på!

36-årig kvinna

Vecka 39+2

- BMI 27
- Viktuppgång 25 kg
- Astma
- Singelnjure
- Rökare
- IV-gravida, III-para (PN)

- PROM
- Ultraljud
  - Placenta framvägg
  - Ej föreliggande
- Hem

36-årig kvinna

Vecka 39+3

- 8.15 värkar inlagd
- 8.35 kramp
  - Susp eklampsi
  - Nål svårt, stesolid rektalt
- 8.42 magnesium bolus + inf
- 8.51 Bltr 192/106 p 115
  - Trandate iv
  - Fortsatt medvetslös
- 8.53 fosterbradykardi
  - Larmsnitt (Op sal på avd)

- 8.54 flytt till operationsbord
  - Andningsstopp
  - Intubation
  - Första andetaget imma och CO2 retur
  - Fjärde andetaget ingen CO2 retur
- 8.57 cirkulationskollaps
  - HR 33 – atropin (pvk subkutan)
  - Hjärtstopp – HLR, adrenalin
  - Hjärtlarm och perimortem snitt
  - Barn utskaffas lätt Apgar 1-4-4
  - Ingen ablatio eller blod i buk

36-årig kvinna

- HLR
  - Artärnål (bra pulsationer)
  - Utbyte CO2
  - Mätbara blodtryck
- Perimortem snitt
  - Inget blod eller ablatio
  - Peanger över kärl och packar buk
- Adrenalin 1 mg x 8
- Calcium
- Tribonat
- Blodgas
- Svårt med nålar
- Tilltagande stor blödning uterus
  - 2 st 0 neg blod

Vecka 39+3

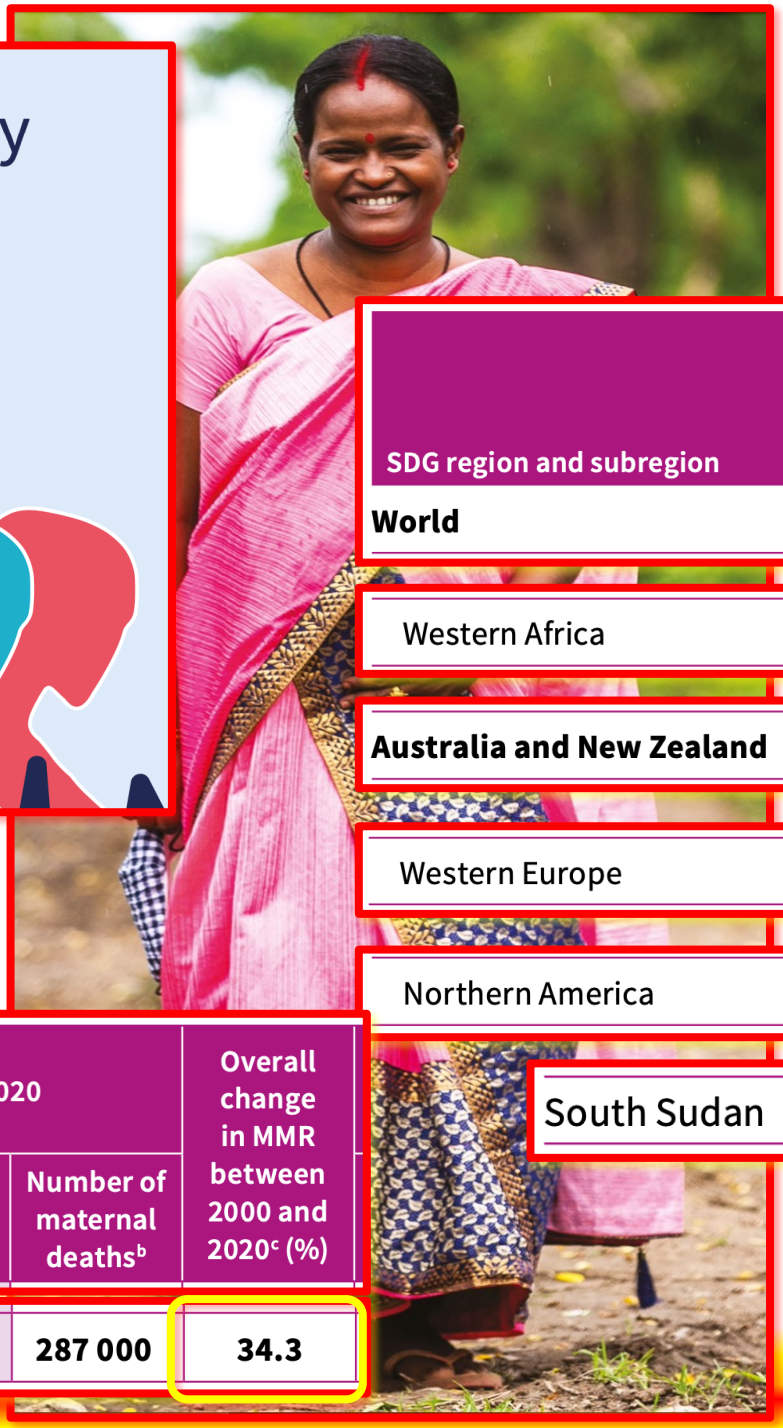
- UCG (ej hjärtprob)
  - Ev vätske spatium perikard
  - Upprepade gånger
  - Total akinesi
- Perikardtappning x 2
  - Indikation: ev behandlingsbar åtgärd
  - 30-40 ml + 20 ml
- HLR lugn och systematisk
- Avbryter HLR efter 40 min
- Postop summerad blödning 4120 ml

Obduktion

- Lungkärl: skivepitel färgat pos för CK 5/6 AE1/3, inga tromber
- Fostervattenembolisering

Trends in maternal mortality 2000 to 2020

Estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/Population Division



SDG region and subregion	MMR[a] point estimate and range of uncertainty interval (UI: 80%)			Number of maternal deaths[b]
	Lower UI	Point estimate	Upper UI	
World	**202**	**223**	**255**	**287 000**
Western Africa	616	754	1024	111 000
Australia and New Zealand	**3**	**4**	**4**	**13**
Western Europe	5	6	7	110
Northern America	16	20	26	810
South Sudan	746	1 223	2 009	3 800

SDG region and subregion	2000		2020		Overall change in MMR between 2000 and 2020[c] (%)
	MMR point estimate[a]	Number of maternal deaths[b]	MMR point estimate[a]	Number of maternal deaths[b]	
World	**339**	**446 000**	**223**	**287 000**	**34.3**

Maternal, Newborn and Infant Clinical Outcome Review Programme

MBRRACE-UK
Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries acr

Saving Lives, Improving Mothers' Care

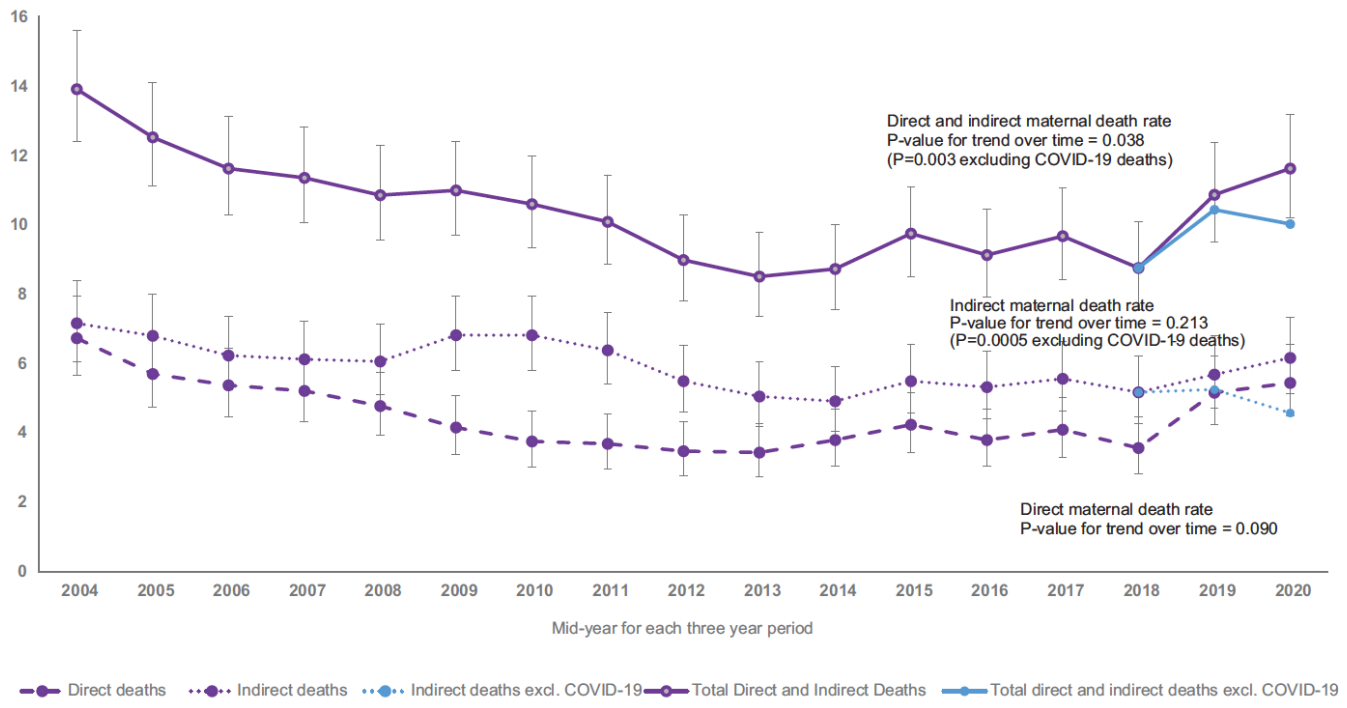
Lessons learned to inform maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2019-21

Compiled report including supplementary material

52 % av fallen bedömda att ett bättre omhändertagande skulle gjort skillnad för utfallet!

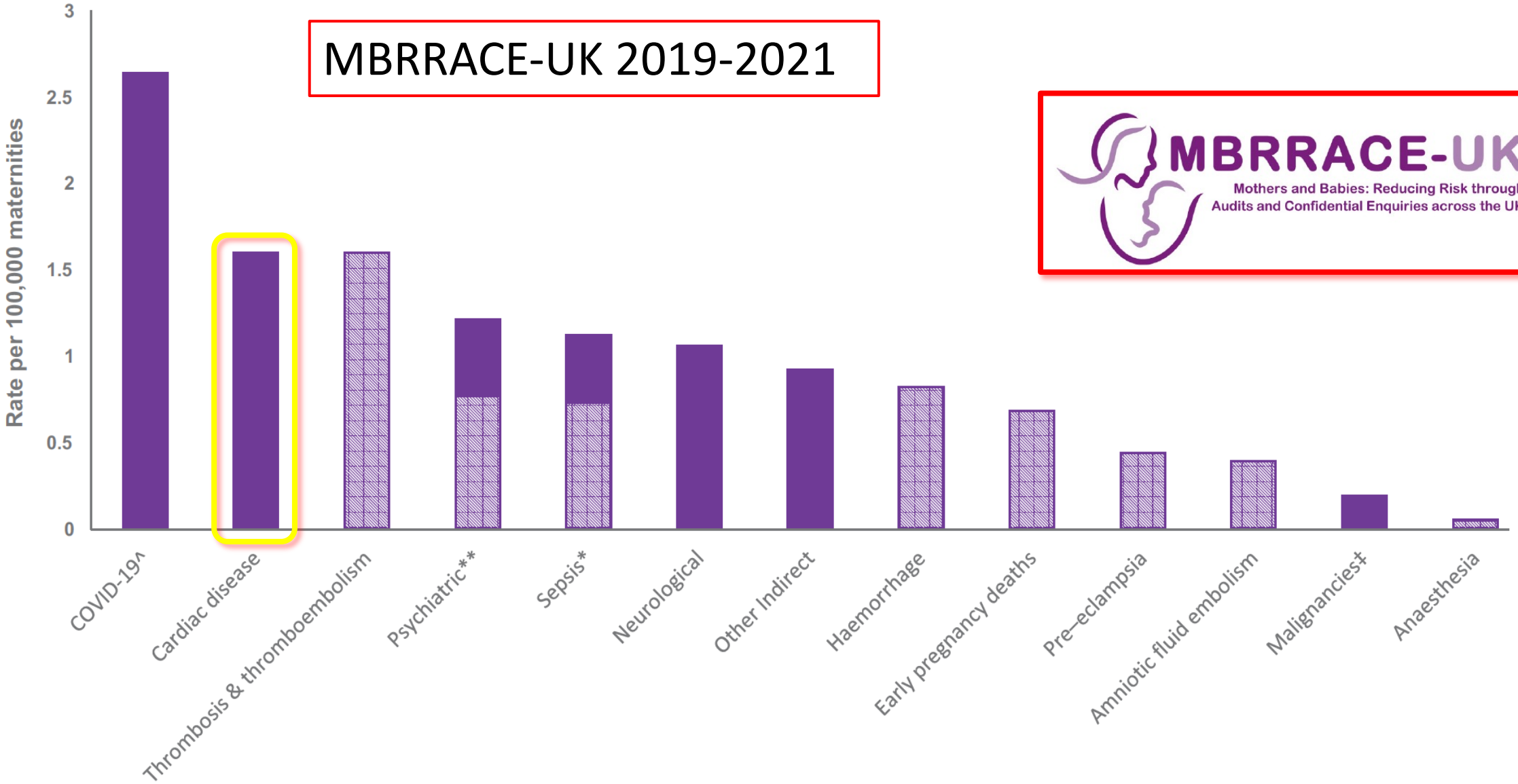
October 2023

11.7 per 100.000 maternities



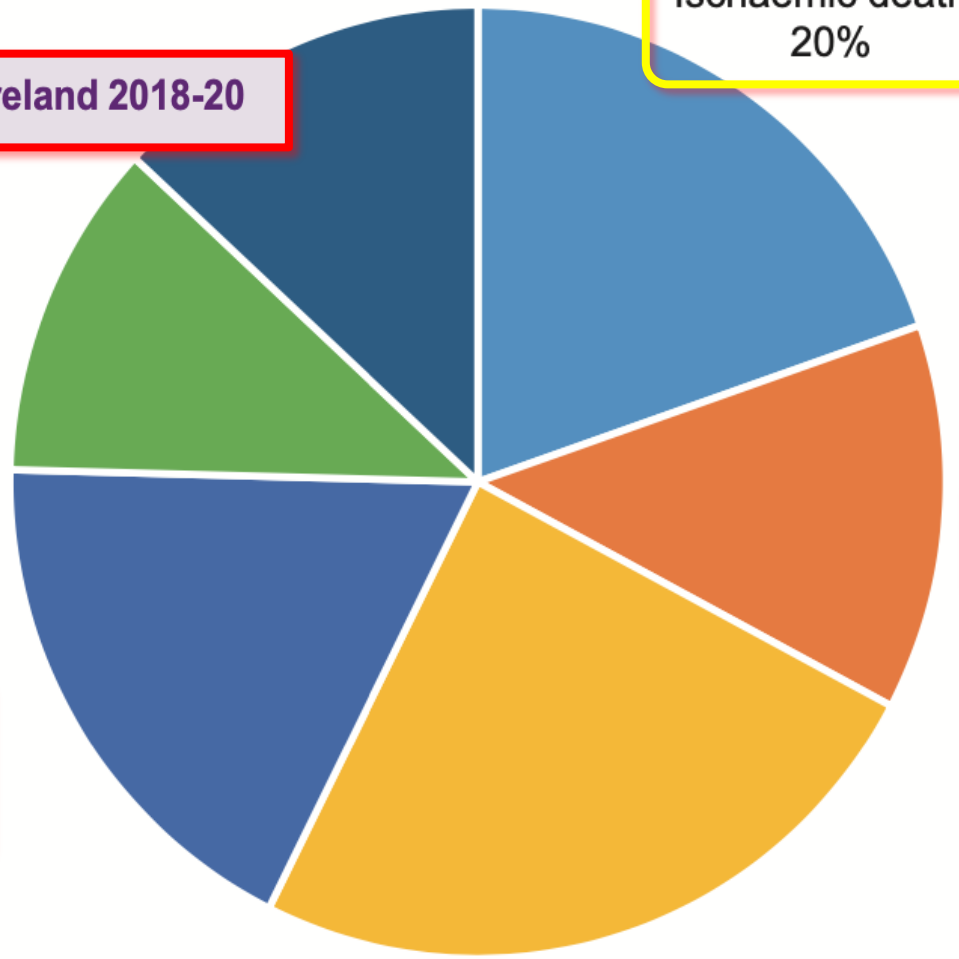
MBRRACE-UK
Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries across the UK

MBRRACE-UK 2019-2021



MBRRACE-UK
Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries across the UK

Causes of cardiovascular deaths, UK and Ireland 2018-20



A raised respiratory rate, chest pain, persistent tachycardia and orthopnoea are important signs and symptoms of cardiac disease which should always be fully investigated. The emphasis should be on making a diagnosis, not simply excluding a diagnosis. (Knight, Nair et al. 2016)

Heart failure in cardiomyopathy can develop rapidl
ure and cardiogenic shock apply. For rapid diagno
algorithm and expert interdisciplinary team are cru
vascular diseases during pregnancy) (Regitz-Zagr

A persistent sinus tachycardia is a 'red flag' and should always be investigated, particularly when there is associated breathlessness. (Saving Lives, Improving Mothers' Care 2019) (Knight, Bunch et al. 2019)

Take a cardiac-specific history and suspect heart failure if there is not another likely cause of any of the

caval compression) or at rest

or which produces frothy pink sputum

m sleep by severe breathlessness and coughing,
roved by moving to an upright position

at rest).

- Symtom hjärtsjukdom – utred!
- Kardiomyopati kan utvecklas snabbt
- Takykardi, bröstsmärta, andnöd, hosta, dyspné mm – anamnes och status
- Tänk "Aorta", dvs aortadissektion
- Gravida och icke gravida ska utredas och behandlas på samma sätt!
- Utbilda medarbetare
- Konsultation före graviditet
- Mekaniska klaffar ökad risk
- El-konvertering akut om instabil vid FF
- Tidigare rapport: Perimortem snitt, transport till sjukhus och högt BMI

Think aorta (Aortic disse

e same as non-pregnant women unless there is a

Ensure that all clinical staff caring
aware of the concerning 'red flag'
medical problems in pregnancy.

or ischemic) should be offered pre-pregnancy
) including contraceptive advice (Saving Lives

Pregnancy in women with a mech
risk of maternal and fetal complica

gnancy:

ded in cases of haemodynamic instability or pre-excited AF

- Therapeutic anticoagulation with heparin or [warfarin] according to the stage of pregnancy is recommended for patients with AF

BJOG An International Journal of Obstetrics and Gynaecology

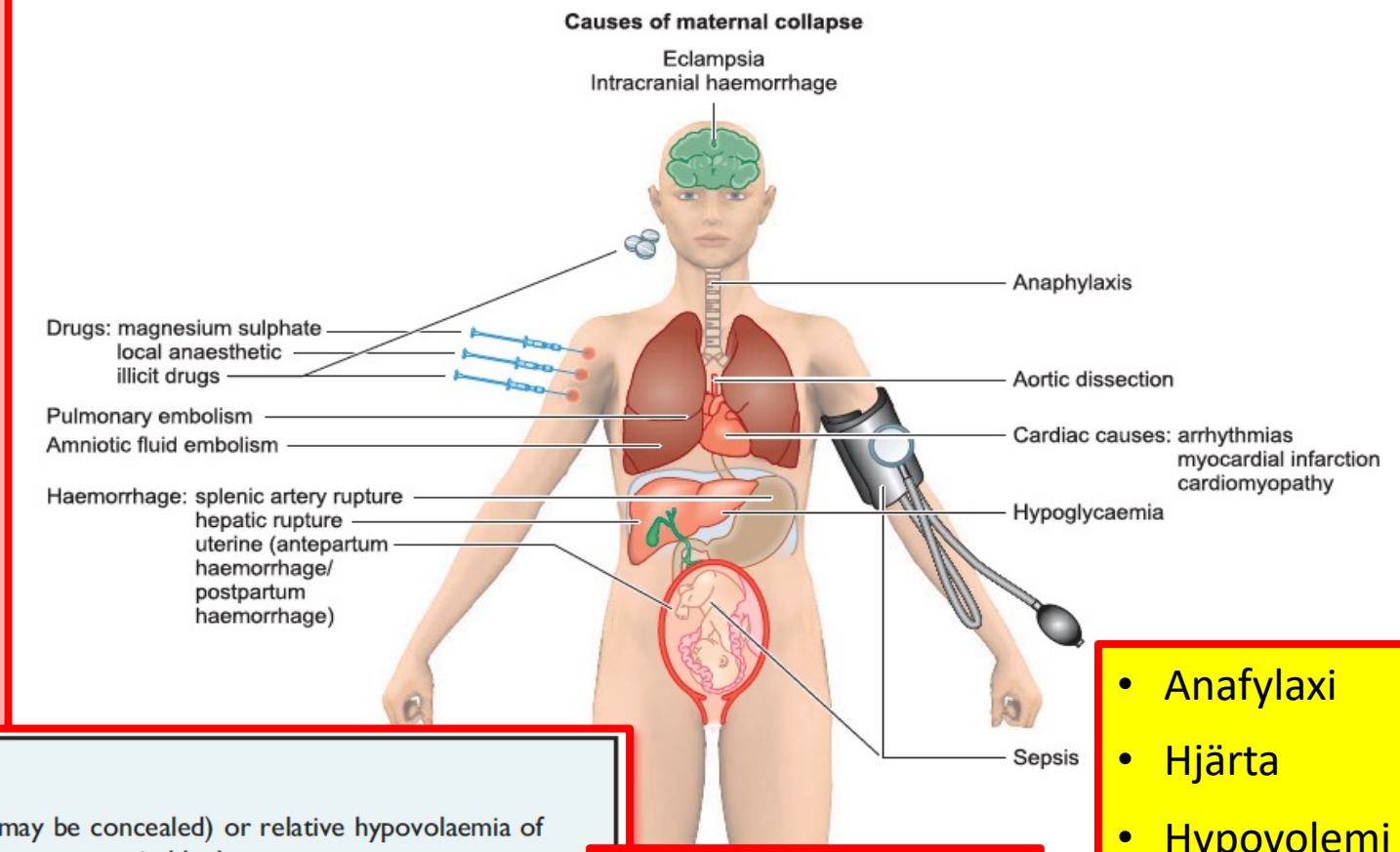
Royal College of Obstetricians & Gynaecologists

Maternal Collapse in Pregnancy and the Puerperium

Green-top Guideline No. 56

December 2019

Please cite this paper as: Chu J, Johnston TA, Geoghegan J, on behalf of the Royal College of Obstetricians and Gynaecologists. Maternal Collapse in Pregnancy and the Puerperium. BJOG 2020;127:e14–e52.



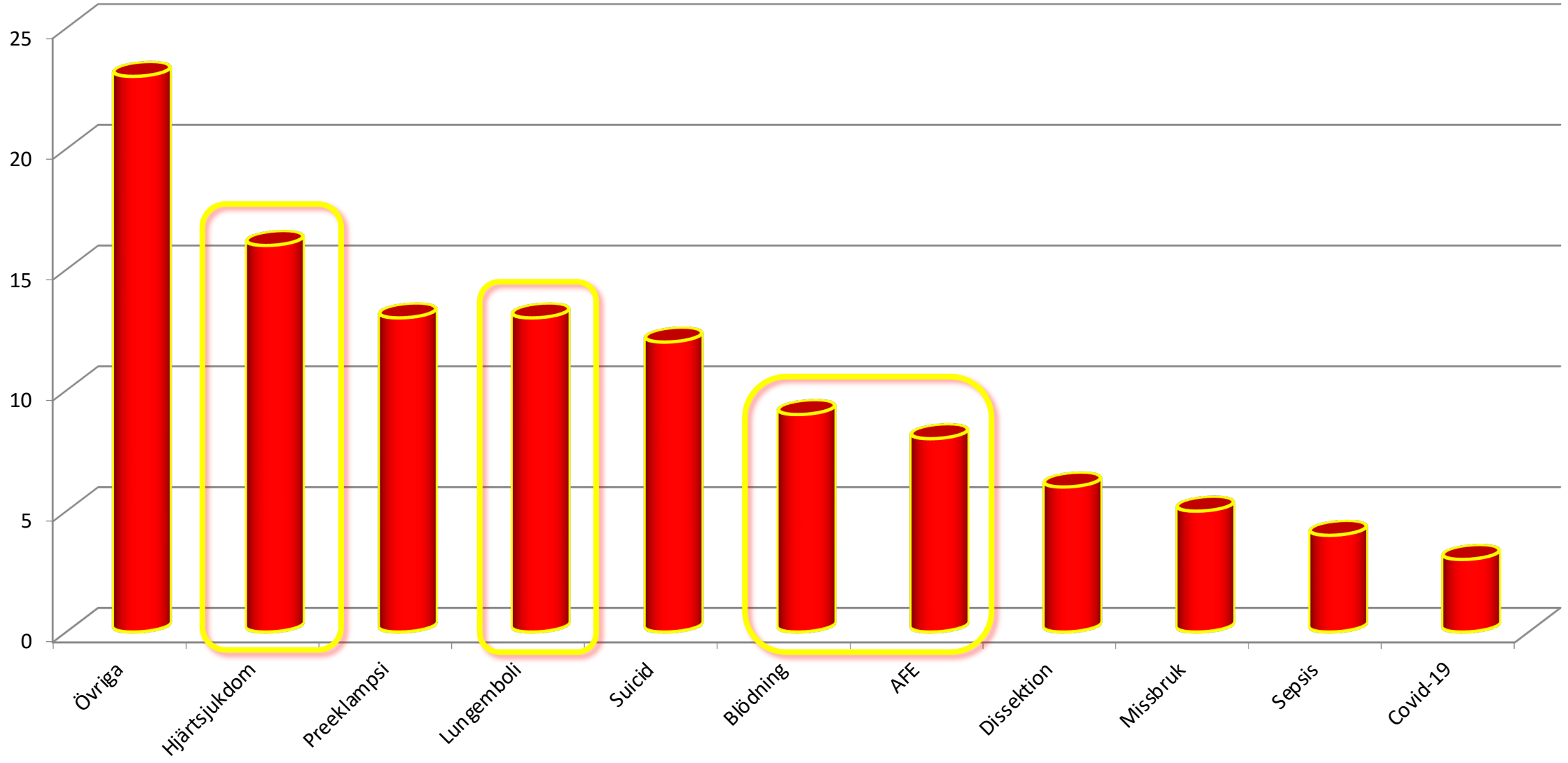
Reversible cause		Cause in pregnancy
4H's	Hypovolaemia	Bleeding (obstetric/other; may be concealed) or relative hypovolaemia of dense spinal block, septic or neurogenic block
	Hypoxia	Pregnant women can become hypoxic more quickly. Cardiac events – peripartum cardiomyopathy, myocardial infarction, aortic dissection, large vessel aneurysms
	Hypo/hyperkalaemia and Hyponatraemia	Hypo and hyperkalaemia are no more likely. Hyponatraemia may be caused by oxytocin use
	Hypothermia	No more likely
4T's	Thromboembolism	Amniotic fluid embolus, pulmonary embolus, air embolus, myocardial infarction
	Toxicity	Local anaesthetic, magnesium, other
	Tension pneumothorax	Following trauma/suicide attempts
	Tamponade	Following trauma/suicide attempts
Eclampsia and pre-eclampsia		Includes intracranial haemorrhage

Behandling:

- BEHANDLA ORSAK
- Intensivvård
  - Hjärta
  - Cirkulation
  - Respiration

- Anafylaxi
- Hjärta
- Hypovolemi
- Hypoxi
- Emboli
- Läkemedel
- Dissektion
- Sepsis
- Fostervattenemboli

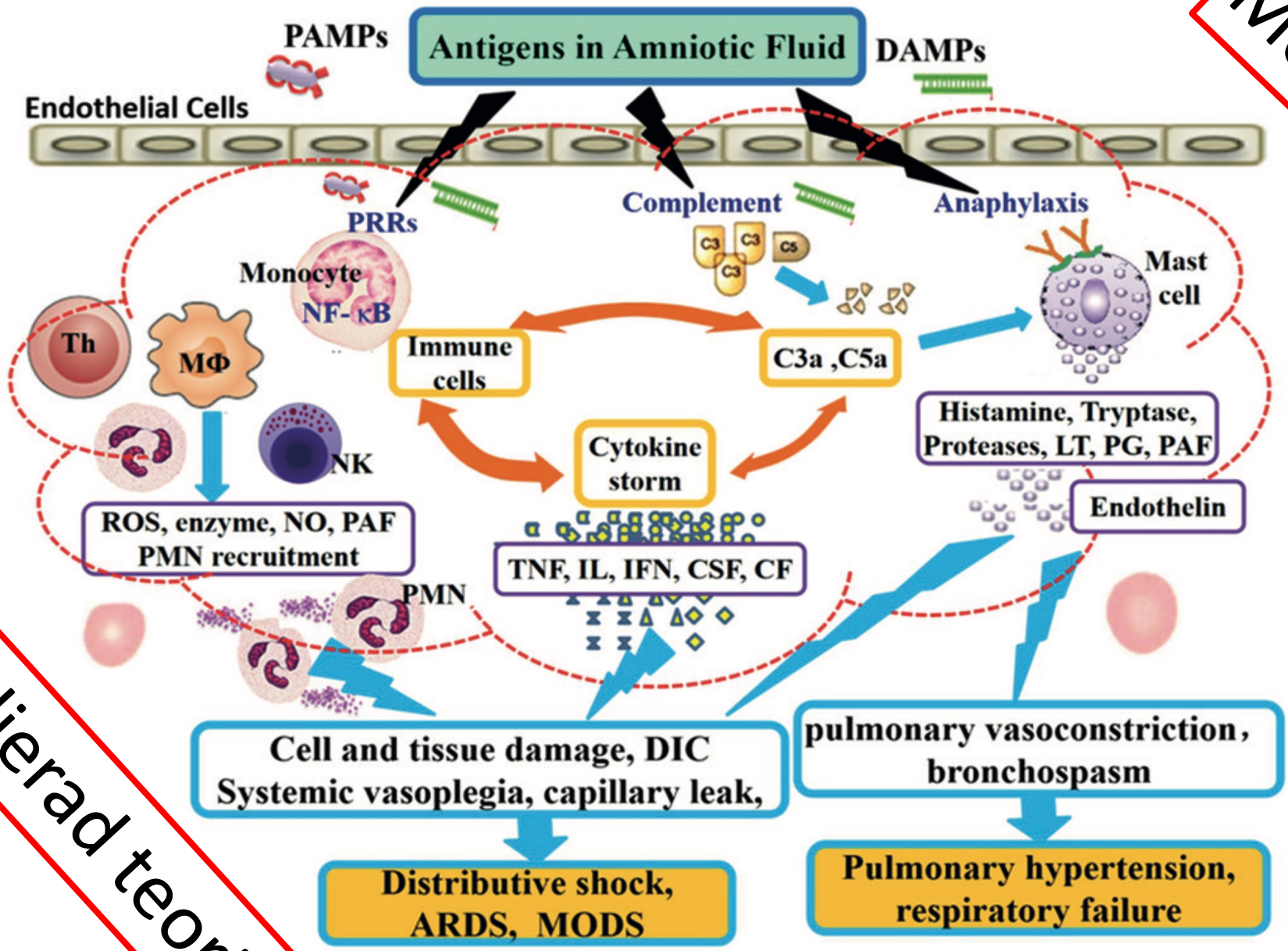
Mödradödlighet Sverige 2007-2023



Lönar det sig att arbeta med det?

Mekanisk teori

Immun medierad teori



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Japan Society of Obstetrics and Gynecology

doi:10.1111/jog.13284

J. Obstet. Gynaecol. Res. Vol. 43, No. 4: 627–632, April 2017

Amniotic fluid embolism: Pathophysiology from the perspective of pathology

Naoaki Tamura, Mustari Farhana, Tomoaki Oda, Hiroaki Itoh and Naohiro Kanayama

Department of Obstetrics & Gynaecology, Hamamatsu University School of Medicine, Hamamatsu, Japan

- 21-100 % fetala celler i moders cirkulation utan AFE
- AFE
  - Fetala celler in i moders cirkulation
  - Signifikant lungemboli 10-15 %, alt
  - Immunologisk/anafylaktoid reaktion
- Olika färgningar för att hitta fetala celler
- Patologiska förändringar i lungor och uterus
  - Lungor: pulmonell vasospasm, ödem och aktivering av trombocyter, vita blodkroppar och komplement
  - Uterus: komplement aktivering och inflammation vilket leder till DIC, atoni och blödning

type of syndrome characterized by the abrupt onset of hypoxia, ular coagulopathy (DIC), occurring during labor, delivery, or f amniotic components into the maternal circulation. AFE is a trical complications, resulting in a high mortality rate among d intensive critical management, we often encounter patients rbation of AFE-related conditions. A major concern is that there , because its pathophysiology is still not well understood. This and currently proposed pathophysiology.

oid reaction, disseminated intravascular coagulopathy, postpar- uterine atony.

Diagnos

- Klinisk diagnos
- Uteslutningsdiagnos
- Obs peripartal kollaps

1. Klinisk diagnos:
   - Akut hypotension
   - Hjärtstopp
   - Akut hypoxi
   - Koagulopati
   - Utan annan förklaring
2. Postmortem diagnostik

Diff diagnoser

- Lungemboli
  - Hela graviditeten ink pp
- Peripartum kardiomyopati
- Sepsis
- Hjärtinfarkt
- PPH
- Luftemboli
- Eklampsi
- Anafylaxi
- Total spinal med flera

Vad göra?

ABCDE ink
Perimortem snitt

Intensivvård
- Respiration
- Hjärta/cirkulation
- Hemostas

Patientnära instrument
- Ultraljud
- TEG/ROTEM
- Blodgas

Can J Anesth/J Can Anesth
https://doi.org/10.1007/s12630-022-02343-9

REVIEW ARTICLE/BRIEF REVIEW

Echocardiography findings in amniotic fluid embolism: a systematic review of the literature

Observations échocardiographiques lors d'une embolie de li amniotique : une revue systématique de la littérature

Daniel Wiseman, MD · Camille Simard, MD · Stephen S. Yang, MD, MSc · Maral Koolian, MD, MSc · Haim A. Abenhaim, MD, MPH · Jed Lipes, MD

Received: 17 May 2022 / Revised: 1 August 2022 / Accep

Abstract
Purpose *Amniotic fluid embolism (AFE) is a lead of obstetrical cardiac arrest and maternal morb*

- Pulmonell hypertension
- Hö kammar svikt
- Biventrikulär svikt
- HK-svikt risk hjärtstopp

Clinical Opinion ajog.org

Amniotic fluid embolism: principles of early clinical management

Luis D. Pacheco, MD; Steven L. Clark, MD; Miranda Klassen, BS; Gary D. V. Hankins, MD

Amniotic fluid embolism is an uncommon, but potentially lethal, complication of pregnancy. Because amniotic fluid embolism usually is seen with cardiac arrest, the initial immediate response should be to provide high-quality cardiopulmonary resuscitation. We describe key features of initial treatment of patients with amniotic fluid embolism. Where available, we recommend performing transthoracic or transesophageal echocardiography as soon as possible because this is an easy and reliable method of identifying a failing right ventricle. If such failure is identified, treatment that is tailored at improving right ventricular performance should be initiated with the use of inotropic agents and pulmonary vasodilators. Blood pressure support with vasopressors is preferred over fluid infusion in the setting of severe right ventricular compromise. Amniotic fluid embolism—related coagulopathy should be managed with hemostatic resuscitation with the use of a 1:1:1 ratio of packed red cells, fresh frozen plasma, and platelets (with cryoprecipitate as needed to maintain a serum fibrinogen of >150—200 mg/dL). In cases that require prolonged cardiopulmonary resuscitation or, after arrest, severe ventricular dysfunction refractory to medical management, consideration for venoarterial extracorporeal membrane oxygenation should be given.

Key words: blood product, cardiac arrest, cryoprecipitate, coagulation, dobutamine, norepinephrine, platelet, right ventricular failure

described in cases of AFE may provide the best chance at improved maternal and fetal outcomes.[4] Although no data exist to document improved survival of such women with any specific treatment regimen, we describe here 1 organized, logical approach to the initial acute management of AFE that is recommended by the authors who have extensive experience in critical care obstetrics.

Cardiac arrest

Because AFE often presents with cardiac arrest, the initial immediate response should be to provide high-quality cardiopulmonary resuscitation (CPR). Without delay, chest compressions should be started, with the heel of the hand placed in the lower half of the sternum and a compression depth of

Diagnostik peripartal maternell kollaps

Ultraljud hjärta

- ***Högerkammarsvikt?***
- Ja → Fostervattenemboli alt lungemboli
- Nej → Diff diagnoser

TEG/Rotem

- ***Koagulationspåverkan?***
- Ja → Fostervattenemboli
- Nej → Lungemboli

iotic fluid embolism: principles of early

Check for updates

FIGURE 2
Immediate acute management of amniotic fluid embolism

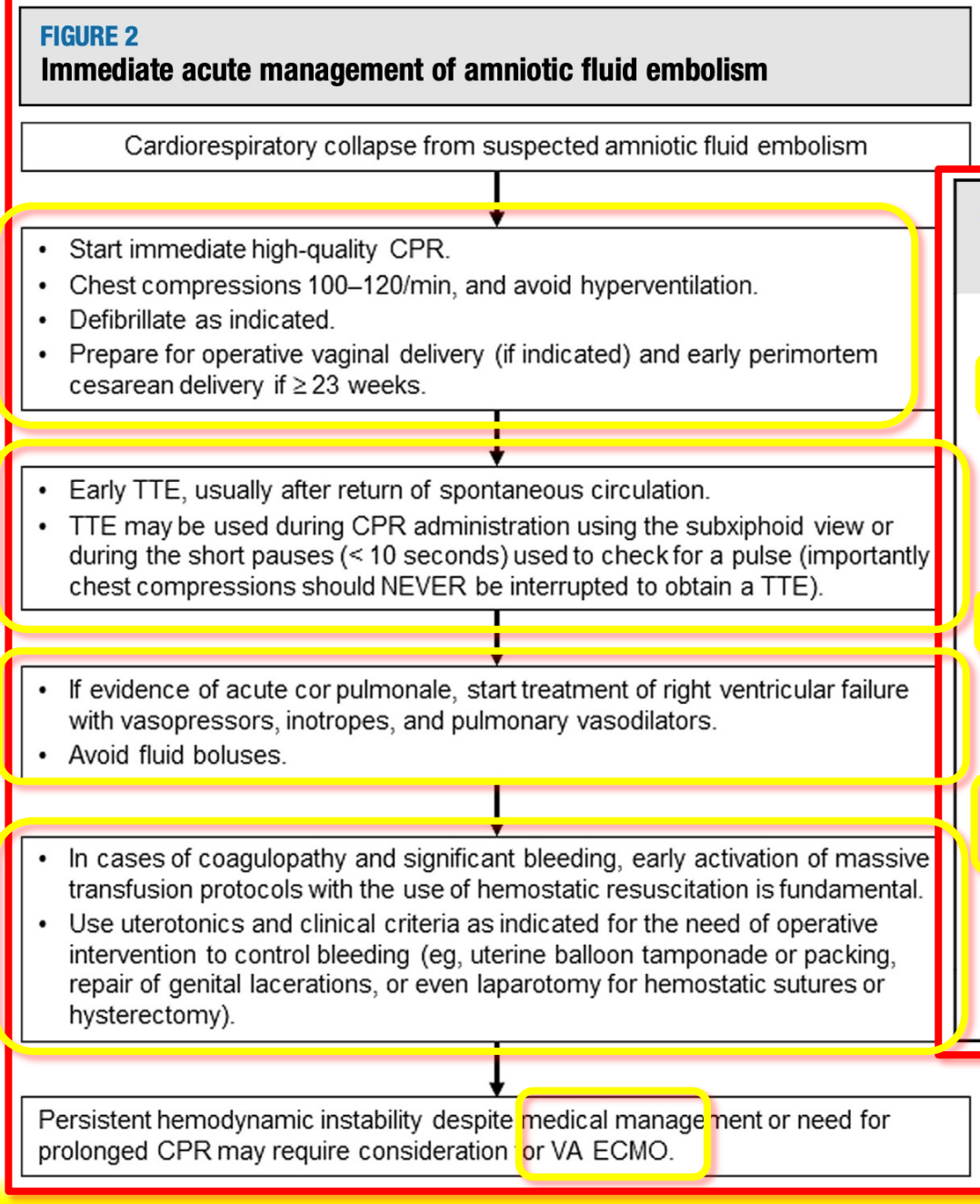


TABLE
Pharmacologic agents used to treat acute right ventricular failure

Pharmacologic agent	Dosage
Norepinephrine (vasopressor)	0.05–3.3 μg/kg/min
Dobutamine (inotrope)	2.5–5 μg/kg/min (usually avoid doses >5 μg/kg/min because tachycardia at higher doses may limit right ventricular filling and consequently cardiac output)
Milrinone (inotrope)	0.25–0.75 μg/kg/min
Sildenafil (pulmonary vasodilator)	20 mg orally every 8 hrs
Inhaled nitric oxide (pulmonary vasodilator)	5–40 parts per million
Inhaled prostacyclin (epoprostenol, pulmonary vasodilator)	10–50 ng/kg/min
Intravenous prostacyclin (epoprostenol, pulmonary vasodilator)	Start at 1–2 ng/kg/min, titrate to desired effect

Pacheco. Immediate management of amniotic fluid embolism. Am J Obstet Gynecol 2020.

- Tranexamsyra
- 4:4:1
- Fibrinogen

30-årig kvinna

- Frisk, BMI 29
- II-gravida, I-para
- 2019 grad IV bristning
- Graviditetsvecka 38+3
- Plan: elektivt kejsarsnitt

Elektivt kejsarsnitt

- Spinal ua
- Fenylefrin pga blodtrycksfall
- Barnet utskaffas med lätthet, placenta framvägg och exprimeras lätt.
- 5-10 minuter efter avnavling, plötsligt händer det något:
  - Pat känner sig konstig och illamående
  - Blodtryck bra
  - Okontaktbar och får sträckkramp

30-årig kvinna

Okontaktbar och kramp, vad göra?

- Ringer efter hjälp
- Söver och intuberar ua
- Lättventilerad.
- Bradykardi
- Inget koldioxid utbyte
- Huuuuu, asystoli…

1. HLR och adrenalin
2. ROSC inom 2 minuter
3. Artärnål, blodgas
4. UCG
5. ROTEM

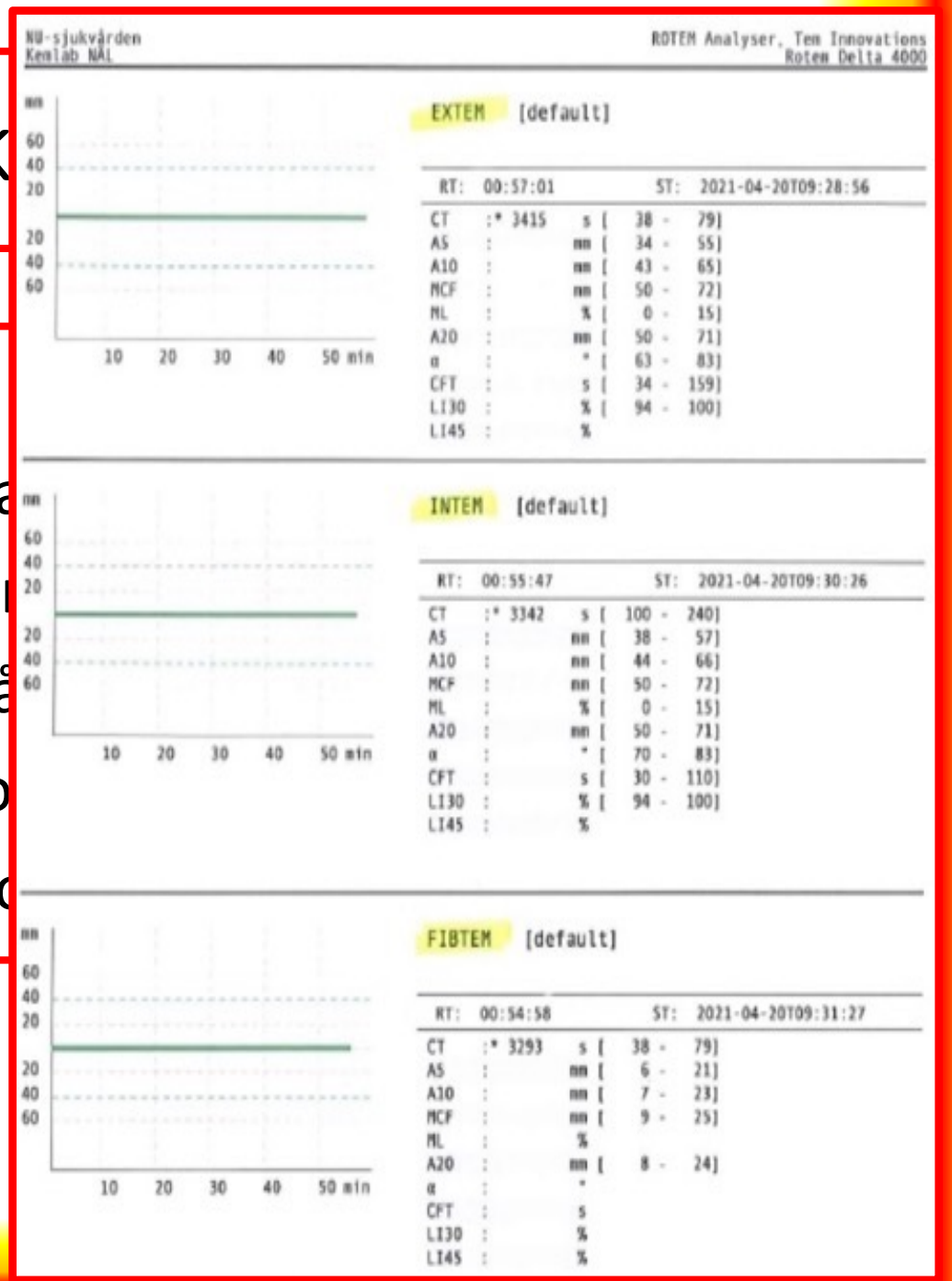
30-årig kvinna

Maternell k

- Diagnos?
  - Hjärtstopp
  - Lungemboli
  - Cirkulations kollaps
  - Blödningschock
  - Allergisk chock
  - Fostervattenemboli

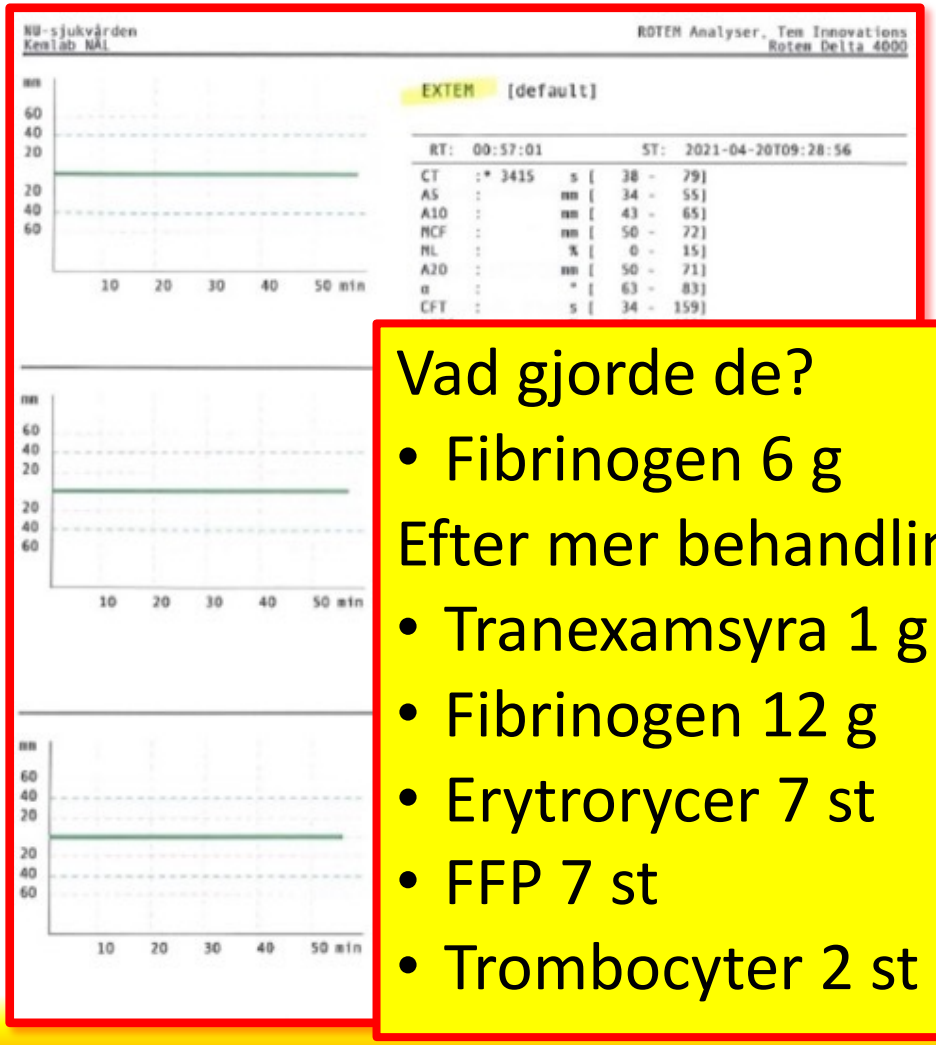
Vad göra?

- Obstetriker avsluta
- Viss atoni, oxytoci
- Viss blödning, 2 på
- Överväger trombo
- CT hjärna, thorax c



30-årig kvinna

Maternell kollaps, Rotem



Vad gjorde de?

- Fibrinogen 6 g

Efter mer behandling:

- Tranexamsyra 1 g
- Fibrinogen 12 g
- Erytrorycer 7 st
- FFP 7 st
- Trombocyter 2 st

30-årig kvinna

Maternell kollaps, IVA

- Lättventilerad
- Noradrenalin 0,4 mg/kg/min
- Fortsatt blödning
- Försök uterusballong
- Transfusion
  - Erytrocyter
  - FFP
  - Trombocyter

- Dag 1
  - Extuberad och till avd
- Dag 2
  - UCG ua
- Dag 5
  - Hem

Diagnos: Fostervattenemboli

- Maternell kollaps
- DIC

- ABCDE
- Perimortem snitt

Fostervattenemboli

- Ultraljud
- TEG/ROTEM

- Milrinon
- Noradrenalin

- Tranexamsyra
- 4:4:1
- Fibrinogen

- Prostac.
- NO
- ECMO

Lungemboli

ABCDE ink
Perimortem snitt

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journal homepage: www.elsevier.com/locate/bpobgy

9

Pulmonary embolism in pregnancy and the puerperium

Terence T. Lao

Department of Obstetrics & Gynaecology, The Chinese University of Hong Kong, Prince of Wales Hosp Shatin, Hong Kong

Keywords:
Pregnancy
Pulmonary embolism
Risk factors
Ventilation-perfusion scan
Pulmonary angiography
Anticoagulation

A B S T R A C T

Pulmo
increa
allowi
increa
conce
mater

- Actilyse
  - 10 mg iv under 1-2 minuter
  - 90 mg iv under 2 timmar
  - Vid mycket kritiskt läge
    - O,6 mg/kg under 2 min (max 50)
    - 50 mg under 60 minuter

Kunskapsstöd för vårdgivare

Riktlinjer och rekommendationer för specialiserad vård i region Stockholm, n Nationellt

Lungemboli med hemodynamisk påverkan – trombolys

Överväg trombolys vid

- Hemodynamisk påverkan; systoliskt BT <90-100, alternativt BT-fall >40 mmHg under minst 15 minuter, klinisk chockbild.
- Submassiv lungembolism, Individuell bedömning, diskussionsfall. Det gäller påverkad patient med bevarat blodtryck, sänkt syremättnad (oxygenbehov 5-10 l/min), förhöjt troponin och/eller NT-proBNP. Ekokardiografi visar högerkammarbelastning.

Trombolys kan även ges under pågående LMH/UFH. Starta heparininfusion ca 1 timme efter avslutad trombolys förutsatt att APT-tiden är <80 s. Om APT-tiden är >80 s startas heparininfusionen 2 tim efter avslutad trombolys.

Trombolys

Trombolysbehandling ska ges vid hemodynamisk instabil lungemboli på samma indikation som till icke-gravida och då används rekombinant tissue plasminogen activator exempelvis t-PA (Actilyse).

24-årig kvinna

Akutmottagning, vad göra?

- Frisk
- Förstgravida
- Graviditetsvecka 36
- Hittas livlös av sambo
- Ambulans på plats efter 15 minuter
- Konstaterar asystoli

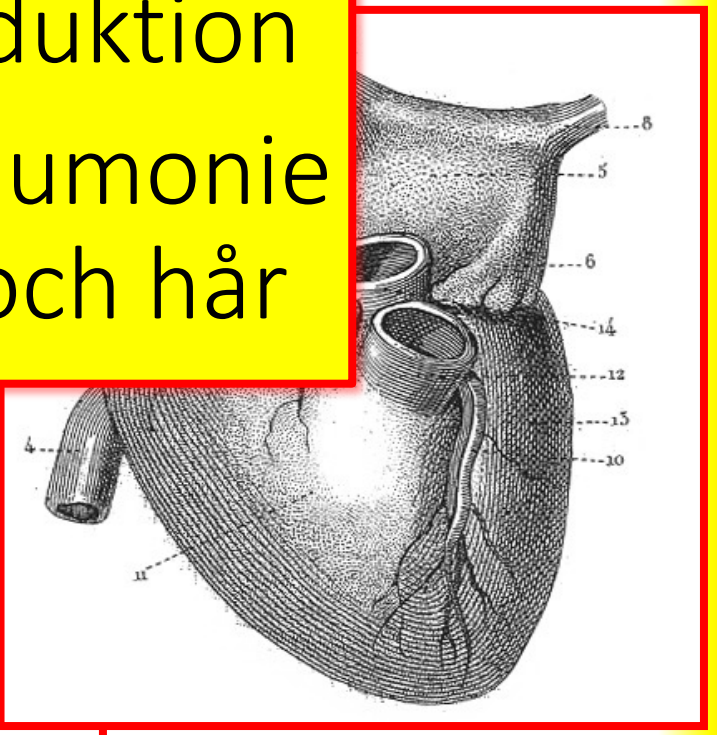
1. Konstatera dödsfall
2. Fortsätta avancerad HLR
3. Till operation för urakut kejsarsnitt
4. Utföra perimortem kejsarsnitt på plats

24-årig kvinna

Rättsmedicinsk obduktion

Staphylococcus pneumonie

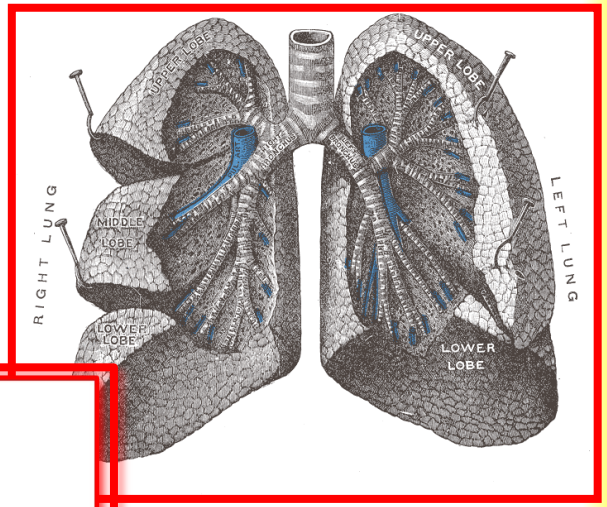
Amfetamin i blod och hår



På akutmottagning:

- Perimortem kejsarsnitt på akutrummet
- Barnet förlöses 50 minuter efter konstaterat hjärtstopp
- Barnet visar inga livstecken
- Avbryter HLR efter ytterligare 20 minuter

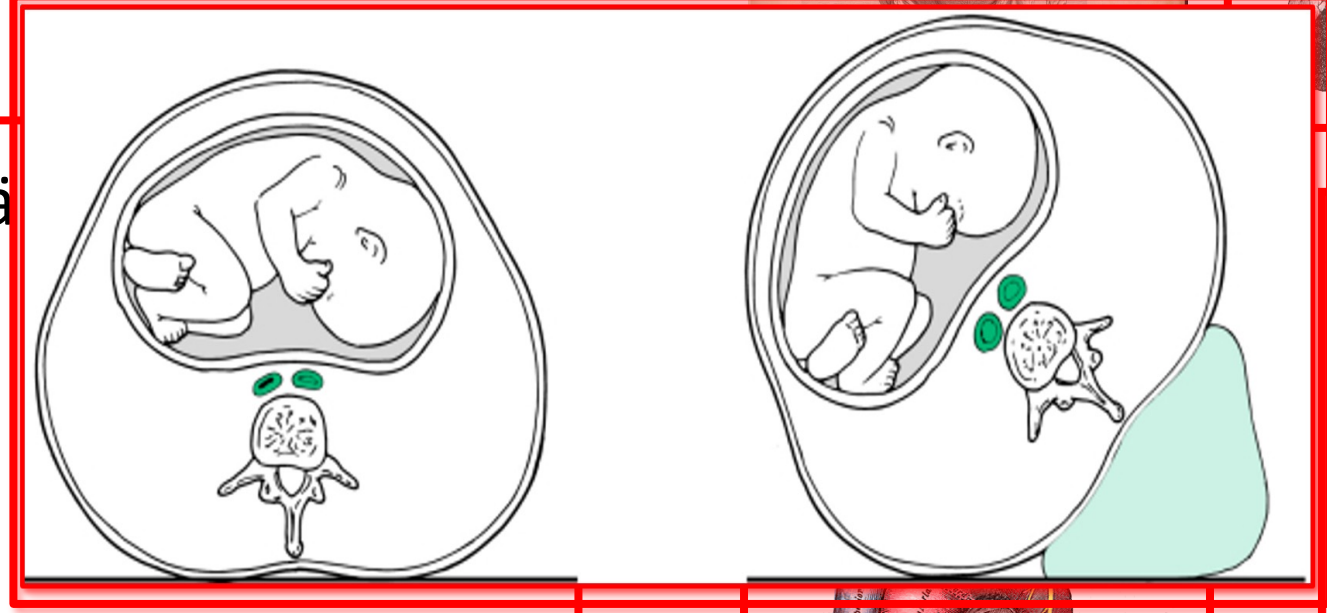
Graviditet

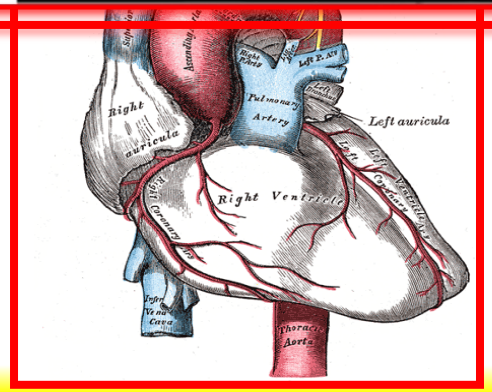


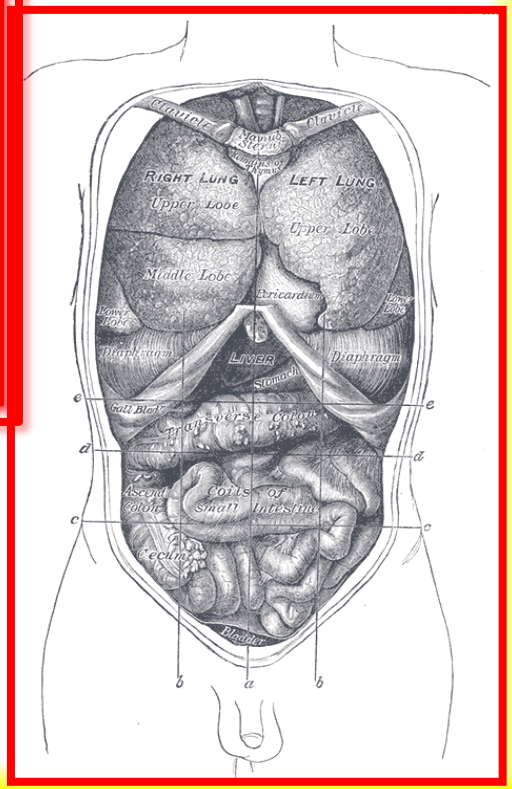
Fysiologisk förä

- Metabolism
- Respiration
- Cirkulation
- GI-kanalen

→ HLR på gravid kvinna svårt







PERIMORTEM CESAREAN DELIVERY

Vern L. Katz, MD, Deborah J. Dotters, MD, and William Droegemueller, MD

Postmortem cesarean delivery is an operation that has been practiced since antiquity. In previous centuries low infant survival rates led to negative opinions regarding the operation's usefulness. A review of the past centuries' cases and a review of fetal physiology suggest that to obtain optimum infant survival, cesarean delivery should be initiated within four minutes of maternal cardiac arrest. The physiology of cardiopulmonary resuscitation during pregnancy is analyzed, and recent cases of maternal cardiac arrest with successful maternal resuscitation are reviewed. This data suggests that perimortem cesarean delivery initiated within four minutes of maternal cardiac arrest will yield the highest rates of maternal survival. Legal liability from the operation is minimal. *(Obstet Gynecol 68:571, 1986)*

Table 2. Postmortem Cesarean Deliveries With Surviving Infants With Reports of Time From Death of the Mother Until Delivery (From 1900–1985)

Cases	No. patients	Percent
0–5 min	42 (normal infants)	70
6–10 min	7 (normal infants)	13
	1 (mild neurologic sequelae)	
Subtotal	8	
11–15 min	6 (normal infants)	12
	1 (severe neurologic sequelae)	
Subtotal	7	
16–20 min	1 (severe neurologic sequelae)	1.7
21 + min	2 (severe neurologic sequelae)	
	1 (normal infant)	3.3
Subtotal	3	
Total	61	100

1. Most fetal survivors were delivered within five minutes
2. Cesarean delivery could be undertaken up to 25 minutes after maternal death
3. Conclusion
   - Cesarean delivery should be begun within four minutes and the infant delivered within five minutes after maternal cardiac arrest
   - Four minutes rule will provide the optimal opportunity for saving the lives of both the mother and child

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ELSEVIER

American Journal of OBSTETRICS and GYNECOLOGY
www.ajog.org

Perimortem cesarean delivery: Were our assumptions correct?

Vern Katz, MD,[a,*] Keith

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Table III Effect of perimortem cesarean section on maternal circulation, reported cases 1985-2004[7,9-18,22,23,27-29,33,35]

Time from maternal cardiac arrest until delivery (min)	Return of spontaneous circulation and or improvement in hemodynamic status	No change
0-5	5	2
6-10	3	—
11-15	1	—
>15	4	5
Not reported	1	1
Total	12	8

Table II Reported cases of perimortem cesarean deliveries with cause of maternal cardiac arrest, 1985-2004

Cause of maternal cardiac arrest	Cases
Trauma	8
Cardiac	8
Embolism (AFE, air)	7
Magnesium overdose	5
Sepsis	3
Anesthesia	2
Eclampsia	1
Spontaneous uterine rupture	1
Intracranial hemorrhage	3
TOTAL	38

13 kvinnor överlevde

Conclusion: Published reports from 20 years support, but fall far from proving, that perimortem cesarean delivery within 4 minutes of maternal cardiac arrest improves maternal and neonatal outcomes.

Circulation

Part 1: Executive Summary

2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

INTRODUCTION

The *2020 American Heart Association* (AHA) *Guidelines for Card*
citation (CPR) *and Emergency Cardiovascular Care* provides a co
of evidence-based recommendations for resuscitation and emerg
care. The initial guidelines for CPR were published in 1966 by an a
tee of the Division of Medical Sciences, National Academy of Sci
search Council.[1] This occurred in response to requests from sever
agencies about the need for standards and guidelines regarding tra

Since then, CPR guidelines have been reviewed, updated, an
cally by the AHA.[2–9] In 2015, the process of 5-year updates wa
online format that uses a continuous evidence evaluation process
reviews. This allowed for significant changes in science to be revie
manner and then incorporated directly into the guidelines if d
The intent was that this would increase the potential for more in
from guidelines to bedside. The approach for this 2020 guideline
alignment with the International Liaison Committee on Resuscita
sociated member councils and includes varying levels of evidenc
the scientific questions considered of greatest clinical significance

Over a half-century after the initial guidelines were publis
remains a leading cause of mortality and morbidity in the Unit
countries worldwide. As reported in the AHA "Heart Disease
tics—2020 Update," emergency medical services respond to
adults and more than 7000 children (less than 18 years of age) w
cardiac arrest (OHCA) each year in the United States.[10] In-hos
(IHCA) is estimated to occur in 9.7 per 1000 adult cardiac arr
292 000 events annually) and 2.7 pediatric events per 1000 h
addition, approximately 1% of newly born infants in the United
sive resuscitative measures to restore cardiorespiratory function

Overall, although both adult and pediatric IHCA outcomes hav
since 2004, similar gains are not being seen in OHCA.[10] The pro
tients with return of spontaneous circulation (ROSC) following C
ed by emergency medical services has remained essentially uncha

Much of the variation in survival rates is thought to be due
the Chain of Survival (Figure 1), the critical actions that must oc
sion to maximize the chance of survival from cardiac arrest.[14] A
has been added to each Chain with this version of the guideline
importance of recovery and survivorship for resuscitation ou
Chains of Survival have also been developed for pediatric O
adult and pediatric IHCA. Similarly, successful neonatal resuscit
continuum of integrated lifesaving steps that begins with care

Cardiac arrest in pregnancy: We present updated recommendations and a new algorithm highlighting the concept that the best outcomes for both mother and fetus are through successful maternal resuscitation.[74] Team planning for cardiac arrest in pregnancy should be done in collaboration with the obstetric, neonatal, emergency, anesthesiology, intensive care, and cardiac arrest services (Class 1, LOE C-LD). Priorities for treating the pregnant woman in cardiac arrest should include provision of high-quality CPR and relief of aortocaval compression through left lateral uterine displacement (Class 1, LOE C-LD). If the pregnant woman with a fundus height at or above the umbilicus has not obtained ROSC with usual resuscitation measures plus manual left lateral uterine displacement, it is advisable to prepare to evacuate the uterus while resuscitation continues (Class 1, LOE C-LD).[75–79] To accomplish delivery early, ideally within 5 minutes after the time of arrest, it is reasonable to immediately prepare for perimortem cesarean delivery while initial BLS and advanced cardiovascular life support (ACLS) in-

AHA Scientific Statement

Cardiac Arrest in Pregnancy

A Scientific Statement From the American Heart Association

Farida M. Jeejeebhoy, MD, Chair; Carolyn M. Zelop, MD; Steve Lipman, MD; Brendan Carvalho, MD; Jose Joglar, MD; Jill M. Mhyre, MD; Vern L. Katz, MD; Stephen E. Lapinsky, MB BCh, MSc; Sharon Einav, MD; Carole A. Warnes, MD; Richard L. Page, MD; Russell E. Griffin, LP, FP-C; Amish Jain, MD; Katie N. Dainty, PhD; Julie Arafeh, RN, MS; Rory Windrim, MD; Gideon Koren, MD; Clifton W. Callaway, MD, PhD; on behalf of the American Heart Association Emergency Cardiovascular Care Committee, Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation, Council on Cardiovascular Diseases in the Young, and Council on Clinical Cardiology

Abstract—This is the first scientific statement from the American Heart Association on maternal resuscitation. This document will provide readers with up-to-date and comprehensive information, guidelines, and recommendations for all aspects of maternal resuscitation. Maternal resuscitation is an acute event that involves many subspecialties and allied health providers; this document will be relevant to all healthcare providers who are involved in resuscitation and specifically maternal resuscitation. **(*Circulation*. 2015;132:1747-1773. DOI: 10.1161/CIR.0000000000000300.)**

- High quality CPR
- Patient positioning during CPR
- Manual left uterine displacement
- Emergency Caesarean Delivery
- Within 5 minutes after the time of arrest

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REVIEW ARTICLE

Perimortem caesarean deliveries

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ABSTRACT
Although cardiac arrest in pregnancy is rare, it is important that all individuals involved in the acute care of pregn
suitably trained, because the outcome for both mother and fetus can be affected by the management of the arres
caesarean delivery was first described in 715 BC. Initially the procedure was performed principally for religious or pc
Although the potential for fetal survival was proposed, it was rarely successful, probably because the delivery wa
maternal death was established. However, in recent decades, case reports have suggested improved maternal as w
vival if perimortem caesarean section was performed rapidly once maternal arrest has occurred. While evidence fo
based on case reports, the physiological advantages including removing inferior caval obstruction, and hence imp
return to the heart, reducing oxygen requirement and improving chest compliance appear compelling. Factors that reduce errors
ance of training, organizational
robable that both maternal and

improves with early delivery. Perimortem caesarean delivery remains a key part of CPR of women in the second half of pregnancy.

- Behov tydligt protokoll

AOGS
ACTA Obstetricia et Gynecologica Scandinavica

AOGS REVIEW ARTICLE

Perimortem cesarean section for maternal and fetal salvage: concise review and protocol

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ELSEVIER

- Sidoförflytta uterus
- Ej vinkla under HLR
- Simulering och träni

11

Management of cardiac arrest in pregnancy

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Resuscitation

journal homepage: www.elsevier.com/locate/resusci

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- 1980 – 2010
- 94 fall
- 54 % överlevde
- Ok inom 10 min

Review article

Maternal cardiac arrest and perimortem caesarean delivery: Evidence or expert-based?☆,☆☆

Sharon Einav[a,*], Nechama Kaufman[a,b], Hen Y. Sela[c]

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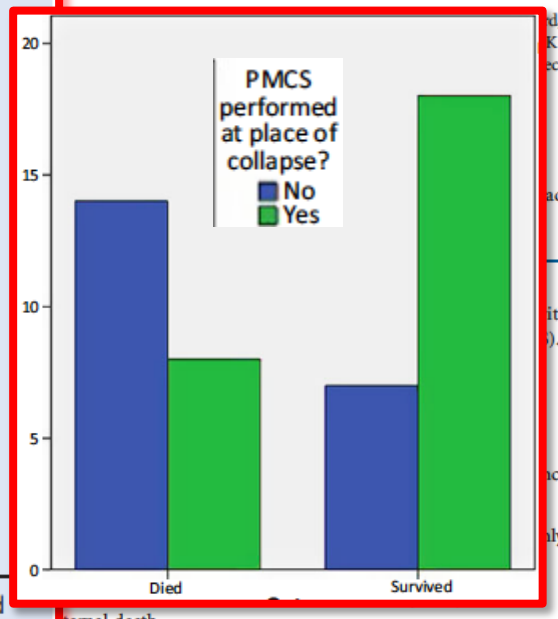
[c] *The Department of Obstetrics and Gynaecology, Division of Maternal Fetal Medicine, Columbia University Medical Center, New York, USA*

Cause	Women who survived (*n* = 37)	Women who died (*n* = 22)
Presumed premortem causes (*n* = 59)		
Cardiac tamponade	1	0
Hypoxia	4	0
Hypovolaemia	5	8
Venous thromboembolism	1	7
Toxic drug cause	1	0
Anaphylaxis	1	0
Sepsis	0	1
Anaesthetic cause	17	0
Amniotic fluid embolism	5	3
Cardiac cause	5	1
Intracerebral bleed	0	3
Aortic dissection	0	2
Asthma	0	1
Pulmonary artery rupture	0	1
Postmortem causes of collapse (*n* = 19)		
Amniotic fluid embolism		6
Vessel bleed/rupture		5
Thrombembolic		3
Cardiomyopathy		2
Other		3

Data were available for 59 women. Some women were suspected of having more than one cause, where this is the case both causes have been recorded.



BJOG An International Journal of Obstetrics and Gynaecology

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The CAPS Study: incidence, managemen outcomes of cardiac arrest in pregnancy UK: a prospective, descriptive study

VA Beckett,[a] M Knight,[b] P Sharpe[c]

d, UK [b] National Perinatal Epidemiology Unit, Univ
K
cology, Bradford Teaching Hospitals NHS Foundati

act available at https://vimeo.com/rcog/authorinsights14521.

ternal death.

sults There were 66 cardiac arrests in pregnancy, resulting in an idence of 2.78 per 100 000 maternities (1:36 000; 95% CI 2.2–). In all, 28 women died (case fatality rate 42%); 16 women arrested solely as a consequence of obstetric anaesthesia, 12 of whom were obese. Basic and advanced life support were rapidly delivered. Those who died were more likely to have collapsed at home. Perimortem caesarean section was performed in 49 women, 11 in the emergency department. The time from collapse to PMCS was significantly shorter in women who survived (median interval 3 versus 12 minutes, $P = 0.001$). Forty-six of 58 babies were born alive; 32 babies to surviving mothers and 14 to women who died.

Conclusion Cardiac arrest is rare in the pregnant UK population, however, nearly a quarter of cases are precipitated by obstetric anaesthesia, suggesting an opportunity to reduce the incidence further. Maternal survival rates of 58% were achieved with timely resuscitation, including PMCS, delay in which was associated with maternal death. Inpatient arrests were associated with higher survival rates than arrests that occurred outside the hospital setting.

Keywords Cardiac arrest, maternal morbidity, maternal mortality perimortem caesarean section, resuscitation.

Tweetable abstract 25% of cardiac arrest in pregnancy is caused by anaesthesia. Rapid perimortem section improves survival.

Linked article This article is commented on by JM Mhyre and Bateman, p. 1382 in this issue. To view this mini commentary visit https://doi.org/10.1111/1471-0528.14569. This article has journal club questions by BD Einerson, p. 1383 in this issue. To view these visit http://dx.doi.org/10.1111/1471-0528.14662.

Table 2. Time to emergency procedures in minutes, median (range), following maternal collapse

	Women who survived (*n* = 38)	Women who died (*n* = 28)	*P*-value
Collapse to BLS	0 (0–17)	0 (0–23)	0.28
Collapse to ALS	1 (0–36)	0 (0–24)	0.08
Collapse to PMCS	3 (0–39)	12 (0–67)	0.01

Mann–Whitney *U* tests for nonparametric data were applied.

- Prospektiv studie UK
- juli 2011 – juni 2014
- 66 st hjärtstopp
- ¼ orsak anestesi
- Överlevnad 58 %
  - HLR inom tid
  - Perimortem snitt
  - Sjukhus

- Kvinna 30 år
  - Gravid v 24
  - Preeklampsi
  - Obesitas
- Anafylaxi, dextran
- Postpartum LUCAS
- HLR 50 minuter
- Riktlinje Stryker: graviditet inga kontraindikationer

Resuscitation (2006) 68, 155—159

RESUSCITATION

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CASE REPORT

Cardiac arrest and resuscitation with an automatic mechanical chest compression device (LUCAS) due to anaphylaxis of a woman receiving caesarean section because of pre-eclampsia☆

Tor Thomas Vatsgar[a], Ola Ingebrigtsen[b], Lars Olav Fjose[a], Bente Wikstrøm[a], Jan Erik Nilsen[a,c], Lars Wik[d,*]

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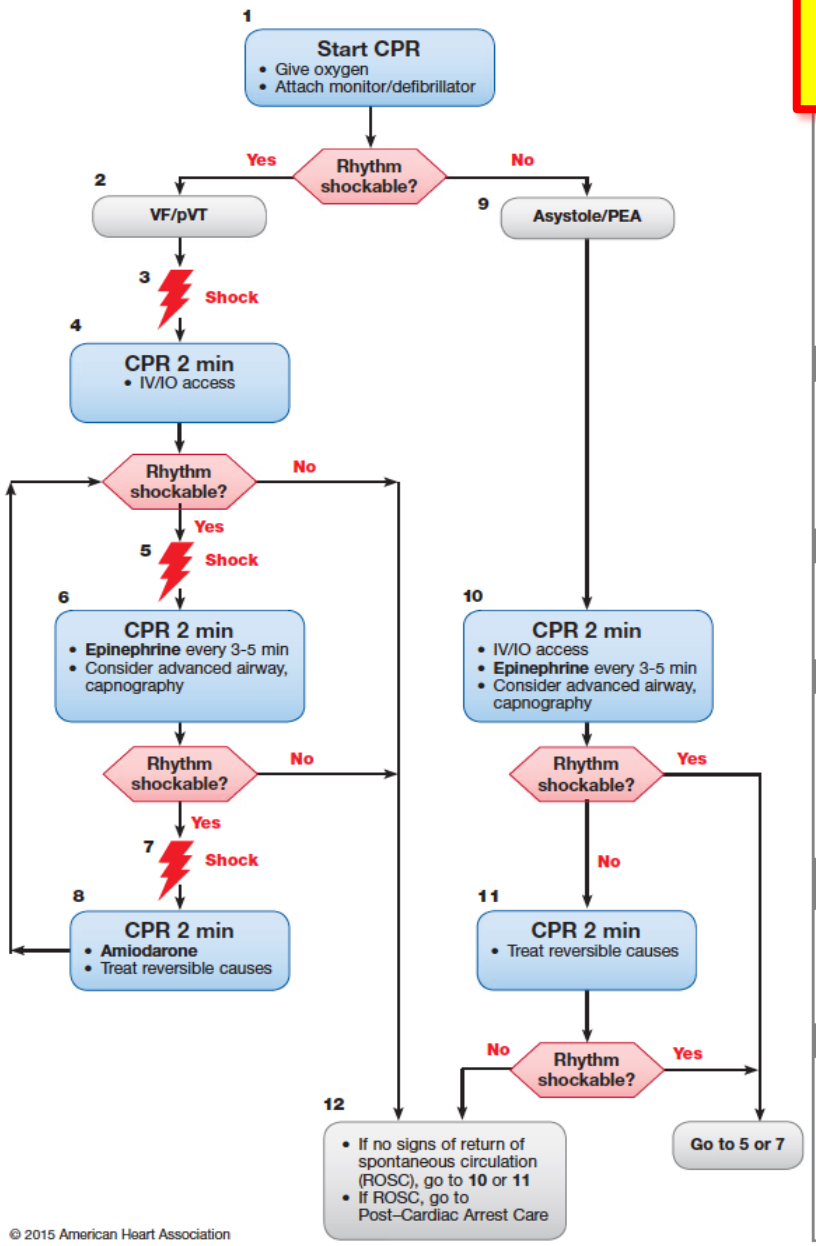
Received 3 June 2005; accepted 3 June 2005

KEYWORDS
Cardiac arrest;
Resuscitation;
LUCAS;
Anaphylaxis

Summary We report a case of anaphylaxis with pulseless electrical activity (PEA)(verified by ECG and a radial intra-arterial line) in a 30-year-old woman who received 3G Promiten (dextran-1) and a prophylactic intra-venous infusion of Macrodex (dextran) for postoperative thromboembolism during caesarean section for pre-eclampsia in the 24th week of gestation. Manual chest compressions, followed by mechanical chest compressions (LUCAS, Jolife, Lund, Sweden), were performed for 50 min before restoration of spontaneous circulation (ROSC). She awoke the next day with no sequelae. She had some suction cup marks on the sternum but otherwise no complications of the chest compressions. At follow up by phone 1 month later, she and her baby were doing well.

KRÅNGLIGA?

Adult Cardiac Arrest Algorithm—2015 Update



2 minutes, or sooner if fatigued.
- If no advanced airway, 30:2 compression-ventilation ratio.
- Quantitative waveform capnography
  - If P_{ETCO_2} <10 mm Hg, attempt to improve CPR quality.
- Intra-arterial pressure
  - If relaxation phase (diastolic) pressure <20 mm Hg, attempt to improve CPR quality.

Shock Energy for Defibrillation

- **Biphasic:** Manufacturer recommendation (eg, initial dose of 120-200 J); if unknown, use maximum available. Second and subsequent doses should be equivalent, and higher doses may be considered.
- **Monophasic:** 360 J

Drug Therapy

- **Epinephrine IV/IO dose:** 1 mg every 3-5 minutes
- **Amiodarone IV/IO dose:** First dose: 300 mg bolus. Second dose: 150 mg.

Advanced Airway

give 1 breath every 6 seconds (10 breaths/min) with continuous chest compressions

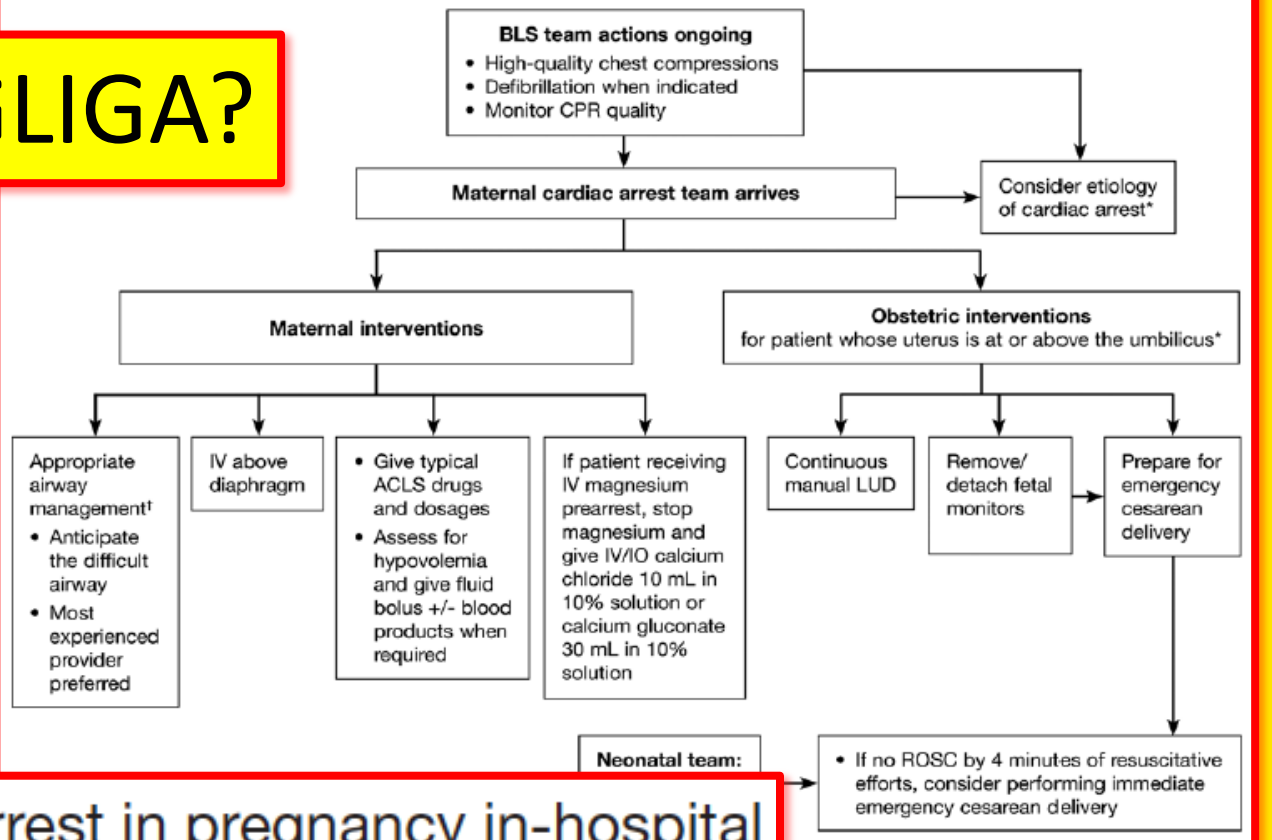
Return of Spontaneous Circulation (ROSC)

- Pulse and blood pressure
- Abrupt sustained increase in P_{ETCO_2} (typically ≥40 mm Hg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

Reversible Causes

- **H**ypovolemia
- **H**ypoxia
- **H**ydrogen ion (acidosis)
- **H**ypo-/hyperkalemia
- **H**ypothermia
- **T**ension pneumothorax
- **T**amponade, cardiac
- **T**oxins
- **T**hrombosis, pulmonary
- **T**hrombosis, coronary

Cardiac arrest in pregnancy in-hospital



*Potential etiology of maternal cardiac arrest:

A Anesthetic complications/accidents
B Bleeding
C Cardiovascular
D Drugs
E Embolic
F Fever
G General nonobstetric causes of cardiac arrest (H's and T's)
H Hypertension

†Appropriate airway management for pregnancy:

- 100% oxygen at ≥15 L/min and continue BLS airway strategies
- Optimally 2 attempts per technique:
  - First intubation attempt—if failed go to
  - Second intubation attempt—if failed go to
  - First supraglottic airway attempt—if failed go to
  - Second supraglottic airway attempt—if failed go to mask ventilation
  - If mask ventilation inadequate—attempt cricothyrotomy
- Avoid airway trauma
- Ventilate with 8–10 breaths/min
- Monitor capnography
- Minimize interruptions in chest compressions during advanced airway placement
- Recommend 6.0- to 7.0-mm inner diameter ETT

Doknr. i Barium	Dokumentserie	Giltigt fr o m	Version
20795	su/med	2016-11-22	3

RUTIN Hjärtlarm gravid kvinna

Innehållsansvarig: Ove Karlsson, Överläkare, Läkare Anestesi Operation Intensivvård område 2 (oveka1)
Godkänd av: Göran Sandström, Verksamhetschef, Verksamhet Anestesi Operation IVA Östra (gorla4)
Denna rutin gäller för: Verksamhet Anestesi Operation IVA Östra; Obstetrik gemensamt

1. Konstatera Hjärtstopp

2. Larma

- Ring 39090
- Säg: Hjärtlarm gravid, Östra sjukhuset. Avdelning? Rum?
- Avdela personal att visa vägen till patienten.

3. Sidoförflytta uterus åt vänster

4. Påbörja HLR

- 30:2 dvs 30 kompressioner och 2 inblåsningar.
- Fortsätt enligt handlingsplan samt defibrillera vid behov.

5. Perimortem kejsarsnitt

- Indikation
  - Graviditetsvecka > 24.
  - Övervägs från vecka 20.
  - Om cirkulation ej omedelbart återkommer.
- Barnet bör vara ute senast 5 minuter efter hjärtstopp.
- Utföres på plats där kvinnan påträffas.
- Utföres med engångsskalpell, peang, sax och handskar.
- Personal från KK-Op kommer med mer utrustning.

6. Om cirkulation återkommer, transportera patient till operation och avsluta operation.

Övrigt

- Vid hjärtstopp gravid kvinna slår växeln ut 2 st larm, ”Hjärtlarm” och ”Hjärtlarm gravid”.
- I sökare står texten ”HJÄRTA GRAVID”
- Efter ”Hjärtlarm gravid” kommer ett textmeddelande om var patienten finns. Larmgruppen skall dock ringa växeln och kvittera larmet.
- Lag kommer från KK-Op, inklusive obstetriker, neonatolog och barnsjuksköterska. Växeln meddelar sektionsledare, specialförlossning för ID-märkning av barnet.
- Akut väska med utrustning för perimortem kejsarsnitt finns på samtliga avdelningar på KK, HIA, akutmottagning CK samt på infektionskliniken avd 302 och 303.
- Syftet med perimortem kejsarsnitt är att återställa moderns cirkulation.

Granskare/arbetsgrupp

Monica Eriksson Orrskog, vårdenhetsöverläkare, Normalförlossningen, område 1
Mårten Alkmark, vårdenhetsöverläkare, Specialförlossningen, område 1

1. **Konstatera Hjärtstopp**
2. **Larma**
   - Ring 39090
   - Säg: Hjärtlarm gravid, Östra sjukhuset. Avdelning? Rum?
   - Avdela personal att visa vägen till patienten.
3. **Sidoförflytta uterus åt vänster**
4. **Påbörja HLR**
   - 30:2 dvs 30 kompressioner och 2 inblåsningar.
   - Fortsätt enligt handlingsplan samt defibrillera vid behov.

Före och efter HLR
Ej under HLR

5. Perimortem kejsarsnitt

- Indikation
  - Graviditetsvecka > 24.
  - Övervägs från vecka 20.
  - Om cirkulation ej omedelbart återkommer.
- Barnet bör vara ute senast 5 minuter efter hjärtstopp.
- Utföres på plats där kvinnan påträffas.
- Utföres med engångsskalpell, peang, sax och handskar.
- Personal från Operation 2 Östra (KK-Op) kommer med mer utrustning.

Övrigt

- Vid hjärtstopp gravid kvinna slår växeln ut 2 st larm, ”Hjärtlarm” och ”Hjärtlarm gravid”.
- I sökare står texten ”HJÄRTA GRAVID”
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- Syftet med perimortem kejsarsnitt är att återställa moderns cirkulation.


Hjärtstartare


Perimortem set
Packade 210114

11.2 Hjärtstopp på sjukhus

Det finns i nuläget inget vetenskapligt validerat och säkert verktyg som kan hjälpa till i beslutet att avbryta pågående HLR. Beprövad erfarenhet säger att HLR bör fortgå så länge rytmen är ventrikelflimmer eller ventrikeltachykardi. Generellt anses 20 minuter asystoli vara förknippat med mycket dålig prognos men det finns undantag med patienter som överlevt betydligt längre perioder med asystoli. Som nämnts i kapitel 4.3 finns prediktionsverktyg för att uppskatta chansen till överlevnad *före* ett eventuellt hjärtstopp inträffar.[31] Sådana prediktionsverktyg kan användas som hjälpmedel tillsammans med andra faktorer (bevittnat/obevittnat hjärtstopp, initial rytm, HLR-duration etc.) men skall inte användas isolerat eller övertolkas.

11.3 Hjärtstopp utanför sjukhus

Ett stort antal studier har genomförts med syfte att finna tydliga gränser för när HLR utanför sjukhus anses medicinskt utsiktslöst och bör avbrytas. Svenska HLR- rådets algoritm för avbrytande av HLR prehospitalt tar hänsyn till initial rytm, om hjärtstoppet var bevittnat eller ej, om HLR har utförts innan ambulansens ankomst samt om puls eller livstecken ses under HLR. Vägledningen täcker dock inte alla situationer och det finns fall när fortsatt HLR trots uppfyllda kriterier för avbrytande kan anses motiverat. Generellt anses 20 minuter asystoli även vid hjärtstopp utanför sjukhus vara förknippat med mycket dålig prognos. Vid initial defibrilleringsbar rytm bör HLR pågå i 40 minuter eller längre.

- Att ta hänsyn till:
  - Bevittnat/obevittnat hjärtstopp
  - Initial rytm
  - HLR duration och kvalitet

- Dålig prognos vid 20 min asystoli
- Vid initial defibrilleringsbar rytm bör HLR pågå > 40 min

Kvinna 35 år

- II-gravida, I-para
- PN 2018
- Postpartum
  - Trött
  - Blåsljud
  - UCG
    - MI 1/3
    - Susp Mb Barlow (mitralprolaps)
- Inför aktuell graviditet
  - UCG oförändrad
  - GUCH konferens
  - Susp Mb Barlow och MAD (Mitral annular disjunction)

Plötsligt en kväll

- 22.00 ont i käken
- 22.55 hjärtstopp
  - Larm
  - Make HLR
- 23.02 ambulans på plats
  - VF
    - Defibrillering, tot 4 ggr
    - Adrenalin
    - Cordarone
  - LUCAS
- 23.25 Akutmottagning

Kvinna 35 år

- Akutmottagning
  - 23.30 perimortem snitt
  - 23.32 partus
  - Defibrillering
  - ROSC ca 23.33
- Efter ROSC
  - PCI-lab, koronarangio, aortografi och pulmonalisangio ua
  - UCG
- Till operation
  - Op 01.48 – 02.43
- Under natten
  - Till IVA

Hjärtstopp, vad göra?

- Dag 1
  - IVA och respirator
- Dag 2
  - Extuberas
  - Initialt desorienterad
- Dag 3
  - HIA
- Under vårdtiden
  - Klarare för varje dag
  - MR hjärta ua
  - ICD
  - Hem dag 20

Att fundera på!

- Misstänk och utred hjärtsjukdom
- Inför NEWS 2
- Många orsaker till maternell kollaps
- Hjärtlarm gravid kvinna
- Perimortem kejsarsnitt
- HLR träning och simulering
- Att arbeta med detta skapar bra samarbete och bättre relationer
- Multidisciplinärt teamarbete
- Patientnära instrument

Fostervattenemboli
Maternell kollaps

Plötsligt medvetslös