Pregnancy-related Cardiovascular diseases

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7th Annual Cardiovascular Symposium
Cardiocare Multispecialty Hospital
Abuja

Disclosures

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- Past speaking fees/support from Servier, Pfizer, Astra Zeneca, Boehringer Ingelheim, Phillips, Interpharma/Cadila, Mega Lifesciences, Marcsonhealth, & MSN laboratories.

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Outline

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- Introduction/Epidemiology
- Spectrum of pregnancy-related CVDs
- Risk factors
- Haemodynamic changes in pregnancy
- Clinical presentation
- Spectrum types & management
- Summary

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Introduction

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- Cardiovascular disease (CVD) is the leading cause of maternal mortality.
- Increased prevalence of cardiovascular disease in women of childbearing age.
- Up to 4% of pregnancies may have cardiovascular complications despite no known prior disease.
- The spectrum of CVD in pregnancy differs between countries.

Mancia et al,2023 ESH Guideline.

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Epidemiology

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- Hypertensive disorders are the most frequent CVD during pregnancy, occurring in 6–8% of all pregnancies.
- In the western world, congenital heart disease is the most frequent.
- Rheumatic valvular disease dominates in non-western countries, comprising 56–89%.
- Nigeria has the highest burden of PPCM in the world, with an incidence as high as 1:96 deliveries and mortality of 47.4% at 1 year.

Mancia et al, 2023 ESH Guideline. Regitz-Zagrosek et al, 2018 ESC Guideline. Kwaye et al, JACC 2020.

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Spectrum of CVDs in pregnancy

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- Hypertension
- Peripartum cardiomyopathy
- Congenital heart disease
- Valvular heart disease
- Coronary heart disease
- Pulmonary embolism
- Arrhythmias- SVT/AF/VT/VF
- Stroke
- Aortic disease

Regitz-Zagrosek et al, 2018 ESC Guideline.

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Risk factors

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- Increasing age at first pregnancy
- Cardiovascular risk factors—diabetes, hypertension, and obesity
- Improved treatment of congenital heart disease
- Autoimmune disease
- Nulliparity/Multiparity/Multifetal pregnancies
- Long inter-pregnancy interval
- Assisted Reproductive Technology

Regitz-Zagrosek et al, 2018 ESC Guideline. Mancia et al, 2023 ESH Guideline.

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Hemodynamic changes in pregnancy

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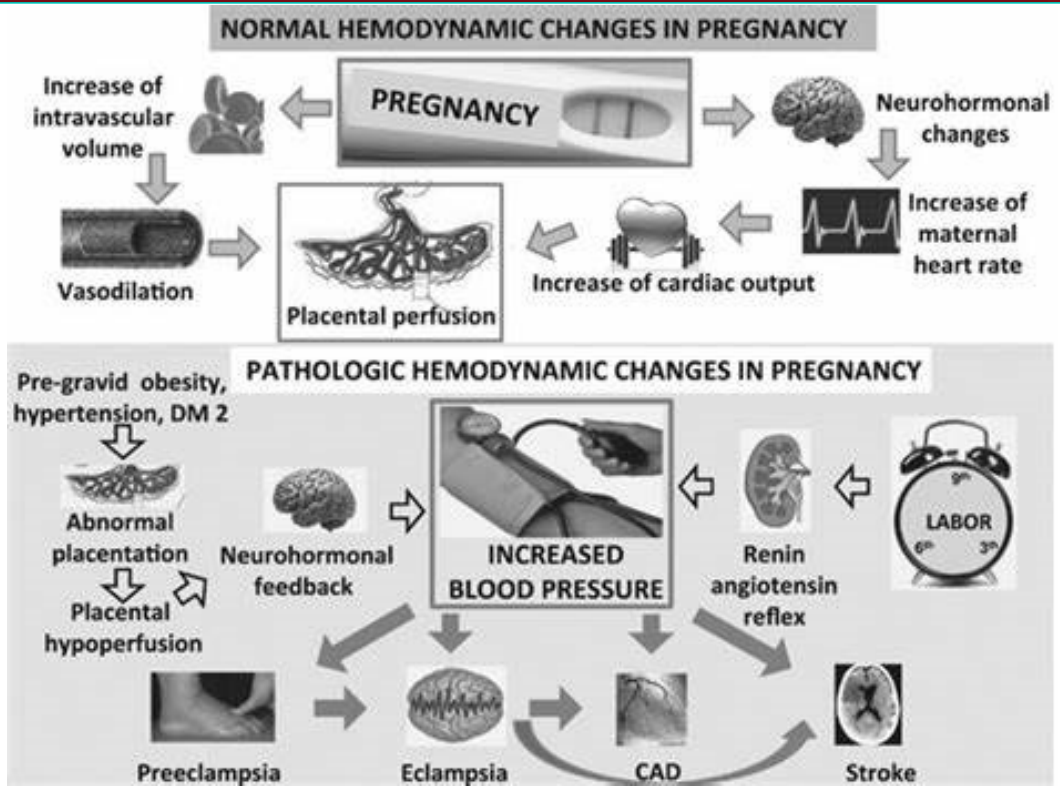

First trimester

- Increased CO by 30-50% (HR ↑10-15bpm & blood volume)
- BP ↓10-15mmHg (↓SVR from low resistance placenta)
- Haematocrit ↓

Second trimester

Changes peak

Third trimester

Changes plateau

- Reduced CO from vena cava compression

Labour/Delivery/Postpartum

- Increased CO, BP, HR, SVR

van Oppen et al, Obstet Gynecol 1996. Robsonet al, Br J Obstet Gynecol 1987.

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Clinical presentation

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- Physiological changes that occur during pregnancy can mimic CVDs.
- Careful history and a thorough physical examination is important.
- BP should be measured.
- Listen for pathological murmurs (physiologic murmurs are usually soft, mid-systolic murmurs along the left sternal edge).
- Urinalysis for proteinuria.

Stout et al, Heart 2007.

Mishra et al, BMJ 1992.

Question 1

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- The following are symptoms of normal pregnancy:

a) Dyspnea on exertion **T**

b) Orthopnea **T**

c) Angina **F**

d) Resting dyspnea **F**

e) Paroxysmal nocturnal dyspnea **F**

Question 2

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- The following are signs of normal pregnancy:

a) Jugular venous distension **T**

b) Apical S_3 **T**

c) Basal crackles **T**

d) Prominent left and right ventricular apical impulses **T**

e) Peripheral edema **T**

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Evaluation

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- ECG- basic screening to identify need for further study.
- ECHO- preferred imaging modality in pregnancy.
- Exercise testing
- CXR/CT/MRI/Cardiac Cath
- Genetic testing and counselling
- Pre-natal diagnosis
- Maternal CV risk assessment

Regitz-Zagrosek et al, 2018 ESC Guideline.

Maternal cardiovascular risk assessment

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Table 3 Modified World Health Organization classification of maternal cardiovascular risk

	mWHO I	mWHO II	mWHO II–III	mWHO III	mWHO IV
Diagnosis (if otherwise well and uncomplicated)	Small or mild – pulmonary stenosis – patent ductus arteriosus – mitral valve prolapse Successfully repaired simple lesions (atrial or ventricular septal defect, patent ductus arteriosus, anomalous pulmonary venous drainage) Atrial or ventricular ectopic beats, isolated	Unoperated atrial or ventricular septal defect Repaired tetralogy of Fallot Most arrhythmias (supraventricular arrhythmias) Turner syndrome without aortic dilatation	Mild left ventricular impairment (EF >45%) Hypertrophic cardiomyopathy Native or tissue valve disease not considered WHO I or IV (mild mitral stenosis, moderate aortic stenosis) Marfan or other HTAD syndrome without aortic dilatation Aorta <45 mm in bicuspid aortic valve pathology Repaired coarctation Atrioventricular septal defect	Moderate left ventricular impairment (EF 30–45%) Previous peripartum cardiomyopathy without any residual left ventricular impairment Mechanical valve Systemic right ventricle with good or mildly decreased ventricular function Fontan circulation. If otherwise the patient is well and the cardiac condition uncomplicated Unrepaired cyanotic heart disease Other complex heart disease	Pulmonary arterial hypertension Severe systemic ventricular dysfunction (EF <30% or NYHA class III–IV) Previous peripartum cardiomyopathy with any residual left ventricular impairment Severe mitral stenosis Severe symptomatic aortic stenosis Systemic right ventricle with moderate or severely decreased ventricular function

In women with a moderate or high-risk of complications during pregnancy (mWHO II–III, III, and IV), pre-pregnancy counselling and management during pregnancy and around delivery should be conducted in an expert centre by the pregnancy heart team.

Regitz-Zagrosek et al, 2018 ESC Guideline.

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Maternal cardiovascular risk assessment

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Risk	No detectable increased risk of maternal mortality and no/mild increased risk in morbidity	Small increased risk of maternal mortality or moderate increase in morbidity	Intermediate increased risk of maternal mortality or moderate to severe increase in morbidity	Significantly increased risk of maternal mortality or severe morbidity	Extremely high risk of maternal mortality or severe morbidity
Maternal cardiac event rate	2.5–5%	5.7–10.5%	10–19%	19–27%	40–100%
Counselling	Yes	Yes	Yes	Yes: expert counselling required	Yes: pregnancy contraindicated: if pregnancy occurs, termination should be discussed
Care during pregnancy	Local hospital	Local hospital	Referral hospital	Expert centre for pregnancy and cardiac disease	Expert centre for pregnancy and cardiac disease
Minimal follow-up visits during pregnancy	Once or twice	Once per trimester	Bimonthly	Monthly or bimonthly	Monthly
Location of delivery	Local hospital	Local hospital	Referral hospital	Expert centre for pregnancy and cardiac disease	Expert centre for pregnancy and cardiac disease

Regitz-Zagrosek et al, 2018 ESC Guideline.

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High risk pregnancies

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- Pulmonary arterial hypertension
- Severe ventricular dysfunction (EF <30% or NYHA class III-IV)
- PPCM with residual impairment
- Severe MS
- Severe symptomatic AS
- Systemic RV with moderate or severe decreased ventricular function
- Severe aortic disease- dilatation, Vascular Ehler-Danlos syndrome etc

Regitz-Zagrosek et al, 2018 ESC Guideline.

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General recommendations of management

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Recommendations	Class[a]	Level[b]
Pre-pregnancy risk assessment and counselling is indicated in all women with known or suspected congenital or acquired cardiovascular and aortic disease.[39]	I	C
It is recommended to perform risk assessment in all women with cardiac diseases of childbearing age before and after conception, using the mWHO classification of maternal risk.[11]	I	C
It is recommended that high-risk patients are treated in specialized centres by a multidisciplinary pregnancy heart team.[39]	I	C
Foetal echocardiography by experienced specialists is recommended when there is an elevated risk of foetal abnormalities.[76–80]	I	C
Echocardiography is recommended in any pregnant patient with unexplained or new cardiovascular signs or symptoms.	I	C
If cardiac surgery is to be performed after 24 weeks and before 37 weeks of gestation, then corticosteroids are recommended for the mother.[134]	I	C
Vaginal delivery is recommended as the first choice in most patients; for most important exceptions see below.[96]	I	C

Regitz-Zagrosek et al, 2018 ESC Guideline.

Cardio-Obstetrics model

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Preconception
- Contraception advice
- Optimize medical status
- Medication adjustment
- Risk assessment:
  - mWHO
  - CARPREG II
  - ZAHARA

Pregnancy
- Team-based care with patient
- Serial monitoring
- Delivery planning balancing maternal/ fetal risks

Labor/Delivery
- Mode: Vaginal delivery usually preferred
- Regional anesthesia
- Monitoring: consider pulse oximetry, telemetry if indicated

Postpartum
- Monitoring: minimum 48 hours
- Assess and treat cardiovascular complications
- Patient counseling on symptoms of complications

Fourth Trimester
- 3-7 days follow-up post-discharge
- Comprehensive evaluation within 6 weeks
- Consider addition of telehealth visits
- Contraception

Long-Term
- Identify women with APO (preeclampsia and hypertensive disorders, gestational diabetes, preterm delivery, small for gestational age)
- CVD risk screening

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Virani et al, 2023AHA/ACC/ACCP/ASPC/NLA/PCNA Guideline.

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Spectrum of CVDs in pregnancy

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- Hypertension
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- Coronary heart disease
- Pulmonary embolism
- Arrhythmias- SVT/AF/VT/VF
- Stroke
- Aortic disease

Regitz-Zagrosek et al, 2018 ESC Guideline.

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Hypertensive disorders

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- Hypertension in pregnancy is persistent elevated BP ≥ 140/90mmHg.
- Severe hypertension ≥ 160/110mmHg
- Hypertensive emergency ≥ 170/110mmHg

  - Preexisting hypertension
  - Gestational hypertension
    - Preeclampsia
    - Transient hypertension
  - Preexisting hypertension + superimposed gestational hypertension
  - Antenatally unclassified

Mancia et al, 2023 ESH Guideline.

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Management of Hypertension

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- **Refer** ≥160/110mmHg or acute worsening of BP control in pregnant women with preexisting hypertension
- Target <140/90mmHg

Recommendations and statements	CoR	LoE
In women with hypertensive disorders in pregnancy, initiation or intensification of drug treatment is recommended when SBP is ≥ 140 mmHg and/or DBP ≥ 90 mmHg.	I	C
In women with pre-existing hypertension (with or without superimposed pre-eclampsia), BP should be lowered to a target below 140/90 mmHg.	I	A
In women with gestational hypertension (with or without pre-eclampsia), BP should be lowered to a target below 140/90 mmHg.	I	C
In women with hypertensive disorders in pregnancy, too marked BP-lowering should be avoided. On-treatment DBP <80 mmHg is not recommended.	III	C
Labetalol[a] and α-methyl-DOPA are the first choice BP-lowering agents for hypertensive disorders in pregnancy unless contraindicated.	I	B
Extended-release nifedipine is recommended as an alternative BP-lowering agent during pregnancy.	I	B

Mancia et al, 2023 ESH Guideline.

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Heart failure/PPCM

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- 39 yr old AE with difficulty with breathing 6/52 following delivery in 2019
- ECHO showed dilated LV with EF of 42%
- Had frusemide, bisoprolol, enalapril, and dapagliflozin later.
- Linear & biplane EF 56% & 54% 2021 | Linear & biplane EF 61% &56% 2022
- ECG- sinus rhythm with 1AVB | NTproBNP of 18.6pg/ml in April 2023
- BP- 120-132/70-86mmHg

DESIRIOUS OF PREGNANCY, CAN SHE?

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Heart failure

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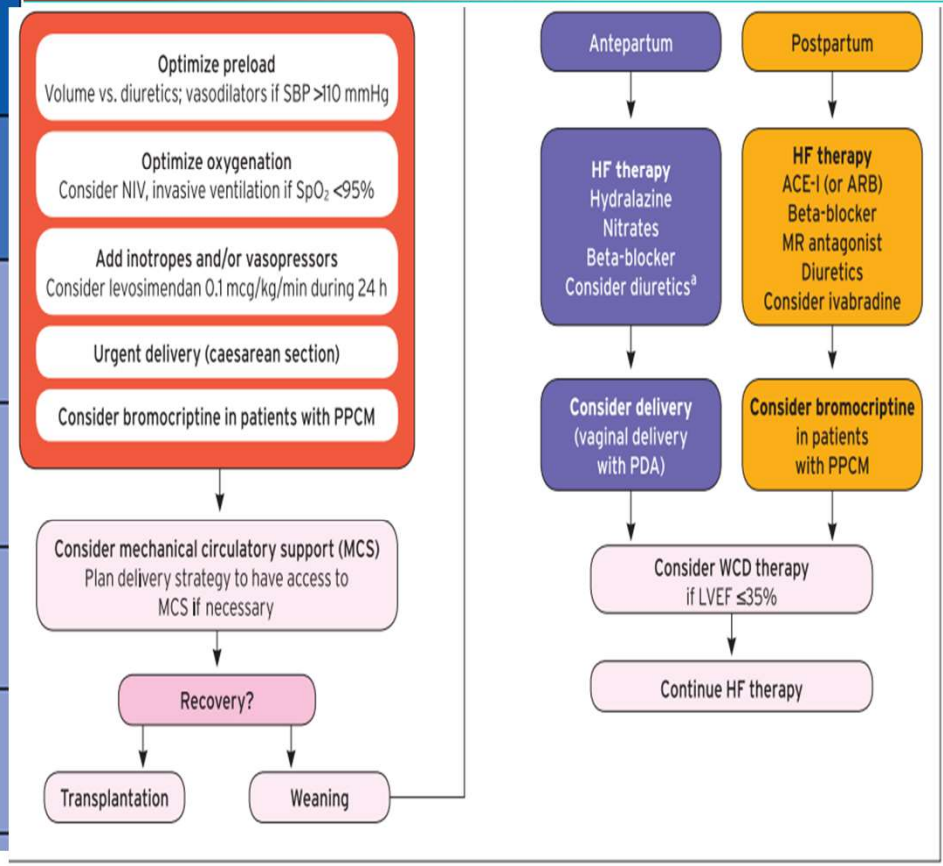
Anticoagulation is recommended in patients with intracardiac thrombus detected by imaging or with evidence of systemic embolism.[286]	I	A
It is recommended to treat women with HF during pregnancy according to current guidelines for non-pregnant patients, respecting contraindications for some drugs in pregnancy[263] (see *Table 7*).	I	B
It is recommended to inform women with HFrEF about the risk of deterioration of the condition during gestation and peripartum.[29]	I	C
Therapeutic anticoagulation with LMWH or vitamin K antagonists according to the stage of pregnancy is recommended for patients with atrial fibrillation.	I	C
In HFrEF, it is recommended that beta-blockers are continued in women who used them before pregnancy or are installed with caution, if clinically indicated.	I	C
In patients with PPCM and DCM, counselling for recurrence risk during subsequent pregnancy is recommended in all cases, even after recovery of LV function.	I	C



Regitz-Zagrosek et al, 2018 ESC Guideline.

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Not all HF are PPCM!

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- 33 yr old hypertensive with cough and shortness of breath noted 3/7 after EMCS. Being managed for chest infection.
- Cardiology called for BP control
- Associated orthopnea, PND and bilateral leg swelling
- HR 116bpm, BP 160/100mmHg
- Early diastolic murmur along the left sternal edge

ECHO →
Concentric LVH
Hyperdynamic LV systolic function EF83%
Grade 2 LV diastolic dysfunction
Thickened AV leaflets with severe AR

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Native valvular disease/Prosthetic valves

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- Manage pregnancy in women with mechanical valves in a centre with a pregnancy heart team.
- Medical therapy is recommended in pregnant women (diuretics/b-blockers)
- Intervention is recommended before pregnancy in patients with severe MS, severe AS with symptoms or EF<50%, severe AR/MR with reduced EF and Marfan with AOD of >45mm.
- A bioprostheses should be considered in young women contemplating pregnancy.

Regitz-Zagrosek et al, 2018 ESC Guideline. Bahanian et al, 2021 ESC/EACTS Guideline.

Stroke

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- 33 year old G4P3 at EGA 5/52
- Had MV replacement and tricuspid annuloplasty in 2015
- Regular clinic follow-up and medication compliance
- On Warfarin 6mg od with INR of 2.6

WHAT IS THE NEXT STEP?

a) Continue warfarin for all trimesters
b) Change to LMWH for all trimesters
c) Change to DOACs
d) Change to UFH

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Stroke

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- Warfarin replaced with Enoxaparin in the clinic
- Presented 4/52 later with sudden onset weakness of the left side of the body
- Brain CT showed infarct in the internal capsule
- Enoxaparin 40mg bd (Preg. Heart Team)
- Made fully recovery

TABLE 28 Anticoagulation Strategies During Pregnancy.

Antenatal Options

	Method 1	Method 2	Method 3	Alternative Method 4
First trimester	Warfarin ≤5 mg	LMWH	UFH	LMWH
Second trimester	Warfarin	Warfarin	Warfarin	LMWH
Third trimester	Warfarin	Warfarin	Warfarin	LMWH

Delivery Planning

	Method 1	Method 2
1 wk before	Discontinue warfarin → continuous IV UFH	Dose-adjusted LMWH
36 h before	Continuous IV UFH	Switch to continuous IV UFH
4-6 h before	Stop IV heparin	Stop IV heparin

Joglar et al, 2023 ACC/AHA/ACCP/HRS Guideline

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Thromboembolic disease- DVT & PE

- 38 yr old seizure disorder patient with # of the left leg at EGA 16 weeks
- ✓ Declined anticoagulation at the GP
- ✓ Presented to the ER 1/52 later with severe hypoxia

- 41 yr old physician and asthmatic with IVF multiple gestation with chest tightness of about 1 week
- ✓ Thought it was asthma exacerbation
- ✓ Slumped and died
- ✓ Autopsy confirmed PE

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Arrhythmias- SVT

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- 41 yr old hypertensive GDM at EGA 26 weeks with palpitations
- Asymptomatic
- HR of 179bpm, BP 138/80mmHg
- Chest clear
- Modified valsalva maneuver- not successful
- ECHO- normal cardiac wall and chambers, EF 73%

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What is next ?

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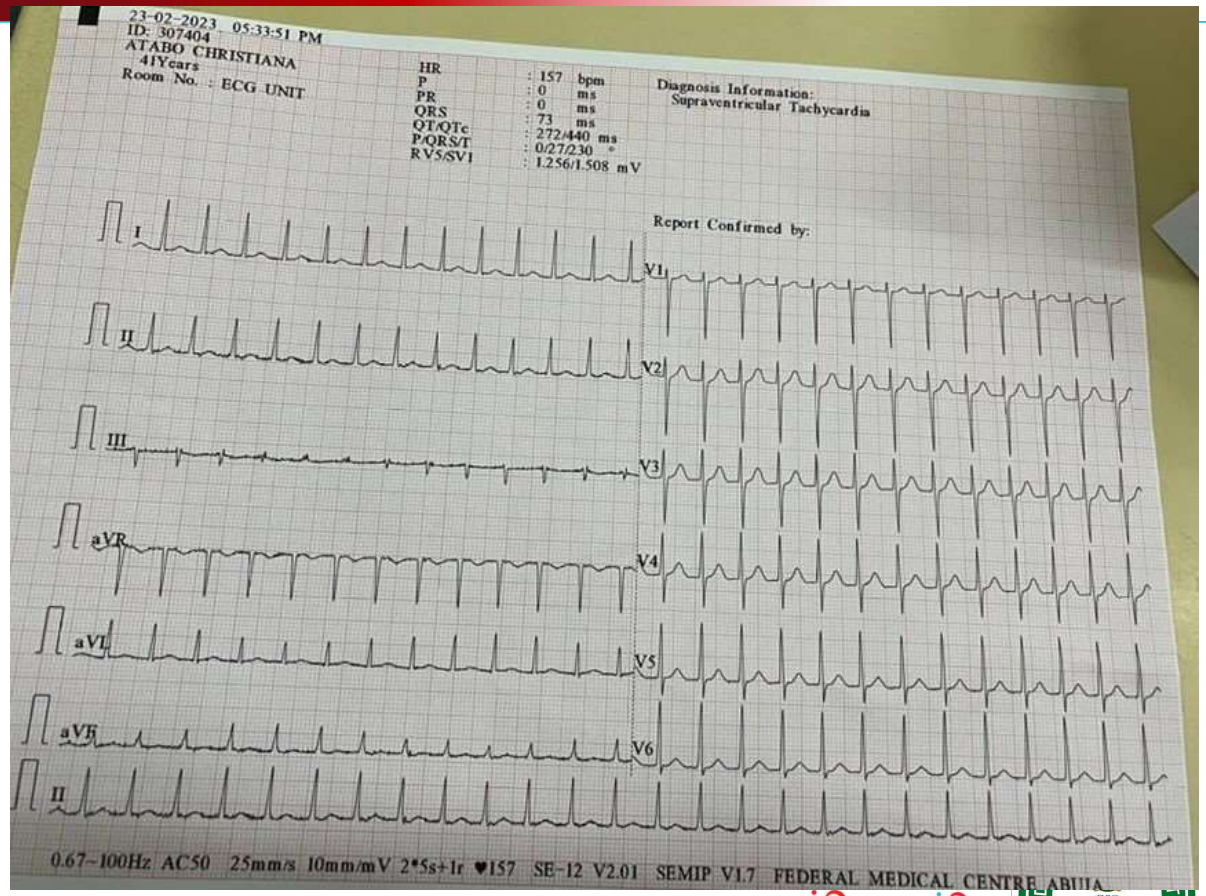
a) IV metoprolol

b) Vagal maneuver followed by IV adenosine

c) DC cardioversion

d) Vagal maneuver followed by oral metoprolol SR

e) IV amiodarone



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SVT/AF

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- ✓ **Had IV adenosine 6mg with reversion to sinus rhythm**
- ✓ **Discharged on**
  - Tab metoprolol tartrate 100mg bd
  - Tab digoxin 0.25mg od
  - Tab aldomet 500mg bd
  - Tab Aspirin 75mg od
- ✓ **6/12 follow-up**
  - Tab metoprolol tartrate 25mg bd
  - Tab amlodipine 10mg od
  - Tab aldomet 500mg bd

Recommendations for the management of arrhythmias

Recommendations	Class[a]	Level[b]
Acute management (intravenous administration of drugs) of SVT and AF		
Vagal manoeuvres and if these fails, adenosine are recommended for acute conversion of PSVT.[12,326,327]	I	C
Immediate electrical cardioversion is recommended for any tachycardia with haemodynamic instability and for pre-excited		
Long-term management (oral administration of drugs) of SVT and AF		
Beta-1-selective blockers or verapamil[d] is recommended for the prevention of SVT in patients without pre-excitation on resting ECG.[12,327]	I	C

Recommendations for Pregnancy
Referenced studies that support the recommendations are summarized in the Online Data Supplement.

COR	LOE	RECOMMENDATIONS
1	B-NR	1. In pregnant patients with AF, DCCV is safe to the patient and fetus and should be performed in the same manner as in patients who are not pregnant.[1]
2b	C-LD	2. In pregnant individuals with structurally normal hearts and hemodynamically stable AF, pharmacological cardioversion with agents with history of safe use in pregnancy, such as intravenous procainamide, may be considered.[1,2]
2a	C-LD	3. In pregnant individuals with AF and without structural heart disease, antiarrhythmic agents with history of safe use in pregnancy (eg, flecainide and sotalol) are reasonable for maintenance of sinus rhythm.[1,2]
2a	B-NR	4. In pregnant individuals with persistent AF, rate-control agents with a record of safety in pregnancy, such as beta blockers (eg, propranolol or metoprolol) and digoxin, either alone or in combination with beta blockers, are reasonable as first-line agents.[1,2]
2b	C-LD	5. Pregnant individuals with AF and elevated risk of stroke may be considered for anticoagulation with the recognition that no anticoagulation strategy is completely safe for both the mother and fetus, and an SDM discussion should take place regarding risks to both mother and fetus (Table 28).[3]

Regitz-Zagrosek et al, 2018 ESC Guideline. Joglar et al, 2023 ACC/AHA/ACCP/HRS Guideline

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CAD

- Will be common as maternal age for pregnancy increases
- Aetiology different from those of the general population
- Treatment of acute MI similar to that of the general population.

Recommendations for the management of coronary artery disease

Recommendations	Class[a]	Level[b]
ECG and measurement of troponin levels are recommended when a pregnant woman has chest pain.[225,227]	I	C
Primary coronary angioplasty is mended as the preferred reperf apy for STEMI during pregnancy.		
An invasive management strateg considered for NSTE-ACS with criteria.[226]		
Conservative management shou sidered for stable NSTE-ACS wi criteria.		
Follow-up should be considered least the next 3 months.		

TABLE 20 CARPREG II Risk Prediction Model

CARPREG II Predictors	Points
Previous cardiac vent or arrhythmia	3
Baseline NYHA functional class III to IV or cyanosis	3
Mechanical valve	3
Ventricular dysfunction	2
High-risk left-sided valve disease and LVOT obstruction	2
Pulmonary hypertension	2
CAD	2
High-risk aortopathy	2
No previous cardiac intervention	1
Late pregnancy assessment	1

CARPREG II Score	Predicted Risk, %
0 to 1	5
2	10
3	15
4	22
>4	41

Byrne et al, 2023 ESC Guideline

Virani et al, 2023AHA/ACC/ACCP/ASPC/NLA/PCNA Guideline.

Pulmonary hypertension and Eisenmenger syndrome

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- PH is an elevation in mean pulmonary arterial pressure (PAP) ≥20 mmHg at right heart catheterization.
- Eisenmenger syndrome- irreversible PH
- Pregnancy should be discouraged in severe PH and termination should be discussed where pregnant.
- **Right Heart Catheterization is available here**

Recommendations for pregnancy and pulmonary arterial hypertension

Recommendations	Class[a]	Level[b]
Right heart catheterization is recommended to confirm the diagnosis of PAH (group 1). This can be performed during pregnancy but with very strict indications.[10]	I	C
Treatment dose LMWH is recommended in pregnant patients with chronic thromboembolic pulmonary hypertension.	I	C

Humbert et al, 2023 ESC/ERS Guideline.

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Labour/Delivery and Breast feeding

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- Vaginal delivery preferred for most of pregnancy-related CVDs with some exceptions
- CS is indicated for obstetric reasons mostly
- Before pharmacological treatment in pregnancy is started, it is recommended to check for clinical safety data .

Virani et al, 2023AHA/ACC/ACCP/ASPC/NLA/PCNA Guideline.

Summary

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- Pre-pregnancy counselling is recommended for all pregnant women with CVDs.
- Prompt referral of patients with CVDs in pregnancy is essential.
- CVDs in pregnancy should be managed in centers with multispecialty pregnancy heart teams.
- Pregnancy is discouraged in high risk CVDs.

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