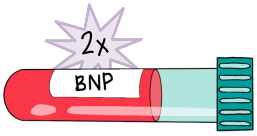
Society for Maternal-Fetal Medicine

Consult Series #73

Diagnosis and management of RIGHT AND LEFT HEART FAILURE during pregnancy and postpartum

Cardiac changes in pregnancy

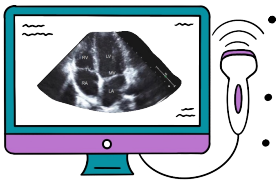
- 30-50% ↑ in blood volume
- Heart rate ↑ by 10-20 bpm
- Systemic and pulmonary vascular resistance ↓
- Vasodilation leads to ↓ in diastolic and systolic blood pressure



B-type natriuretic peptide (BNP) may rise two-fold

May cause elevation in BNP			
Preeclampsia	Congenital heart disease	Renal failure	
Sepsis	Pulmonary embolism	Anemia	
Cardiomyopathy	Critical illness		

Echocardiographic changes in pregnancy



- ↑ left and right ventricular dimension and volume
- ↑ stroke volume
- ↑ cardiac output without a change in the left ventricular ejection fraction

Heart Failure — Clinical syndrome with signs/ symptoms from structural or functional impairment of ventricular filling or ejection of blood

- Heart failure with preserved ejection fraction (HFpEF)
- Heart failure with reduced ejection fraction (HFrEF)
  - Encompasses peripartum cardiomyopathy and dilated cardiomyopathy
  - Primary type of heart failure seen in pregnancy
  - Left ventricular ejection fraction (LVEF) of <40%
  - Pressure overload + Volume overload + Decreased contractility

Preconception counseling

for patient with a history of heart failure (HF)

- Assess functional status
- Review etiology of HF and impact on pregnancy
- Assess for structural defects, prior cardiac events, and the presence or absence of arrhythmias
- Review compatibility of HF medications with pregnancy
- Use a model (see below) for cardiac risk stratification
- Option for pregnancy termination should be available to all patients

ADVISE AGAINST PREGNANCY IF

Persistent LVEF <45% after a diagnosis of peripartum cardiomyopathy in prior pregnancy

LVEF <30% at the time of presentation with peripartum cardiomyopathy

TABLE 1 Relevant echocardiographic parameters, clinical implications, and reasonable next steps for management of abnormal results

Parameter	Normal values in reproductive-aged females	Clinical implication	Next steps
RVSP	<40 mmHg	The tricuspid regurgitant jet velocity is a non-invasive measure of pulmonary artery systolic pressure and quantifies pulmonary hypertension. Elevated levels can be indicative of pulmonary hypertension, fluid overload, or right ventricular dysfunction.[22,23]	Confirmation: 25% of RVSP measures are inaccurate. Consider other echocardiographic and clinical parameters, serial follow-up, and expert consultation. Right heart catheterization may be advised. If confirmed, classification into 5 groups of pulmonary hypertension is recommended (see Table 4). The classification/group usually guides treatment.[22,23]
TAPSE	>1.7 m/s	Assessment of right ventricular function. M-mode is used to measure the vertical movement of the lateral tricuspid valve annulus. Lower values can be indicative of right ventricular dysfunction and failure.[22,23]	Expert consultation: Right ventricular failure or depression can be very morbid and mortal in the context of pregnancy. Swift consultation is advised. Observe other right-sided echocardiographic findings, including right atrial volume and IVC diameter. Medical management could include diuresis, afterload reduction, and inotropy[22,23]
Left atrial volume	22-52 (mL)[24]	Increased size indicates increased filling pressures and fluid overload and can place patients at risk for arrhythmia (i.e., atrial fibrillation).	Expert consultation: Increased left atrial volume can indicate heart failure or obstructive process and left-sided cardiac pathology (i.e., heart failure, mitral stenosis, aortic stenosis,[24,25] hypertrophic cardiomyopathy). Observe other echocardiographic findings. Assess mitral and aortic valves for stenosis or regurgitation, left ventricular failure, etc. Medical management can include diuresis, afterload reduction, beta-blockade for arrhythmia treatment.
Mitral septal E/e'	<13	Increased levels are indicative of increased left ventricular filling pressure and increased pulmonary capillary wedge pressures and can be found in HFpEF[26]	Expert consultation: Increased mitral septal E/e' values >13 can be indicative of increased left ventricular filling pressures, fluid overload, and heart failure[26] Observe other echocardiographic findings such as valvular function, left atrial volume, left ventricular systolic function, and left ventricular wall thickness. Medical management can include treatment of chronic medical conditions (i.e., hypertension), diuresis, and expanding differential diagnosis for chronic cardiac disease and hypertrophic cardiomyopathy.

E, mitral inflow velocity of early diastolic filling; e', tissue Doppler mitral annular velocity; HFpEF, heart failure with preserved ejection fraction; IVC, inferior vena cava; RVSP, Right ventricular systolic pressure; TAPSE, Transannular planar systolic excursion

RISK STRATIFICATION

Modified WHO Classification of Maternal Cardiovascular Risk

Categorizes individuals into risk categories ranging from

I — extremely high risk of maternal mortality or severe morbidity

↓

IV — no detectable increased risk of maternal mortality and no/mild increased risk in morbidity

PREDICTOR	POINTS
Prior cardiac events or arrhythmias	3
Baseline NYHA III-IV or cyanosis	3
Mechanical valve	3
Ventricular systolic dysfunction[1]	2
High risk left-sided valve disease/left ventricular outflow tract obstruction[2]	2
Pulmonary hypertension	2
Coronary artery disease[3]	2
High risk aortopathy[4]	2
No prior cardiac intervention[5]	1
Late pregnancy assessment[6]	1

CARPREG II Risk Predictor

Predicted risk for a primary cardiac event	
0-1 points	5%
2 points	10%
3 points	15%
4 points	22%
>4 points	41%

[1]Left ventricular ejection fraction <55%
[2]Aortic valve <1.5 cm², subaortic gradient >30 mmHg, mitral valve area <2 cm², moderate to severe mitral regurgitation
[3]Angiographically proven coronary obstruction or past myocardial infarction
[4]Marfan syndrome, bicuspid aortopathy with aortic dimension >45 mm, Loeys-Dietz syndrome, vascular Ehlers-Danlos syndrome, prior aortic dissection or pseudoaneurysm
[5]No cardiac repair of congenital lesions, valvular replacement or repair, percutaneous or operative treatment of arrhythmias
[6]First visit after 20 weeks of gestation

RV FAILURE

Causes of right ventricular failure in pregnancy

Acute Right Ventricular Failure	Chronic Right Ventricular Failure
Embolism • Pulmonary thromboembolism • Amniotic fluid embolism • Air or fat embolism Right ventricular infarction	Left heart failure Right-sided valve disease Cardiomyopathies involving the RV Pulmonary hypertension ✳ Chronic thromboembolic disease Interstitial lung disease

✳ Pulmonary hypertension = Mean pulmonary artery pressure >20 mmHg

RV systolic dysfunction

- Reduces forward flow to the pulmonary circulation
- Decreasing LV stroke volume and cardiac output
- Neurohormonal activation promotes renal sodium and water retention
- Systemic venous hypertension
- Hepatic congestion, ascites, lower extremity edema

RV is sensitive to afterload (accustomed to pumping into low-resistance pulmonary circulation)

Any sudden increase in pulmonary artery pressure (eg pulmonary embolism) may lead to cardiogenic shock

Symptoms of RV failure

Shortness of breath on exertion

Fatigue

Initial diagnostic tests

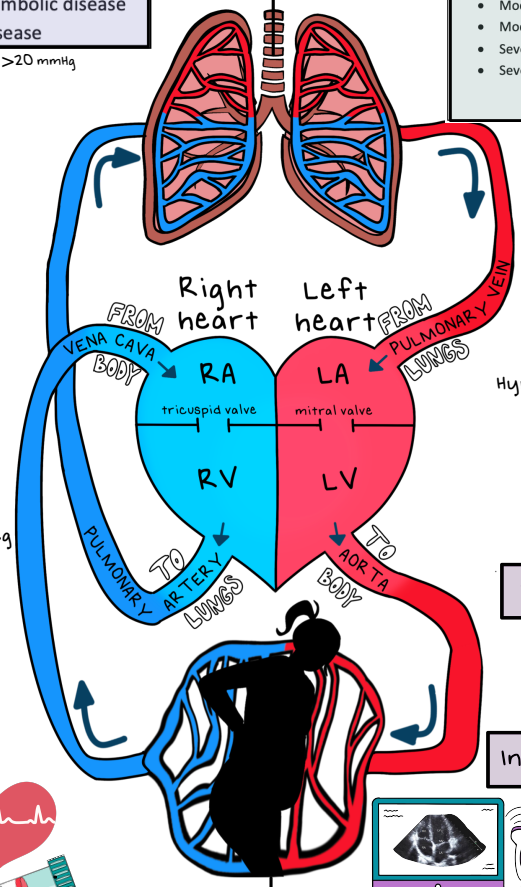
Echocardiogram

EKG

BNP levels

Management

- RV failure due to pulmonary hypertension
  - Counsel on high risk of morbidity and mortality
  - Refer to center with expertise in pulmonary hypertension
  - Oxygen saturations maintained at ≥90% (preferably ≥95%)
  - Maintain intravascular volume
- RV failure due to left heart failure or volume overload
  - Diuretic therapy
- PE and RV infarction
  - Anticoagulation
  - Adequate intravascular volume
- RV failure due to arrhythmias and low cardiac output
  - Based on underlying etiology

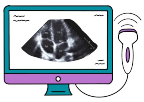


LV FAILURE

Causes of left ventricular failure

Cardiomyopathy • Peripartum cardiomyopathy • Non-ischemic dilated cardiomyopathy • Tachycardia induced cardiomyopathy • Stress (Takotsubo) cardiomyopathy • Hypertrophic cardiomyopathy • Left ventricular non-compaction Progressive valve disease • Moderate to severe aortic stenosis • Moderate to severe mitral stenosis • Severe aortic regurgitation • Severe mitral regurgitation	Acute valve disease • Prosthetic valve thrombosis Arrhythmias • Atrial fibrillation • Atrial flutter • High frequency ventricular ectopy • Ventricular tachycardia Acute coronary syndrome • Coronary artery dissection • Thrombosis Ion channel disorders Myocarditis Acute diastolic dysfunction Preeclampsia with severe range blood pressure

Peripartum cardiomyopathy (PPCM)



Presents on echo with LV enlargement + dysfunction with LVEF <45%

Diagnosis of exclusion, must rule out other causes of heart failure

Consider referral to a genetics provider

Hypertrophic cardiomyopathy (HCM) = LV hypertrophy

Thickening of myocardium >15mm

May lead to LV outflow obstruction, diastolic dysfunction, ischemia, mitral regurgitation

Risk of arrhythmias and sudden death

Often tolerate pregnancy well due to volume expansion

Symptoms of LV failure

Shortness of breath

Cough

May have chest pain

Initial diagnostic tests

Echocardiogram

EKG

Consider cardiac MRI

BNP levels

Cardiac enzymes

Electrolytes

Renal function

CBC

History and physical examination

Weight gain

Jugular venous distension

Tachycardia

Crackles

S3 or S4

Murmurs

Pedal edema

NYHA functional class

Management

	Acute Left Ventricular Heart Failure	Chronic Left Ventricular Heart Failure
Experts	Cardiology, cardiac surgeon (possible mechanical circulatory support, MCS), intensivist, maternal-fetal medicine, cardiac anesthesiologist, obstetric anesthesiologist	Maternal-fetal medicine, cardiology, heart failure specialist, obstetric anesthesiologist
Resources	Intensive care unit (sub-specialized in cardiac care preferred), MCS capabilities	Outpatient imaging capabilities
Medications	Afterload reduction: hydralazine, nitroprusside Diuresis: furosemide, bumetanide Inotropy: dobutamine, epinephrine	Afterload reduction: hydralazine, isosorbide dinitrate Beta-blockade: metoprolol, carvedilol, bisoprolol Diuretic: furosemide **All other GDMT (goal-directed medical therapy) agents (ACEi, ANRi, mineralocorticoid antagonists) are contraindicated during pregnancy**
Anticoagulation	Mechanical or pharmacological thromboprophylaxis	Consider if EF < 35%
Fetal Monitoring	At least daily if the fetus is considered viable.	Individualized

Refractory heart failure

Candidates for intravenous inotropic therapy, left ventricular assist device, extracorporeal membranous oxygenation, and cardiac transplantation

Require transfer to a high level of care

In most cases, necessitate abortion care or delivery of fetus

Arrhythmia and heart failure

Sustained cardiac arrhythmias can cause HF

Medical and procedural care for SVT and ventricular arrhythmias in pregnant patients with HF is incredibly nuanced; it is imperative to involve HF and/or EP specialists

Treatment of SVT in HF involves using nodal blocking agents (eg beta-blockers, calcium channel blockers) and diuresis if overloaded

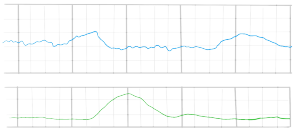
Fetal considerations

Pregnant individuals with cardiac disease are at increased risk for adverse perinatal outcomes, including small for gestational age birth, lower Apgar scores, and prematurity

A fetal echocardiogram is indicated in the cases of maternal congenital defect

Serial growth ultrasounds should be performed

Recommend continuous fetal heart rate monitoring during anesthesia administration, labor, and delivery

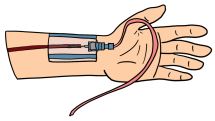


Recommend fetal heart rate monitoring in the case of maternal cardiovascular changes prompting inpatient assessment

Labor and delivery

Cesarean delivery reserved for typical obstetric indications

Telemetry is often utilized for patients at risk for arrhytmias

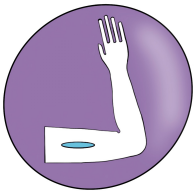


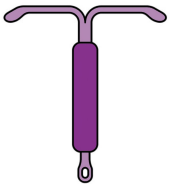
Consider arterial line in patients who may benefit from continuous blood pressure and cardiac output monitoring (Eg critical aortic stenosis, previous peripartum cardiomyopathy with unrecovered function)

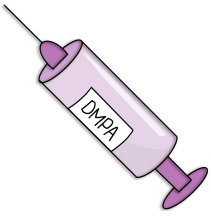
Recommend use of neuraxial anesthesia in most patients with heart failure

Instances in which to limit or avoid valsalva may include:

- Severe pulmonary hypertension
- LV outflow tract obstruction
- Compromised venous return
- Substantially compromised myocardial contractility







Recommend comprehensive contraceptive counseling taking into consideration medical criteria and patient preferences