

## Aortopathies

RECOMMEND AVOIDANCE OF PREGNANCY	<ul style="list-style-type: none"> <li>Marfan Syndrome, Loeys-Dietz, or Other Hereditary Thoracic Artery Disease: Aortic Dilation &gt;45 mm</li> <li>Bicuspid aortic valve: Aortic Dilation &gt; 50 mm</li> <li>Turner: Aortic Size Index &gt;25 mm/m<sup>2</sup></li> <li>Vascular Ehlers-Danlos</li> <li>Severe coarctation</li> <li>Prior aortic dissection</li> </ul>
PATHOPHYSIOLOGY	<ul style="list-style-type: none"> <li>Hormonal and hemodynamic changes of pregnancy increase risk of aortic dissection.</li> <li>Dissection can occur at any point in pregnancy with highest risk in third trimester and postpartum</li> </ul>
CLINICAL PRESENTATION	<p>Aortic Dissection-Surgical Emergency</p> <ul style="list-style-type: none"> <li>Abrupt, acute onset pain in the chest or back (90%).</li> <li>Symptoms correlate with the involved segments of the aorta.</li> <li>Red flags: Aortic dimension reaches threshold (Aortic size is the major determinant of risk -10% risk if aortic root diameter &gt; 40mm), personal/family hx aortic dissection, rapid enlargement &gt;5mm/year</li> </ul>
IMAGING	<ul style="list-style-type: none"> <li>Transthoracic echocardiogram (TTE)</li> <li>Computed Tomographic Angiography (CTA) or Magnetic Resonance Angiography (MRA) to evaluate entire aorta. Can use gadolinium as benefit outweighs risk.</li> <li>Transesophageal Echocardiography (TEE) when needed to assess valvular pathology.</li> </ul>
ANTEPARTUM	<ul style="list-style-type: none"> <li>TTE every 4-12 weeks during pregnancy and 6 months postpartum</li> <li>If unable to visualize aortic dilatation, recommend serial monitoring with MRI (without gadolinium)</li> <li>Beta-blockers during pregnancy</li> <li>Serial monitoring for fetal growth</li> <li>Strict blood pressure control (goal BP &lt;120/80 mmHg)</li> <li>Multidisciplinary team at tertiary center recommended</li> </ul> <p>Type B- conservative management; TEVAR considered in select cases; Serial TTE q 4-12w</p> <p><b>OTHER COMORBIDITIES:</b></p> <p>Vascular EDS: Uterine rupture Loeys-Dietz: Mitral regurgitation Marfan Syndrome: Mitral regurgitation, Heart failure, Arrhythmias Turner Syndrome: Hypertension, DM, Bicuspid aortic valve, Coarctation Bicuspid aortic valve: Aortic stenosis or regurgitation</p>
MAINSTAY OF TREATMENT	<ul style="list-style-type: none"> <li>Avoid Hypertension</li> <li>Beta blockers to maintain strict BP control</li> </ul>
OBSTETRIC MEDICATIONS TO AVOID OR USE CAUTION	<p>Use with Caution:</p> <ul style="list-style-type: none"> <li>Magnesium Sulfate</li> <li>Oxytocin (no bolus, Use as dilute solution in IV infusion)</li> </ul> <p>Contraindicated:</p> <ul style="list-style-type: none"> <li>Terbutaline</li> <li>Methylergonovine (Methergine)</li> <li>Carboprost tromethamine (Hemabate), avoid if vascular disease or aortic aneurysm</li> <li>Epinephrine, avoid with aortic disease, coronary dissection</li> </ul>
BLOOD PRESSURE AND HEART RATE PARAMETERS	<ul style="list-style-type: none"> <li>2 large bore IV</li> <li>Continuous monitoring of heart rate and blood pressure</li> <li>Use of beta-blockers (Esmolol or Labetalol infusion) <ul style="list-style-type: none"> <li>Heart rate: &lt;60 beats per minute</li> <li>Systolic blood pressure: 100-120 mmHG</li> </ul> </li> <li>If maximal beta-blockade, can use IV Nitroglycerin or Nicardipine to lower blood pressure</li> </ul>
TIMING OF DELIVERY	If dissection: Type A >28 weeks-> CD first, then repair; if <28 wks repair alone
MODE OF DELIVERY	Vaginal delivery (Assisted-second stage if aorta ≤ stable during pregnancy); Cesarean delivery: dilated aorta > 40mm, OB reasons, prior dissection repair, increasing size aorta during pregnancy. Delivery must be at place with CV surgery available; also consider antibiotics for risk of endocarditis
INTRAPARTUM	Strict BP and HR control, continue beta-blockers; Avoid pain, monitor for sx of aortic dissection
ANESTHESIA	<ul style="list-style-type: none"> <li>Slow dose epidural (Avoid CSE/Spinal)</li> <li>Avoid rapid drop in blood pressure and sympathetic blockade</li> <li>Evaluate for dural ectasia</li> </ul>
POSTPARTUM	- Aortic dissection risk persists pp; - monitor for signs/sx; - continue B-blockers; clinical aortic f/u for 2-6 months (high-risk- weekly; low-risk- monthly)
REGIONAL ANESTHESIA-EPIDURAL and CSE/SPINAL	Optimal pain management; caution due to high prevalence of dural ectasia; >70% LDS and Marfans can have lumbosacral dural ectasia-> increase CSF volume, risk of CSF leak w/ dural puncture

## Pulmonary Artery Hypertension

RECOMMEND AVOIDANCE OF PREGNANCY	ALL
PATHOPHYSIOLOGY	As PVR increases, PAP increases leading to RV failure and decreased CO leading to hypotension (this is when pts become symptomatic- CO drops and present w/SOB w/minimal exertion). Right atrial pressure (RAP) increases (due to "blown" tricuspid valve with regurgitation from RV back into RA). RV ischemia and dysfunction leads to fluid retention (impaired venous return) and DEATH!
CLINICAL PRESENTATION	Secondary causes: ASD, VSD, or PDA. Disease progression: exertional chest pain, peripheral edema, anorexia and/or early satiety, RUQ pain, <b>***EXERTIONAL SYNCOPES***, prodrome to SUDDEN DEATH! - NOT RESUSCITABLE!</b>
IMAGING	- Need FULL 4-chamber TEE, need bubble study- look for "tunneled" ASD, also image first 2-3 cm IVC, image hepatic vein; need immediate right heart catheterization after diagnosis; limited right heart echo 1 week prior to delivery w/ volume assessment and imaging of IVC
ANTEPARTUM	- Manifests at 16-28w; esp. 24-28w; Hospitalize immediately if symptomatic! Can be deadly! Also consider chronic pulmonary emboli;
MAINSTAY OF TREATMENT	- Maintain afterload (Do NOT fluid overload) - Minimize PVR - Maintain adequate blood volume & venous return - avoid myocardial depressants (B-blockers) - Aggressive diuresis postpartum- NET negative 5-7 L by 72h pp
FLUID MANAGEMENT	Worsen b/c of fluid retention and overload with right heart dysfunction; Goal of management postpartum: aggressive diuresis. Use caution with diuresis if heart failure develops.
OBSTETRIC MEDICATIONS TO AVOID OR USE CAUTION	Terbutaline, avoid myocardial depressants (B-blockers), avoid oversedation (NO strong opioids). <b>AVOID carboprost (Hemabate)- it increases pulmonary artery pressure by over 100%!!!</b>
TIMING OF DELIVERY	32 - 36 weeks
MODE OF DELIVERY	Controversial: VAGINAL Assisted second stage (Valsalva may decrease preload), may need scheduled Cesarean Section to allow optimization with multidisciplinary teams
ANESTHESIA	Slow dose epidural (Avoid CSE/Spinal), Avoid rapid drop in blood pressure and sympathetic blockade
POSTPARTUM	Admit to CCU/ ICU/ strict I's & O's q4hrs x 72 hours/ start IV diuretic (IV Lasix) immediately q 4h -> goal uop net negative 2 L by the time the epidural/spinal wears off then net neg 5-7L by 72 hours (c/s will take up to 5 days); limited R heart echo daily & once RV functioning properly and adequate diuresis, consider d/c home/ see in cardiology with R heart echo. <b>HIGHEST RISK OF DEATH- PPD 5 - if not diuresed adequately as above &gt;&gt;&gt; FULMINANT PULMONARY EDEMA &gt;&gt;&gt; which can lead to DEATH!!!</b>
REGIONAL ANESTHESIA-EPIDURAL	YES- MANDATORY- carefully titrate neuraxial anesthesia onset; avoid pain
REGIONAL ANESTHESIA-CSE/SPINAL	NO- avoid- rapid drop in bp; avoid rapid sympathetic blockade

## Mitral Stenosis

RECOMMEND AVOIDANCE OF PREGNANCY	Severe
PATHOPHYSIOLOGY	Increase in cardiac output leads to worsening of left sided stenotic lesions. 2 ways to decompensation and DEATH- 1. Increased blood volume leads to increase in left atrial pressure -> A.Fib and/or pulmonary edema ->DEATH! 2. Simultaneously fixed preload to LV leads to an inability to generate CO leading to cardiogenic shock and DEATH!
CLINICAL PRESENTATION	Rheumatic heart dz; Predictors of cardiac events: prior cardiac events, prior use of medication, pulmonary hypertension
IMAGING	echo to establish severity of stenosis and size of the left atrium; EKG to exclude atrial fibrillation, echo at least once/trimester (q 4-8 w for >mild MS or symptomatic)
ANTEPARTUM	Worsens from 23-34 weeks and then again immediately to 4 weeks postpartum. Complete TTE with full anatomic and hemodynamic assessment of the valves. Even worsening stenosis or heart failure usually responds well to medication and surgery not indicated. However, Severe rheumatic MS presents a significant risk of maternal adverse outcome during pregnancy. In asymptomatic women with severe rheumatic MS (mitral valve area ≤1.5 cm <sup>2</sup> , Stage C) and favorable valve morphology who are considering pregnancy, PMBC results in an increase in mitral valve area and reduction in transmitral gradient, which makes the patient more resilient to the hemodynamic load of pregnancy. Monitor BNP and pro-BNP levels correlate to mitral valve area as well as pulmonary artery pressure (normal BNP in pregnancy 30-60pg/mL, anything above 100 is concerning pro-BNP >300 concerning)
MAINSTAY OF TREATMENT	- Maintain normal HR- Avoid A.Fib - Prevent & monitor for pulmonary edema - Manage pulmonary edema - PP monitoring for pulmonary edema; Exercise restriction; Consider anticoagulation
FLUID MANAGEMENT	Avoid fluid overload; start diuretics to treat pulmonary edema
OBSTETRIC MEDICATIONS TO AVOID OR USE CAUTION	Terbutaline; tocolytics that can cause tachycardia
BLOOD PRESSURE AND HEART RATE PARAMETERS	Avoid tachycardia; avoid decreases in SVR/hypotension; Start beta blockers to maintain goal HR <100 (nodal blockade goal HR <80bpm; AVOID A-fib; Cardiovert new-onset A-fib; treat RVR
MODE OF DELIVERY	assisted vaginal delivery with regional anesthesia to avoid pain and increase in HR; cesarean only for obstetric indications
INTRAPARTUM	intra-arterial bp monitoring in labor/CD and 5-lead ECG; continuous pulse ox w/ waveform; labor in upright position
ANESTHESIA	Slow dose epidural (Avoid CSE/Spinal), Avoid rapid drop in blood pressure and sympathetic blockade
POSTPARTUM	5-lead ECG with continuous pulse oximeter w/ waveform (monitoring closely for pulmonary edema); If pulmonary edema develops-> diurese, supplemental O <sub>2</sub> , remain upright position; if necessary, intubate for controlled ventilation with PEEP
REGIONAL ANESTHESIA-EPIDURAL	Yes- avoid pain
REGIONAL ANESTHESIA-CSE/SPINAL	No- avoid- rapid drop in bp; avoid rapid sympathetic blockade
GENERAL ANESTHESIA	Be prepared for intubation and controlled ventilation with PEEP

# CARDIO-OB

## Quick Reference Guide



## Cardiomyopathy/Heart Failure

## Cardiomyopathy/Heart Failure

## Pregnancy-Associated MI (PAMI)/SCAD

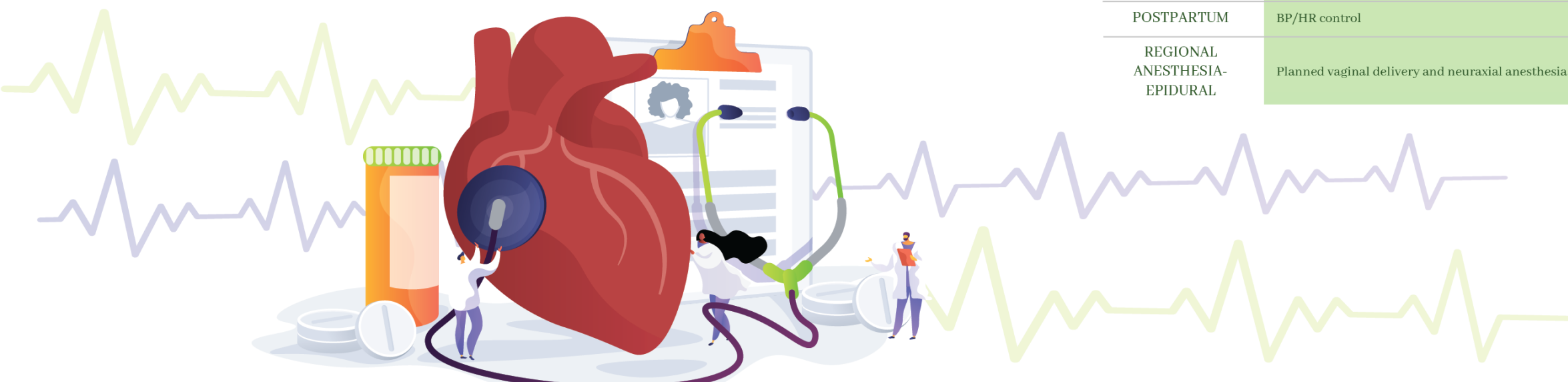
## Aortic Stenosis

RECOMMEND AVOIDANCE OF PREGNANCY	Severe systemic left ventricular dysfunction (LVEF < 30%, NYHA III or IV)
PATHOPHYSIOLOGY	Impaired Systolic Function or Systolic Dysfunction (left ventricle) caused by Left Ventricular Hypertrophy creates reduced elasticity and compliance of LV, leading to decrease filling and emptying and therefore decrease cardiac output. Commonly caused by untreated HTN, Valve disease (esp Aortic Stenosis), Ischemic heart disease (CAD/MI), Arrhythmias (A Fib or tachycardia). Can have "Preserved EF" (compensated) or "Decreased EF" (decompensated). Can be genetic, caused by alcoholism, drug use, previous myocarditis or chemotherapy.
CLINICAL PRESENTATION	Any history of arrhythmia, valve disease or CAD/MI. Elevated BP readings or diagnosis of hypertension. Most normal pregnancy symptoms mimic those of cardiomyopathy/HF. Consistent complaints or worsening complaints of decreased exercise tolerance, swelling, fatigue, dyspnea, orthopnea, palpitations, dizziness, syncope. Greatest risk during delivery and PP to develop acute HF or PE (16-35% chance). EF <40% associated with 30-60% adverse events. Severe ventricular systolic dysfunction; Prior PPCM w/residual reduced LVEF systolic dysfunction; Fontan w/ reduced systemic ventricular systolic dysfunction and/or heart failure. PREGNANCY SPECIFIC RISK FACTORS: Advanced Maternal Age, Multifetal Gestation, African American, poor nutrition, Smoking.
IMAGING	TTE, EKG, Chest X-Ray.
ANTEPARTUM	Baseline EKG and TTE, consider HOLTER. Baseline Pro BNP (>450 pg/mL abnormal) and BNP (abnormal > 100 pg/mL). Monitor BNP levels each trimester. Anticoagulation with valve disease and arrhythmias. If symptomatic and valve disease, use BB, lasix, CCB and verapamil. If still symptomatic consider early delivery. If symptomatic and no valve disease with EF<50% DO NOT USE BB, use hydralazine, lasix and nitrates. If symptomatic and no valve disease with EF >50% USE BB, verapamil, and lasix
MAINTAINSTAY OF TREATMENT	Normal HR (avoid bradycardia- tx w/ ephedrine and glycopyrrolate prn) - Maintain afterload (avoid hypo/hypertension) - Maintain contractility - Beta Blockers (Metoprolol Succinate and Carvedilol) Digoxin (need fetal surveillance) and hydralazine - Prevent, monitor and manage pulmonary edema - Monitor for ischemia/arrhythmia - Minimize PVR. Anticoagulant therapy

FLUID MANAGEMENT	Maintain afterload - Maintain normovolemia Will worsen condition, judicious use only.
OBSTETRIC MEDICATIONS TO AVOID OR USE CAUTION	*Non-dihydropyridine calcium channel blockers, *diltiazem, *verapamil, *carboprost (Hemabate), *Ibuprofen *Azithromycin *Celexa (doses greater than 40 mg) *Does Magnesium Sulfate decrease SVR in a way that could complicate Peripartum Cardiomyopathy or Heart Failure? Some research suggests that nifedipine and magnesium together could worsen heart failure. Use with caution.
BLOOD PRESSURE AND HEART RATE PARAMETERS	Between 110/70 to <140/90 mmHg, HR 60-110 AVOID: vasodilation, blood loss, hypotension, Valsalva, excess catecholamines, exercise, hypervolemia
TIMING OF DELIVERY	37-39 weeks not after 40 weeks
MODE OF DELIVERY	Assisted vaginal delivery with regional anesthesia to avoid pain and increase in HR; cesarean only for obstetric indications
INTRAPARTUM	Monitoring for Pulmonary Edema, AVOID VALSAVA, use of telemetry can be helpful,
ANESTHESIA	Slow dose epidural (Avoid CSE/Spinal), Avoid rapid drop in blood pressure and sympathetic blockade
POSTPARTUM	Monitor urine output, lasix if needed, Pulse oximetry monitoring. Can wear an external defibrillator. Consider anticoagulation. Early follow up 3-5 days.
REGIONAL ANESTHESIA-EPIDURAL	Yes- avoid pain
REGIONAL ANESTHESIA-CSE/SPINAL	No- avoid- rapid drop in bp; avoid rapid sympathetic blockade

PATHOPHYSIOLOGY	PAMI: Higher incidence of HF, malignant arrhythmias and cardiogenic shock. Main mechanism is NOT atherosclerotic dz, higher incidence of LM involvement and multivessel SCAD, higher incidence of instability, Higher rate of CABG, higher rate of mortality. SCAD: Most common cause of MI in pregnancy Hormonal changes in estrogen and progesterone lead to vessel wall changes Formation of intramural hematoma, separation occurring in the outer third of the tunica media and IMH occupying the dissection and compressing the true lumen, leading to coronary insufficiency and MI. Risk factors, FMD, multiparity, Marfan's, Ehlers Danlos, OCPs, infertility treatment, autoimmune disease. >50% precipitating factor such as intense exercise, valsalva, retching, lifting heavy objects.
CLINICAL PRESENTATION	Fibromuscular dysplasia (FMD) or other arteriopathies in up to 80%; coronary artery tortuosity can be a clue SCAD highest risk during first month postpartum (w/in 12 w of delivery)
IMAGING	TTE for wall motion abnormalities, consider LHC
ANTEPARTUM	SCAD: 1. Clinically stable, no high-risk anatomy>> conservative management, monitor inpatient 3-5d; 2. Clinically stable w/left main or severe proximal 2-vessel dissection>> consider CABG, conservative rx may be reasonable; 3. Active/ongoing ischemia/hemodynamic instability >> Consider PCI if feasible, or urgent CABG
MAINTAINSTAY OF TREATMENT	Early invasive strategy for ACS vs. conservative medical mgmt. Most resolved within 1 month. Risk of cardiac arrest present
OBSTETRIC MEDICATIONS TO AVOID OR USE CAUTION	Carboprost (Hemabate), methylergonovine (Methergine)
BLOOD PRESSURE AND HEART RATE PARAMETERS	BP goals <120/80, B-blocker use for HR control
TIMING OF DELIVERY	Determined by gestational age, obstetric considerations and clinical status of mother
MODE OF DELIVERY	Assisted vaginal delivery with regional anesthesia to avoid pain and increase in HR; cesarean only for obstetric indications
POSTPARTUM	BP/HR control
REGIONAL ANESTHESIA-EPIDURAL	Planned vaginal delivery and neuraxial anesthesia

RECOMMEND AVOIDANCE OF PREGNANCY	Severe Symptomatic
PATHOPHYSIOLOGY	Increase in cardiac output leads to worsening of left-sided stenotic lesions. Cardiac output increases>> left ventricular pressure increases>> symptomatic heart failure, arrhythmia, syncope. As SVR decreases, DBP decreases leading to decreased coronary perfusion to thickened myocardium >> ISCHEMIA. Myocardial ischemia leads to decreased LV function and decreased cardiac output>> more ISCHEMIA leading to DEATH!
CLINICAL PRESENTATION	10% risk cardiac event with severe AS. Fixed and Limited cardiac output, through restricted valve area. Avoid hypotension and decrease preload. Red flags: previous valve intervention, ventricular dysfunction, worsening NYHA, NYHA III/IV, hx arrhythmia, hx non-vagal syncope, elevated BNP, new cardiac symptoms, worsening ventricular function, increasing pulmonary pressures, new severe valve regurgitation, more than expected increase in valve gradient, increasing BNP, coexistent dilated ascending aorta
IMAGING	echo to evaluate size of aortic valve opening, gradient across valve and EF (Severe= valve area <1cm2, peak gradient >75 mmHg, or EF <55%)
ANTEPARTUM	Complete TTE with full anatomic and hemodynamic assessment of the valves. Diuresis with activity restriction for CHF Cardiology comanagement Anesthesia consult Murmurs need follow up, Vital Signs. Surgery for severe AS with worsening NYHA class III/IV
MAINTAINSTAY OF TREATMENT	Maintain afterload - Normal HR (avoid tachycardia) - Diuretics (afterload reduction) & B-blockade, exercise restriction; Prevent & monitor for ischemia - Maintain normovolemia -PP monitoring for hypotension/ischemia. Valve surgery during pregnancy is high risk, with a 30% to 40% fetal mortality rate and up to 9% maternal mortality rate reported. It should be reserved only for patients with severe, intractable symptoms unresponsive to bed rest and maximally tolerated medical therapy.
FLUID MANAGEMENT	Judicious Use. Maintain preload. Maintain normovolemia. AVOID hypotension. Pulse Pressure, wide PP = high preload. STV variation, does a pressure need fluids or pressor. Pulse OX waveform Degree of Stenosis: strivt IVF management especially in the labor process to maintain fluid balance.
OBSTETRIC MEDICATIONS TO AVOID OR USE CAUTION	Terbutaline, carboprost (Hemabate)
BLOOD PRESSURE AND HEART RATE PARAMETERS	AVOID hypotension, MAP <65 Abnormal 10% of baseline systolic AVOID: excessive blood loss, Valsalva, bradycardia/tachycardia, hypervolemia Individualized in pts with comorbid HTN; Treat hypotension with phenylephrine; Maintain normal HR
MODE OF DELIVERY	labor or C/S in Main OR w/ CV surg on standby, arterial line; avoid exertion/Valsalva > assisted second stage
INTRAPARTUM	intra-arterial bp monitoring in labor/CD and 5-lead ECG
ANESTHESIA	Slow dose epidural (Avoid CSE/Spinal), Avoid rapid drop in blood pressure and sympathetic blockade
POSTPARTUM	close monitoring to avoid postpartum pulmonary edema (autotransfusion); also monitor for pp hypotension and ischemia
REGIONAL ANESTHESIA-EPIDURAL	YES- MANDATORY- carefully titrate neuraxial anesthesia onset; avoid pain
REGIONAL ANESTHESIA-CSE/SPINAL	NO



Disclaimer: "This document serves only as a general guide in cases where appropriate subspecialists are not acutely available. This guide should NOT be used in place of consultation with subspecialists or transfer to tertiary care facilities. Please individualize the care of each patient."



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