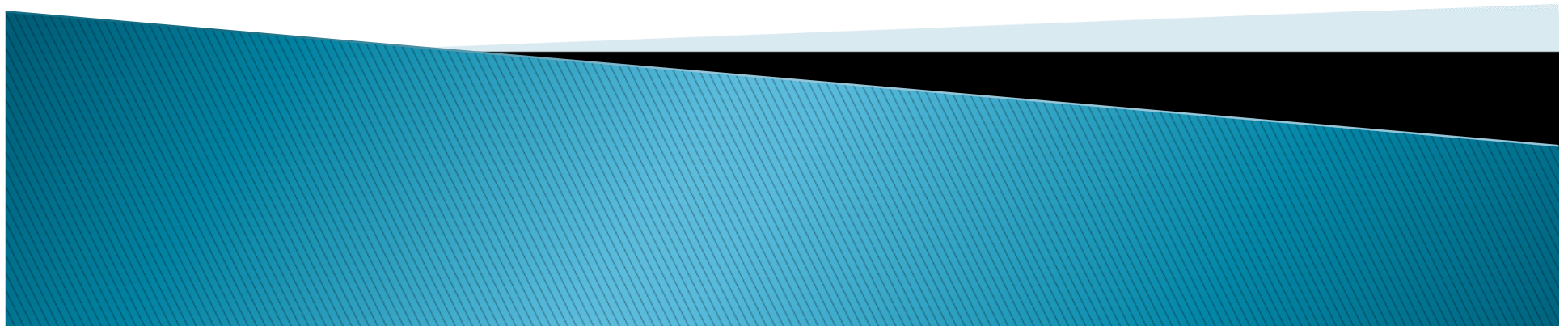


Anaesthetic Considerations In Pregnancy Induced Hypertension



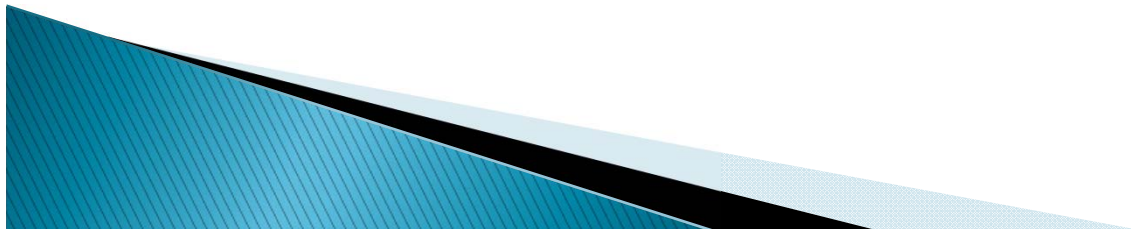
Contents

- ▶ Introduction
- ▶ Classification
- ▶ Gestational HTN
- ▶ Chronic HTN
- ▶ Preeclampsia
- ▶ Eclampsia
- ▶ HELLP syndrome
- ▶ Conclusion



Introduction

- ▶ PIH encompasses a range of disorders collectively & formerly known as toxemia of pregnancy
- ▶ It includes gestational hypertension, preeclampsia, eclampsia & HELLP syndrome
- ▶ Seen in 6% to 8% of all pregnancies
- ▶ A major cause of obstetric & perinatal morbidity & mortality
- ▶ Contribute significantly to still birth, neonatal morbidity & mortality



Classification of hypertensive disorders of pregnancy

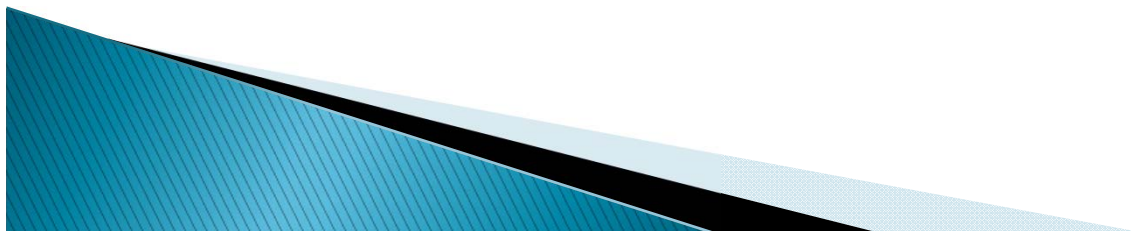
- ▶ Gestational HTN (6-7%)
- ▶ Preeclampsia
 - Mild (75%)
 - Severe (25%)
- ▶ HELLP syndrome
- ▶ Chronic hypertension preceding pregnancy
- ▶ Chronic HTN with superimposed preeclampsia

Acc to ACOG practise bulletin 2002



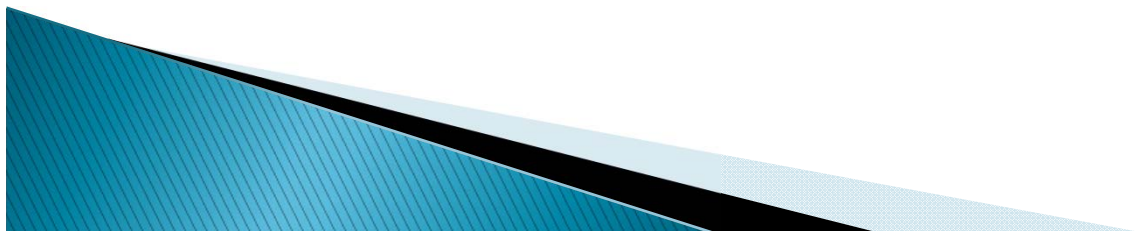
Gestational hypertension

- Transient HTN of BP $> 140/90$ without proteinuria or end-organ damage
- May occur late in pregnancy, during labor, or within 24 hrs postpartum
- BP returns to normal within 10 days postpartum



Chronic hypertension

- Begins prior to pregnancy
- BP > 140/90mmHg
- Not associated with proteinuria or end-organ damage
- Continues well after delivery (6wks)

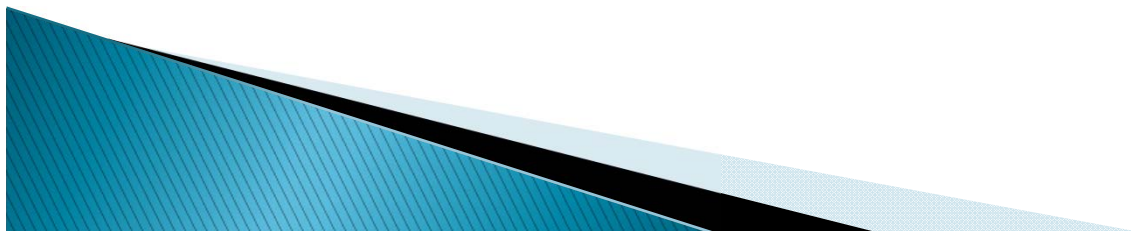


Definitions of Hypertensive Disorders in Pregnancy

Type	Blood Pressure	Onset	Proteinuria
Gestational hypertension	$\geq 140/90$	After mid-pregnancy	Absent
Preeclampsia	$\geq 140/90$	After 20 weeks gestation	> 300 mg/24 h
Preeclampsia with chronic hypertension	$\geq 140/90$	Before 20 weeks gestation/sudden increase in HTN	Sudden increase in proteinuria
Chronic hypertension	$\geq 140/90$	Before 20 weeks gestation/without resolution PP	Absent

Preeclampsia

- ▶ Defined as HTN(> 140/90 mm Hg) occurring after 20 weeks' gestation or in the early postpartum period & returning to normal within 3 months after delivery & at least one of the following:
 - Proteinuria > 300 mg/24 hr
 - Oliguria
 - Sr.- plasma creatinine ratio > 0.09 mmol/L
 - Headache with hyperreflexia or visual disturbances
 - ↑ liver enz, plasma Glut-S-transferase- α 1-1 or RUQpain
 - Thrombocytopenia, ↑ LDH, hemolysis, DIC
 - IUGR



Classification of Preeclampsia

Parameters	Mild	Severe
SBP	< 160 mm Hg	> 160 mm Hg
DBP	< 110 mm Hg	> 110 mm Hg
Urinary protein	< 5 g/24 hrs, dipstick 1+,2+	> 5 g/24 hrs, dipstick 3+,4+
U/O	> 500 ml/24 hrs	< 500 ml/24 hrs
Headache	A	P
Visual disturbances	B	R
Epigastric pain	S	E
RUQ abd pain	E	S
Pul oedema	N	E
Cyanosis	N	N
HELLP syndrome	T	T
Platelet count	> 1 lac/mm ³	< 1 lac/mm ³

RISK FACTORS FOR PIH

Hypertensive ds

- Prev PIH
- Syst HTN during early preg
- H/O chr HTN
- Family h/o HTN during preg
- ↑Pulse pressure in 1st trimester

coexisting vasc & endothelial ds

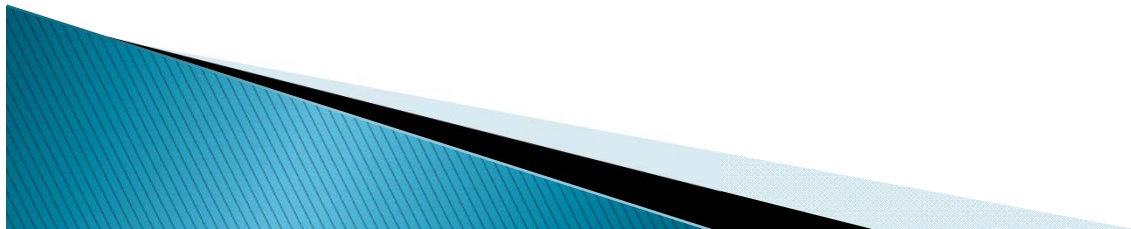
- Chr renal ds
- SLE
- Protein S def
- Activated protein C resistance
- Circulating Anticardiolipin antibody

obstetric factors

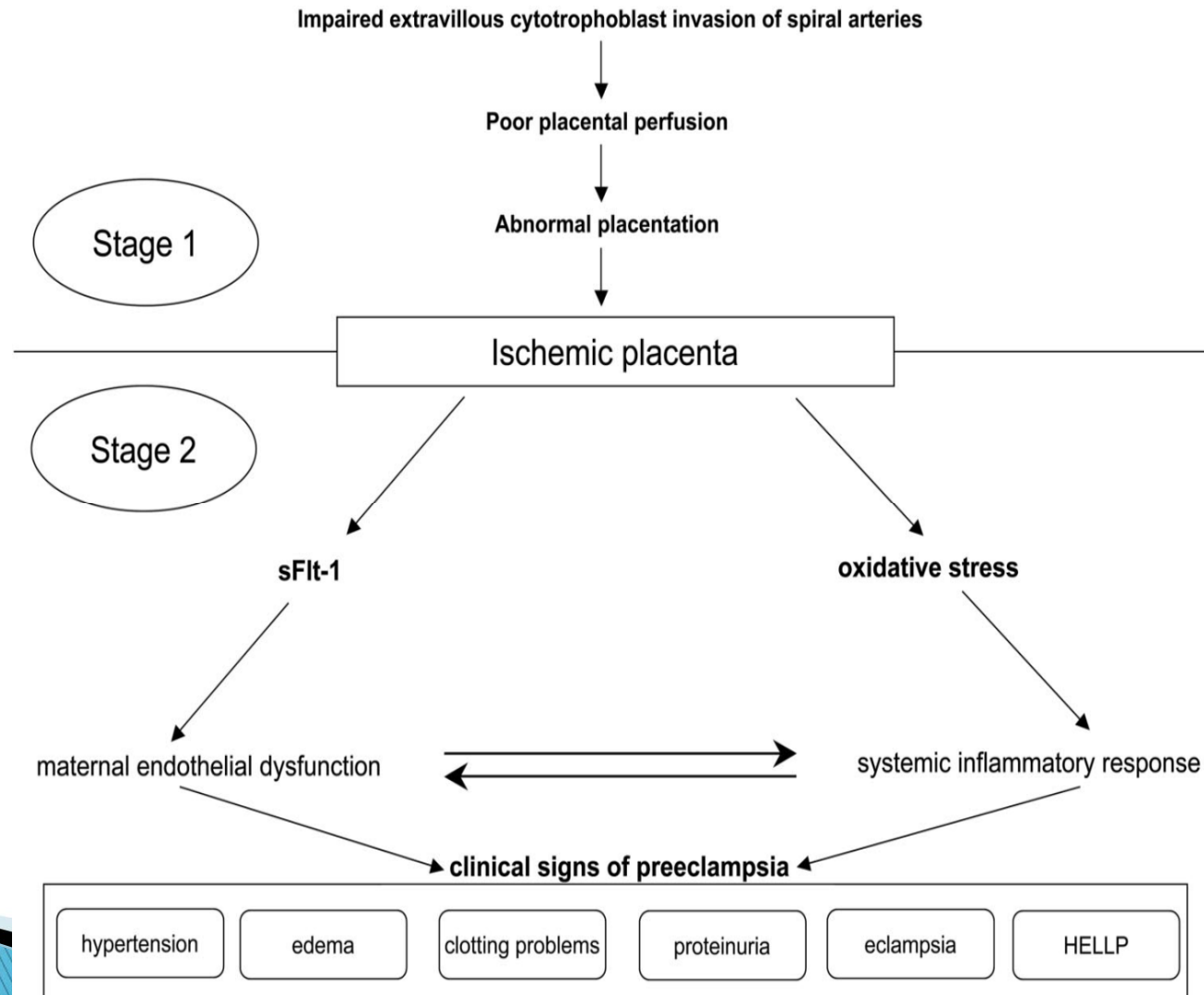
- Nulliparity
- Age > 40 yrs
- H/O smoking
- Obesity
- Multiple gest, molar preg
- DM
- Polyhydramnios

Pathophysiology of PIH

- ▶ Possible mechanisms :
 - ❖ Abnormal placentation & failure of normal invasion of trophoblast cells leading to maladaptation of maternal spiral arteries
 - ❖ Disequilibrium in action of arachidonic acid metabolites, TXA2 & prostacyclins
 - ❖ Genetic – a preeclampsia gene with many modifier genes in conjunction with environmental factors have been implicated
 - ❖ ↑ Cytoplasmic Ca levels in response to angiotensin II
 - ❖ Altered handling of fatty acids by the liver

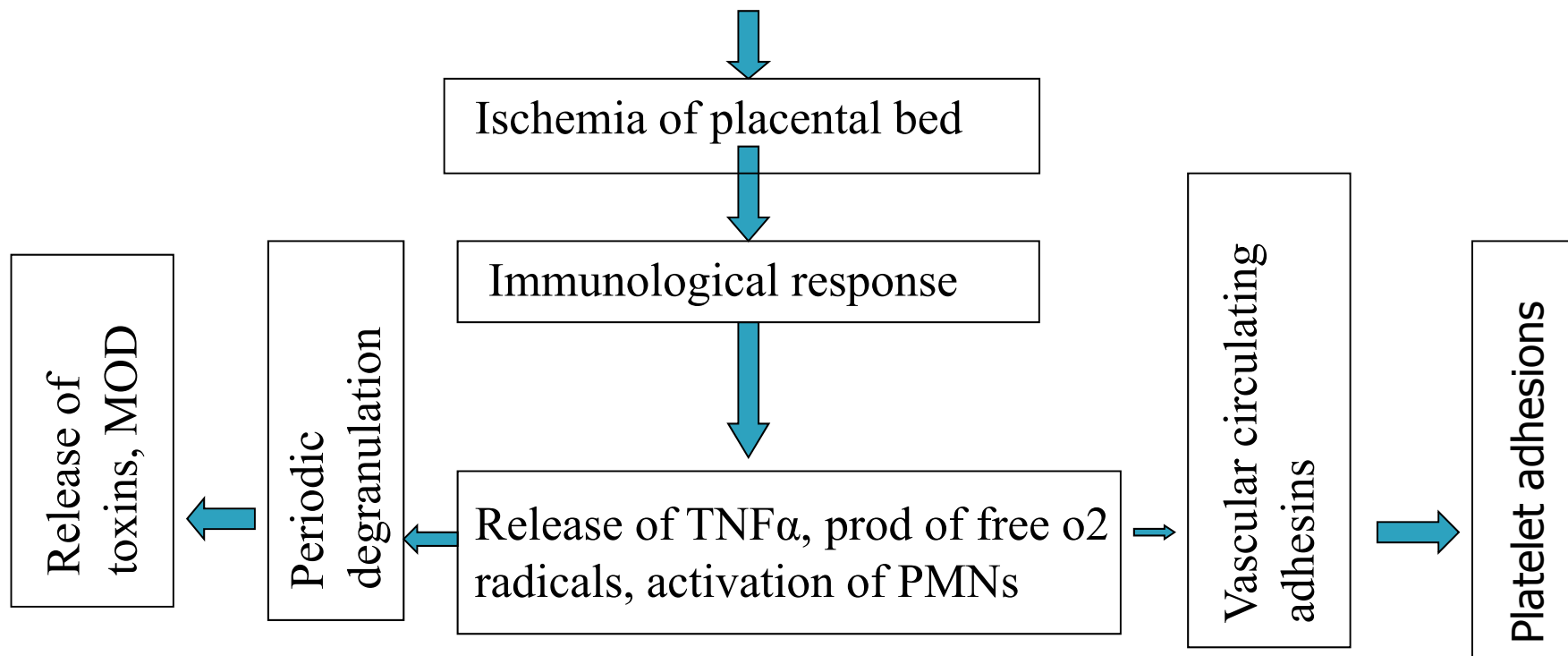


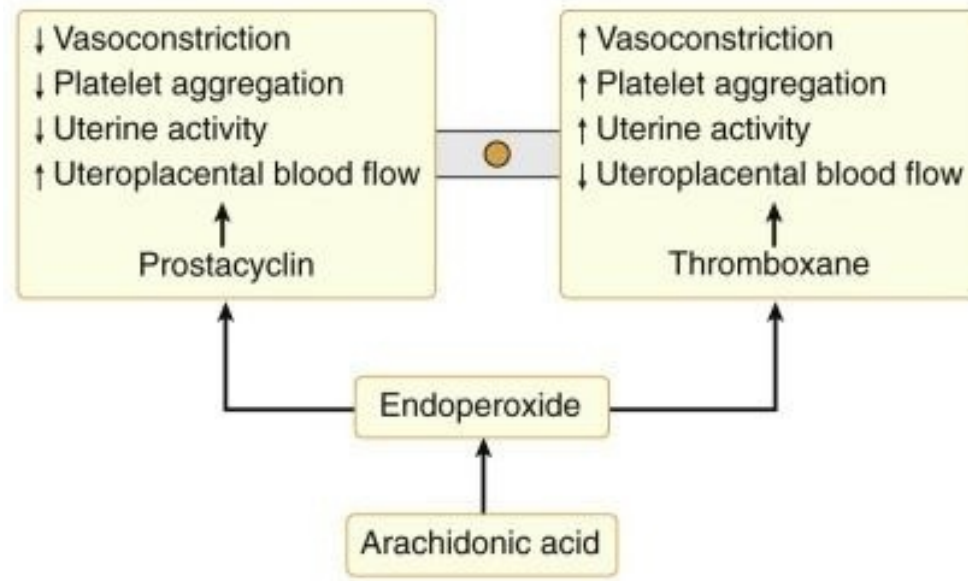
Pathophysiology of preeclampsia



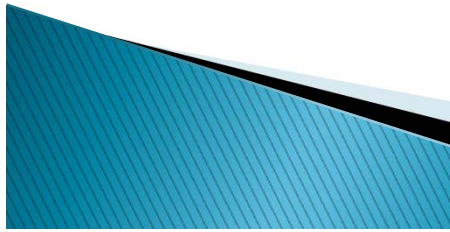
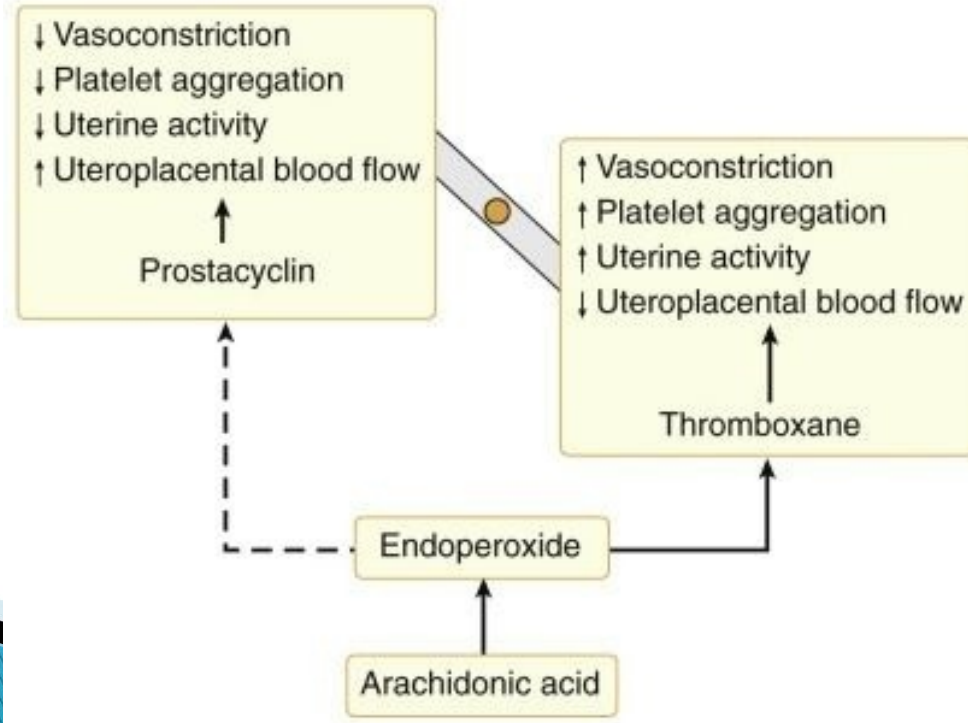
Pathophysiology of PIH

Failure of trophoblastic invasion of decidual arteriole in placental bed

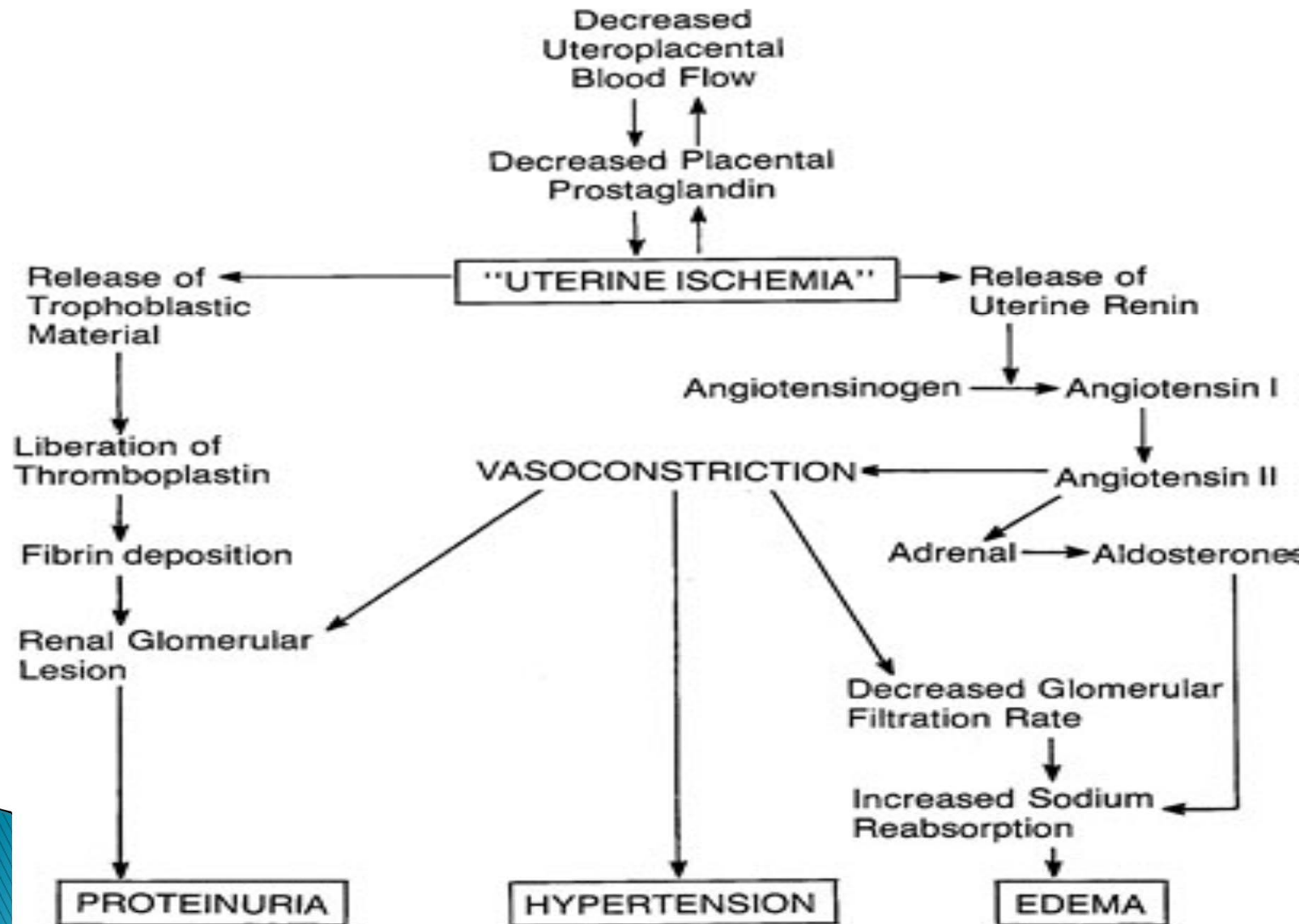




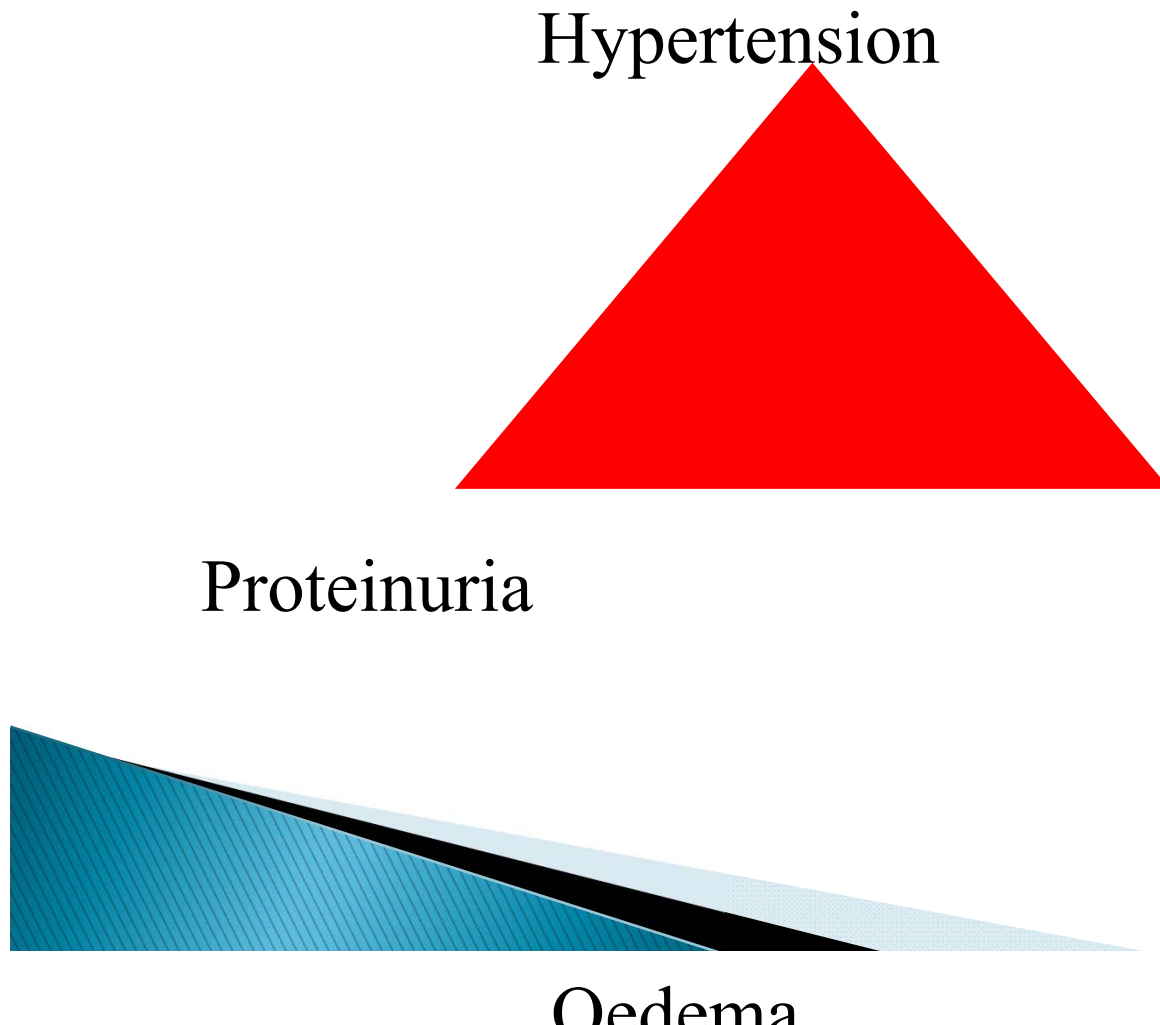
Preeclampsia



Pathophysiological changes in PIH



▶ THE CLASSIC TRIAD OF Preeclampsia



Hallmarks of PIH

- ▶ Vasoconstriction
- ▶ Reduced blood volume
- ▶ Platelet aggregation
- ▶ Uteroplacental hypoperfusion



Organ system derangements in PIH

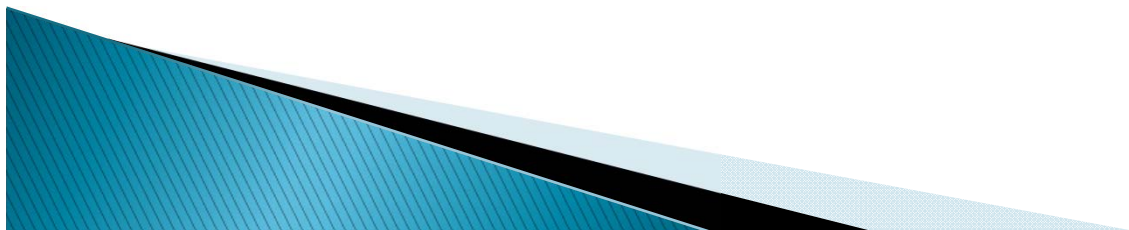
▶ CVS

- Generalised vasospasm
- ↑SVR
- ↑CO
- ↓ CVP
- ↑ BP
- ↓ Blood vol → hemoconc.
- ↑ Response to adr & nor adr

▶ Respiratory system

- Laryngopharyngeal oedema
- Tongue swelling
- Lung vol, capacities not altered
- Maternal CoHb ↑, 2 3 DPG ↓ - left shift of ODC
- Resp. depression – Mg 2+, narcotics / sedatives / hypoxia/ hypercarbia
- Pulm Edema with LVF- injudicious fluid hydration

Difficult
intubation



Organ system derangements in PIH

▶ Renal

- ↓GFR
- ↓RPF
- ↓Uric acid clearance
- Proteinuria, oliguria
- ARF – Abruptio placentae, DIC,HELLP & superimposed essential HTN
- Complete recovery of renal function is anticipated unless b/l renal cortical necrosis occurs

▶ Hepatic

- ↑S. transaminase
- Periportal necrosis
- Subcapsular hematoma
- Hepatic swelling – epigastric pain



Organ system derangements in PIH

▶ CNS

- Cerebral oedema
- Cerebral haemorrhage
- Hyperexcitability
- ↑ ICP
- Visual disturbances – photophobia, diplopia, scotoma, blurring of vision

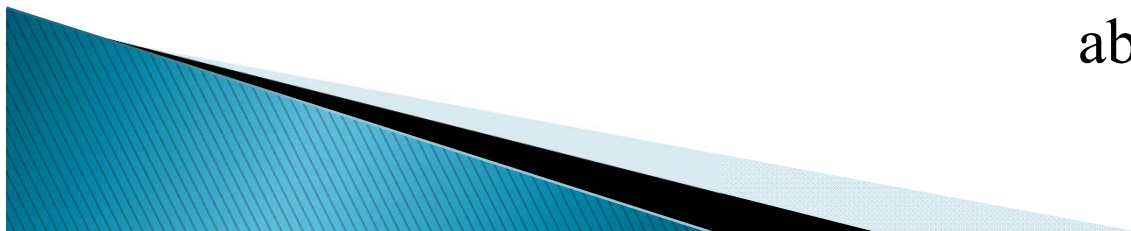
▶ Haematological

- ↓PV
- ↑Bld viscosity
- ↑ Haematocrit
- Coagulopathy
- Thrombocytopenia
- Microangiopathic hemolysis



Organ system derangements in PIH

- ▶ Endocrine system
 - ↓Plasma renin
 - Suppression of RAA system
 - Imbalance b/w vasoconstrictors, vasodilators
- ▶ Uteroplacental perfusion
 - Uterus - hyperactive & ↑ sensitive to oxytocin
 - Rapid & preterm labor with painful contractions
 - Uteroplacental blood flow ↓- ↑vascular resistance & maternal blood viscosity
 - Small Placenta- premature aging, infarct, fibrin deposition, calcification & abruptio



Clinical presentation

▶ Symptoms

- ❖ Oedema
 - ❖ Headache
 - ❖ ↓U.O.
 - ❖ Epigastric pain
 - ❖ Convulsions
 - ❖ Blurring of vision – retinal vasospasm
- Vascular endothelial damage
Extravasation of fluid
Interstitial hyperoncocity
- Hemorrhagic gastritis, subcapsular hematoma
Hepatic rupture

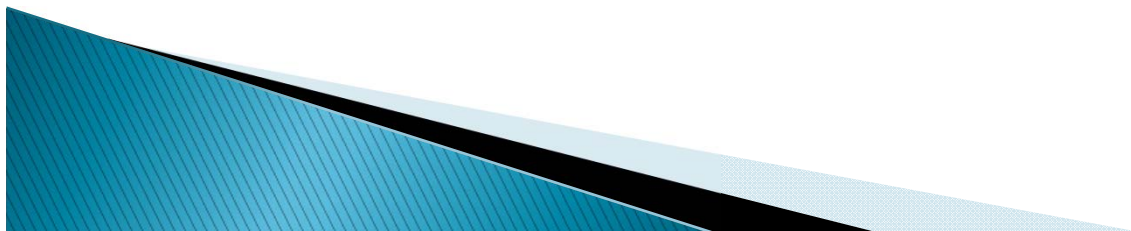
▶ Signs

- ❖ Weight gain > 2lbs/wk or > 6 lbs/mnth
- ❖ HTN



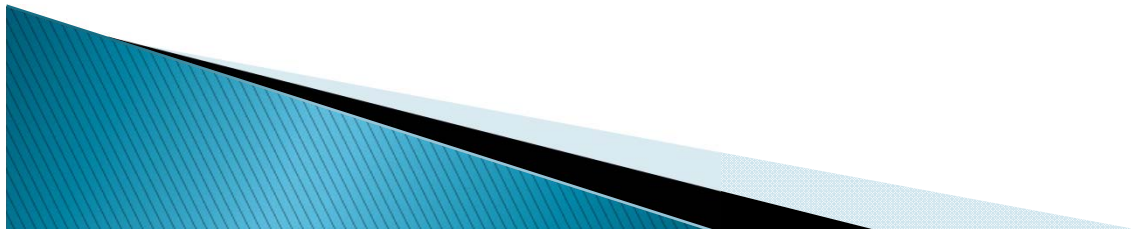
Prediction

1. Roll over test - $\uparrow >20\text{mmHg}$ of DBP when turned from left lateral position to supine position
2. $\text{MAP} > 85\text{mmHg}$ during 20-28 weeks of gestation
3. Hypocalciuria
4. \uparrow Plasma homocysteine, S.sFlt 1; \downarrow placental growth factor, vascular endothelial growth factor
5. Uric acid levels $> 5.9 \text{ mg/dl}$
6. Angiotensin II infusion test
7. \downarrow urinary kallikrein excretion
8. Doppler velocimetry studies of uterine arteries



Investigations

- ▶ Complete Hmg
- ▶ Urine - routine & microscopy
- ▶ Complete LFTs
- ▶ Complete RFTs (BUN, Sr. creatinine , uric acid).
- ▶ Sr. electrolytes
- ▶ RBS
- ▶ BT, CT, Coagulation profile(PT, INR, PTTK, FDPs, D-dimers, AT-3)
- ▶ Fundoscopy
- ▶ USG abdomen with doppler
- ▶ MRI/ CT brain
- ▶ Blood grouping & cross matching



Prevention

- ▶ Low dose aspirin
(Comparative low dose aspirin study in pregnancy)
- ▶ Calcium supplementation
- ▶ Magnesium supplementation
- ▶ Fish oil supplementation
- ▶ Antioxidant use – vit C & E
- ▶ Ketanserin



T/t of Preeclampsia

- ▶ Salt restriction
- ▶ Adequate hydration
- ▶ Sedation
- ▶ Control of HTN
- ▶ Seizures prophylaxis with magnesium sulphate
- ▶ Delivery of fetus



ANTIHYPERTENSIVE AGENTS

Antihypertensives

Acute therapy

Hydralazine

Labetalol

Nifedipine

Nitroglycerine

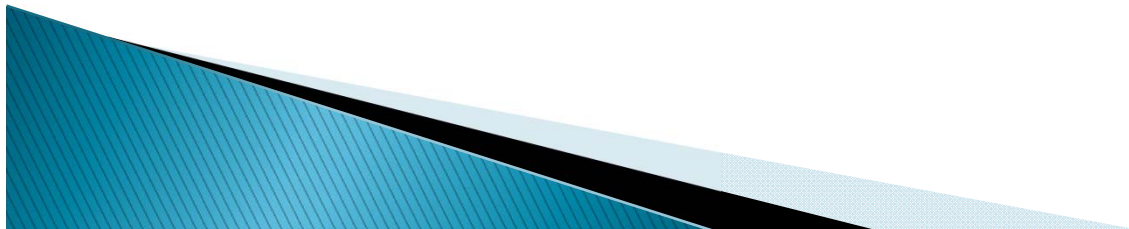
Nitroprusside

Chronic therapy

methyl dopa 250-500mg tds/qid

Labetalol 2-10 mg/kg/day

Nifedipine 0.8-1.2 mg/kg/day



Drugs used in acute HTN control

Drug	Dose	Onset	Duration	S/E
Hydralazine	5-10mg IV q 20 min	10-20 min	3-6hrs	↑HR, headache, flushing, ppt of angina
Labetalol	20-40mg IV q10min → 1mg/kg infusion	10-20 min	3-6 hrs	Scalp tingling, vomiting, heart block
Nifedipine	10-20mg PO q 20-30min	10-15min	4-6hrs	Headache, ↑HR, synergistic interaction with MgSO ₄
SNP	0.25-0.5ug/kg/min IV	Immediate	1-2min	Nausea-vomiting, muscle twitching, TCN&CN toxicity
NTG	5-100ug/min IV	2-5min	3-5min	Headache, methemoglobinemia, tachyphylaxis

Anticonvulsant agent

MgSO₄

- ▶ Site of action - *N*-methyl-DL-aspartate receptors
- ▶ Beneficial effects –
 - Anticonvulsant
 - Vasodilatation - ↑UBF & RBF, ↓BP
 - Attenuation of vasopressor response
 - ↓ Platelet aggregation
 - Bronchodilatation
 - Tocolysis- improves uterine blood flow, antagonizes uterine hyperactivity
- Detrimental effects –
 - increases sensitivity to DMR & NDMR
 - postpartum uterine atony
 - Muscle weakness or apnea in the neonate



Effects of Increasing Plasma Magnesium Levels

Dose - loading dose of 2 to 4 gms IV over 15 min f/b 1-3 g/hr

Plasma Mg (mEq/L)

1.5–2.0

Normal plasma level

4.0–8.0

Therapeutic range
Effects

5.0–10

ECG changes (↑PQ intv, QRSwidening)

10

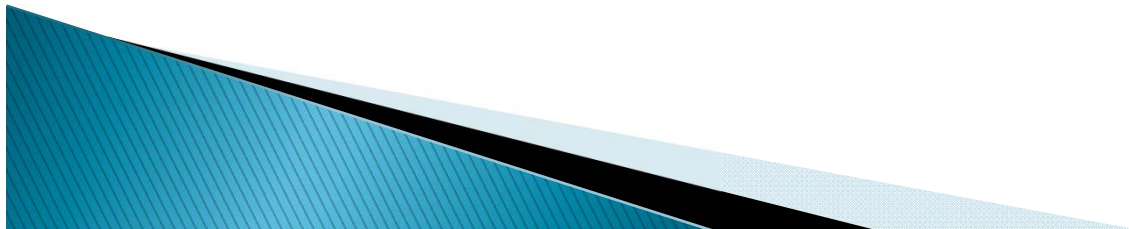
15

SA & AV block, Respiratory paralysis

25

Cardiac arrest

Loss of DTR



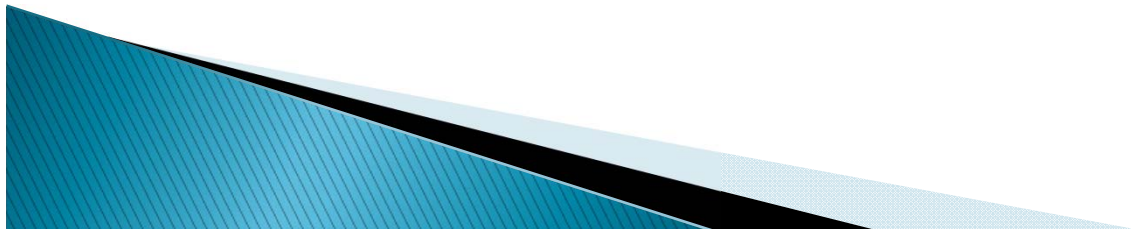
- ▶ C/I : (1) absent / v.sluggish knee jerk
 - (2) RR < 16/min
 - (3) U/O < 100ml in the preceding 4 hours (25ml/hr)

- ▶ T/t of Mg toxicity - Stop infusion
 - O2 supplementation
 - Sr. Mg levels monitored
 - 10ml 10%Ca gluconate slow iv
 - Resp.Distress - intubation & CV



Other drugs used in PIH

- ▶ Furosemide 20-40 mg IV
- ▶ 20% Mannitol 0.5mg/kg
- ▶ Dexamethasone 10 mg BD
- ▶ Plasma expanders



Indications for delivery in preeclampsia

▶ **Maternal indications**

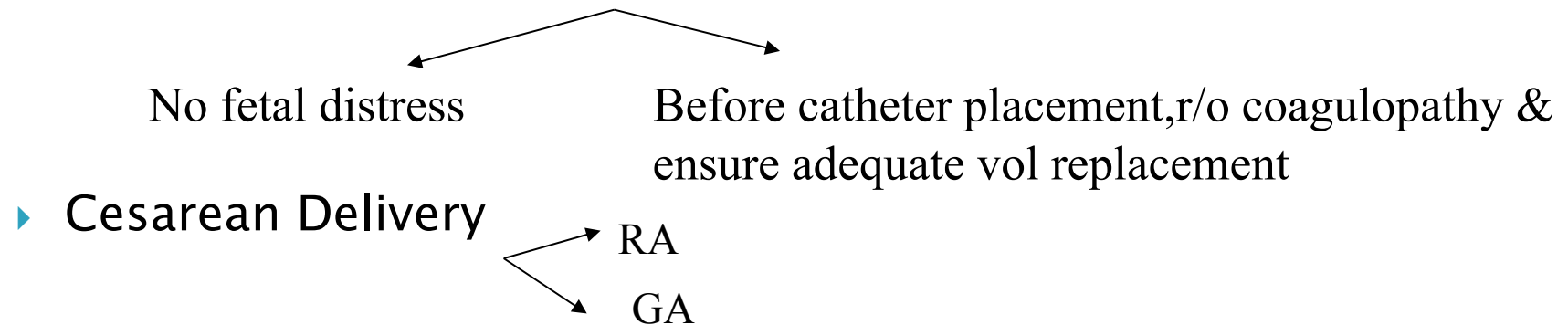
- ▶ Gestational age \geq 38 wks
- ▶ Platelet count \leq 100,000 cells /mm³
- ▶ Deteriorating liver & renal fn
- ▶ Abruptio placentae
- ▶ Persistent severe headaches or visual changes
- ▶ Persistent severe epigastric pain or nausea-vomiting

▶ **Fetal indications**

- Severe fetal growth restriction
 - Nonreassuring results from fetal testing
 - Oligohydramnios
- 

MANAGEMENT

- ▶ Definitive treatment for Preeclampsia is delivery of the fetus & placenta
- ▶ Vaginal Delivery – Lumbar epidural analgesia



- if fetal distress occurs
- Use epidural if in place
- SAB



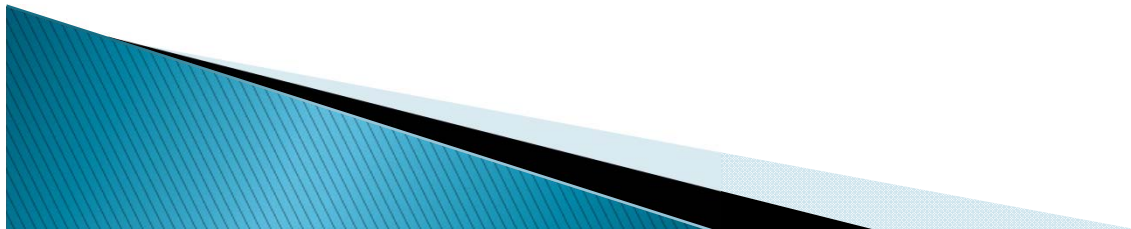
Pre-anesthetic Evaluation

▶ **Assessment of target organ-system involvement**

1. CVS : HTN control, LV fn, intravascular depletion
2. Renal : degree of oliguria, hematuria, creatinine level
3. Liver : LFTs, signs of liver capsule stretching
4. Coagulation profile : platelet count, PT, PTT
5. Airway examination : degree of laryngeal edema

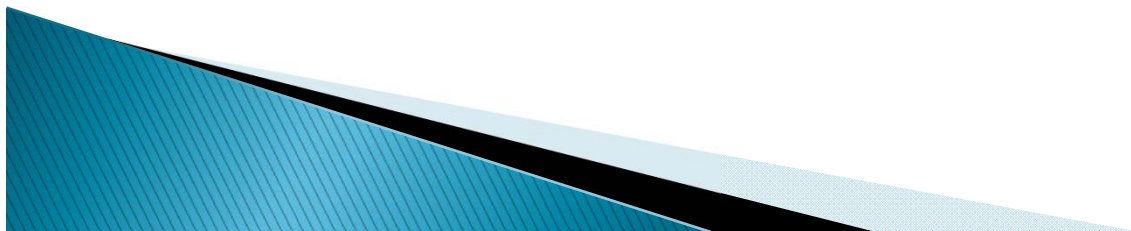
▶ **Anesthetic risk factors**

1. Poorly controlled HTN
2. >2+ urinary protein
3. ↑ Sr. uric acid
4. Thrombocytopenia < 75,000
5. Central vascular vol depletion
6. Ass. chronic HTN & IDDM

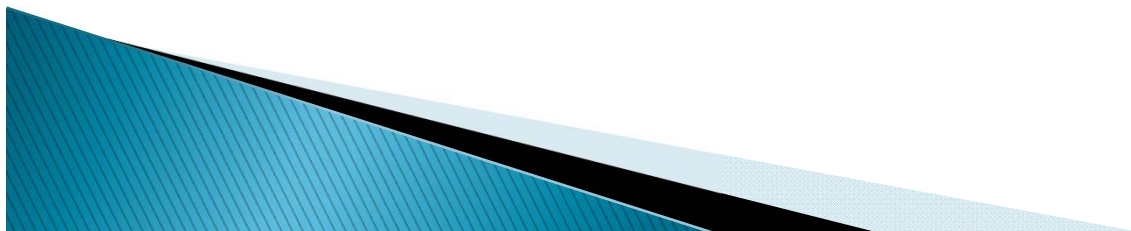


Preanesthetic Assessment

- ▶ Particular attention - to airway assessment.
- ▶ Facial edema/stridor - indicates airway edema & difficult intubation.
- ▶ Preeclamptic pts - hypovolemic & prone to hypotension with neuraxial anesthesia .
- ▶ They are also at risk of pulm. edema ; thus, judicious hydration is indicated.
- ▶ A 500- to 1000-mL crystalloid preload is appropriate before neuroaxial block.

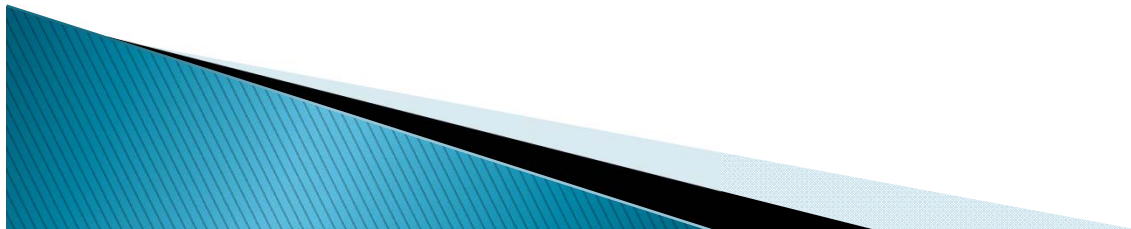


- ▶ ↑ hematocrit suggests hypovolemia
- ▶ Platelet count $< 70,000/\text{mm}^3$ - ↑ risk of epidural hematoma
- ▶ A test of platelet fn is useful in such pts
- ▶ LFTs, BUN & creatinine - determines severity of preeclampsia or in identifying +nce of HELLP syndrome
- ▶ ABG & CXR - indicated if there are s/s of pulm. edema



Goals of the anesthesiologist

1. Control CNS irritability – MgSO₄ ↓es irritability of NM jn
2. Restore intravasucular fluid volume - monitor U/O
 - CVP monitor with goal 4-6 cmH₂O
3. Normalize BP – MgSO₄
 - Labetolol , Hydralazine , nifedipine , SNP
4. Correct coagulation abnormalities - Platelets, FFP, Cryoprecipitate



Monitoring

- ▶ HR and cont ECG
- ▶ BP & MAP
- ▶ Pulse Oximetry
- ▶ RR
- ▶ Knee jerks
- ▶ Urine output
- ▶ Level of consciousness
- ▶ Fetal heart rate and partogram
- ▶ CVP monitoring



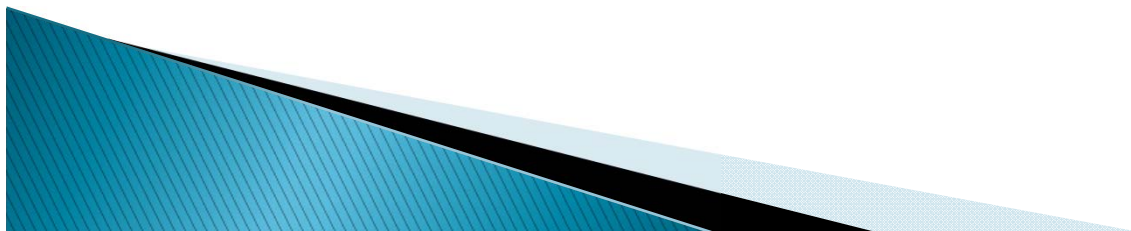
Invasive Monitoring

- ▶ CVP catheter/ PICC
- ▶ IBP _ Sustained DBP > 90 mm Hg
 - Use of IV vasodilators (SNP, NTG)
 - Ind. of anesthesia with potential rapid BP fluctuations
- ▶ PAC – Severe HTN unresponsive to t/t
 - Severe pulm edema
 - Oliguria unresponsive to fluid challenge



Labor Analgesia

- ▶ Epidural analgesia
 - Preferred technique
 - Facilitates BP control in labor
 - Improves uteroplacental performance & fetal well-being
 - Early epidural placement can be used for CS, thus avoiding the risks of GA
- ▶ Technique
 - Cont. infusions of LA sol. combined with an opioid
 - Avoid add. of adr d/t hypersensitivity of maternal vasculature to catecholamines



Regional Anesthesia for Preeclamptic Patient

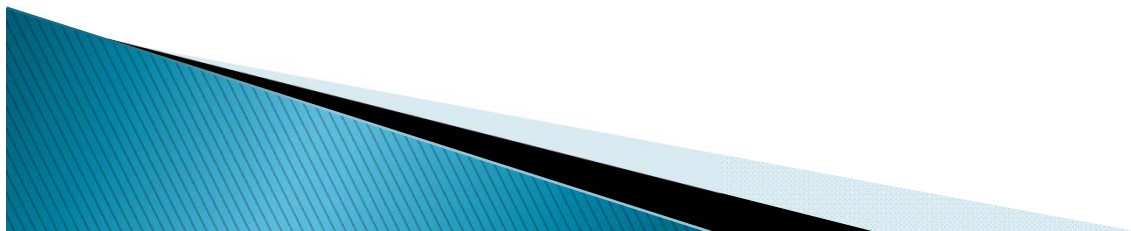
- ▶ Advantages of epidural anesthesia
 - Blunts hormonal & hemodynamic responses
 - Provides better hemodynamic stability
 - ↑es renal & uteroplacental bld flow
 - ↓es potential for seizures
- ▶ Spinal anesthesia
 - Growing evidence of safety in preeclampsia
 - Less hemodynamic stability (?)
 - Less potential for hematoma
- ▶ CSE – 1.25-2.5 mg bupivacaine or 20-25 ug fentanyl intrathecally followed by epidural infusion



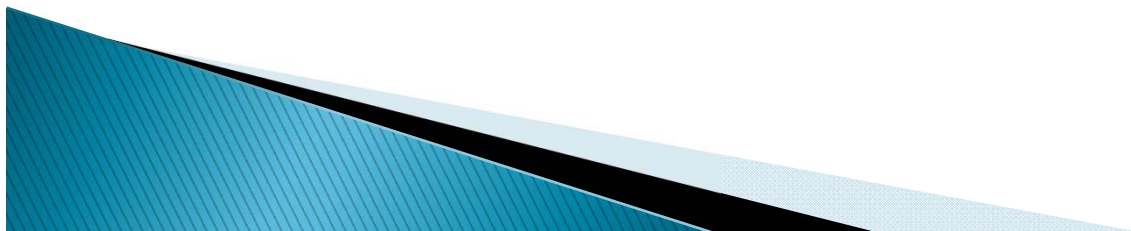
Spinal Anaesthesia

- ▶ Traditionally been discouraged because of risk of severe hypotension
- ▶ However, in pts with severe PIH, the magnitude of maternal BP ↓es are similar following either spinal or epidural anesthesia for CS
- ▶ Adq. IV hydration before performing SAB is essential
- ▶ T4 sensory level is needed for CS

J Anaesthesiol Clin Pharmacol. 2011 Apr-Jun; 27(2): 169–173.



- ▶ If SBP ↓es > 30% of preblock value, T/t should consist of
 - Lt uterine displacement
 - ↑ rate of fluid infusion
 - small dose of ephedrine (5 mg IV) or phenylephrine (100 μg IV)
- ▶ Anesthetic requirements are ↓ed in parturients
 - Inj. bupivacaine (12–15 mg) is adq. to achieve T4 sensory level & 120 min of anesthesia
 - Fentanyl (10-15mcg) can be added.



General Anesthesia for Preeclamptic Patient

- ▶ Indications :
 - Coagulopathy
 - Acute fetal distress
 - Pt refusal
 - Failure of RA

- ▶ Risks of GA :
 - Aspiration
 - Airway compromise
 - Cerebral haemorrhage
 - Pulm oedema



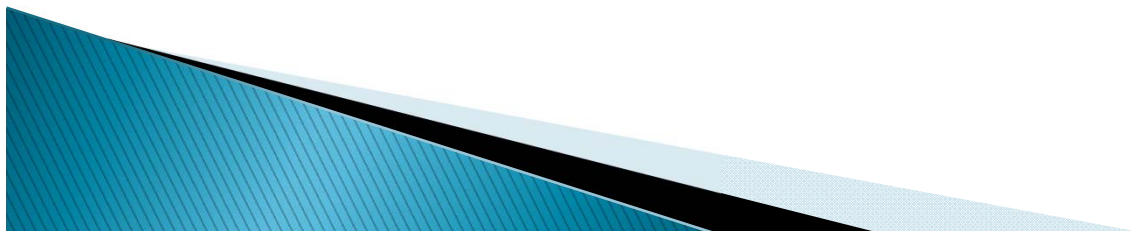
▶ Problems

- ▶ Airway edema
 - ▶ Difficult intubation
 - ▶ Hypertensive response at Induction, intubation & extubation
 - ▶ HTN & tachycardia can lead to ↑ed ICP
 - ▶ Interaction of anesthetic agents with MgSO₄
-
- ▶ Preparation for difficult intubation tray
 - ▶ Preoperative control of HTN



General Anesthesia for Preeclamptic Pt contd.

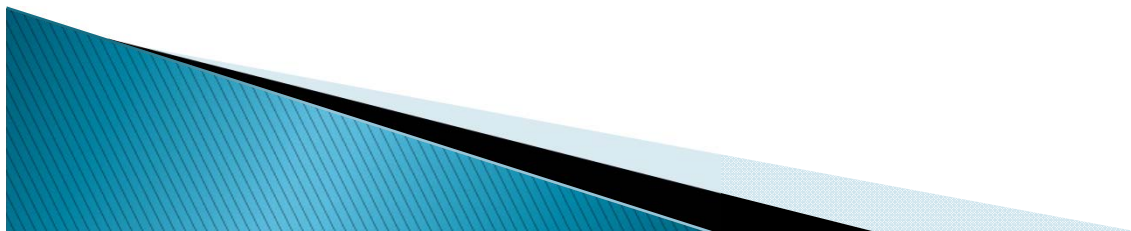
- ▶ Attenuation of pressor response by –
 - Hydralazine (5–10 mg IV over 10–15 min before induction)
 - Labetalol (10–20 mg IV 5–10 min before induction)
 - NTG (1–2 µg/kg IV just before initiating direct laryngoscopy)
 - Fentanyl (2–3 mcg/kg IV 3–4 min before laryngoscopy)
 - Lidocaine (1.5 mg/kg IV before laryngoscopy)
- ▶ RSI with Sellick's manoeuvre
- ▶ Relaxants should be used in minimal doses if MgSO₄ is given
- ▶ Isoflurane is used for maintenance
- ▶ NTG spray or i.v. lidocaine given just prior to extubation to attenuate extubation response



Parameter	Regional	General
Airway	No intubation response No failed intubation No sedative	↑ intubation response ↑ risk of failed intubation
Drug / technique	Risk of high block	Maternal awareness Fetal depression
Speed of induction	Spinal -5-10 min Epidural-20-30 min ↓ catecholamine	Fast < 5 min ↑ catecholamine
BP control	Less ↓ BP- epidural	↑ BP , PAWP , CVP
Coagulation	Risk of epidural hematoma	Risk of Airway h'age
Uteroplacental circulation	improves	impaired

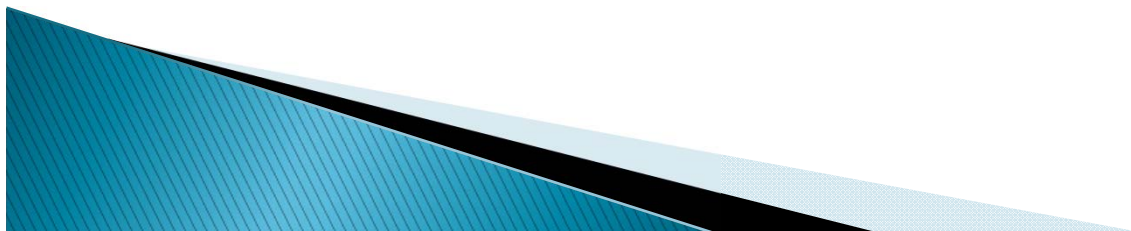
Postpartum care


- Analgesia- 2.5 to 3 mg morphine epidurally
- Strict intake output charting- 24 hrs/ diuresis develops
- Continue MgSo₄ – 24 hrs
- Reinstigate antihypertensive therapy to avoid rebound hypertension
- Careful monitoring for evidence of pulmonary congestion



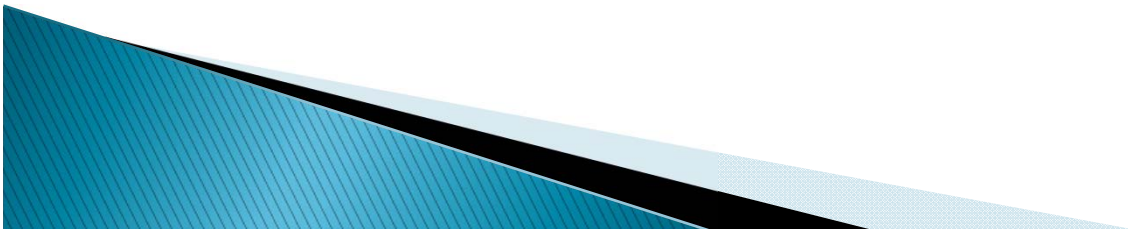
HELLP Syndrome

- ▶ Seen in 20% of parturients who develop severe preeclampsia
- ▶ Hemolysis, ↑ liver enz & low platelet counts
- ▶ Clinical s/s – HTN
 - Proteinuria
 - Epigastric pain
 - Upper abdominal tenderness
 - Nausea and vomiting
 - Jaundice



- ▶ Complications - pulmonary oedema
 - pleural effusion
 - cerebral edema
 - hematuria, oliguria, ATN
 - panhypopituitarism
 - ▶ DIC is most dangerous complication
 - ▶ Maternal & perinatal mortality is ↑sed
 - ▶ Lab diagnosis - Sr. Bilirubin > 1.2 mg/dl
 - Abonrmal PS showing burr cells schistocytes
 - Sr. LDH > 600 u/l.
 - Aspartate aminotransferase >70 u/l
 - Platelet count < 1 lakh
- 

- ▶ T/t - Delivery of fetus
 - PRC, FFP, Cryoppt adm.
 - Maintain adequate fluid status (CVP4-6) & U/O @ 1ml/kg/hr
- ▶ Patients who undergo cesarean section should be transfused if their platelet count is less than 50,000 per mm³ (50 × 10⁹ per L)
- ▶ Insertion of an epidural catheter is generally safe in patients with a platelet count greater than 100,000 per mm³ (100 × 10⁹ per L), normal coagulation studies and a normal bleeding time.²⁶



Comparison of Risk Factors for HELLP Syndrome and Preeclampsia



HELLP syndrome	Preeclampsia
Multiparous	Nulliparous
Maternal age >25 yrs	Maternal age <20 / >45 yrs
White race	Family h/o preeclampsia
h/o poor pregnancy outcome	Minimal prenatal care



Eclampsia

- Preeclampsia accompanied by grandmal convulsion not related to cerebral conditions
- Incidence – Ante partum – 50%
Intrapartum- 25%
Postpartum- 15%
- Pathogenesis - Cerebral vasospasm, ischemia, Hemorrhage
 - HTNsive encephalopathy
 - DIC
- Premonitory - Transient visual disturbances
 - Headache
 - Epigastric/ RUQ pain



Differential diagnosis

Not considered until eclampsia is ruled out

1. Epilepsy
2. Encephalitis
3. Meningitis
4. CVA
5. Cerebral tumors



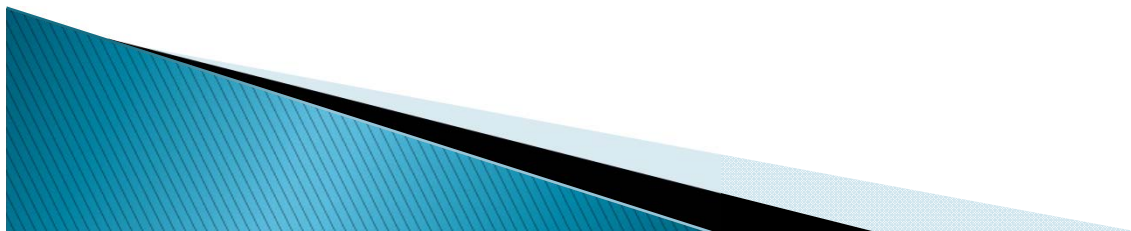
Course of seizure

- Self limiting- 1-2 min
- Abrupt onset-tonic clonic
- Abnormal fetal HR pattern-
 - Bradycardia
 - ↓variability
 - Late deceleration
 - Reflex tachycardia
 - Resolve – 5 min of cessation of seizure



Management of Eclampsia

- ▶ Control seizures & protect the pt from aspiration pneumonitis
- ▶ Anticonvulsants - Thiopental 2-3 mg/kg IV
 - Diazepam 0.02 -0.2 mg/kg IV
 - Midazolam 0.03-0.05 mg/kg IV
 - MgSO₄ 4gms IV loading followed by IV infusion @1-2 gm/hr
- ▶ Airway support - oral or nasopharyngeal airway, suction, 100% O₂
- ▶ Endotracheal intubation - if seizures are not controllable & risk of aspiration is high



Delivery in eclampsia

- Vaginal
- LSCS for obstetric indication only
- MgSO₄ throughout labor & postpartum-24hrs



Causes of mortality in PIH

- ▶ Intracranial haemorrhage is the leading cause.
- ▶ Congestive heart failure with pulmonary edema
- ▶ Aspiration pneumonitis
- ▶ Postpartum haemorrhage
- ▶ DIC
- ▶ Acute renal failure
- ▶ Ruptured liver in HELLP
- ▶ Septic shock
- ▶ ARDS & ventilator associated pneumonia



Conclusion

- ▶ Preeclampsia is a fairly common multisystem disorder
- ▶ Ass. with high maternal & perinatal morbidity & mortality
- ▶ Magnesium sulfate remains the mainstay of seizure prophylaxis
- ▶ Magnesium sulfate administration does not reduce overall perinatal morbidity & mortality, it may ↑ risk of maternal respiratory depression



- ▶ Spinal block could be a safe anesthetic choice for women with severe preeclampsia having a cesarean delivery if patient has no c/i to neuraxial block
- ▶ Imp steps in anesthesia management
 - Close communication with obstetrical colleagues
 - Early & detailed preop assessment & plan
 - Meticulous monitoring, including invasive monitors if indicated
 - Utilization of advantages of RA when appropriate
 - Close postoperative follow-up



Thank you

