

# ANAESTHETIC IMPLICATION OF PREGNANCY CHANGES

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# INTRODUCTION



Obstetric patients are unique population



Physiological changes happen to save fetus



Altered physiology become detrimental in diseased mother



Altered physiology should not be more altered by anesthesia and surgery



A decent knowledge is essential for a successful obstetric practice

# CARDIOVASCULAR SYSTEM

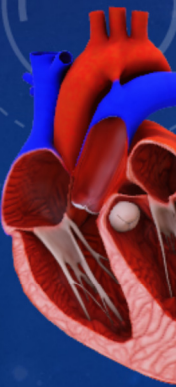
happens for 3 purposes: to support fetal growth  
to ↑ uterine perfusion  
to prepare for blood loss

Blood volume ↑ by **35-40%**

Plasma volume ↑ by **55%**

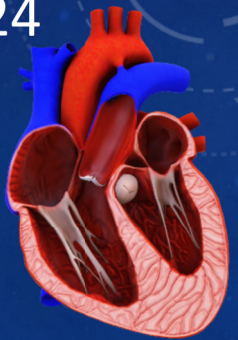
RBC volume ↑ by **17%**

Disproportionate ↑ causes physiological anemia



# CVS CHANGES

- Cardiac output ↑ - begins at 5<sup>th</sup> week
- I trimester- **35%** ↑ above baseline
- II trimester- **50%** ↑, no change in III trimester
- early I stage-**10%**, late I stage- **25%**
- II stage- **40%** ↑
- immediate postpartum- **75%** above
- Decrease to pre labor values by 24hrs postpartum & pre pregnancy level by 12-24 weeks

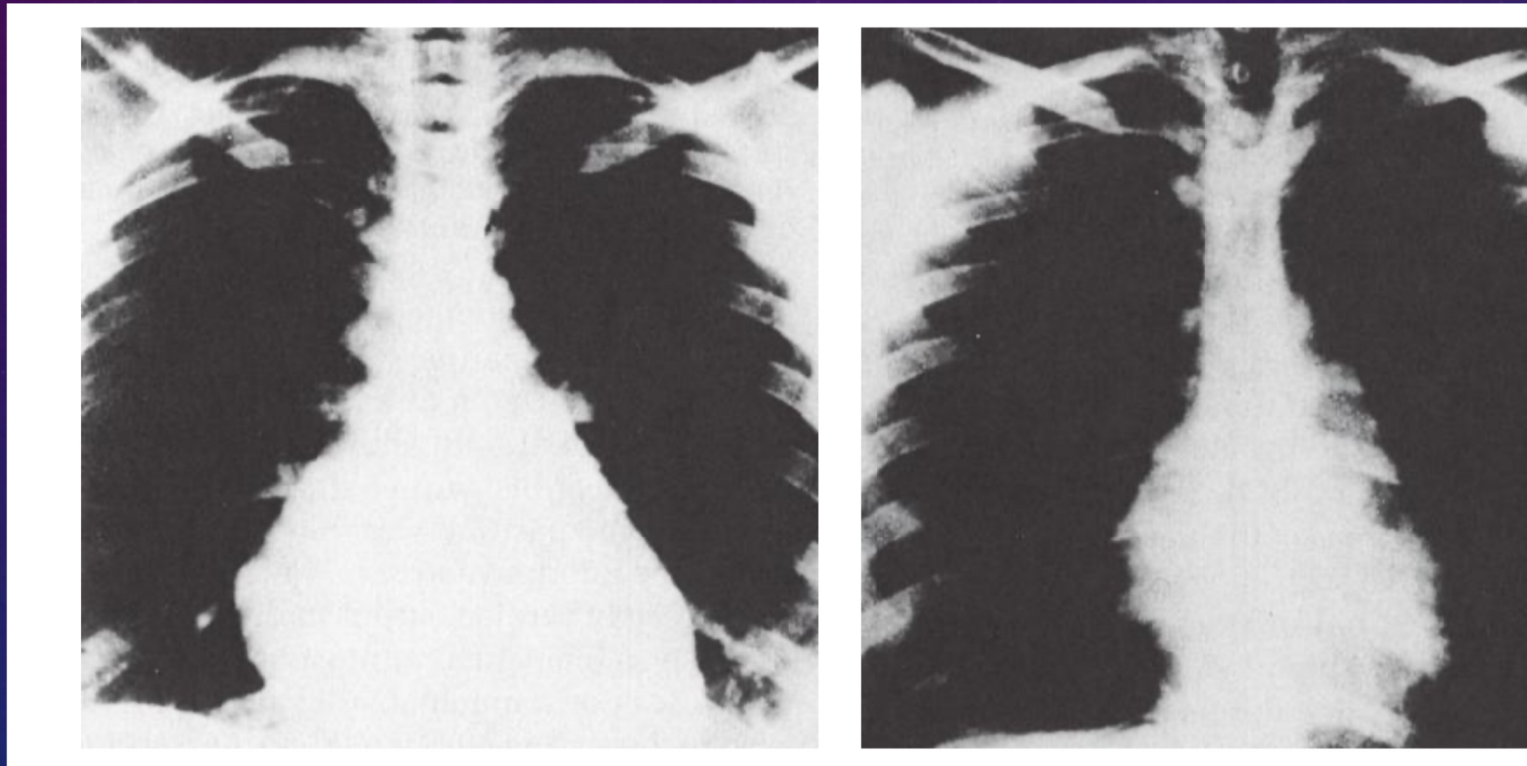


# CVS CHANGES

- Leftward shift of heart-silhouette appears enlarged
- ↑ in cardiac myocyte size, not numbers
- Short PR, QT interval, axis deviation, ST segment changes
- Benign dysrhythmias : atrial, ventricular ectopics
- Pulmonary, tricuspid regurgitation seen in 90% cases
- S1 loud& split, S2 IS N, S3 may be heard, systolic murmur grade I, II
- Systolic, diastolic & MAP ↓ by. 10-15 mmHg

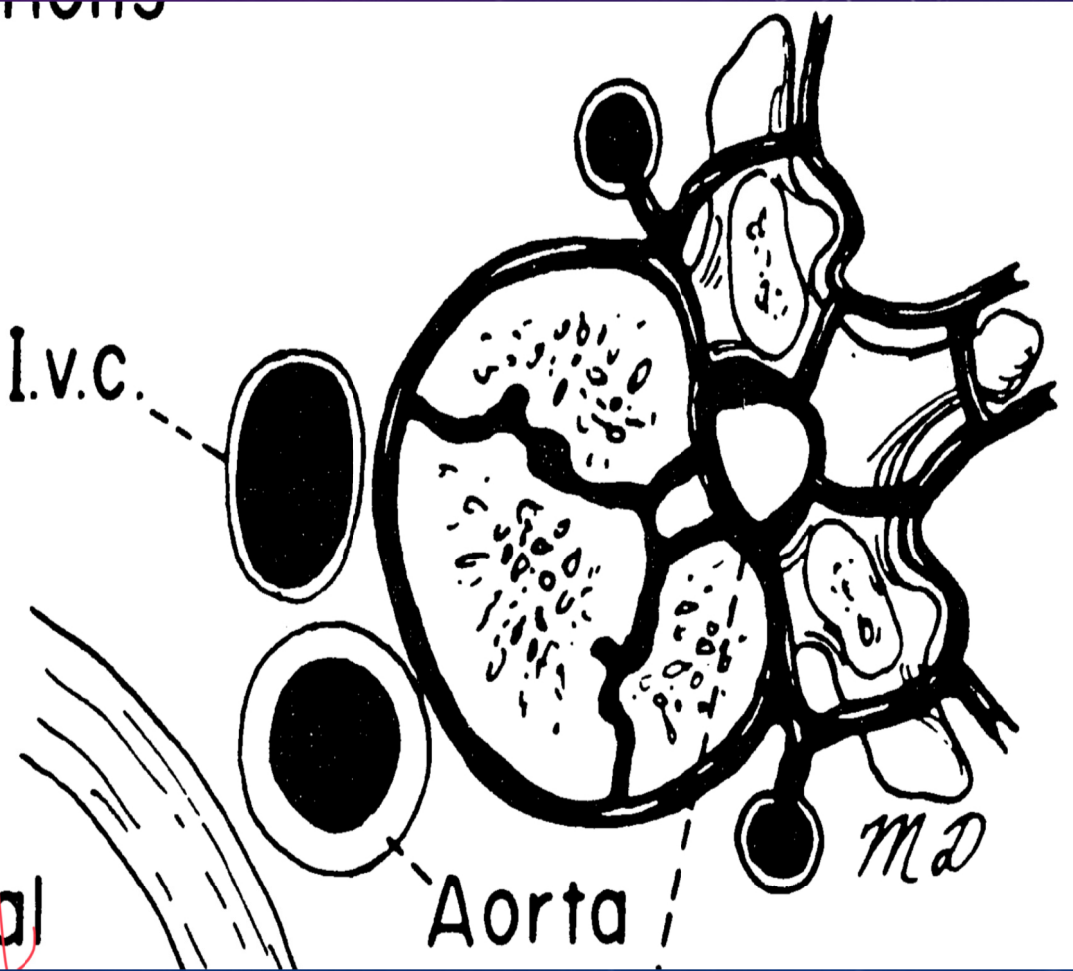
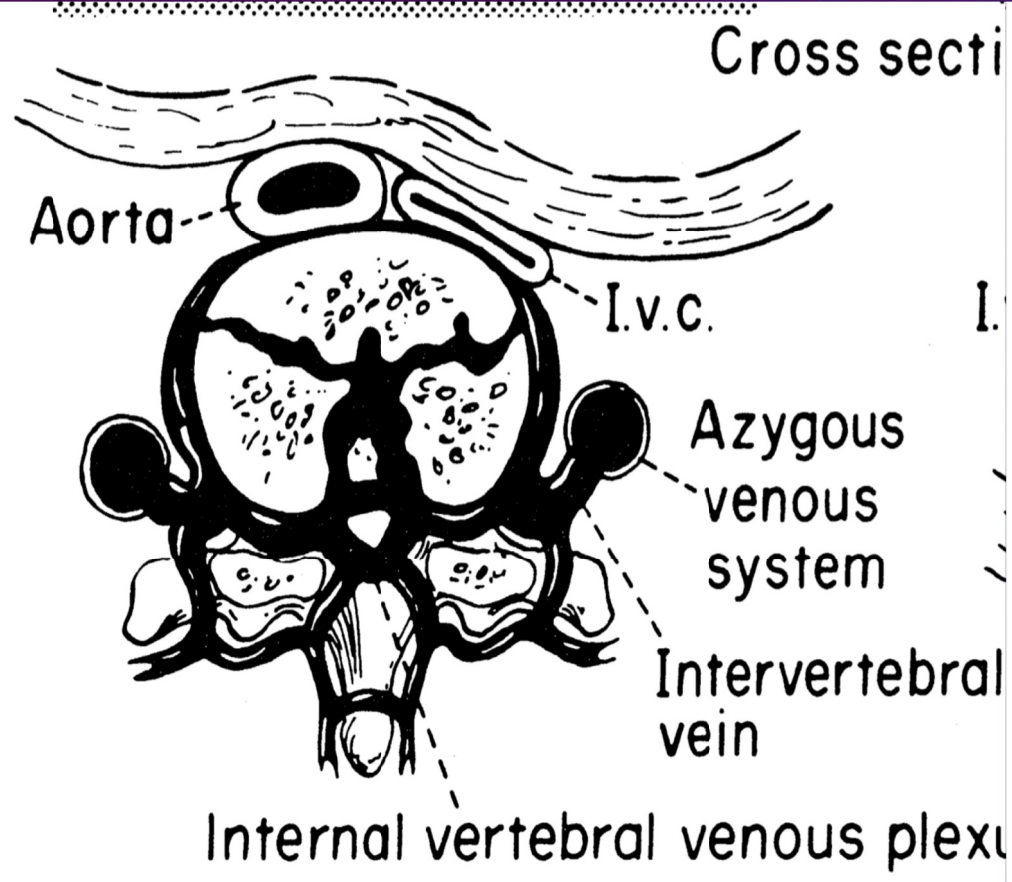


# X RAY OF A PATIENT IN PREGNANT AND POSTPARTUM



# AORTOCAVAL COMPRESSION

- Gravid uterus compresses aorta-↓ blood flow to uterus
- Also compress IVC- ↓ venous return- ↓ cardiac output
- Happens in supine position, aggravated under GA, RA
- 1943- BY MCLENNEN
- How much tilt? During shift/in ward- complete left lateral position
- In OR table- 15° tilt is ideal
- OBESE PARTURIENT,CPR implications





# ANAESTHETIC IMPLICATIONS

- Pregnancy induced symptoms, ECG changes, physical findings-cardiac evaluation should be done in detail.
- LABOR & IMMEDIATE POSTPARTUM- high incidence of pulmonary edema due to high C.O and low COP
- Venodilation : perform epidural carefully
- Always avoid aortocaval compression
- Treat a fall in maternal BP –as it affects uterine blood flow

# GASTROINTESTINAL SYSTEM

- Age old teaching is gastric emptying delayed
- Ultrasound studies disproved it..
- Onset of labor pain - emptying delayed
- Opioids thro any route delays gastric emptying
- Allow them to consume clear fluids except laboring parturient who are obese, diabetic and difficult airway
- Gastric secretions are unchanged despite the placental gastrin

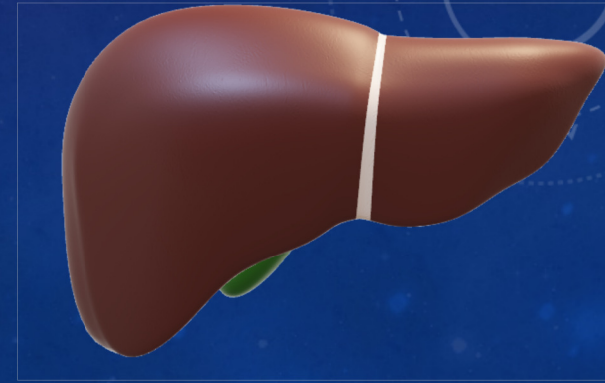


# GIT CONTINUED..

- Lower esophageal sphincter tone ↓ by hormones
- Pinch valve mechanism lost due to displaced stomach
- Risk of regurgitation, aspiration still exist
- Lower esophageal high pressure zone (LEHPZ)-tone gets reduced
- GERD is very common .

# LIVER PHYSIOLOGY

- Size, blood flow do not change, but displaced
- Serum bilirubin, ALT, AST, LDH  $\uparrow$  to upper normal limit
- Alkaline phosphatase-  $\uparrow$  2- 4 fold
- Gall bladder hypomotility- biliary stasis- gall stone disease common
- Estrogen causes spider naevi, palmar erythema
- Esophageal varices appear in 60% cases
- Pseudocholinesterase activity  $\downarrow$  by 25%



# ANESTHETIC IMPLICATIONS

- **10- 20 fold increase** in ALT,AST – suspect **PHELLP**,if associated HT, proteinuria, thrombocytopenia is present
- **300- 500 fold increase** – suspect **Acute fatty liver of pregnancy**-also associated with hypoglycemia, hyperammonemia, hyperuricemia
- Intrahepatic cholestasis of pregnancy and hyperemesis gravidarum are other two conditions to be kept in mind

# KIDNEY –PHYSIOLOGIC CHANGES

- Earliest ,most dramatic change happen here
- Renal blood flow  $\uparrow$ - **50 to 80%**, size  $\uparrow$  30%
- Ureter dilatation due to hormonal, mechanical factors
- Hydronephrosis is seen in 80% patients
- Increase in GFR & creatinine clearance – blood urea and serum creatinine levels  $\downarrow$
- Physiologic glucosuria and proteinuria (200mg is upper limit)
- Respiratory alkalosis –kidney excrete bicarbonate buffer



# ANAESTHETIC IMPLICATIONS

- Recurrent Urosepsis is common and a recent one pose hemodynamic challenge under anesthesia
- A small  $\uparrow$  in serum creatinine should alarm you for a search
- Proteinuria  $>300$  mg/day more likely to progress to preeclampsia than women with hypertension alone
- ABG analysis: bicarbonate level will be 18-21 m Eq/l

# CENTRAL NERVOUS SYSTEM CHANGES

- SLEEP DISTURBANCES- insomnia, daytime sleepiness
- CBF ↑, BBB permeability ↑,
- Hormonal effect
- Elevated endorphins and enkephalins level- ↑pain threshold
- MAC ↓ by **30%**
- Neuraxial anesthesia dose ↓ by **25-40%**





# CAUSES FOR ↓ DOSE IN SPINAL ANESTHESIA:

- IVC compression- epidural venous plexus engorged
- Epidural fat ↑
- CSF volume in spinal cord ↓, Higher level of apex of thoracic kyphosis
- Altered receptor activity.
- Modulation of Na channel.
- Altered permeability of neuronal membrane.
- RETURN TO NORMAL 24 HRS POSTPARTUM

HORMONE

EFFECT



# HAEMATOLOGIC CHANGES

- **Pregnancy is a hypercoagulable state**
- **Changes more near term & immediate postpartum**
- **Physiologically prevents blood loss, DVT is 5 times common**
- **Fibrinolysis is decreased**
- **Gestational thrombocytopenia –benign ,resolve spontaneously**

# WHAT HAPPENS TO CLOTTING FACTORS

## UNCHANGED

PROTHROMBIN (F II)

FACTOR V

PROTEIN C

## DECREASED

PROTEIN S

TISSUE PLASMINOGEN  
ACTIVATOR

FACTOR XI

ANTITHROMBIN III

## INCREASED

FIBRINOGEN

FACTORS VII,VIII,IX,X,XII

PLASMINOGEN

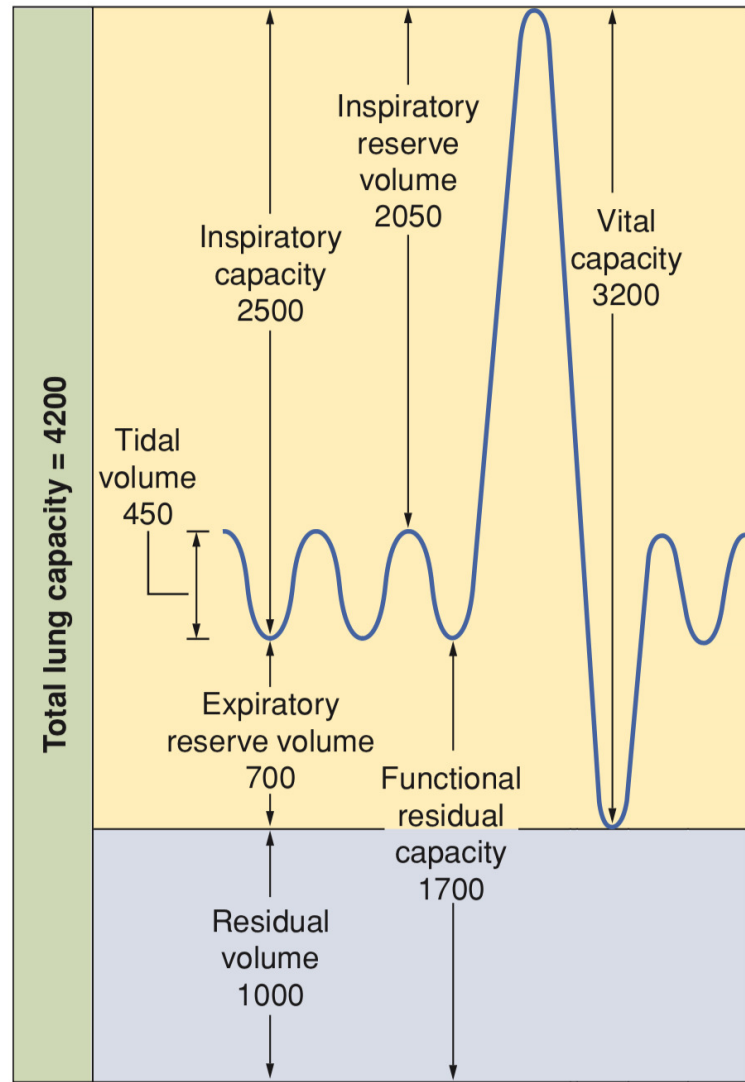
PAI,TAFI

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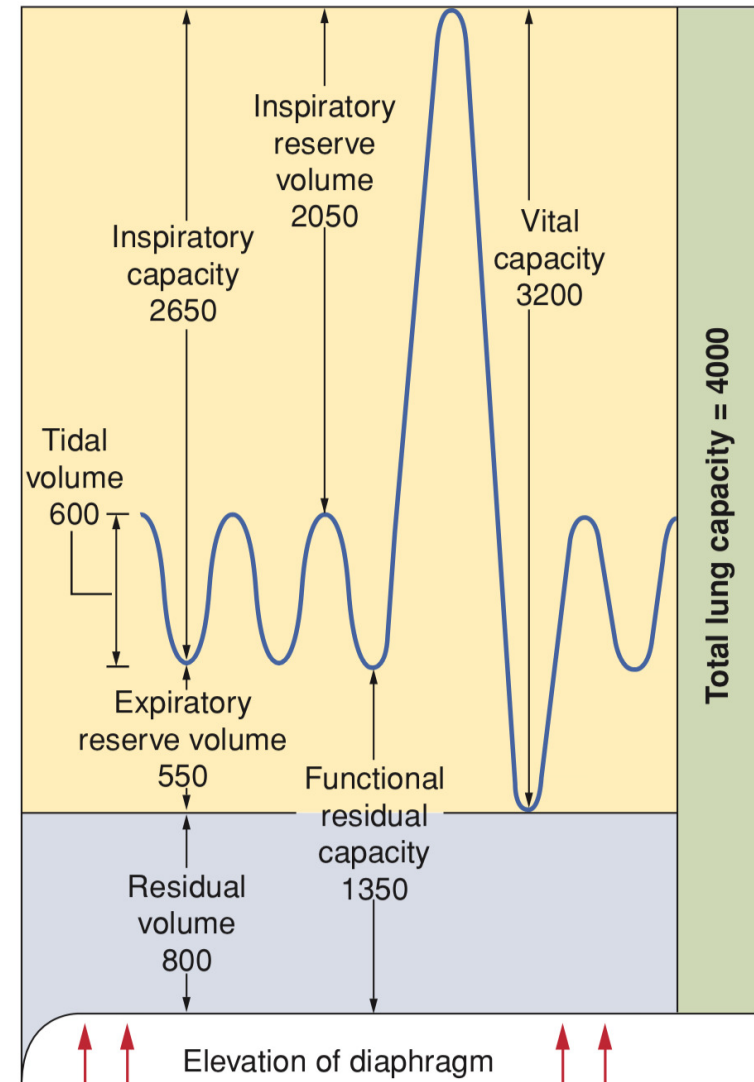
VWF,THROMBIN AT  
COMPLEX

# RESPIRATORY SYSTEM CHANGES

- Upper airway- hypervascularity, edematous changes
- AP diameter of thorax  $\uparrow$  5-7cm, diaphragm elevated by 4cm
- Subcostal angle  $\uparrow$  by 50%
- Lung volumes: TV  $\uparrow$  **45%**, ERV  $\downarrow$  **25%**, RV  $\downarrow$  **15%**
- Capacities: FRC  $\downarrow$  **20%**, IC  $\uparrow$  **15%**
- MV, ALV. VENTILATION, DEAD SPACE all  $\uparrow$  by **45%**



**Nonpregnant**



**Gravida at term**

# VENTILATION, ABG CHANGES

- CO<sub>2</sub> production ↑ - progesterone effect
- PaCO<sub>2</sub> ↓ to 30 mmHg - due to hyperventilation
- Metabolic compensation by ↑ bicarbonate excretion
- So ABG shows ↑ pH (7.41-44) & ↓ HCO<sub>3</sub> (20 m Eq/l)
- PaO<sub>2</sub> ↑ slightly (103-107 mmHg)
- Oxygen consumption is ↑ - demand by fetus, RS & CVS

# ABG OF A PREGNANT LADY:

7.41–7.44

103

30–32

20

# ANESTHETIC IMPLICATIONS

- Use smaller size ETT.
- Manipulation during intubation, Ryle's tube insertion BE GENTLE
- Trauma in thoracic region –suspect concurrent abdominal injury
- Faster induction and rapid desaturation happens –FRC effect
- Avoid hypoxemia and hyperventilation –both detrimental to fetus



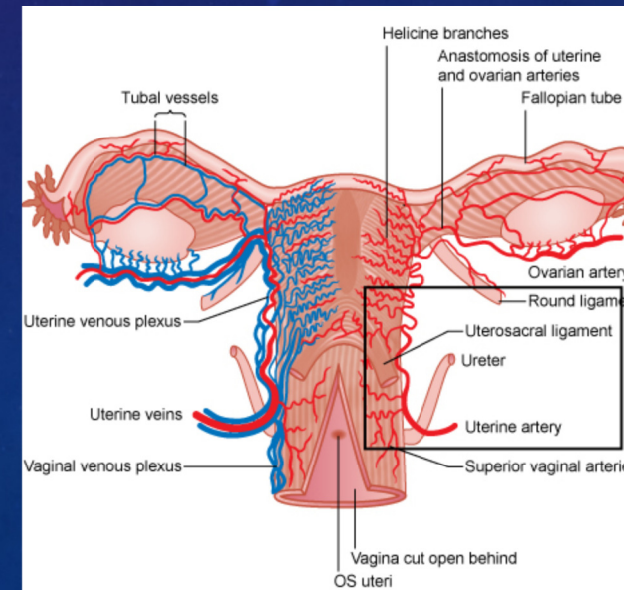
# CPR IN PREGNANCY

- **Most challenging, most rewarding scenario**
- **Maternal mortality, maternal near miss**
- **CABU- LUD should be continuous**
- **PERIMORTEM CAESAREAN DELIVERY**
- **3 TEAM, 3EQUIPMENT TRAYS NEEDED FOR BETTER OUTCOME**



# UTERINE BLOOD FLOW

- Not autoregulated, flow is proportional to perfusion pressure
- UAP – UVP/Uterine vascular resistance
- Contraction, hypotension and hypertension all in excess can ↓ blood flow
- 700ml/ minute at term

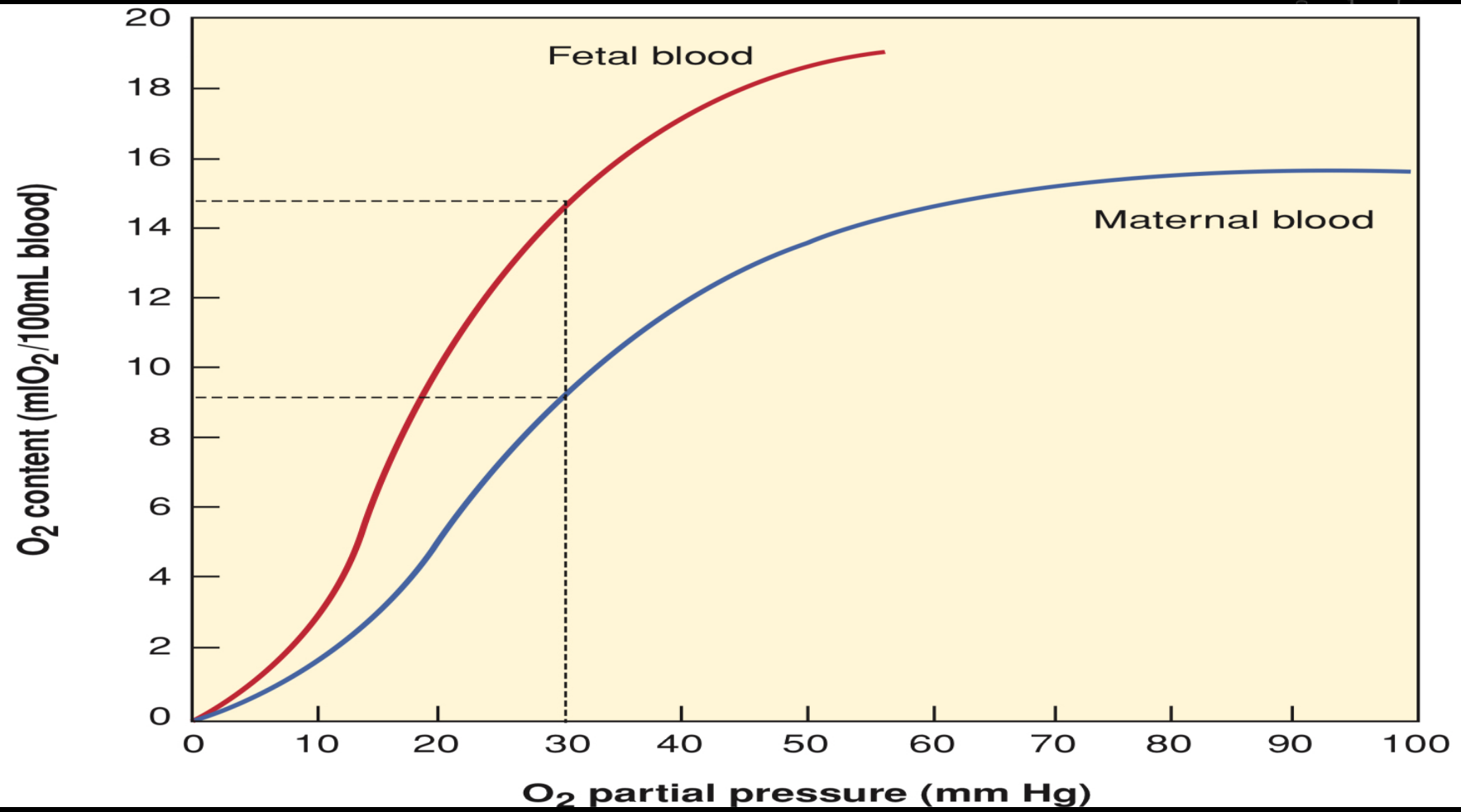


# ROLE OF INTRAUTERINE RESUSCITATION

- **Measure to improve O2 delivery to placenta & umbilical blood flow**
- **Done for reversal of fetal hypoxia and acidosis**
- **PUT THE PATIENT IN LEFT LATERAL, KNEE CHEST POSITION**
- **DISCONTINUE OXYTOCIN INFUSION**
- **SUPPLEMENT O2 to mother**
- **RAPID INFUSION OF CRYSTALLOID**
- **VASOPRESSOR TO TREAT HYPOTENSION**
- **TOCOLYSIS WITH NTG, TERBUTALINE**
- **AMNIOINFUSION**

# FACTORS AFFECTING OXYGEN TRANSFER FROM MOTHER TO FETUS

- Intervillous blood flow
- Oxygen tension of maternal blood
- Oxygen tension of fetal arterial blood
- Oxygen affinity
- Oxygen capacity
- Maternal and fetal blood pH & pCO<sub>2</sub> (Bohr effect)
- Placental oxygen consumption



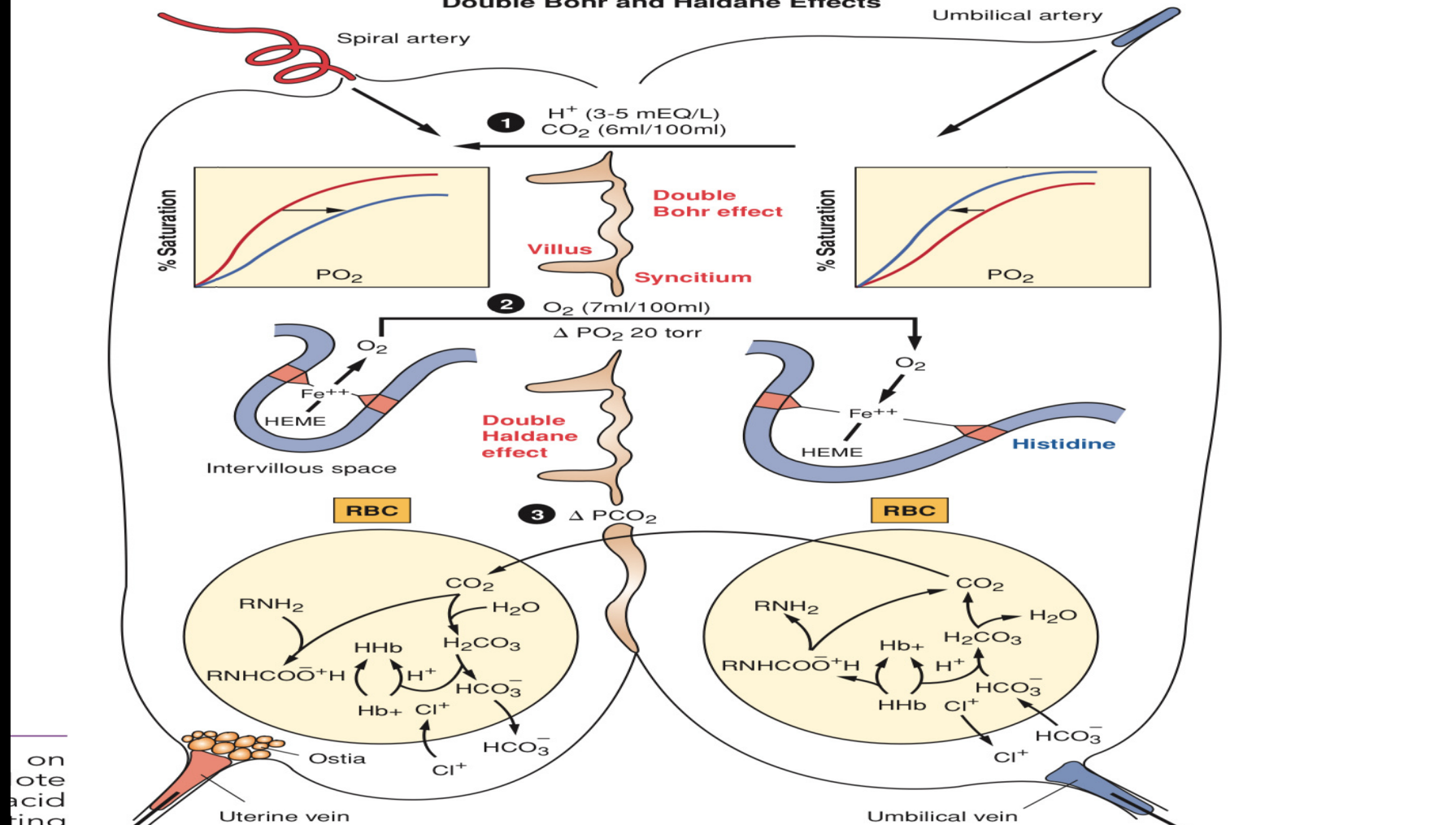
# BOHR,DOUBLE BOHR EFFECT

- Rise in CO<sub>2</sub>(alkalosis) and rise in pH shift the **ODC TO RIGHT**
- Fall in CO<sub>2</sub>(acidosis) and fall in pH shift **ODC TO LEFT**
- Oxygen affinity measured by concept of P<sub>50</sub>
- Change of P<sub>50</sub> decide the shift of curve
- P<sub>50</sub> of fetal Hb is 18mm Hg
- P<sub>50</sub> of maternal Hb is 27 mm Hg
- Oxygen capacity depend on Hb conc.( maternal-12g, fetal- 15gm/dl)

## CONTINUED...

- Fetal CO<sub>2</sub> – diffuse into maternal side- ↑ in intervillous H<sup>+</sup> - cause ↓ affinity of maternal Hb for oxygen – facilitate O<sub>2</sub> transfer
- Sametime Fetal side ↓ in CO<sub>2</sub>-alkaline -↑ affinity –fetal Hb uptake
- Bohr effect happening on both sides of O<sub>2</sub> delivery/uptake : so called **DOUBLE BOHR EFFECT**
- Rise or fall in O<sub>2</sub> tension leads to ↓ or ↑ affinity for CO<sub>2</sub>-facilitate transport of CO<sub>2</sub>: Haldane effect
- Maternal deoxyHb-↑ affinity for CO<sub>2</sub>,fetal blood takes up more O<sub>2</sub>-enhancing CO<sub>2</sub> release: **DOUBLE HALDANE EFFECT**

### Double Bohr and Haldane Effects



on  
ote  
acid  
ing





**When physiology starts, everything  
ends...!!**

**– Dhananjay Kejariwal**

**When under pressure,  
it is wise to behave like a duck.**



*By Robert Lind*

**Keep calm and unruffled on the surface,  
but paddle like the hell underneath.**

THANK  
YOU ALL