



PHYSIOLOGY OF PREGNANCY AND ASSESSMENT OF FETAL WELL BEING

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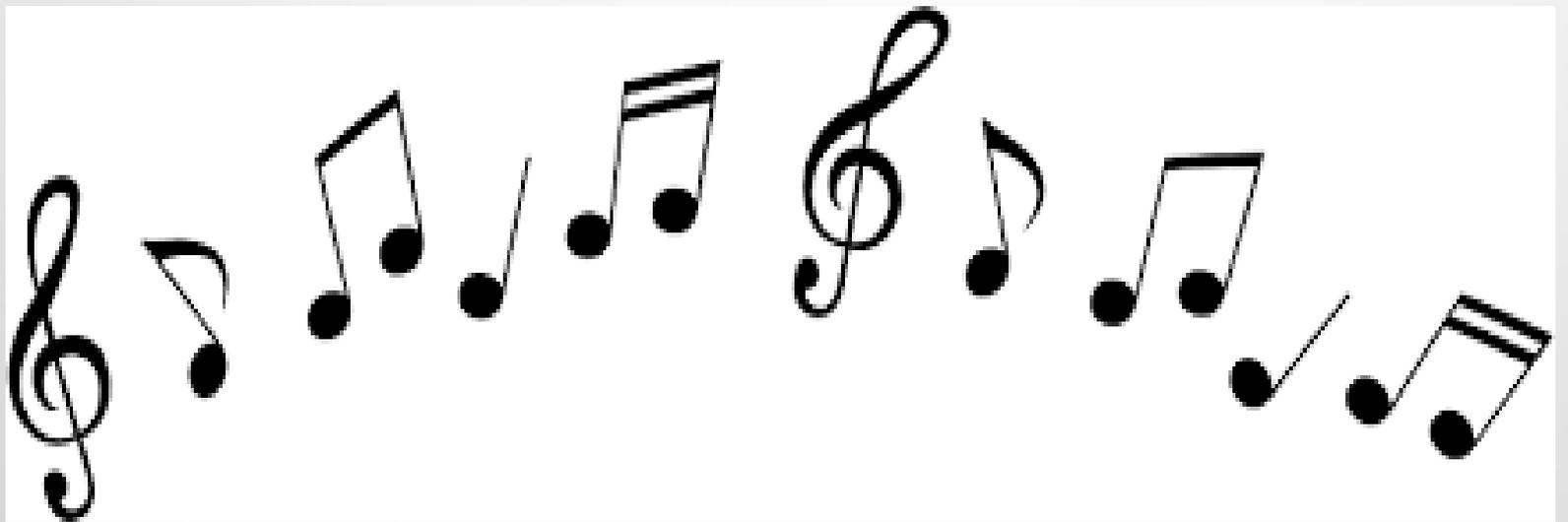
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PHYSIOLOGY OF PREGNANCY AND ASSESSMENT OF FETAL WELL BEING LEARNING OBJECTIVES

At the conclusion of this presentation, the neonatologist will be able to:

1. Describe the major cardiopulmonary changes that occur in pregnancy.
2. Describe the major hematologic changes that occur in pregnancy.
3. Describe the major GI and renal alterations associated with pregnancy.
4. Describe the principal antenatal fetal monitoring tests.

ULTIMATE LEARNING OBJECTIVE

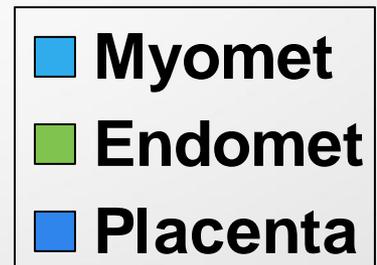
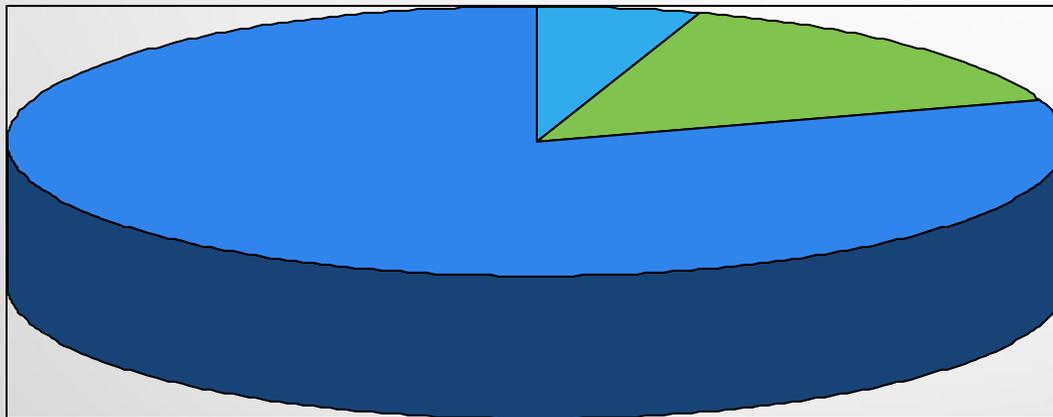


CHANGES IN UTERUS

- Uterine blood flow increases significantly
- Uterine blood flow approaches 500 – 750 ml/ minute near term
- Clinical significance → obstetric hemorrhage

Maternal Condition	% of C.O. That Perfuses the Uterus
Non-pregnant	< 1 %
Pregnant	15-20%

DISTRIBUTION OF UTERINE BLOOD FLOW DURING PREGNANCY



CARDIOVASCULAR CHANGES DURING PREGNANCY

CARDIAC FUNCTION	PERCENT INCREASE IN PREGNANCY
Heart rate	5-15%
Stroke volume	25-30%
Cardiac output	35-50%

CHANGES IN CARDIAC OUTPUT DURING LABOR

STAGE OF LABOR	ADDITIONAL PERCENT INCREASE IN CARDIAC OUTPUT
Early first	15-20%
Late first	30-35%
Second	35-40%

DANGEROUS CARDIAC DISEASES IN PREGNANCY

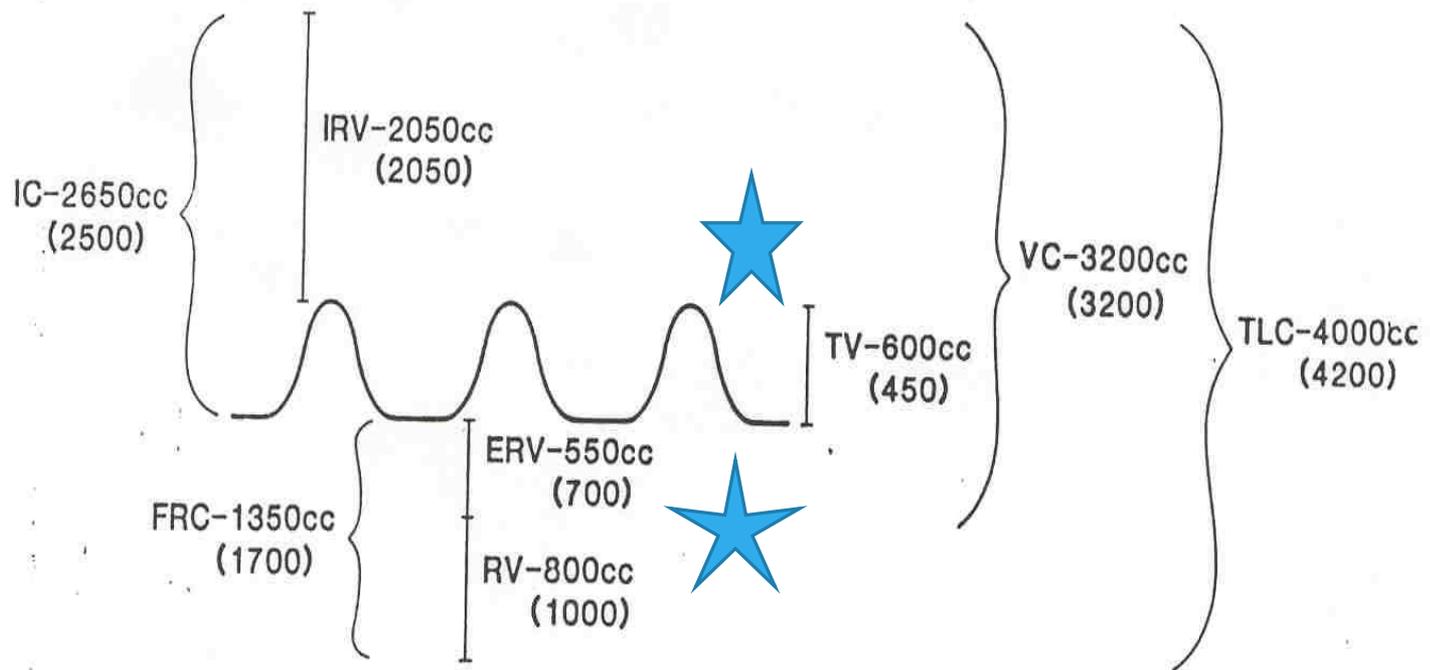


- Stenotic valve lesions
- Ischemic heart disease
- Marfan syndrome
- Eisenmenger's syndrome
- Primary pulmonary hypertension



PULMONARY FUNCTION

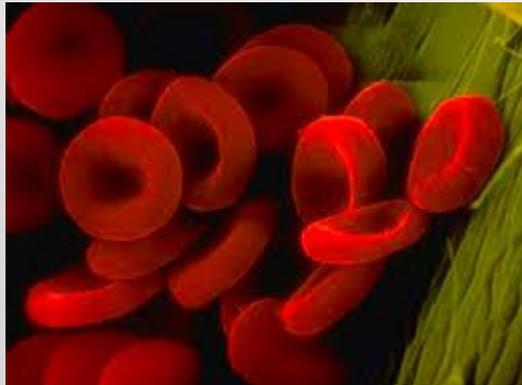
Pulmonary Volumes and Capacities
() – Non-Pregnant Values



ALTERATIONS IN ARTERIAL BLOOD GASES



- Increased pH
- Decreased $p\text{CO}_2$
- Decreased HCO_3^-
- **PARTIALLY COMPENSATED RESPIRATORY ALKALOSIS**



HEMATOLOGIC ALTERATIONS IN PREGNANCY

COMPONENT	PERCENT INCREASE
Blood volume	30-50%
Plasma volume	50%
Red cell number	30%

Net Effect → dilutional anemia is second only to iron deficiency as a cause of anemia in pregnancy.

HEMATOLOGIC ALTERATIONS IN PREGNANCY

CELL LINE	CHANGE
White blood cells	Slight increase*
Platelets	Unchanged to slight decrease**

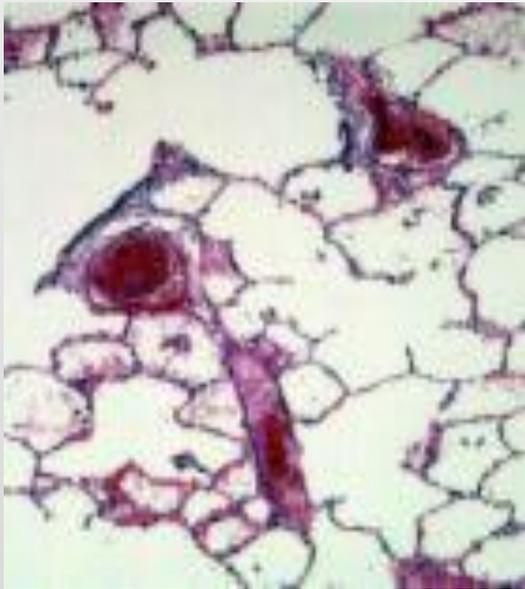
*Mild elevation in wbc is not necessarily indicative of infection

**Most common causes of thrombocytopenia – pre-eclampsia and gestational thrombocytopenia

COAGULATION CHANGES IN PREGNANCY

- Enhanced hepatic synthesis of I, II, VII, VIII, IX, and X
- Placenta → III (tissue thromboplastin)
- Platelets → aggregate more readily

VIRCHOW'S TRIAD → THROMBOSIS

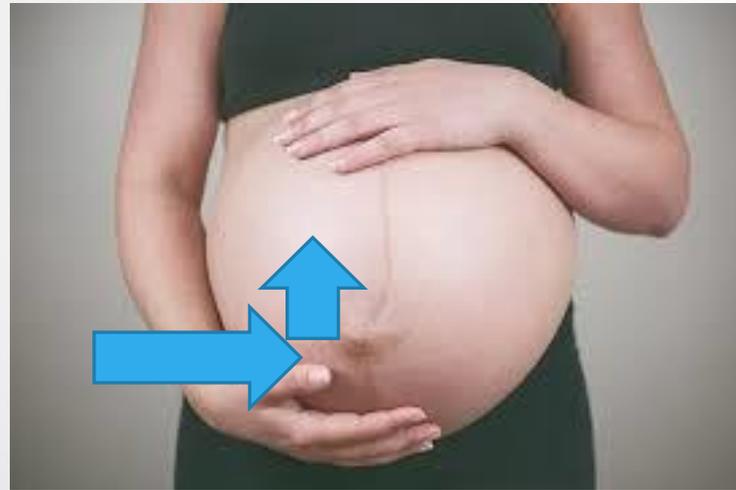


- Venous stasis
- Alteration in venous wall
- Hyper-coagulable state

GASTROINTESTINAL ALTERATIONS IN PREGNANCY

ALTERATION	CLINICAL CONSEQUENCE
Delayed gastric emptying (gastroparesis)	GERD Early satiety
Biliary duct stasis	Cholelithiasis → Cholecystitis and pancreatitis
Change in location of appendix	Delay in diagnosis

CHANGE IN ANATOMICAL LOCATION OF APPENDIX IN PREGNANCY



CONSEQUENCE → DELAY IN DIAGNOSIS

GASTROINTESTINAL ALTERATIONS IN PREGNANCY

ALTERATION	CONSEQUENCE
Increased intra-abdominal pressure	Hiatal hernia Bloating
Delayed colonic motility	Constipation

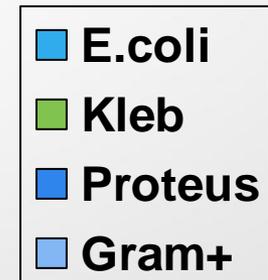
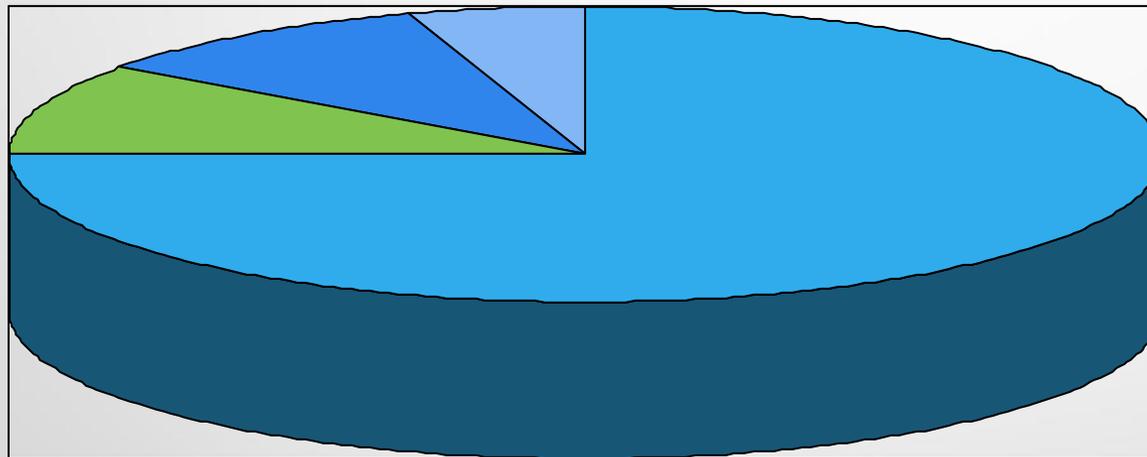
RENAL FUNCTION ALTERATIONS IN PREGNANCY

- Renal blood flow increases 30 – 40 % above pre-pregnancy levels
- GFR (creatinine clearance) increases
 - Normal value is 100-150 ml/min
- Serum BUN, creatinine, and uric acid decrease

FREQUENCY OF UTIs IN PREGNANCY

TYPE OF INFECTION	FREQUENCY
Asymptomatic bacteriuria	5-10%
Acute cystitis	2-3%
Pyelonephritis	1-2%

MICROBIOLOGY OF UTIs IN PREGNANCY



INCREASED RISK OF PYELONEPHRITIS IN PREGNANCY

- Progesterone inhibits ureteral peristalsis
- Mechanical compression of ureter by gravid uterus
 - R >> L
- Complications of pyelonephritis
 - Preterm labor, sepsis, ARDS



INCREASED RISK OF NEPHROLITHIASIS

- Increased concentration of calcium in the urine
 - Most stones are calcium oxalate
- Urinary stasis
- Stones are most common on right side
- Stones predispose to ascending infection



Left-sided stones or infection should raise suspicion of anatomic abnormality

ANTENATAL SURVEILLANCE MOST COMMON INDICATIONS

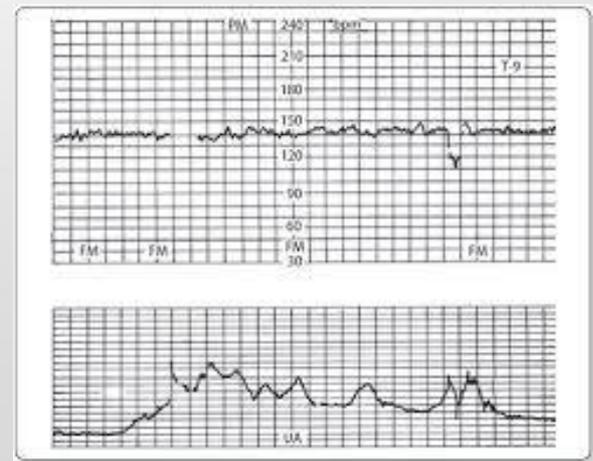
- Hypertensive disorders
- Diabetes
- Advanced maternal age
- Fetal growth restriction
- Obesity

ANTENATAL SURVEILLANCE TESTING MODALITIES

- Fetal kick counts
 - Target is 10 movements within 2 hours
- Non-stress test
- Biophysical profile
- Doppler
 - Umbilical artery
 - Middle cerebral artery

ANTENATAL SURVEILLANCE NON-STRESS TEST

- 20 minute test period
- Interpretation
 - Reactive
 - Non-reactive



BIOPHYSICAL PROFILE

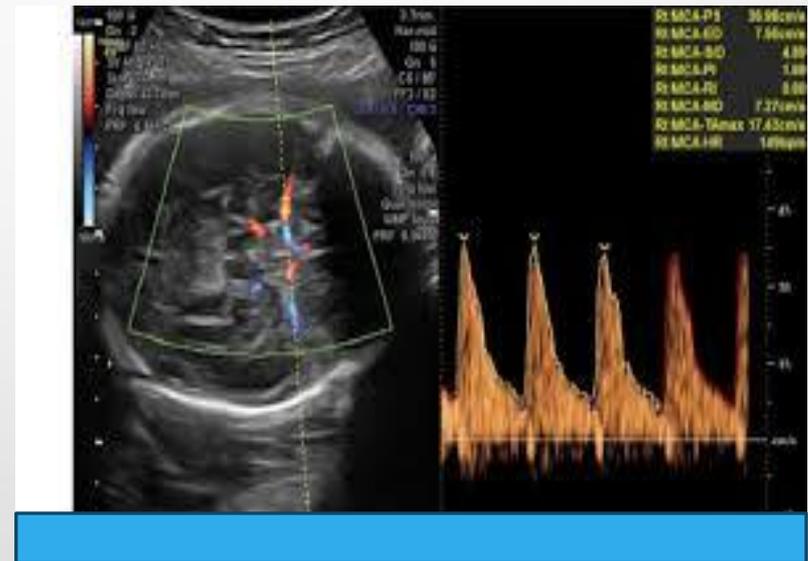
COMPONENT	0	2
NST	Non-reactive	Reactive
AFV	Low	Normal
Fetal breathing	Absent	Present
Fetal tone	Absent	Present
Fetal movement	Absent	Present

BIOPHYSICAL PROFILE INTERPRETATION

SCORE	INTERPRETATION AND MANAGEMENT
8, 10	Reassuring – no need to deliver
6	Problematic – delivery may be indicated
0,2,4	Alarming - deliver

MIDDLE CEREBRAL DOPPLER VELOCIMETRY

- Key indication – detection of fetal anemia
 - Isoimmunization
 - Parvovirus infection



ANTENATAL SURVEILLANCE

- Timing – begin at the point when you first anticipate normal testing and are prepared to intervene if the testing is abnormal
 - 28 weeks at the earliest
 - 32-34 weeks for most other indications
- Frequency – once to twice each week
- Predictive value
 - Risk of FDIU within one week of a reassuring test – 1/1000
 - Most non-reassuring tests are false alarms

SUMMARY

TWO KEY POINTS

- Cardiovascular disease is now the number one cause of maternal mortality
- Antenatal testing is highly effective in predicting a good outcome for the fetus/neonate and not so good at predicting an adverse outcome

