

MATERNAL PHYSIOLOGICAL ADAPTATION IN PREGNANCY

INTRODUCTION

Pregnancy – Can be Natural –normal coitus or ART –Assisted Reproductive Technologies –IVF/AI

Confirm Pregnancy- Do a pregnancy test-PDT – Use – Urine/Saliva/Serum-Blood. Marker of Pregnancy- Beta –HCG –Beta chain specific – LH/FSH has similar Alpha chain. Using serum can confirm presence of Hcg within 48hrs of fertilization –levels as low as 5miu/ml – Basis of Diagnosis of Chemical pregnancies. Urine based tests usually positive about 8-10 days detecting levels of about 25miu/ml

Ova/Egg/Sperm – Fertilisation-in the fallopian tubes –Transfer to uterine cavity –Implantation – then Placentation. Hence importance of proper Decidualisation of the Endometrium. Normal process leads to Normal pregnancy. If any abnormalities occur likely outcomes – Ectopic pg, Abortions – missed abortion, Habitual, Blighted ova, Congenital anomalies, GTDs, Abnormal placentations etc.

Note that Genetics/Chromosomal , Hormonal, and Immunological factors- have a significant effects and influence normal pregnancy physiology.

Normal pregnancy divided into 3 trimesters each of about 14wks. 1st trimester – Embryogenesis and Organogenesis, 2nd trimester Organogenesis, Development and Growth and 3rd trimester Development, Growth and Maturation.

Signs/Symptoms of Pregnancy-

Change in menstrual pattern –AUB – missed periods, irregular bleeding,

Complications of pregnancy – Ectopics, Abortions

Fatigue –tiredness and sleepy – poor feeding, poor appetite, nausea/vomiting –morning sickness

Acne

Breast –Tender, Enlargement, heavy and prominent veins over the surface, darkening of the areola skin and some watery secretions by 16wk

Others as per systems

The anatomical /physiological and biochemical adaptations to pregnancy begins soon after fertilization and continue throughout pg. The fetus and placenta provides the stimuli for these changes.

Metabolic changes

Rapidly growing fetus and placenta increase the demand for nutrients leading to an overall wt gain. On average a pg woman adds between 8-15kg (ave 12.5kg)

Water metabolism

There is water retention leading to oedema of pg mainly due to decrease in osmolality (dilutional effects). **Pathological retention of sodium and water leads to oedema of PET.**

At term the fetus/placenta/amniotic fluid accounts to 3.5l of fluid and blood another 3l, hence overall fluid retention of **upto 6.5l** during a normal pg. Pitting oedema in pg is due to increase in venous pressure as a result of occlusion of the inferior venacava by the gravid uterus and decrease in interstitial colloid osmotic pressure as a result of water retention –dilutional effects and decrease in plasma proteins –albumin mainly.

NB: The amount of fluid to be mobilized and excreted after delivery depend upon amount retained during pg, degree of hydration or dehydration during labour and amount of blood lost during delivery.

PROTEINS: the products of conception, uterus and maternal blood all rich in proteins. At term the POCS – fetus/placenta weighs 4kg of which 500gms is proteins. Another 500gms is in contractile proteins in uterus, breast for lactation and maternal blood –haemoglobin and plasma proteins. The overall proteins retention during pregnancy is about – 1000gms.

Carbohydrates: Pg is a diabetological state and healthy pg women have low levels of FBS due to hemodilution and increase in insulin. Placental hormones also have a role in metabolism eg HPL –Human placental lactogen (**MORE DURING DIABETES MELLITUS IN PG**)

Lipids: There is increase in lipids and lipoproteins in plasma with deposits of fat along the trunk.

MINERALS: The Iron requirements during pg often exceed available

amount hence supplement in pg required in most women. Other elements required in large amount in pg –ca/mg/folate/zinc

HAEMATOLOGICAL CHANGES:

The hormones Aldosterone, Estrogen and Progesterone seem to play a role in the changes. The blood volume increase by about 20 -100%. The rise depend on-

- size of the woman
- No of pregnancies has had
- No of births
- No of fetuses in index pg – single/twins/multiple

On average the blood volume rises by about 40 -45% and RBC by 33% and hence the high demand for iron.

THE IMPORTANCE OF THE INCREASE:

- demand for the growing fetus/placenta and uterus
 - protect the mother and fetus against deleterious effects of impaired venous return in supine and erect position
 - safeguard the mother against the adverse effects of blood loss at delivery.
- At delivery –Vaginal delivery blood loss about 500-600ml and Caesarean Section upto 1000ml.

Bone marrow undergoes slight hyperplasia. Hb and Packed Cell Volume are reduced due to hemodilution and slight fall in blood viscosity. The White blood cells- a slight rise.

Total iron stores – 4gm in men and 2-3gm in women. In pg 1gm iron extra is needed -300mg for fetus, 500mgs for extra blood cells (1ml of RBC =1.1 mg of iron) and 200mgs lost in normal ways. Amount of iron in diet not enough hence supplementation in pg especially the 2nd half of pg. Iron deficiency anemia may lead to premature labour and late spontaneous abortions

Immunological/leucocytes functions.

In pg there is a slight suppression of the immune system both humoral and CMI to accommodate the foreign semi-allergenic fetal graft. Leucocyte increase in number but chemo taxis and adhesion function decrease hence increased incidence of infection in pg women.

Blood coagulation

In pg there is increase in several blood coagulation factors eg Fibrinogen (factor 1), factors 7, 8, 9, 10, 12. This is to prevent excess bleeding at delivery (protective mechanism). **Combined with stasis and immobility in pg there is increased risk of DVT.**

Prothrombin (factor 2) –little change

CVS:

Heart displaced upward and to the left –enlarged uterus and elevated diaphragm. The heart size increases by about 12%. The cardiac output increase due to rise in blood volume, heart rate and decrease in vascular resistance – upto 70 -80ml. Functional murmurs are common due to increased cardiac output (CO). Systemic BP –decrease mostly diastolic pressure (by 5 -10%). Anaemia- may cause hemic murmurs.

Effects of labour on CVS –

On Supine position uterine contractions –increase CO by 25% and decrease HR by 15% overall rise of Stroke volume (SV) by 33%. The pulse pressure rise by 26 %.(occlusion by IVC by gravid uterus)

Left lateral position –hemodynamics parameters stabilizes- CO rise by 7.6%, HR fall by 0.7%, and SV rise by 7.7% and pulse pressure by 6%.

Urinary System:

Kidneys increase in size by 1 -1.5 cm and the renal pelvis dilates upto 60ml (from 10ml)

GFR/Renal plasma flow increase by upto 50% and this causes increase in loss of nutrients like water soluble vitamins. **Loss of sugars causes some glycosuria and loss of proteins cause proteinuria** but in trace levels -200-300mg/24hrs. +1 on a dipstick =300mg/24hrs. Urea and creatinine levels fall hence interpretation of renal functions in pg must take the changes in account. **Hematuria is a sign of UTI.**

Hydronephrosis/hydronephrosis with Right-side > L side. The R side – there is **dextrorotation of uterus and R ovarian complex.** L side –protection by the **sigmoid colon** reduces pressure by the gravid uterus.

The effects of Progesterone – causes hypotonia and hyperplasia of smooth muscles within distal third of ureter, hence reducing the ureter lumen and this causes dilatation of the upper two-thirds.

Bladder – frequency and urgency of micturation especially **8-12wks** (gravid uterus a pelvic organ –pressure on the bladder) and at **36-40wks** of gestation due to engagement of the presenting part.

GIT:

There is overall decrease in GIT motility. This may be one of the cause of Heartburn, Bloating and Constipation in pregnancy. Excessive salivation is due increased salivary glands activity and nausea of pg. The Gastric emptying and intestinal transient time is delayed. No tooth decay or mobilization of bone calcium occurs during pg. The Gums are hypertrophic and hyperemic – spongy and friable and bleed easily.

Gastric production of HCL increases. Increased Gastrin –increase stomach volume and decrease stomach PH. Esophageal peristalsis decrease and gastric reflux increases due to slower emptying time and dilatation or relaxation of the cardiac sphincter. Gastric reflux more in later pg due to elevation of stomach by enlarged uterus. This may simulate hiatus hernia. The above changes – leads to increased heartburn and risk of regurgitation – high risk of aspiration highly acidic material eg under anaesthesia for emergency CS.

LIVER: serum alkaline phosphatase activity rise twice due to rise of placental alkaline phosphatase isozymes- Decrease in plasma albumin and slight fall of plasma globulin – decrease in albumin: globulin ratio (a sign of liver dse in non-pg women)

Some women appetite rise but in some it drops or have nausea and vomiting due to hormonal changes of pg. Some pg women crave for bizarre things like clay, soil. coal etc (PICA)

Hemorrhoids –are fairly common in pg due to constipation and elevated pressure in veins below the level of enlarged uterus.

Musculoskeletal

Progressive lordosis during pg is due to compensate for the anterior position of the enlarging uterus. Lordosis is due to shift of center of gravity back over the lower extremities. There is increased mobility of the sacrococcygeal and pubic joints. All these leads to altered maternal posture and discomfort in the lower portion of the back (aching, numbness, weakness –may be with traction on nerves)

Pulmonary system:

The Capillary dilatation in the respiratory tract –leads to engorgement of nasopharynx, larynx, trachea and bronchi –leads to breathing difficulty with blocked nose and sometimes epixtasis

Chest X-Rays- increased lungs marking

The Enlarged uterus elevates the diaphragm 4cm and the ribcage displaced upward and widen. Increase in lower thoracic diameter by 2cm and circumference by upto 6cm. Dead space increase due to relaxation of muscles. Tidal volume increase and total lung capacity decrease. Pg leads to hyperventilation – decrease alveolar CO₂ leading to decrease of maternal Pco₂. During labour –anxiety/fear/other emotional reactions –may affect the rate and depth of respiration and hence Pco₂. Most pg patients dyspneic, hyperventilate – respiratory alkalosis- May cause carpopedal spasms and acid-base imbalance