Intrauterine Growth Restriction (IUGR)

Definition

- Foetuses of birth weight less than 10th percentile of those born at same gestational age.

« small for gestational age »(SGA) fetuses, all of which may not necessarily growth restricted as many of these may be just constitutionally small and not at risk of any adverse outcome.)

- « Therefore the term IUGR should more strictly refer to foetuses that are small for gestational age and display other signs of chronic hypoxia or failure to thrive. »

Incidence

- Approximately 3-5% of all pregnancies.

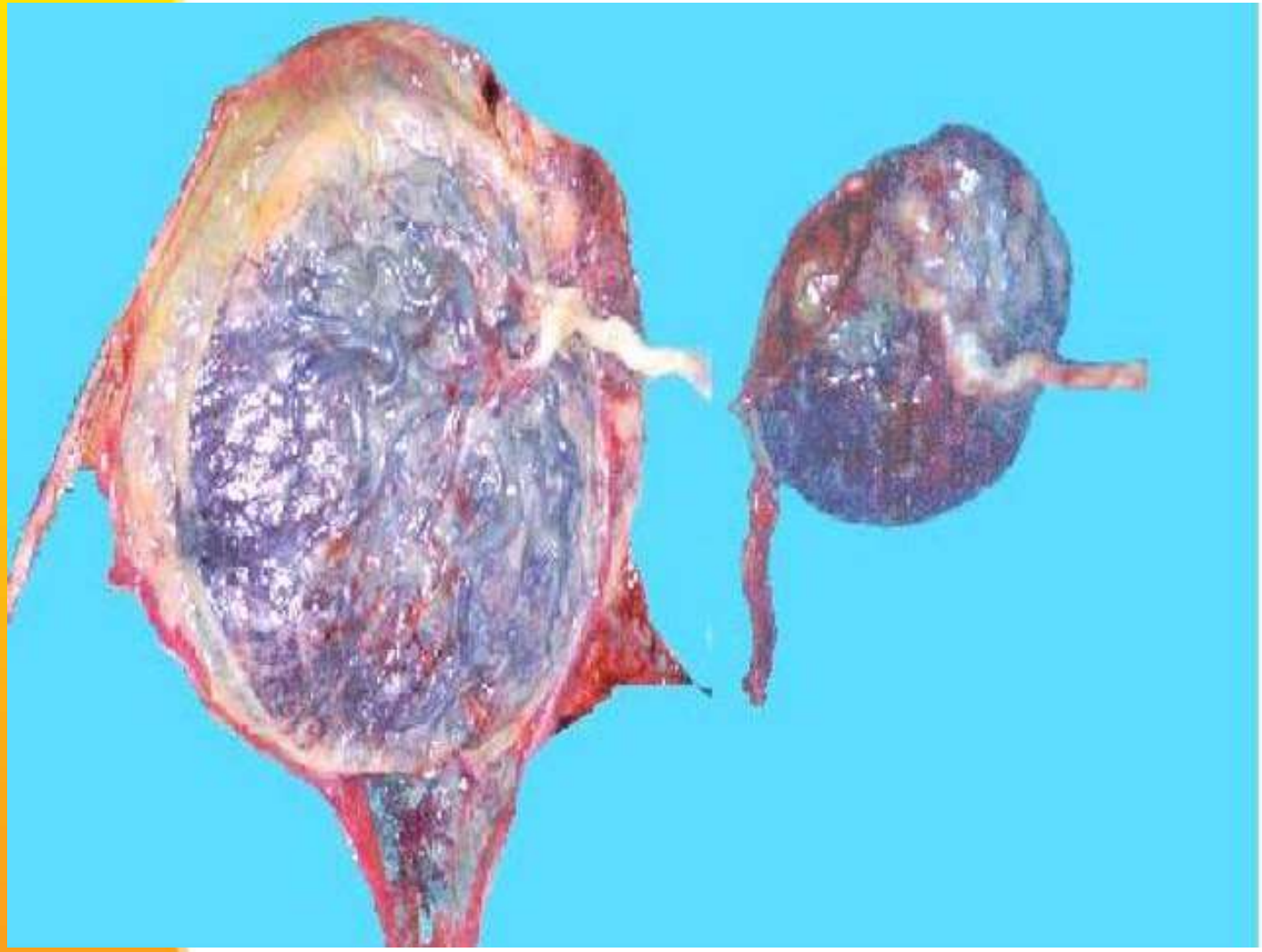
Normal Fœtal Growth

- Fœtal growth depends on two components:
  - Genetic Potential
  - Substrate supply

The genetic potential is derived from both parents and is mediated through growth factors such as insulin-like growth factor.

Adequate substrate supply is essential to achieve genetic potential. This is derived from placenta which is dependent upon the uterine and placental vascularity

A comparision between normal and IUGR babies.



Normal and IUGR placenta

Normal Fetal Growth

- Normal fetal growth is characterized by

  cellular hyperplasia followed by

  hyperplasia and hypertrophy and lastly by

  hypertrophy alone.

Foetal Growth indices

➢ Weight gain

- Foetal growth accelerates from about 5g per day at 14 -15 wks of gestation to

- 10g per day at 20 wks

- Peaks at 30 -35g per day at 32-34wks

- After which growth rate decreases.

- Symphysiofundal height increases by about 1cm per wk between 14 and 32 wks.

- Abdominal girth increases by 1 inch per wk after 30 wks. It is about 30 inches at 30wks in an average built woman.

Classification of Inrauterine Growth Restriction

1. Type 1 or symmetrical or intrinsic IUGR
2. Type 2 or assymetric IUGR
3. Intermediate IUGR

Classification of IUGR

- ***Type 1 or symmetrical IUGR- (20-30%)***

  Occurs as a result of growth inhibition **early in pregnancy** i.e. the *hyperplastic stage*. Any pathological insult at this phase leads to reduced no. of cells in fetus and overall decreased growth potential.

  Causes include-

  ✓ Intrauterine infections (TORCH)

  ✓Chromosomal disorders

  ✓Congenital malformations

All parameters(head and abdo circumference, length and weight) are below 10th percentile for gestational age, hence ***normal ponderal index*** *(birth weight/ht3).*

Type 2 or asymmetric IUGR *(70-80%)*

Occurs as a result of restriction of nutrient supply in utero i.e. *uteroplacental insufficiency.*

- It is usually associated with maternal diseases like:-
  - Chronic hypertension
  - Renal disease
  - Vasculopathies

- The onset of growth restriction occurs usually after 28 wks of gestation i.e. in the stage of *hypertrophy. The fetus has near normal total no. of cells but cell size is reduced.*
- *There is **brain sparing effect** so that the head growth remains normal* but the abdominal girth slows down.
- The **Ponderal index is low**

- Liver size is reduced because of diminished glycogen stores.
- In case of severe placental insufficiency the head growth may also be affected.

  This type of growth restriction leads to decreased amniotic fluid, chronic hypoxia and may result in fetal death.

Intermediate IUGR (5-10% of all growth restricted fetuses)

- It is a combination of type 1 and type 2.
- Fetal growth restriction occurs during ***intermediate phase of growth*** affecting *both hyperplasia and hypertrophy,* resulting in decrease in cell no. as well as size.
- Causes include
  - ✓Chronic HT
  - ✓Lupus nephritis
  - ✓Maternal vascular diseases that are severe and have onset in early 2nd trimester

- IUGR may also be classified simply as
  - ✓ Early onset (onset before 32 weeks)
  - ✓ Late onset (onset after 32 weeks)

Etiology

- IUGR is a manifestation of fetal, maternal and placental disorders that affect fetal growth.

A. Fetal Causes

1. Chromosomal Disorders-

usually result in early onset IUGR.

- ✓ Trisomies 13, 18, 21 contribute to 5% of IUGR cases
- ✓ Autosomal deletions
- ✓ Ring chromosomes
- ✓ Sex chromosome disorders are frequently lethal, fetuses that survive may have growth restriction (Turner Syndrome)

Fetal causes contd..

2. Congenital Infections:

- The growth potential of fetus may be severely impaired by intrauterine infections.
- The timing of infection is crucial as the resultant effects depends on the phase of organogenesis.
- Viruses- rubella, CMV, varicella and HIV
  - ✓ rubella is the most embryotoxic virus, it cause capillary endothelial damage during organogenesis and impairs fetal growth.
  - ✓ CMV causes cytolysis and localized necrosis in fetus.
- Protozoa- like malaria, toxoplasma, trypanosoma have also been associated with growth restriction.

Fetal causes contd..

3. Structural Anomalies-

All major structural defects involving CNS,CVS,GIT, Genitourinary and musculoskeletal system are associated with increased risk of fetal growth restriction.

If growth restriction is associated with polyhydramnios, the incidence of structural anomaly is substantially increased.

Fetal causes contd..

4. Genetic Causes-

Maternal genes have greater influence on fetal growth.

Inborn errors of metabolism like agenesis of pancreas, congenital lipodystrophy, galactosemia, phenylketonuria also result in growth restriction of fetus.

B. Placental causes

- Placenta is the sole channel for nutrition and oxygen supply to the fetus.
  - ✓Single umblical artery
  - ✓abnormal placental implantation
  - ✓velamentous umblical cord insertion
  - ✓bilobed placenta
  - ✓placental haemangiomas have all been associated with fetal growth restriction

C. Maternal Causes

1. Maternal Characteristics:

   those contributing to IUGR are-

   - ✓ Extremes of maternal age
   - ✓ Grandmultiparity
   - ✓ History of IUGR in previous pregnancy
   - ✓ Low maternal weight gain in pregnancy

2. Maternal diseases:

Uteroplacental insufficiency resulting from medical complications like

- ✓ Hypertension
- ✓ Renal disease
- ✓ Autoimmune disease
- ✓ Hyperthyroidism
- ✓ Long term insulin dependent diabetes

Maternal causes contd..

- Smoking- active or passive, especially during third trimester is important cause of IUGR. Nicotine has vasoconstrctive effect on the maternal circulation and leads to formaton of toxic metabolites in fetus.
- Alchohol and Drugs- Alchohol crosses the placenta freely. It acts as a cellular poison reducing fetal growth potential.
  - Cocaine and opiates are potent vasoconstrictors.
  - Warfarin, anticonvulsants and antineoplastic agents are also implicated in growth restriction

- Thrombophilias- antiphospholipid antibody syndrome and other thrombophilias leading to placental thrombosis and impaired trophoblastic function.
- Nutritional Deficiency- poor intake

  -inflammatory bowel disease

Complications of IUGR

- Antepartum period-

  - Chronic heart failure

  -Fetal death

- During labour-

  -meconium aspiration

  -fetal distress

  -intrapartum fetal death

Complications of IUGR contd..

- Neonatal period- increased incidence of-

  -Hypoxic ischemic encephalopathy

  -Persistent fetal circulation insufficiency

They have difficulty in temperature regulation because of absent brown fat and small body mass relative to surface area.

Lack of glycogen stores may predispose to hypoglycemia

Chronic intrauterine hypoxia may lead to polycythemia, necrotizing enterocolitis, other metabolic abnormalities.

Complications cont..

- After birth-

Immediate:

Asphyxia,RDS

Hypoglycemia due to shortage of glyogen reserve in the liver as a result of chronic hypoxia

Meconium aspiration,Hypothermia ,Pulmonary haemorrhage,Polycythemia

Late: Retarded neurologic and intellectual development

- Maternal :

Preeclampsia

Heart disease

Malnutrition

Pathophysiology

- Basic pathophysiology in small for gestational age is due to reduced availability of nutrients in the mother or its reduced transfer by the placenta to the fetus.
- It may also be due to reduced utilization by the fetus.Brain cell size (asymmetric)as well as brain cel no(symmetric) are reduced.

- There is oligohydramnios as the renal and pulmonary contribution to antibiotic fluid are diminished due to reduction in blood flow to these organs.
- The SGA fetus is at risk of intrauterine hypoxia and acidosis ,which if severe may lead to IUD.

Diagnosis of IUGR

Identifying mothers at risk:

- Poor maternal nutrition
- Poor BMI at conception
- Pre-eclampsia
- Renal disorders
- Diseases causes vascular insufficiency
- Infections (TORCH)
- Poor maternal wt. gain during pregnancy

Diagnosis of IUGR

1. Clinically- Serial measurement of fundal height and abdominal girth.
   - ✓ Symphysio-fundal height normally increases by 1cm per wk b/w 14 and 32 wks.
   - ➢ ***A lag in fundal ht. of 4wks is suggestive of moderate IUGR.***
   - ➢ ***A lag of >6 wks is suggestive of severe IUGR.***
   - ➢ ***Mesearment of the abdominal girth***

2. Sonographic evaluation-

- ✓ most useful tool for diagnosis of IUGR
- ✓ To differentiate between symmetrical and asymmetrical IUGR
- ✓ To monitor the fetal condition.

Fetal biometry:

i. BPD(Biparietal Diameter)- determines gestational age and type of IUGR.

When growth rate of BPD is below 5^{th} percentile, 82% of births are below 10^{th} percentile(i.e. IUGR).

ii. Head circumference and andominal circumferance ratio:

- Exeeds 1.0 before 32 weeks .It is approximately 1.0 at 32-34 weeks. After 34 weeks it falls below 1.0
- .

- If the fetus is affected by asymetric IUGR ,the HC remains larger.The HC/AC is then elevated.
- In symmetric IUGR,both the HC &AC are reduced

Using HC/AC ratio ,85% of IUGR fetuses are detected .

- Femur length: It is not affected in asymetric IUGR.The FL/AC ratio is 22 at all gestational ages from 21 weeks to term .FL/AC ratio greater than 23.5 suggests IUGR.

- Placental Morphology: *Acceleration of placental maturation may occur with IUGR and PIH.*

  (Placenta is graded from grade 0 to grade III)

- *Amniotic fluid volume:* type 2 IUGR is usually associated with oligohydramnios.
  - ✓Amniotic fluid index(AFI) between 8 and 25 is normal.
  - ✓A vertical pocket of amniotic fluid <2 cm suggested IUGR.
  - ✓AFI less than 5 indicates oligohydramnios.

3. Doppler Velocimetry:

Elevated uterine artery systolic/diastolic(S/D) ratio (>2.6) and or presence of diastoic notch are associated with IUGR and intrauterine fetal death.

- Umblical Artery doppler- In IUGR there is increased umblical artery resistance (increased S/D ratio), absent end diastolic flow and finally reversed end diastolic flow.

  Perinatal mortality rate increases significantly in fetuses with absent end diastolic flow (9-41%) and reversed end diastolic flow (33-73%) in umblical artery.

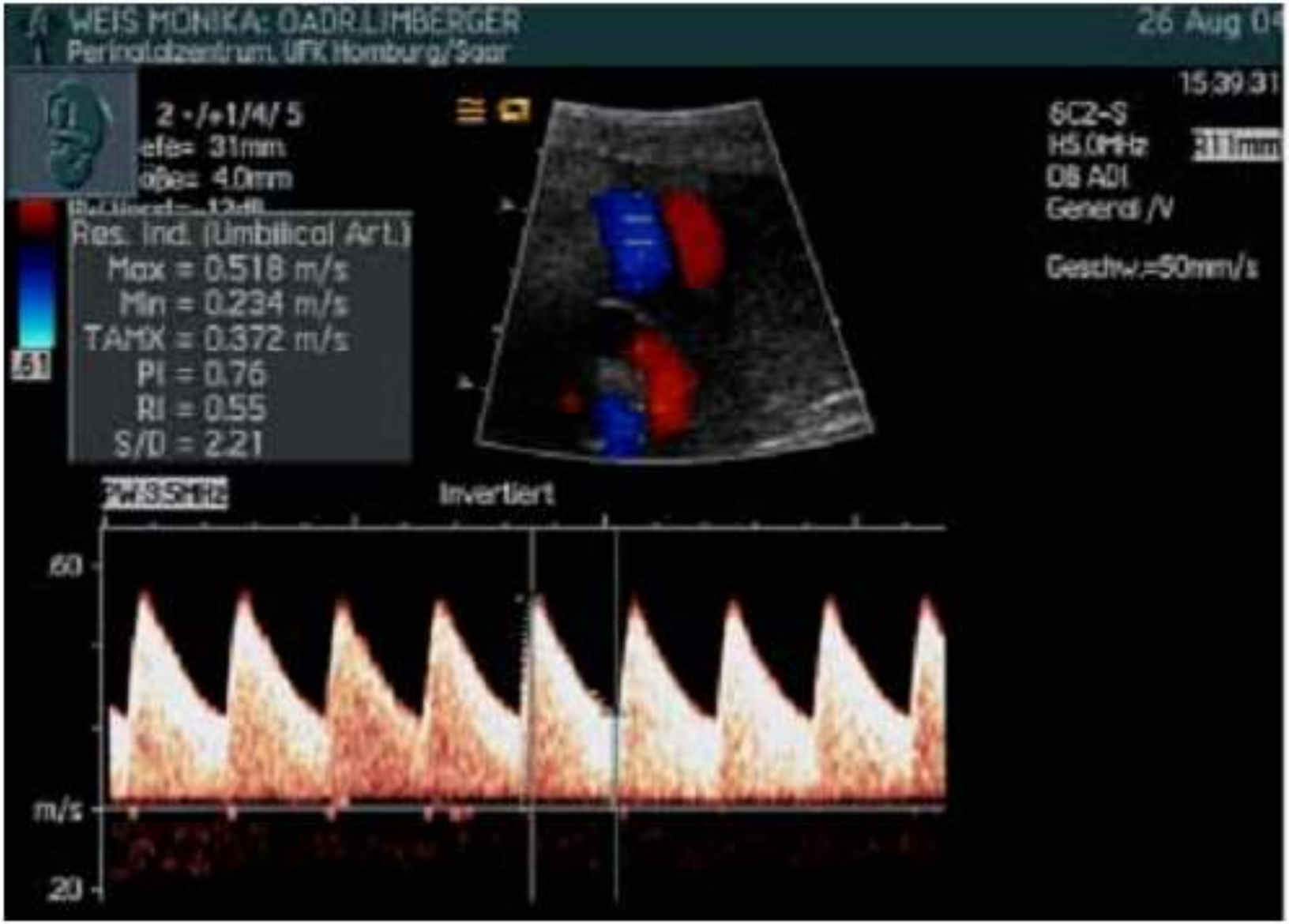


Fig. 54.1: Normal flow velocity waveforms of the umbilical artery in the third trimester

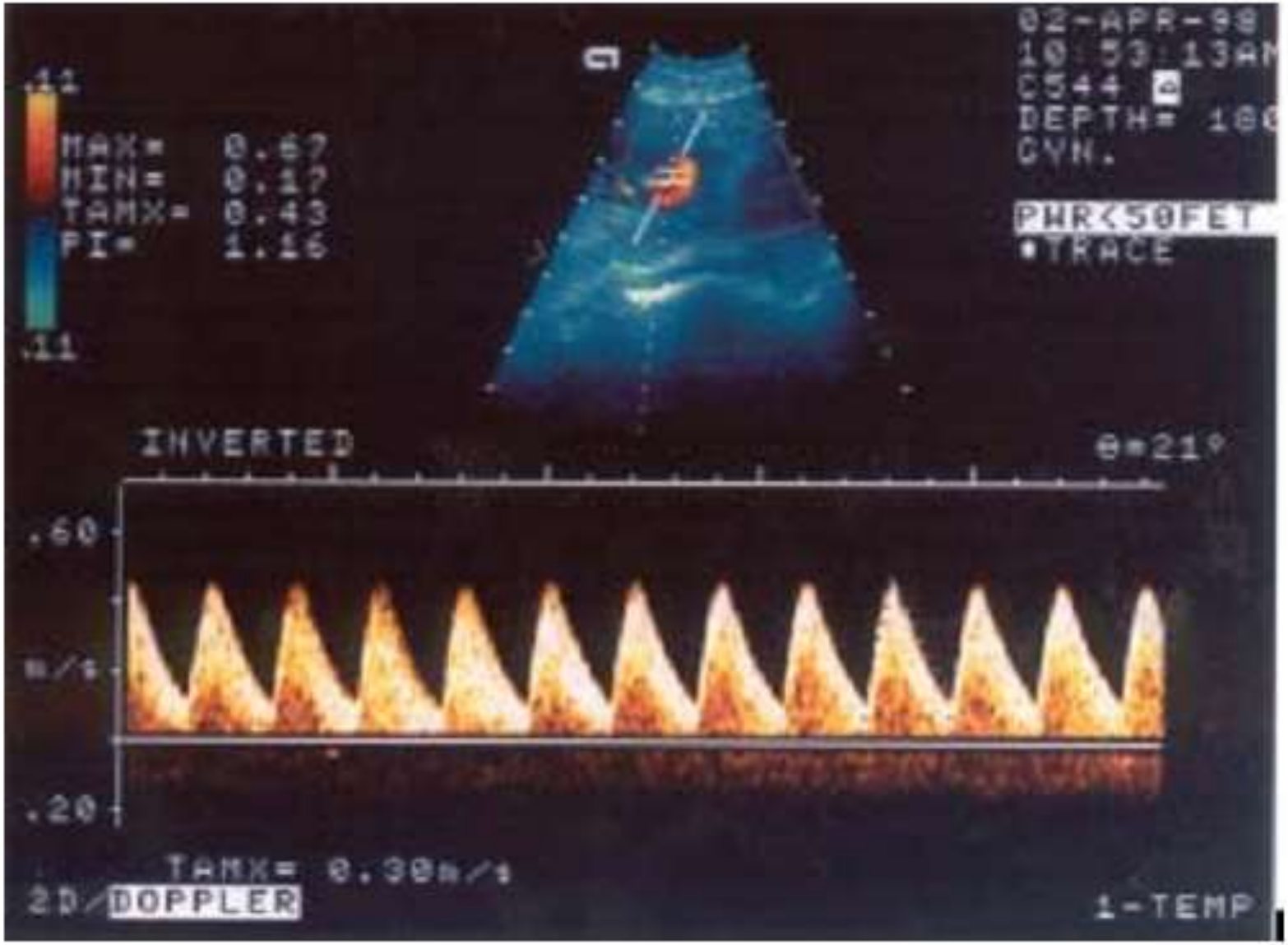
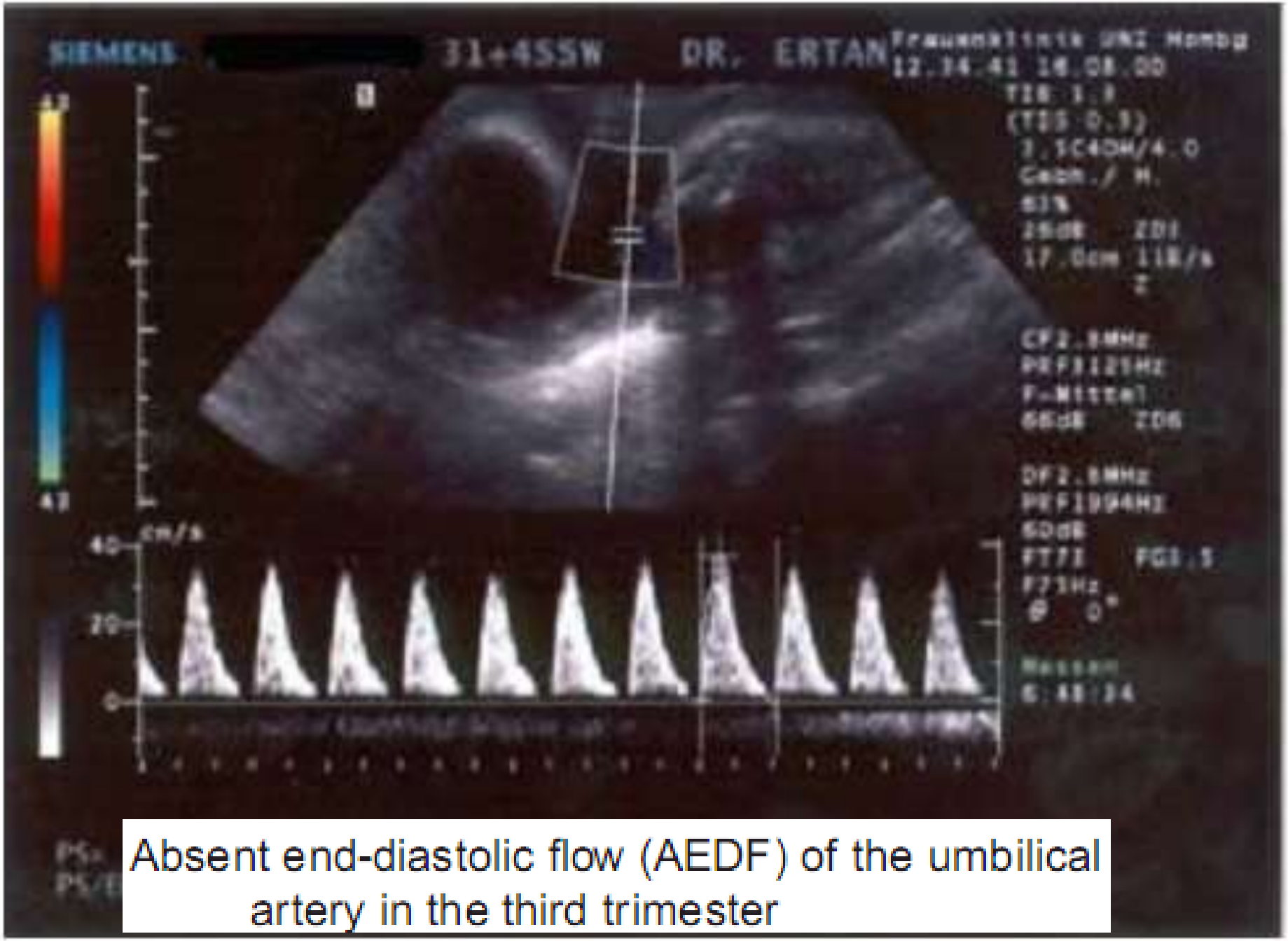


Fig. 54.2: Abnormal flow velocity waveforms of the umbilical artery in the third trimester (high resistance index)



Absent end-diastolic flow (AEDF) of the umbilical artery in the third trimester

- Ductus venosus doppler: Perinatal mortality in growth restricted fetuses has been found to be significantly worse when abnormalities in fetal venous circulation are detected.
  - In the normal fetus, flow in the ductus venosus is forwards , moving towards the heart during entire cardiac cycle.
  - When circulatory compensation of the fetus fails, the ductus venosus waveform shows absent or reverse blood flow during atrial conraction. Perinatal mortality being 63-100%.
  - Therefore it is recommended that fetus should be delivered before the development of absent of reversed blood flow of DV.

Ponderal index

- The ponderal index is used determine those infants whose soft tissue mass is below normal for their stage of skeletal development. Ponderal index below 10th percentile is taken IUGR.

$$\text{Ponderal Index} = \frac{\text{birth weight} \times 100}{\text{crown-heel length}}$$

Typical values are 20 to 25.


Weight deficit
Large head circumference
Old man look
Cartilaginous ridges on pinna
Dry wrinkled skin

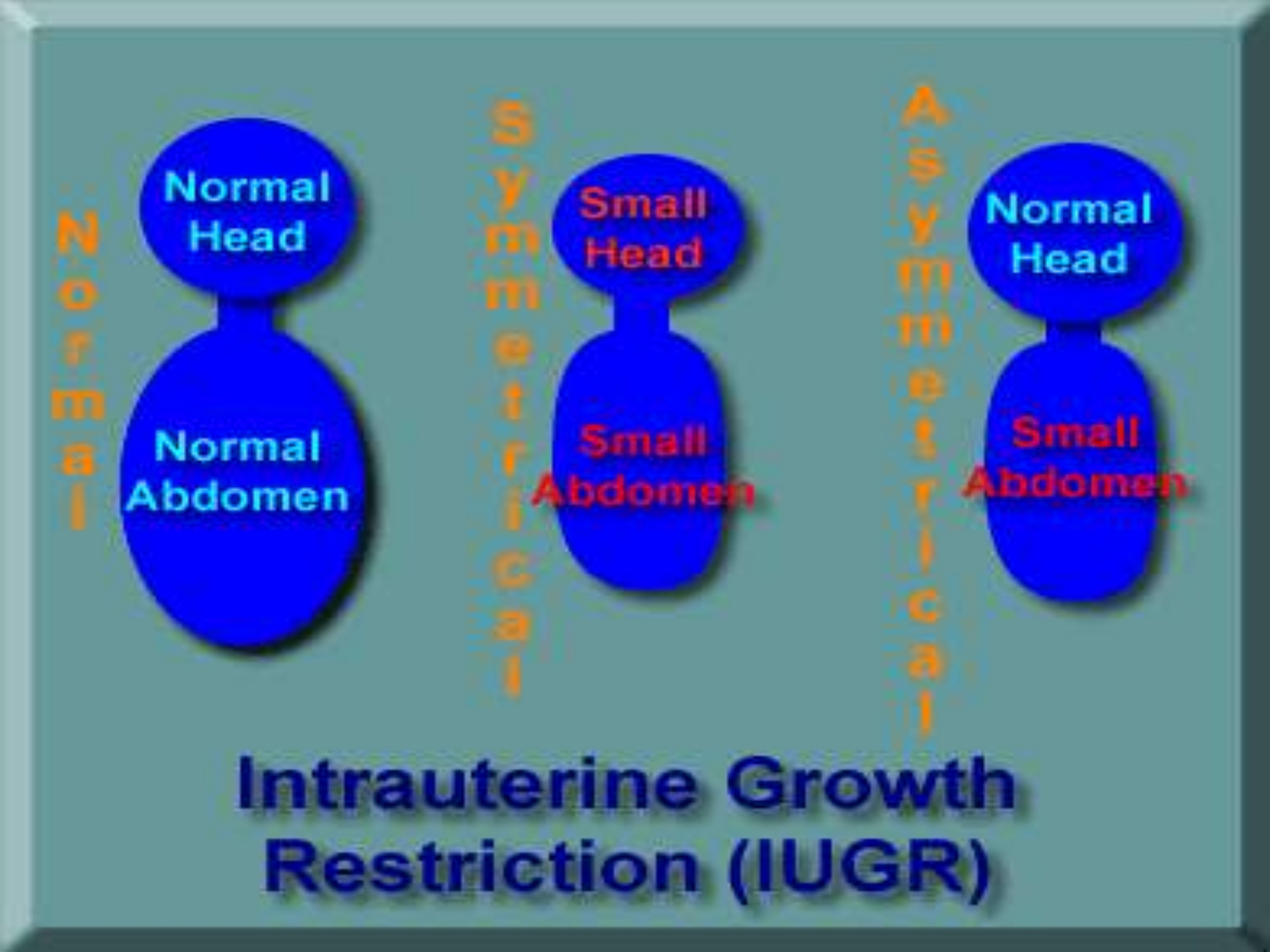

Length remain unaffected
Open eyes
Alert and active
Normal cry
Thin umbilical cord
Normal reflexes

Scaphoid abdomen

Physical fetures

- Weight deficit at birth about 600 gm below the minimum in percentile standard.
- Length is unaffected.
- Head circumference is relatively larger than the body .
- Dry ,wrinkled skin.
- Subcutaneous fat less.
- Scphoid abdomen

- Thin meconium
- Stained vernix cesosa
- Thin umbilical cord
- Old man look
- Eyes are open
- Normal cry ,active
- Reflexes are normal including moror reflex.


Normal
Normal Head
Normal Abdomen
Symmetrical
Small Head
Small Abdomen
Asymmetrical
Normal Head
Small Abdomen
Intrauterine Growth Restriction (IUGR)

MANAGEMENT

- *Principles:*

1. Identify the cause of growth restriction.
2. Treat the cause if found.
3. General management

MANAGEMENT

- ***First step is to identify the aetiology of IUGR:-***

- **Maternal history** pertaining to the risk factors of IUGR.
- **Clinical examination-** maternal habitus, height, weight, BP etc.
- **Laboratory investigations-** Hb, blood sugar, renal function tests, serology for TORCH

  Specific investigations for thrombophilias in pts with history suggestive of early onset growth restriction.
- **Fetal evaluation:** thorough ultrasound for growth restriction, amniotic fluid, congenital anomalies and doppler evaluation

Management cont..

- ***Treatment of underlying cause:*** such as hypertension, cessation of smoking, protein energy supplementation in poorly nourished and underweight women.

- **General Management:**
- Bed rest in left lateral position to increase uteroplacental blood flow
- Maternal nutritional supplementation with high caloric and protein diets, antioxidents, haematinics and omega 3 fatty acids, arginine .
- Maternal oxygen therapy: Adminitration of 55% oxygen at a rate of 8L/min round the clock has shown decreased perinatal mortality rate.

- **Delivery:** *Since IUGR fetus is at increased risk of intrauterine hypoxia and intrauterine demise, the decision needs to delicately balance the risk to the fetus in utero with continuation of pregnancy and that of prematurity if delivered before term.*

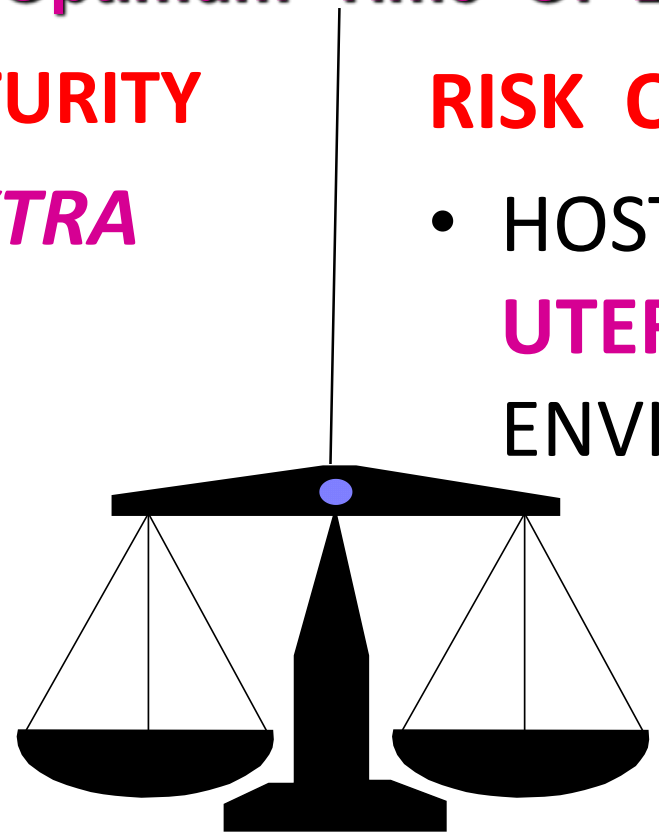
Judge Optimum Time Of Delivery

RISK OF PREMATURITY

❖ *DIFFICULT **EXTRA UTERINE** EXISTENCE*

RISK OF IUD

- HOSTILE **INTRA UTERINE** ENVIRONMENT



- *The optimum timing of delivery is determined by gestational age, underlying aetiology, possibility of extrauterine survival and fetal condition.*
- *Strict fetal surveillance is needed to monitor fetal well being and to detect signs of fetal compromise*

Fetal Surveillance

1. Daily fetal movement score
2. Non stress test(NST)
3. Biophysical profile(BPP)
4. Amniotic fluid index(AFI)
5. Growth parameters
6. Doppler studies

Sonography is usually repeated every 2 wks.

Management cont..

- Role of steroids:

  Antenatal glucocorticoid administration reduces the incidence of respiratory distress syndrome, intraventricular hemorrhage and death in IUGR fetusus weighing less than 1500gm.

Mode of Delivery

- *Fetuses with significant IUGR should be preferably delivered in well equiped centres which can provide intrapartum continuous fetal heart monitoring , fetal blood sampling and expert neonatal care.*

- **Vaginal delivery:** can be allowed as long as there is no obstetric indication for caesarian section and fetal heart rate is normal.
- Fetuses with major anomaly incompatible with life should also be delivered vaginally.

- Caesarian section: In all cases of IUGR with features of acidosis caesarian section should be done without trial of labour. These include:
  - Repetitive late decelerations
  - poor biophysical profile
  - reversal of end diastolic flow in umblical artery
  - abnormal venous doppler
  - blood gas analysis showing acidic pH on cordocentesis.

Conclusion

- *One of the primary aims of antenatal care is to identify fetuses which show a significant growth lag, since they are at a high risk of hypoxic complications in the perinatal period.*
- Management options are limited to close fetal monitoring and termination of pregnancy balancing the risk of prematurity and that of intrauterine demise.