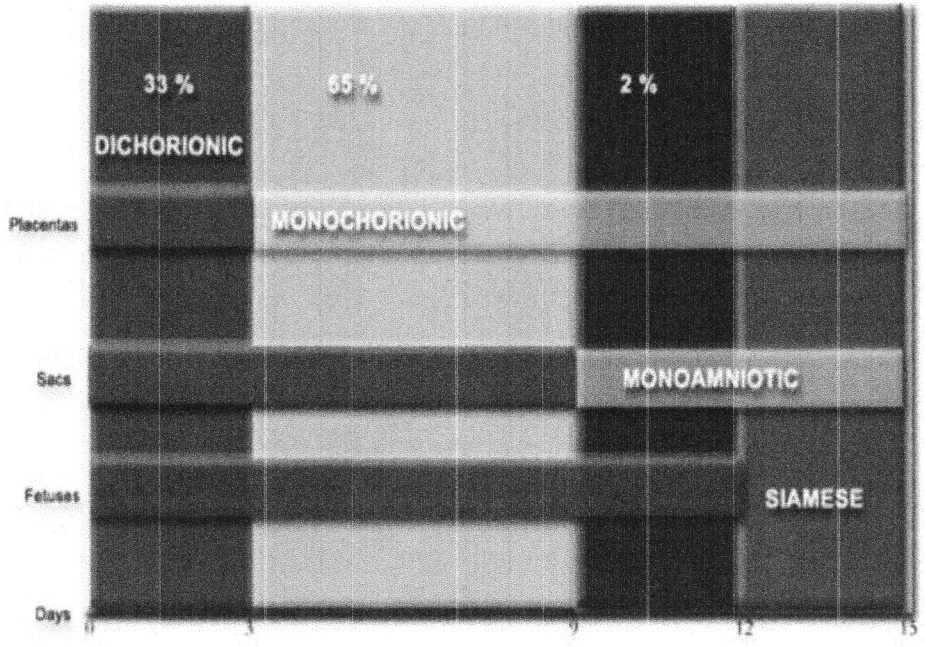
In monozygotic twins :

1. Embryonic splitting within the first **3 days** after fertilization results in a diamniotic and dichorionic pregnancy (**DADC**).
2. Splitting between **days 3 and 9** results in a diamniotic, monochorionic pregnancy.(**DAMC**).
3. Splitting between **days 9 and 12** results in a mono-amniotic, monochorionic pregnancy.(**MCMA**)
4. Splitting **after the 12th day** results in **conjoined twins**



ULTRASOUND IN TWIN GESTATIONS

When should ultrasounds be performed in twin pregnancies and why?

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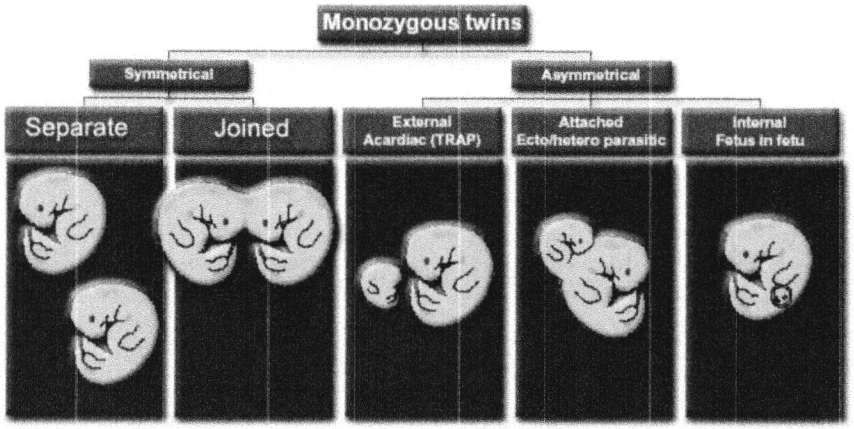
TYPES OF MULTIPLE PREGNANCY

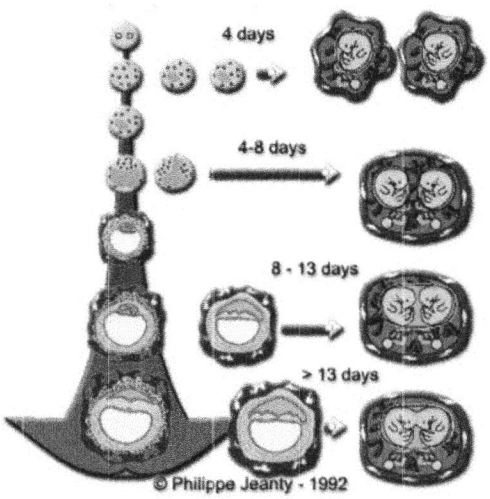
1. Polyzygotic :
   . Multiple pregnancy usually results from of **more than one oocyte**
   . the fetuses are **genetically different** (polyzygotic or non-identical).
   . each zygote develops its **own amnion, chorion and placenta (polychorionic).**

2. Monozygotic :
   . Multiple pregnancy result *from the splitting of one embryonic mass to form two or more*
   . genetically **identical** fetuses (monozygotic).
   . there may be **sharing of the same placenta** (monochorionic), amniotic sac (monoamniotic)
   . or even fetal organs (conjoined or Siamese).

A classification of monozygous twin according to their symmetry or lack of :



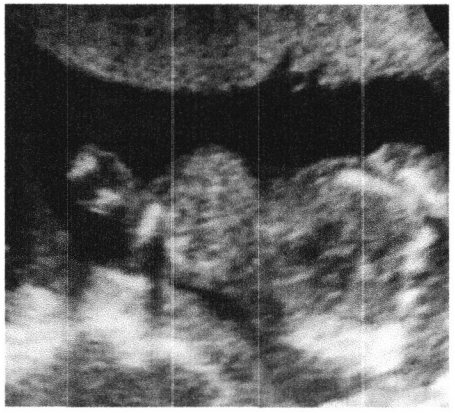
Schematic drawing demonstrating the outcome of twinning at different stages of early embryonic life



Ectoparasitic twins are parts of twins implanted in another fetus.

In this case what appears to be an omphalocele on the left is a fetal abdomen with lower legs on the extreme left.

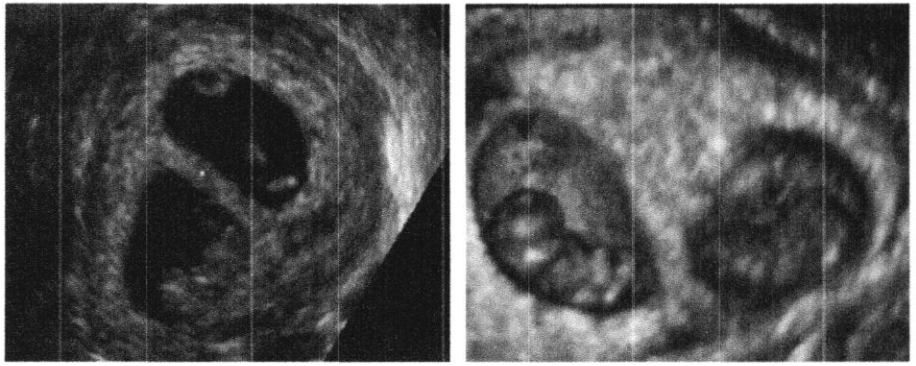
(Courtesy Glynis Sack, MD, www.TheFetus.net)



Cont...

- Fission **before the formation of the inner cell mass** and any differentiation will produce two embryos with two separate chorions, amnions and placentas. (DCDA)
- Twinning at the **early blastocyst stage, after formation of the inner cell mass**, will cause the development of two embryos, with one placenta and one chorion but two separate amnions. (MCDA)
- If separation occurs after the formation of the embryonic disc, the amnion has already formed, and will lead to a MAMC.
- Incomplete fission at this stage or later will result in conjoined twins.

DC at 7-8 weeks,
demonstrating the thick septum (3D scan)



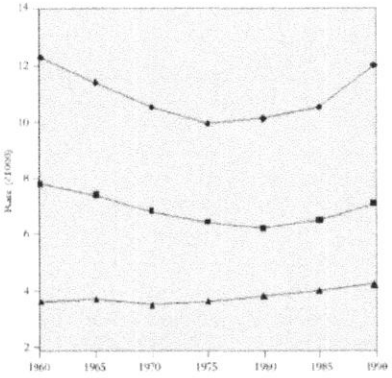
At 11–14 weeks : the presence or absence of the lambda sign → DC or MC

- MC :
  - Single placental mass
  - Absence of the lambda sign .
- DC :
  - Single placental mass .
  - the lambda sign was present .

All pregnancies classified as MC → same-sex twins.
Different-sex pairs were correctly classified → DC

INCIDENCE AND EPIDEMIOLOGY

- Twins about 1% of all pregnancies.
- two-thirds being DZ and one-third MZ.
- The incidence of DZ twins varies with:
  - ethnic group (5 times higher in certain parts of Africa and half as high in parts of Asia).
  - maternal age (2% at 35 years).
  - parity (2% after four pregnancies).
  - method of conception (20% with ovulation induction).
- The incidence of MZtwins is similar- in all ethnic groups and
  - does not vary with maternal age or parity,
  - but may be 2–3 times higher following IVF



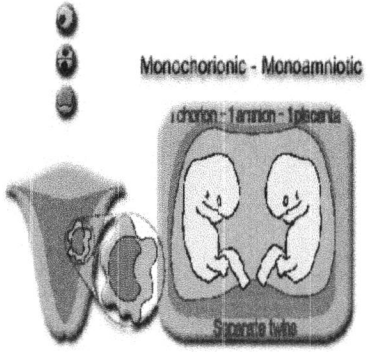
Twinning rate (per 1000 pregnancies) in England and Wales, 1960–1990 for all twins (diamond markers), DZ(square markers) and MZ(triangle markers; adapted from Derom et al. 1995)

ZYGOSITY AND CHORIONICITY

1. Zygosity : - DNA fingerprinting.
   - PND; amniocentesis, placental tissue (CVS),fetal blood (cordocentesis).
2. Chorionicity :
   - USG : fetal gender, number of placentas, characteristics of the membrane between the two amniotic sacs.
   - Different-sex twins are DZ and DC,
   - But in about two-thirds of twin pregnancies the fetuses are of the same sex and these may be either MZ or DZ.
   - Two separate placentas, the pregnancy is DC.

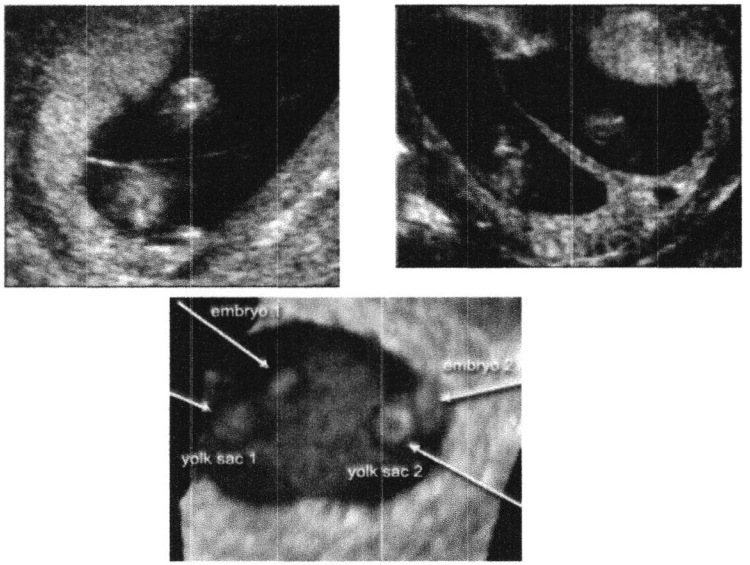
- DC : **thicker and more echogenic**
- MC → **the intertwin membrane thin**
- **Ultrasound examination at 6–9 weeks.**
- **After 9 weeks**, progressively thinner to form the chorionic component of the intertwin membrane → thick and easy to identify : a triangular tissue projection → **lambda sign.**

Sonographic features

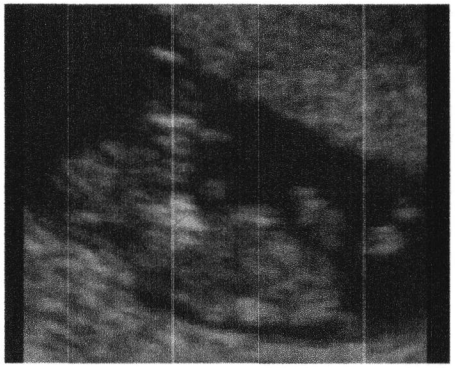


- Single placenta and same sex twins;
- Absence of a dividing membrane .
- A single yolk sac .

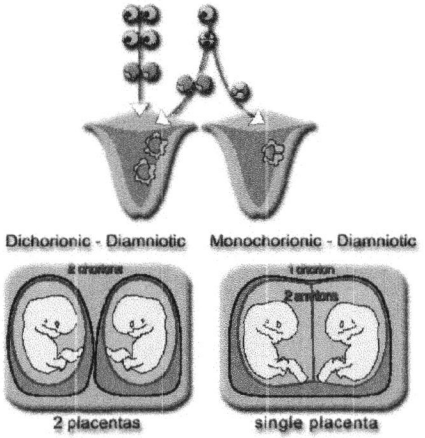
Ultrasound appearance of MC (left) and DC (right) at 12 weeks , DC ; lambda sign



- Absence of a dividing membrane between two fetuses that are intimately in contact.



MC Twin



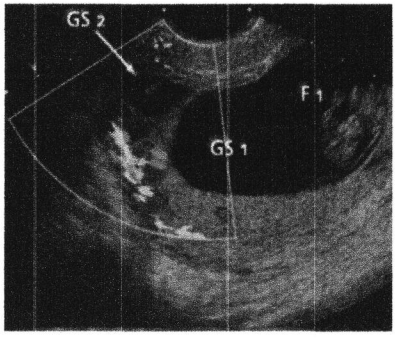
- **Two fertilized eggs : 2 GS, DCDA →** the placenta can insert between the two sacs producing the "**Lambda sign" (lambda sign).**

A single egg can either :

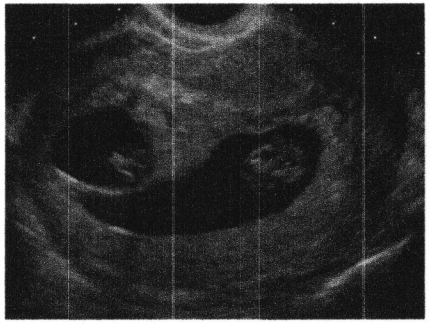
1. **Split early (before 4 days)** into two embryos.
2. **Split between the 4th - 8th days :**
   - the chorion is no longer divisible→Both embryos will then **share the chorion.**
   - the placenta will not be able to infiltrate between the two GS and the membrane insertion will have the **"T" appearance.**

Evolution of the lambda sign with gestation

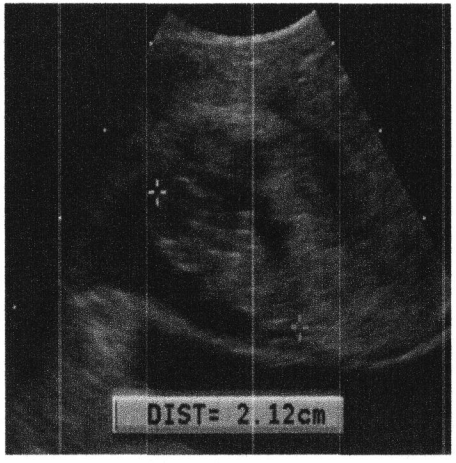
DCDA pregnancy at 8-9 weeks , with a embrionic loss (GS2) and visualization of a live embryo (GS1)

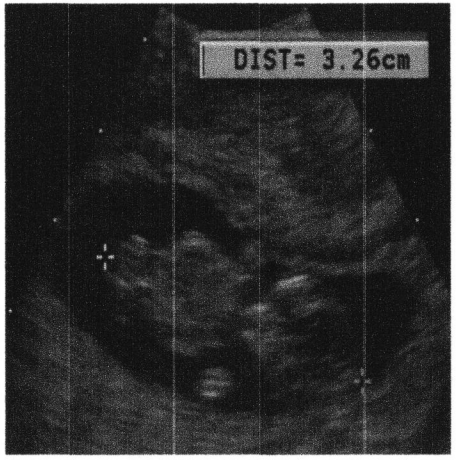


DCDA pregnancy at 9+2 weeks , with a discrepancy of to embryos size.



- With advancing gestation → regression of the chorion laeve→ the lambda sign difficult to identify.





MISCARRIAGE AND PERINATAL MORTALITY

- The perinatal mortality rate in twins is 6 times higher than in singletons·
- This increased mortality, which is mainly due to prematurity-related complications.
- Is higher in MC than DC twin pregnancies.
- In MC twins, complication to prematurity is TTTS.
- The perinatal mortality rate is 3–4 times higher in MCcompared to DC twins.
- Fetal loss before 24 weeks of gestation in 12.7% of MC and 2.5% of DC pregnancies.

Frequency and mortality according to the types of placentation
(Liu S, Bernirschke K, Scioscia AL, Mannino FL. Intrauterine death in multiple gestation. Acta Genet Med Gemellol1992;41:5-26.)

- DADC
  Separate placentae
  - Frequency: 35%Mortality: 13%
- DADC
  fused placentae
  - Frequency: 27%Mortality: 11%
- DAMC
  single placentae
  - Frequency: 36%Mortality: 32%
- MAMC
  single placentae
  - Frequency: 2%Mortality: 44%

- Perinatal mortality in twins, especially those that are MC, is higher than in singleton pregnancies.
- Perinatal statistics underestimate the importance of MC placentation to fetal death since the highest rate of mortality is before 24 weeks of gestation .

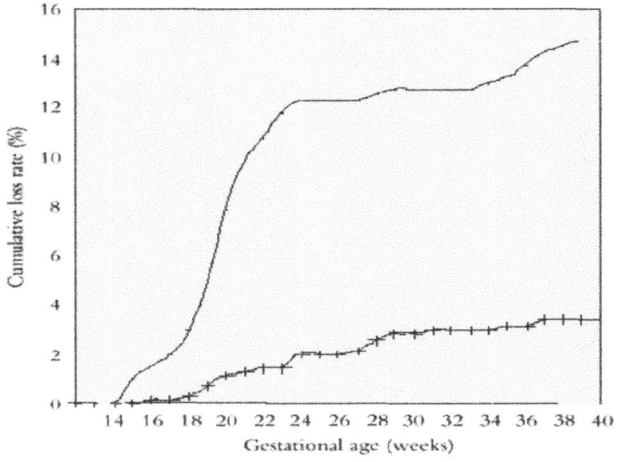
GROWTH RESTRICTION

- In singleton pregnancies : fetal growth are genetic, placental function→ the effectiveness of trophoblastic invasion of spiral arteries.

1. In MC twin pregnancies :
   a. both the genetic constitution and govern trophoblastic invasion should be the same for the two fetuses.
   b. Consequently;
      - Unequal splitting of the initial single cell mass.
      - Imbalance in the bidirectional flow of fetal blood through placental vascular communications between the two circulations.
2. About 90% of DC are DZ, inter-twin disparities :
   → Differences in genetic constitution of the fetuses and their placentas.

- The risk of delivering growth-restricted babies is about 10 times higher than in singleton . 34% for MC and 23% for DC .
- Growth restriction of both twins was about four times as high in MC (7.5%) , DC (1.7%) .

Cumulative fetal loss rates in MC(solid line) and DC(dashed line) twin pregnancies, from 12 weeks of gestation



TWIN-TO-TWIN TRANSFUSION SYNDROME

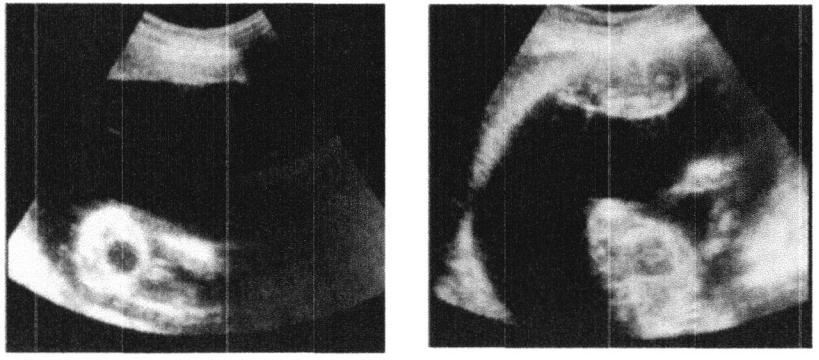
In MC twin :

- Placental vascular anastamoses : AA, VV, AV.
- This phenomenon of a shared circulation between MC.
- Aarterio–venous anastomoses are deep in the placenta .
- In about 25% of MC : imbalance in the net flow of blood across the placental vascular A–V communications from one fetus, the donor, to the other, the recipient → results in TTTS .
- In about half of these cases : severe TTTS : presenting as acute polyhydramnios in the second trimester .

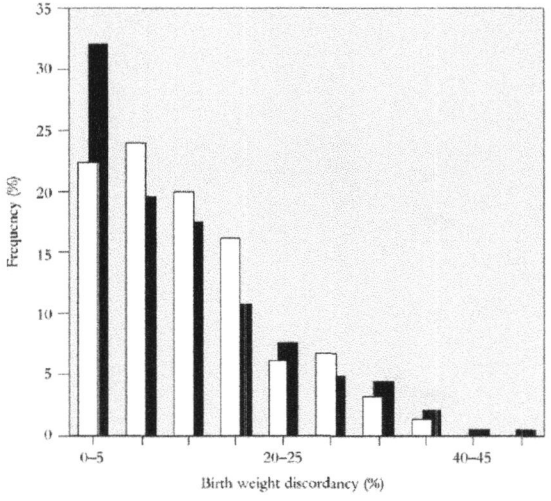
Ultrasonographic studies in the first trimester :

- Disparities in CRL : a difference of more than 3 mm associated with a 50% chance of intrauterine death of the smaller twin.
- no significant correlation between inter-twin disparities in CRL and inter-twin disparities in birth weight.
- In DC with chromosomally abnormal fetuses :
  - Ended in miscarriage or intrauterine death of one or both fetuses.
  - the inter-twin disparity in CRL was significantly higher than in pregnancies resulting in two live births.
- In MC with adverse pregnancy outcome : no significant difference in inter-twin disparity in CRL from pregnancies resulting in two live births.

Severe TTTS at 20 weeks . In the polyuric recipient, there is a large bladder and polyhydramnios (left) and the anuric donor is held fixed to the placenta by the collapsed membranes of the anhydramniotic sac (right)



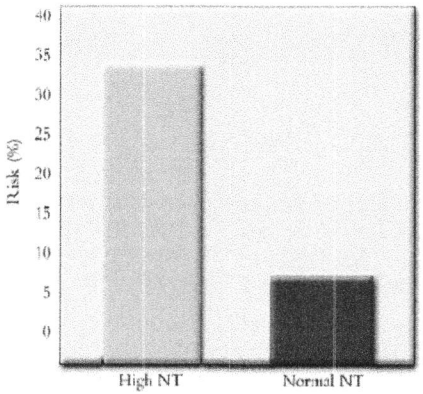
There is no significant inter-twin disparity in birth weight between MC(solid bars) and DC (open bars) twins.



Early prediction of TTTS

Ultrasonographic features :

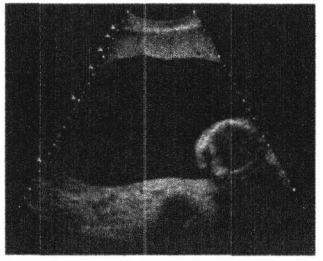
- TTTS present from as early as 11–14 weeks .
- Increased NT in one or both of the fetuses.
- Intertwin discrepancies in CRL were not predictive of TTTS .



- The mechanism by of MC go on to develop TTTS ← hypothesized : **maldevelopment of the placenta of the donor twin may cause increased peripheral resistance in the placental circulation → promotes shunting of blood to the recipient.**
- **Donor therefore suffers from both hypovolemia** → blood loss and hypoxia due to placental insufficiency
- The **recipient fetus compensates with polyuria** → protein and cellular components remain in its circulation → increase in colloid oncotic pressure draws water from the maternal compartment across the placenta → hyper volemia, polyuria and hyperosmolality → to high-output heart failure and polyhydramnios.
- The diagnosis of TTTS :
  - Difference in birth weight of 20% or more .
  - H emoglobin concentration of 5 g/dl or more .
  - Pathognomonic features :
    - = large bladder in recipient fetus , 'absent' bladder in donor.
    - = 'stuck' : immobile at the edge of the placenta or the uterine wall, fixed , anhydramniotic sac .
    - = hypertrophic, dilated and dyskinetic heart,.
    - = Absence or reversal of flow in the DV .
    - = In the donor : heart may be dilated, the bowel is hyperechogenic, and AED in UA, hypoxemic fetuses → severe uteroplacental insufficiency.
    - = oli/polyhydramnios sequence is present → the rate of death of fetuses is about 90%.

MONOAMNIOTIC TWINS

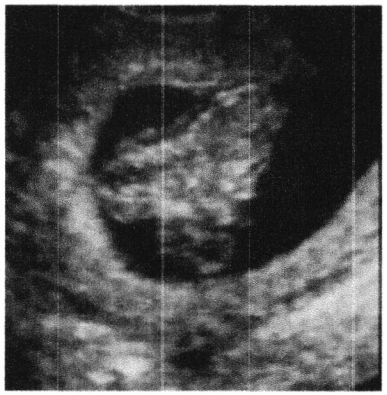
1. Splitting of the embryonic mass after day 9 of fertilization results in MA twins.
2. Single amniotic cavity, single placenta, two umbilical cords insert close to each other.
3. about 1% of all twins or about 5% of MC.
4. the fetal loss rate is about 50–75% : due to fetal malformations, preterm delivery and complications arising form the close proximity of the two umbilical cords.
5. The close insertion of the umbilical cords into the placenta is associated with large-caliber anastamoses between the two fetal circulations.
6. Consequently, an imbalance in the two circulations could → hemodynamic effects, udden fetal death.



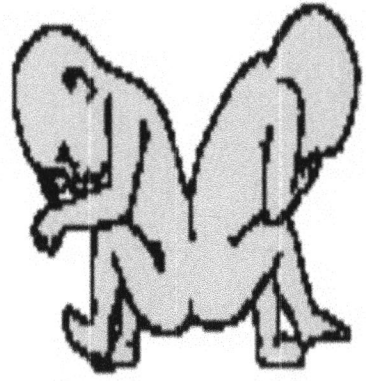
Duplicata incompleta:
duplication occurring in only one part or region of the body.

Examples:

- **Diprosopus:** one body, one head, two faces.
- **Dicephalus:** one body, two heads.
- **Dipygus:** one head, thorax and abdomen with two pelvis, and/or external genitalia.



- **Duplicata completa:** two complete conjoined twins.
- **Terata catadidyma:** conjunction in the lower part of the body.
- **Examples:**
  Ischiopagus: joined by inferior portion of coccyx and sacrum
  Pygopagus: joined by lateral and posterior portion of coccyx and sacrum



Conjoined twins

- Splitting of the embryonic mass after day 12 of fertilization.
- 1% of MC.
- Conjoined twins are classified :
  - according to the dominant site of interfetal body part connection : thoracopagus (thorax, 30–40%), omphalopagus (abdomen, 25–30%), pygopagus (sacrum, 10–20%), ischiopagus (pelvis 6–20%) and craniopagus (head,2–16%).
- The prognosis depends on the site and extent of conjoining, about 50% are stillborn and one-third of those born alive have severe defects for which surgery is not possible.
- In the live-born cases in whom planned surgery is carried out, about 60% of infants survive.

Classification:

- Conjoined twins are classified according : the area of the bodies where the fusion takes place and the involvement of internal organs.
- The symmetrical and equal forms.
- equal or nearly equal duplication of structures ; duplicata completa.
- an unequal duplication of structures ;duplicata incompleta→ includes the most severe types of conjoined twins in
  which just few organs systems are duplicated.
- The most frequent varieties of conjoined twins are : thoracopagus (40-74%), omphalopagus (10-33%), pygopagus (18%), ischiopagus (6%) and craniopagus (1-6%).

Ventral union: twins united along the ventral aspect

1. ***Cephalopagus***
2. ***Thoracopagus***
3. ***Omphalopagus***
4. ***Ischiopagus***

Terata anadidyma:
conjunction in the upper part of the body

Examples:

Syncephalus: joined by the face

Craniopagus: joined at homologous portion of the cranial vault

Lateral union: twins joined side-by-side with shared umbilicus, abdomen, and pelvis.

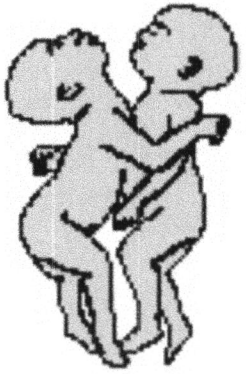
Parapagus:

- twins that share a conjoined pelvis, one symphysis pubis and one or two sacrums.
- Dithoracic parapagus.
- Dicephalic parapagus.
- Diprosopic parapagus.

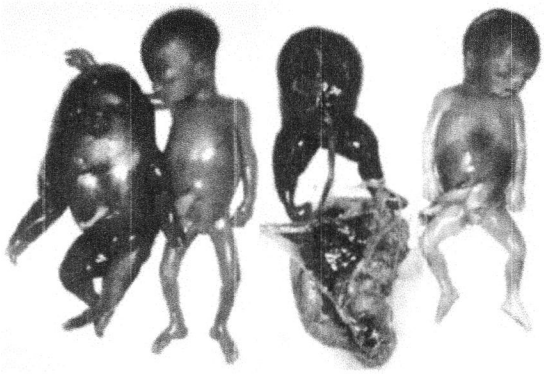
Terata anacatadidyma: conjunction in the midpart of the body

Examples:

Thoracopagus: joined at the thoracic wall
Xiphopagus: joined at xiphoid process
Omphalopagus: joined in the area between the xiphoid cartilage and the umbilicus
Rachipagus: joined at he level of the spines above the sacrum



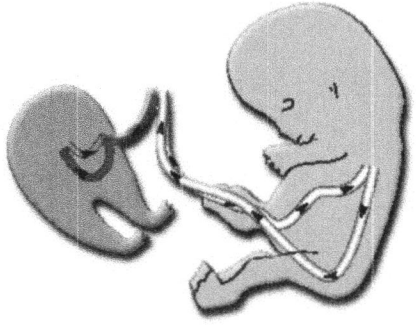
Two sets of acardiac twins demonstrate the range of development (or absence of development) of the cephalic end. (www.thefetus.net)



Dorsal union: twins joined at the dorsal aspect of the primitive embryonic disc. There is no involvement of thorax and abdomen

- ***Craniopagus.***
- ***Pygopagus.***
- ***Rachipagus***

In the twin-reversed arterial perfusion syndrome the "acardiac" twin is perfused retrogradely with poorly oxygenated blood that should have gone to the placenta.



Twin reversed arterial perfusion sequence (TRAP)

- The most extreme manifestation of TTTS , 1% of MC , is acardiac twinning (acardius chorioangiopagus parasiticus).
- This twin disorder has been named 'twin reversed arterial perfusion' (TRAP).
- Prenatal treatment is by occlusion of the blood flow to the acardiac twin by endoscopic ligation or laser coagulation of the umbilical cord.
- A less invasive technique is ultrasound-guided laser coagulation of the umbilical cord vessels within the abdomen of the acardiac twin.

Management TRAP

The management : Conservative and invasive therapies.

1. Conservative ; serial CTG, USG , echocardiography. Non-invasive therapies may be used supporting the cardiac function of the pump twin with digoxin and indomethacin.
2. The more invasive management consists in termination of pregnancy or interruption of flow to the acardiac fetus, by surgical extraction (hysterotomy with selective delivery of the acardiac twin) and ligation of the acardiac twin's umbilical cord . ultrasound-guided embolization of the cardiac twin's umbilical artery with absolute alcohol , platinum coils or thrombogenic coils, laser vaporization .

Thank You