Twin placentation and its complications

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Introduction

- Monochorionic (MC) twin makes up 20% of twin pregnancies

- The risk of death in MC is 12% up to 24 weeks, compared to 2% in dichorionic twin pregnancies.

- 95% - 96% of MC has vascular anastomosis

- This leads to the unique complications of MC twins namely:
  - Twin-to-twin transfusion syndrome (TTTS)
  - The twin anemia polycythemia sequence (TAPS)
  - The twin reversed arterial perfusion syndrome (TRAP)
  - Monoamniotic twinning
Fig 1. Postnatal injection in monochorionic twin placenta. *Blue dye* representing vein from one twin and *yellow arterial dye* from other twin meet in center to indicate arteriovenous anastomosis. A superficial arterioarterial anastomosis is also present at top of figure (indicated by mixing of arterial dyes *yellow and red* within one vessel).
Introduction:

• Why is it so important to understand this?

• The well-being of the two twins critically depends on each other.

• In case of the demise of the one twin the risk to the other twin is:
  – 15% risk of death
  – 25% risk of neurological impairment

• The reason is a drop in blood pressure and acute exsanguination
A. Insertion of catheters after cord is cut 5 cm from its placental insertion. B. Three catheters fixed to cord. C. Before injection with purple, blue, white, and red barium-sulphate mixtures. D. Injection of one of the arteries.

TTTS

• **Diagnosis:**

• **Ultrasound finding is:**
  - Polyhydramnios deepest pool more than 8cm before 20 weeks or more than 10cm after 20 weeks with a distended bladder
  - Oligohydramnios with deepest pool less than 2cm with a small or absent bladder.

• **Incidence:** 10%

• **Develop between 16 and 26 weeks**

• **Pathophysiology:**
  - Important that there is at least 1 ateriovenous anastomosis
  - Usually 4/5 placentas with TTTS have no AA anastomosis present
  - Both twins seem to have the same Hb
  - Endocrine factors related to fluid and homeostasis are also involved.
Placenta is equally shared. There is 1 tiny artery-to-artery anastomosis (star) that could insufficiently compensate flow over 7 arteriovenous anastomoses (open circles) from donor (twin 1, 540 g) to recipient (twin 2, 750 g).

A, Typical monochorionic diamniotic placenta from uncomplicated pregnancy. Delivery was at 35 weeks of 2 healthy neonates of 2534 g and 2440 g. Placenta is equally shared. Each twin has its own individual placental territory (veins colored blue for twin 1 and veins colored brown for twin 2) defined by venous chorionic plate vessels of each twin (dotted line). There is 1 artery-to-artery anastomosis (star); 5 arteriovenous anastomoses (from twin 1 to 2) (open circles); and 6 oppositely directed venoarterial anastomoses (dotted circles). 

B, Magnification of artery-to-artery anastomosis. Each artery-to-artery anastomosis functions as flexible arteriovenous anastomosis. Depending on direction of flow, it can act as arteriovenous anastomosis from twin 1 to 2 (solid arrow), or as venoarterial anastomosis from twin 2 to 1 (dotted arrows).

• **Pathophysiology:**
  - The one twin is exposed to the endocrine environment of the other twin
  - Transfer of renin-angiotensin-aldosterone, which can explain the recipient’s hypertensive cardiomyopathy and volume overload.

• **Complications:**
  - Death
  - Neurological handicap
  - Polyhydramnios induced miscarriage
  - Preterm delivery of sick neonates
• Quintero
  – Stage 1: Oligo/Poly with bladder visible, normal Dopplers
  – Stage 2: Oligo/Poly with absent bladder and normal Dopplers
  – Stage 3: Oligo/poly, no bladder seen and Doppler abnormalities
  – Stage 4: Hydrops
  – Stage 5: Death
• Difficult to predict with both CRL and NT difference not of any help.

• MC should be seen every 2 weeks especially between 16 and 26 weeks.

• Treatment:
  – Fetoscopic laser coagulation
  – The aim is to disconnect the two circulations

• In successful cases the following happens:
  – The donor’s twin urine output normalizes
  – The amniotic fluid volume normalizes
  – Cardiac function of the recipient normalizes
TTTS:

• **Survival post laser:**
  – 50 – 60% survival of both fetuses
  – 80% single survivors
  – Donor survival rates 60%
  – Recipient survival rates is 70%
  – 11% developmental impairment of which cerebral palsy is the most common form - 5%
  – Risk the same in single survivors

• **Missed anastomosis is common in 5 – 30% of cases:**
  – Missed anastomosis usually located at the edge of the placenta
  – Missed large AV anastomosis leads to recurrent TTTS
  – Missed small AV anastomosis leads to TAPS
Patient was delivered at 29 weeks because of nonreassuring heart rate tracing. Twin 1 (ex-donor) and twin 2 (ex-recipient) had hemoglobin of 19 and 8.8 g/dL, respectively. Placenta is shared equally. There is a tiny missed venoarterial anastomosis from twin 2 to 1 at edge of placenta.

Solomon’s technique

Coagulation line is clearly visible connecting one edge of placenta with other (dotted line). Patient delivered 2 healthy newborns of 2310 g and 2100 g, respectively.

Twin anemia polycythemia sequence (TAPS)

- Characterized by severe HB differences between the two fetuses.
- Usually not polyhydramnios
- Result of transfusion over small anastomosis
- **Antenatal diagnostic criteria:**
  - MCA PSV >1.5MoM in one twin
  - MCA PSV <1MoM in other twin
- **Postnatal diagnostic criteria:**
  - Hb discordance at least 8g/dl
- **To differentiate chronic TAPS from acute intrapartum transfusion:**
  - Reticulocyte count in anemic twin should be increased and a decreased count in the polycythemic twin with a ration of >1.7
  - Or on placental injection small anastomosis
Growth had been concordant throughout pregnancy. At birth, there was growth discordance of 30%. Twin 2 weighed 2445 g with hemoglobin of 22 g/dL requiring partial exchange transfusion. Twin 1 weighed 1720 g with hemoglobin of 12 g/dL. Placenta is equally shared. There was 1 tiny arterioarterial anastomosis (star), 4 tiny arteriovenous anastomoses from twin 1 to 2 (open circles), and 1 tiny oppositely directed venoarterial connection (dotted circle).

TAPS

- **Incidence:**
  - 5% of uncomplicated monochorionic pregnancies
  - 13% of incomplete laser for TTTS
- **Spontaneous TAPS present after 26 weeks or 1 – 5 weeks after laser.**
- AA anastomosis are also protective against TAPS.
- If an AA anastomosis is present it measures less than 1mm.
- Morbidity and mortality is less than TTTS, but can cause late IU demise.
- **Neonatal complications include:**
  - Transfusion
  - Partial exchange transfusion of the polycythemic twin
  - Severe prematurity can occur
  - Seldom severe cerebral lesions present.
• Screening:
  – Measurement of the MCA PSV after laser ever 7 to 14 days
  – MCA PSV every 14 days routinely, especially if there is worsening IUGR after 24 weeks.

• Management: Best treatment not yet clear.
  – If TAPS suspected review MCA PSV after 2 – 3 days
  – If discordance present prior to 30 weeks and there is hydrops: Intra uterine transfusion.
  – Second transfusion often indicated.

• In cases of rapid anemia after two transfusions:
  – Delivery
  – Selective reduction
  – Re laser or laser
• If the anemia is rapid recurring there is significant risk of hyperviscosity-related complications it is advised to do only two transfusions.

• Laser difficult due to:
  – Lack of polyhydramnios
  – Small anastomosis
  – Advanced gestation.

• After 30 weeks:
  – Steroids
  – Delivery
Twin Reversed Arterial Perfusion sequence: TRAP sequence

- Blood flow from pump twin umbilical artery in a reversed direction into the umbilical artery of the perfused twin.
- The flow is via AA anastomosis and the return via VV anastomosis.
- The perfused twin receives deoxygenated blood, which results in variable degrees of deficient development of the head, heart and upper limbs.
- The perfused twin usually has no cardiac activity.
- Two criteria necessary for TRAP sequence:
  - Presence of AA anastomosis
  - Discordant development
Cords were entangled. Placenta shows 1 arterioarterial anastomosis (solid star) from cord of smaller triplet 1 (open arrow) and venovenous anastomosis (open star) to larger triplet 2 (open arrow). Triplet 1 was therefore pump triplet, whereas triplet 2 was draining triplet.

TRAP sequence

• **Diagnosis:**
  - Reversed flow in the umbilical artery with colour Doppler flow.

• **Incidence:**
  - 1% of monochorionic twin pregnancies.

• **High morbidity and mortality due to:**
  - High-output cardiac failure
  - Polyhydramnios-related preterm delivery.

• **Treatment:**
  - Arrest the circulation by cord coagulation, laser or radiofrequency ablation.
  - Can only be performed after 16 weeks.
  - Difficult to predict pump twin demise
Monoamniotic twin pregnancies

- Incidence is 1 in 20 monochorionic twin pregnancies.
- This is the result of late division of the inner cell mass. This results in the close insertion of the two cords with large connecting anastomosis.
- There is almost always an AA anastomosis present.
- Diagnosed in the first trimester by the lack of an intertwin membrane.
- Cord entanglement usually present in the first trimester.
- Complications:
  - TRAP and conjoint twins
  - 20% have discordant structural abnormalities vs 6% diamniotic MC
  - Risk of intrauterine demise 15% and 4% after 20 and 32 weeks
  - Death due to an acute fetofetal hemorrhage triggered by cord compression.
Delivery was elective at 32 weeks with birth of 2 healthy neonates of 1510 g and 1570 g, respectively. Placenta is unequally shared. There is 1 large arterioarterial anastomosis from twin 1 to 2 (star). There is no individual placental part for twin 1 that is entirely supplied through at least 8 arteriovenous anastomoses from twin 2.

Monoamniotic twin pregnancies:

- Careful surveillance and planned preterm birth improved survival to 80%.

- Discordant structural abnormalities:
  - Managed by bipolar cord ligation followed by laser transection of the cord.
  - Complication is higher rate of PROM and earlier delivery.

- Recommended management:
  - Inpatient monitoring from 28 weeks or more and delivery at 32 to 33 weeks.
  - Steroids before delivery
Single intrauterine demise:

- **This can be the result of:**
  - Unequal placental sharing
  - TTTS
  - TAPS

- **Result of the demise:**
  - Double demise 15%
  - Antenatal brain damage 25%
  - Preterm delivery 68%

- **Outcome of the survivor depends on:**
  - Type and direction of anastomosis: AA associated with higher morbidity
  - The fetoplacental mass of the demised twin
Single intra uterine demise

• Gestational age and risk of fetal loss:
  – > 10 – 14 weeks 4% single demise
  – Double demise in 6%

• Management:
  – As exsanguination happens at the time of death, delivery increase morbidity and mortality
  – MCA PSV: If normal the prognosis most likely favorable.
  – If anaemic, transfusion may improve mortality but not morbidity
  – Detail scan and MRI: 4 weeks post incident
There was intrauterine demise of smaller twin at 25 weeks. Survivor was anemic (hemoglobin of 7.6 g/dL) and was given intrauterine transfusion. Three weeks later, surviving twin was noted to have infarction of entire brain, except for cerebellum and brain stem. Patient went into preterm labor and twin 2 died intrapartum. Twin 1 was polycythemic. Placenta is unequally shared. Smaller twin 1 has velamentous cord insertion and no individual placental part. There were 2 large arterioarterial (solid stars), 1 venovenous (open star), several arteriovenous (open circles), and several venoarterial (dotted circles) anastomoses. Large artery-to-artery anastomoses explain anemia in larger twin, because of exsanguination into body of demised twin.

Discordant growth

• **Definition:** Discordance between 20 to 25%.

• **Percentage is calculated as:**
  – \( \frac{\text{large} - \text{small}}{\text{large}} \)

• **Incidence is 10 – 15% of MC, same as in dichorionic twins.**

• \( \frac{1}{4} \) MC babies have a birth weight discordance of more than 25%

• **Growth is determined by:**
  – The division of the placenta: Unequal placental sharing the most important cause.
  – Vascular anastomosis

• **Establishing placental sharing:**
  – Difficult
  – Placental cord insertion is helpful.
Birth was by emergency caesarean section because of abnormal heart rate tracing in smaller twin. Birthweights were 1075 g (twin 1) and 670 g (twin 2). Smaller twin was diagnosed with coarctation, which was treated by stent placement on day 26 and coarctectomy at 9 months of age. Larger twin had peripheral pulmonary artery stenosis requiring no treatment. Placenta is unequally shared. There is little individual territory for smaller twin (dotted line). There is large arterioarterial (star) and several arteriovenous (open circles) and venoarterial (dotted circles) anastomoses.

At 23 weeks before laser surgery, recipient (twin 2) was larger with estimated fetal weight of 578 g vs donor 442 g. At 31 weeks at time of birth, recipient was much smaller with birthweight of 810 g as compared to donor 1560 g. Recipient has smaller part of placenta, reflecting lower birthweight (dotted line). There were no missed anastomoses.

Unequal placental sharing is associated with:
- Larger AA anastomoses
- Larger net flow over AA anastomoses
- Larger diameter of all anastomoses

This results in increased availability of oxygen and nutrients to the twin with the smaller placenta.

Thus in these cases laser could cause demise of the smaller twin.

There are differences in the placental characteristics and different clinical outcomes if it present before 20 weeks.
Discordant growth:

- **In cases before 20 weeks:**
  - IUD occurs in 20% of cases
  - Doppler abnormalities start as early as 16 weeks

- **In cases after 26 weeks:**
  - More equally shared placenta
  - Doppler of the smaller twin usually normal
  - Survival almost 100%
  - 1/3 with late onset IUGR have severe Hb difference as seen in TAPS
Discordant growth

- Large AA anastomoses can result in intermittent, absent or reversed end-diastolic flow.

- Classification based on Doppler of the small twin:
  - Type 1: Normal flow pattern
  - Type 2: Persistent absent or reversed end-diastolic flow
  - Type 3: Intermittent absent or reversed end-diastolic flow
## Discordant Growth

<table>
<thead>
<tr>
<th>Doppler Type</th>
<th>Large AA anastomosis (&gt;2mm)</th>
<th>Survival rate</th>
<th>Other risks:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>70%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Type 2</td>
<td>18%</td>
<td>60%</td>
<td></td>
</tr>
<tr>
<td>Type 3</td>
<td>19%</td>
<td>85%</td>
<td>• Increased risk of brain injury.</td>
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<td></td>
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<td></td>
<td>• 15% risk of unexplained death without deterioration of the small twin.</td>
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</tbody>
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Discordant growth

- **Outcome is determined by:**
  - Onset
  - Severity of the discordance
  - The degree of growth restriction
  - Interval growth
  - Amniotic fluid volume of the smaller twin

- **Management: Not well established**
  - Early onset Type 2 & 3: Weekly follow-up
  - In pre-viable cases may offer selective termination in cases of imminent fetal death:
    - *Growth that stops*
    - *Anuria with anhydramnios*
Discordant growth:

- **After 28 weeks:**
  - Patients treated as inpatients
  - Elective preterm birth at 32 to 33 weeks
  - Corticosteroids

- **Late-onset discordant growth and a normal Doppler:**
  - Monitored on a weekly basis
  - Include the MCA-PSV
  - Delivery around 34 – 35 weeks

- **Is laser indicated? No**
  - Demise of the smaller twin in 50 – 70%
  - Does not improve neurological outcome
• Management:
• Influenced by the gestational age at the time of diagnosis
• Selective fetocide has been described as an option
• Delivery should be considered once the healthy twin has a good change of survival without neurological handicap
• Death of the co-twin does not increase the risk for the survivor
Conclusion

- Identify the type of chorionicity in early pregnancy
- Need careful follow up
- Invasive procedures did improve the outcome of the survivor
- After invasive therapy there is less double deaths
- Currently in uncomplicated cases timing of delivery can be closer to term if there is good fetal surveillance possible.

Reference:
TTTS: Treatment