



# TWIN-TWIN TRANSFUSION SYNDROME

Making the Right Connections



**Children's Hospital  
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Richard D. Wood Jr.  
Center for Fetal Diagnosis & Treatment

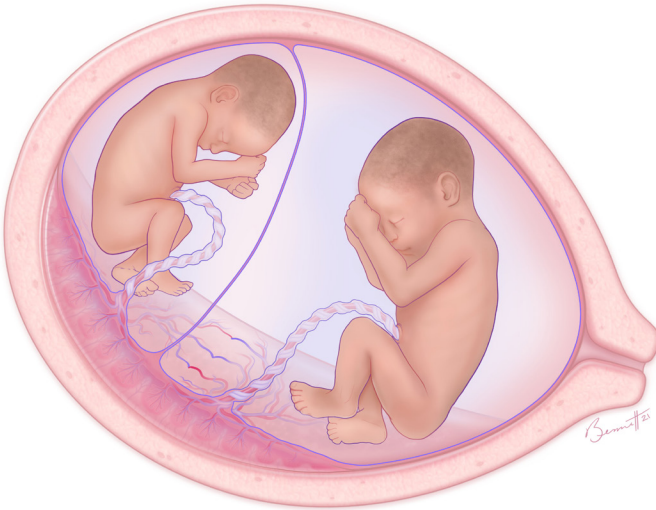
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# GUIDE TO SPECIALIZED CARE OF TTTS

Finding out that unborn babies have a complication such as twin-twin transfusion syndrome (TTTS) can be overwhelming. Learning about TTTS is the first step to understanding what is going on with the babies and what care might entail. This educational guide was developed by our specialized team at Children's Hospital of Philadelphia's Richard D. Wood Jr. Center for Fetal Diagnosis and Treatment to help physicians and parents understand this condition and begin to orchestrate the best care for themselves and their babies.



# FACTS ABOUT TTTS

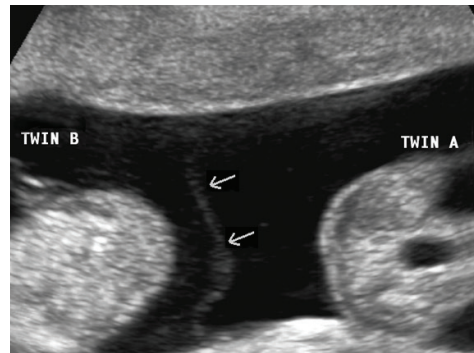


Vascular connections between monozygotic twins results in recipient twin with polyhydramnios and donor twin with oligohydramnios.

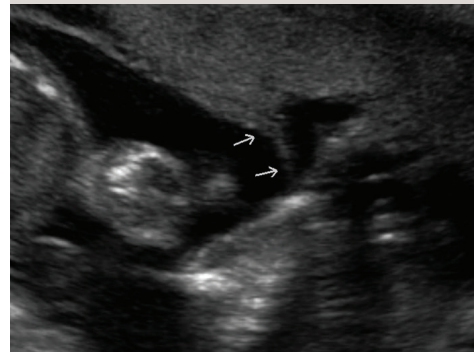
- Occurs in 10% to 15% of monozygotic (MC) twins
- 1 to 3 per 10,000 births
- 17% of all perinatal mortality in twins
- Mortality of 80% to 100% if untreated

# DIAGNOSING TTTS

- Diagnosis of a monochorionic, diamniotic gestation
- Best accomplished in the first trimester
- Single placenta
- Gestational sacs divided by a thin intertwin membrane which contains only two layers of amnion
- Intertwin membrane inserts into the placenta with a “T” configuration
- Same fetal gender
- Dichorionic gestations may have a single fused placenta mass but have a thicker intertwin membrane (two layers of chorion + two layers of amnion) which has a “Y” or “lambda” shaped configuration



“T” configuration of intertwin membrane of monochorionic twins



“Y” shaped insertion of intertwin membrane of dichorionic twins

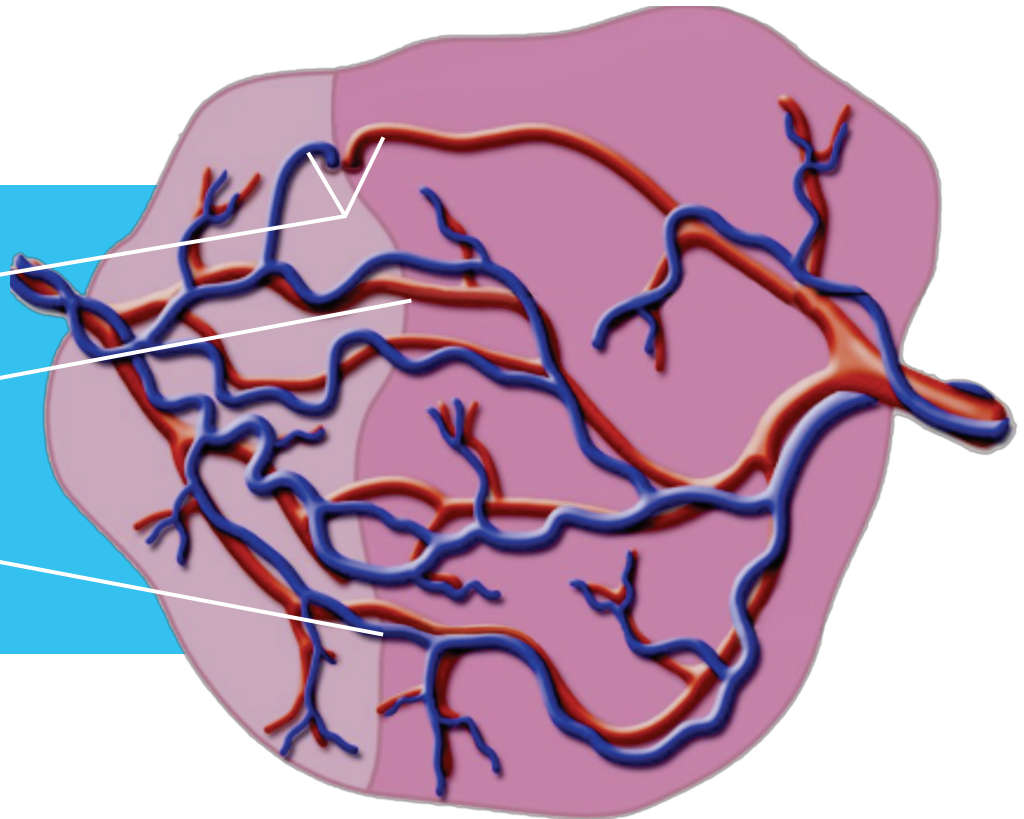
# CONNECTIONS IN A MONOCHORIONIC PLACENTA

Three types of placental vascular connections

Artery-vein

Vein-vein

Artery-artery



# TWIN-TWIN TRANSFUSION SYNDROME: PHYSIOLOGY

## Recipient

**Hypervolemic, polyuric**

- ▶ **Hypertrophic cardiomyopathy, polyhydramnios**
- ▶ **Hydrops** (heart failure) resulting in fetal death, prelabor rupture of the membranes (PROM) or preterm labor (PTL)

## Donor

**Anemic, hypovolemic, oliguric**

- ▶ **Renin-angiotensin system activated**
  - ▶ Increased tubular reabsorption
  - ▶ Oliguria ▶ Oligohydramnios (stuck twin)
- ▶ **Increased angiotensin II**
  - ▶ Hypertension
  - ▶ Increased vascular resistance
  - ▶ Placental vascular changes (SFGR), umbilical artery Doppler changes (AEDF/REDF)

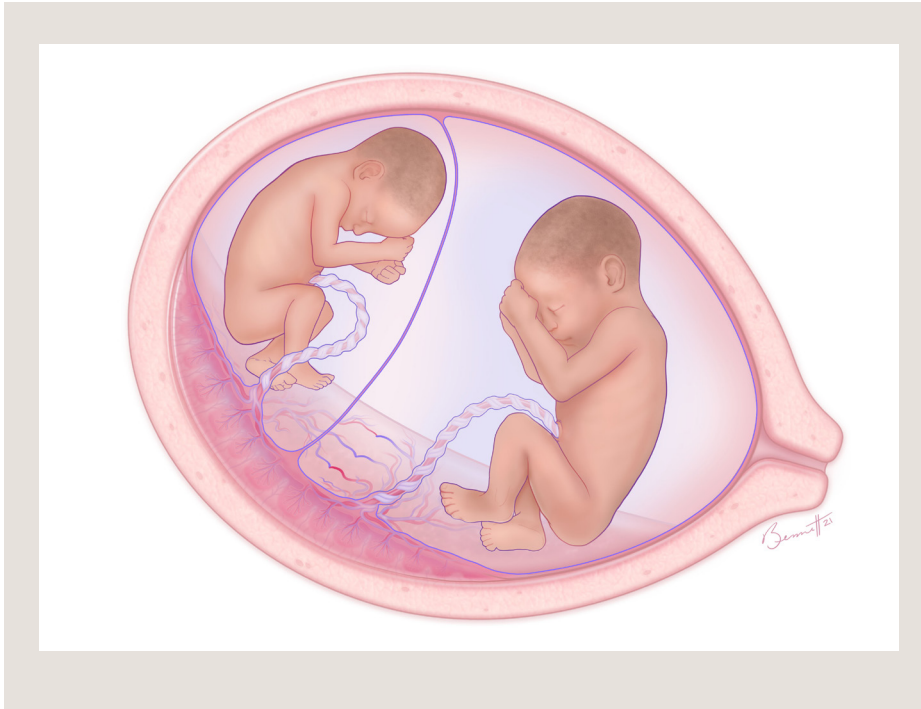


# THE 5 STAGES OF TTTS

In TTTS, there is a characteristic series of pregnancy changes that happens due to the extra blood coming from the donor twin to the recipient twin.

Stage 1	<b>Polyhydramnios</b> – Deepest vertical pocket (DVP) > 8 cm in the recipient sac <b>Oligohydramnios</b> – DVP < 2 cm in the donor sac
Stage 2	<b>Donor bladder not filling or emptying</b>
Stage 3	<b>Doppler abnormalities</b> <ul style="list-style-type: none"><li>• Absent/reversed umbilical artery end-diastolic velocity (UAEDV)</li><li>• Reverse flow in ductus venosus (DV)</li><li>• Pulsatile umbilical vein flow</li></ul>
Stage 4	<b>Hydrops</b>
Stage 5	<b>Intrauterine demise of one or both twins</b> <small>Quintero RA, Morales WJ, et al. Staging of twin-twin transfusion syndrome. <i>J Perinatol.</i> 1999;19(8Pt1):550-555.</small>

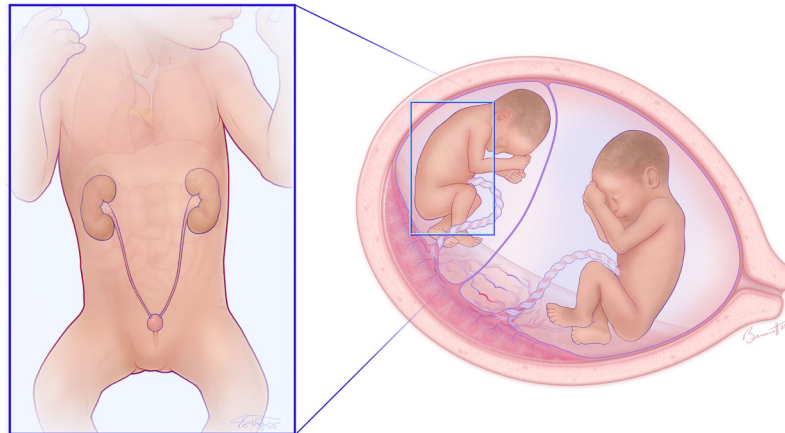
# STAGE 1



In TTTS, unequal blood flow between twins sharing a placenta results in recipient twin (right) having too much amniotic fluid (polyhydramnios), and donor twin (left) with little or no amniotic fluid (oligohydramnios).



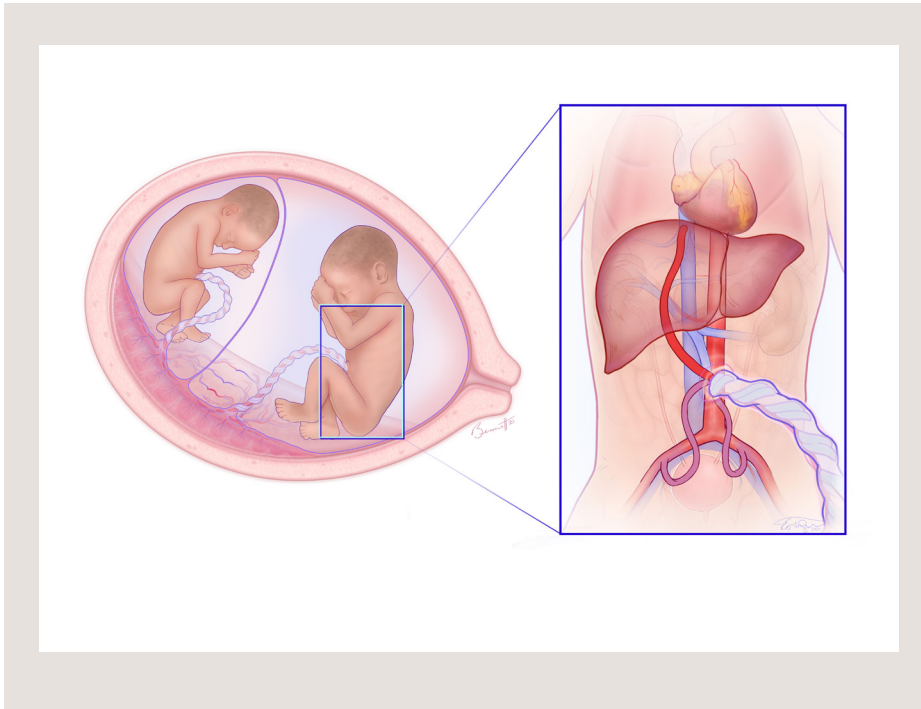
## STAGE 2



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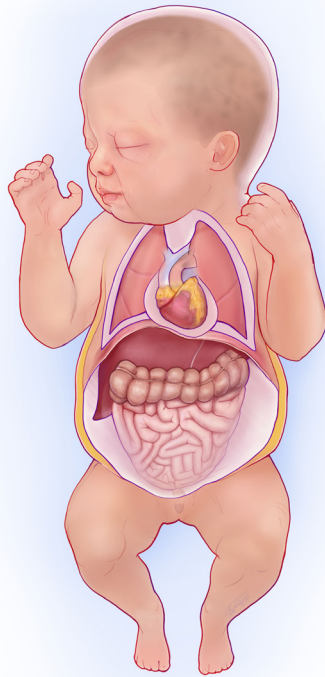
In stage 2, the donor twin's bladder (left) is not filling or emptying, because blood is being diverted from the kidneys to the brain, heart and adrenal glands. This is a survival mode mechanism to preserve the functioning of these vital organs. The kidneys and bladder are still functioning, but more slowly than normal, so you don't see the bladder filling and emptying as normal.

## STAGE 3



In stage 3, abnormal blood flow patterns include reversed flow in ductus venosus (DV), absent/reversed umbilical artery end-diastolic velocity (UAEDV) and/or pulsatile flow in the umbilical vein. Abnormal Dopplers (blood flow patterns) indicate the heart function of one or both twins is affected.

## STAGE 4



In stage 4, hydrops (massive fluid retention) develops, which puts both mother and twins at risk. Hydrops is often due to heart failure in the recipient twin. The recipient's heart is struggling to process all the extra blood being sent from the donor twin.

# CHOP CARDIOVASCULAR SCORE Scoring: Mild = 0-4, Moderate = 5-9 Moderate-severe = 10-14, Severe = 15-20

Recipient Twin		0	1	2	3
Ventricular Characteristics	Cardiac Enlargement	None	Mild	>Mild	
	Vent Hypertrophy	None	Present		
	Systolic Dysfunction	None	Mild	>Mild	
Valve Function	Tricuspid Regurgitation (TR)	None	Mild	>Mild	
	Mitral Regurgitation (MR)	None	Mild	>Mild	
Venous Doppler Characteristics	Tricuspid Valve Inflow	2 Peaks	1 Peak		
	Mitral Valve Inflow	2 Peaks	1 Peak		
	Ductus Venosus	All Forward	Decreased Atrial Contraction	Reversal	
	Umbilical Vein Pulsation	None	Present		
Great Vessel Analysis	Outflow Tracts	Pulmonary Artery (PA) > Aorta (Ao)	PA=Ao	PA=Ao	RV Outflow Obstruction
	Pulmonary Insufficiency	None	Present		
Donor Twin		0	1	2	
Umbilical Artery (UA) Doppler		Normal	Decreased Diastolic Flow	Absent or Reversed Diastolic Flow	

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# THERAPEUTIC OPTIONS FOR TTTS

## EXPECTANT MANAGEMENT

In situations where surgery is not yet indicated (Stage 1 without additional risk factors), close monitoring with periodic ultrasound exams is used to evaluate the condition of both twins and look for signs of progression.

## SERIAL AMNIOREDUCTION

Removal of excess amniotic fluid from the larger twin (recipient) may help ease any pain or discomfort experienced by the mother due to fluid buildup. This is a temporary treatment option and may need to be repeated.

## FETOSCOPIC SELECTIVE LASER ABLATION

A minimally invasive surgery performed on the placenta to disconnect the communicating blood vessels. This procedure, also called selective laser photocoagulation (SLPC), stops the sharing of blood from the donor to the recipient with the goal of halting the progression and then resolving the twin-twin transfusion syndrome.

## SELECTIVE CORD OCCLUSION

A minimally invasive surgery that stops blood flow to one twin in order to maximize the outcome for the other twin.

## PREGNANCY TERMINATION

# DIFFERENTIATING BETWEEN TTTS AND SFGR

Accurate diagnosis is extremely important in distinguishing TTTS from other twin diagnoses such as selective fetal growth restriction (SFGR).

- SFGR occurs when there is unequal placental sharing which leads to suboptimal growth of one twin. In cases of SFGR, the estimated fetal weight of the smaller, growth-restricted twin usually falls below the 10th percentile. This will usually result in more than a 25% weight difference between the twins.
- SFGR is estimated to occur in approximately 10% of monochorionic twin pregnancies.
- TTTS and SFGR both involve a shared placenta, but are differentiated by whether a fluid discrepancy exists.
- In TTTS, there is a very characteristic and progressive series of changes that happens to each twin. In SFGR, the distribution of blood is more balanced, but because the growth-restricted twin has a much smaller portion of the placenta, the resistance in the umbilical artery is higher than normal, resulting in suboptimal fetal growth.
- High-resolution fetal ultrasound examination and fetal echocardiogram are used to identify the direction, velocity and patterns of blood flow in specific blood vessels, which can help characterize TTTS and SFGR.

# ULTRASOUND FEATURES OF SFGR

AGA Twin = Appropriate for Gestational Age Twin • FGR Twin = Growth-restricted Twin

		Type 1	Type 2	Type 3
Amniotic Fluid Volume	AGA Twin	Normal	Normal	Normal – Increased
	FGR Twin	Normal – oligo	Normal – oligo	Normal – oligo
Bladders	AGA Twin	Normal, fills & empties	Normal, fills & empties	Normal, fills & empties
	FGR Twin	May be small, but is seen to fill and empty	May be small, but is seen to fill and empty	Normal or may be small, but is seen to fill and empty
UA Doppler Studies	AGA Twin	Normal	Normal	Normal
	FGR Twin	Normal or decreased EDF	May progress from AEDF → REDF	Variable waveform that includes EDF, AEDF and REDF [iAREDF]
CHOP Cardiovascular Score	AGA Twin	Normal	Normal	May be 2–3 due to right ventricular hypertrophy and dilation from intermittent volume loading
	FGR Twin	Normal	2 if there is AEDF in UA	2 for cyclic occurrence of AEDF and REDF in UA

*Oligo = oligohydramnios • EDF = end diastolic flow • AEDF = absent end diastolic flow • REDF = reversed end diastolic flow  
 UA = umbilical artery • iAREDF = intermittent absent and reversed end diastolic flow*



# THERAPEUTIC OPTIONS FOR SFGR

## Type 1 SFGR

- Continued weekly observation with local maternal-fetal medicine specialist.
- Weekly or twice weekly ultrasounds to closely monitor the growth of both twins and watch for progression to Type 2 or Type 3 SFGR, which may indicate prompt referral for fetal therapy.
- Because preterm deliveries are common in pregnancies affected by SFGR, antepartum consultation with neonatology and delivery in a tertiary referral center will be helpful.

## Type 2 and Type 3 SFGR

- Along with weekly observation by the maternal-fetal medicine specialist, fetal therapy in the form of selective cord occlusion is offered.
- Selective cord occlusion is a minimally invasive surgical procedure that seeks to improve the outcome for the twin that is appropriate for gestational age (AGA) by stopping the blood flow to the growth-restricted twin in a way that minimizes the impact on the neurodevelopment and survival of the AGA twin.
- Selective cord occlusion can be performed using bipolar cord coagulation (BCC) or radiofrequency ablation (RFA) procedures.

Management of SFGR may include continued observation with ultrasound surveillance or fetal therapy. The treatment options will depend upon the type of SFGR diagnosed.

# WHEN TO REFER A PATIENT



Answers to the following questions help us triage the urgency with which patients need to be seen.

- What is the gestational age?
- What are the deepest vertical pockets in each sac?
- Is there a bladder visible in the smaller twin?
- Are there any abnormal Doppler findings?
- Where is the placenta located?
- What is the transvaginal cervical length?
- Has the patient had an amniocentesis or amnioreduction?

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# KEY RESOURCES

## CHILDREN'S HOSPITAL OF PHILADELPHIA

Richard D. Wood Jr. Center for Fetal Diagnosis and Treatment

[fetalsurgery.chop.edu](http://fetalsurgery.chop.edu)

1-800-IN UTERO (468-8376)

## AMERICAN PREGNANCY ASSOCIATION

[americanpregnancy.org/healthy-pregnancy/multiples/twin-to-twin-transfusion-syndrome](http://americanpregnancy.org/healthy-pregnancy/multiples/twin-to-twin-transfusion-syndrome)

## MARCH OF DIMES

[marchofdimes.org](http://marchofdimes.org)

## TWIN TO TWIN TRANSFUSION SYNDROME FOUNDATION

[tttsfoundation.com](http://tttsfoundation.com)



Our team has seen an exceptionally high volume of babies with TTTS since 1995, and we are among the most experienced programs in the world in caring for complex multiple pregnancies.

**SCAN THIS CODE TO LEARN MORE ABOUT  
OUR VOLUMES AND OUTCOMES.**

1-800-IN UTERO (468-8376)  
or 215-590-5190

[fetalsurgery.chop.edu](http://fetalsurgery.chop.edu)



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