Table 1. Maternal Infections and Stillbirths

Organism	Maternal Disease	Comment
Spirochetes		
Treponema pallidum	Syphilis	Major cause of stillbirth when maternal prevalence is high
Borrelia burgdorferi	Lyme disease	Tick-borne infection and a confirmed, but not common, cause of stillbirth
Borrelia recurrentis	Relapsing fever	Tick-borne infection common in the western U.S. and a confirmed but rare cause of stillbirth
Borrelia duttonii	Relapsing Fever	Tick-borne infection common in Sub-Saharan Africa and probably an important cause of stillbirth
Leptospira interrogans	Leptospirosis	Confirmed as cause of stillbirth but not common
Protozoa		
Trypanosoma brucei	Trypanosomiasis	Carried by tsetse fly; a likely cause of stillbirth in southern Africa, but overall contribution unknown
Trypanosoma cruzi	Chagas disease	Carried by the Triatomine (kissing bug) and a confirmed cause of stillbirth in South America, but overall contribution unknown
Plasmodium falciparum	Malaria	Carried by mosquitoes and likely an important cause of stillbirth in newly endemic areas or in newly infected women
Plasmodium vivax	Malaria	Carried by mosquitoes and a possible cause of stillbirth but likely less important than with *Plasmodium falciparum*
Toxoplasmosis gondii	Toxoplasmosis	Confirmed as a rare cause of stillbirth
Coxiella burnetti	Q fever	Confirmed as cause of stillbirth but of unknown importance
Viruses		
Parvovirus (B19)	Erythema infectiosum	Confirmed as cause of stillbirth and likely is the most common viral etiologic agent
Coxsackie A and B	Various presentations	Confirmed as causes of stillbirth and may be an important contributor to overall stillbirth rate
Echovirus	Various presentations	Confirmed as cause of stillbirth but of unknown

		importance
Enterovirus	Various presentations	Confirmed as cause of stillbirth but of unknown importance
Hepatitis E virus	Fulminant hepatic failure	Probable cause of stillbirth, especially in geographic areas with epidemic outbreaks
Polio virus	Polio	Historically likely cause of stillbirth but since routine vaccination is rarely seen in developed countries
Varicella zoster	Chickenpox	Confirmed as a rare cause of stillbirth but with routine vaccination almost never seen
Rubella	German measles	Confirmed as a cause of stillbirth but rarely reported as a cause of stillbirth in developed countries
Mumps	Parotitis	Possibly a cause of stillbirth historically but rarely reported as a cause of stillbirth in developed countries
Rubeola	Measles	A probable cause of stillbirth historically but rarely reported as a cause of stillbirth in developed countries
Cytomegalovirus	Generally asymptomatic in adults	Reported as a cause of stillbirth in case reports but overall contribution is unknown
Variola	Smallpox	Historically a cause of stillbirth but with vaccination no longer seen
Ljungan virus	Diabetes, neurological disease, myocarditis and deaths	Carried by wild rodents, it is associated with several cases of stillbirth in a single report
Dengue virus	Dengue fever	Carried by mosquitoes and confirmed as a cause of stillbirth
Lymphocytic choriomeningitis virus	Lymphocytic choriomeningitis	A possible cause of stillbirth but of unknown importance
Human immunodeficiency virus	Acquired immunodeficiency syndrome	Associated with stillbirth but not likely causative
Bacteria		
E coli	Generally asymptomatic	Confirmed as a cause of stillbirth and is probably the most common organism associated with stillbirth
group B *Streptococcus*	Generally asymptomatic	Confirmed as common cause of stillbirth

Klebsiella	Generally asymptomatic	Confirmed as a common cause of stillbirth
Enterococcus	Generally asymptomatic	Confirmed as a cause of stillbirth
Ureaplasma urealyticum	Generally asymptomatic	Confirmed as a cause of stillbirth
Mycoplasma hominus	Generally asymptomatic	Confirmed as a cause of stillbirth
Bacteroidaceae	Generally asymptomatic	Confirmed as a cause of stillbirth
Listeria monocytogenes	Listerosis	Confirmed as a cause of stillbirth; generally transmitted transplacentally
Other bacterial infections (including Tularemia Brucellosis, Clostridia, Typhoid, Anthrax, Streptococcus pseudoporcinus, Agrobacterium radiobacter, Pseudomonas, etc)		Each organism has been implicated as causal for stillbirth by case reports
Chlamydia trachomatis	Pelvic infection	Suggested as cause of stillbirth by case reports
Neisseria gonorrhoeae	Pelvic infection	Suggested as cause of stillbirth by case reports
Fungi		
Candida albicans	Thrush, vaginitis	Confirmed as cause of stillbirth by case reports

Updated from Goldenberg RL, Thompson C. The infectious origins of stillbirth. Am J Obstet Gynecol 2003;189:861–73.

Table 2. Maternal Medical Disease: Current Stillbirth Rates

Condition	Estimated Stillbirth Rate *
All pregnancies	6-7/1,000
Hypertensive disorders	
Chronic hypertension	5-25/1,000
Superimposed preeclampsia	52/1,000
PIH/mild preeclampsia	9/1,000
Severe preeclampsia	21/1,000
eclampsia	18-48/1,000
HELLP syndrome	51/1,000
Diabetes mellitus	
Gestational diabetes	5-10/1,000
Type 1 diabetes	6-10/1,000
Type 2 diabetes	35/1,000
Obesity	15-20/1,000
Systemic lupus erythematosus	40-150/1,000
Chronic renal disease	
Mild renal insufficiency	15/1,000
Moderate and severe renal insufficiency	32-200/1,000
Thyroid disorders	
Stable treated hyperthyroidism	0-36/1,000
Uncontrolled thyrotoxicosis	100-156/1,000
Subclinical hypothyroidism	0-15/1,000
Overt hypothyroidism	15-125/1,000
Cholestasis of pregnancy	12-30/1,000

Reprinted from Simpson LL. Maternal Medical Disease: Risk of Antepartum Fetal Death. Semin Perinatol 2002;26:47; with permission from Elsevier.

Abbreviations: PIH, pregnancy induced hypertension; HELLP, hemolysis, elevated liver enzymes, low platelets.

* Number of stillbirths at more than 20 weeks of gestation per 1,000 births in patients with the condition.

Reddy UM, Goldenberg R, Silver R, Smith GCS, Pauli RM, Wapner RJ. Stillbirth classification: developing an international consensus for research. Obstet Gyncol 2009;114.

Table 3: The Ten Most Frequent Fetal Malformations Judged to Be Causal

Cause of Death	Number	Stillbirth Cases, %
Trisomy 21 (Down syndrome)	34	1.53
Jugulolymphatic obstruction (Sequence, NOS)	32	1.45
Turner syndrome	24	1.09
Twin-twin transfusion	24	1.09
Anencephaly	22	1.0
Trisomy 18	18	0.81
Amnion disruption sequence	13	0.59
Lower mesodermal defects	11	0.50
Idiopathic nonimmune fetal hydrops	11	0.50
Trisomy 13	9	0.41

NOS, not otherwise specified.

Numbers are from Wisconsin Stillbirth Service Program data for 1983-2007. Total cases assessed were 2,211, among which 544 were identified as having fetal causes.

Table courtesy of Dr. Richard M. Pauli.

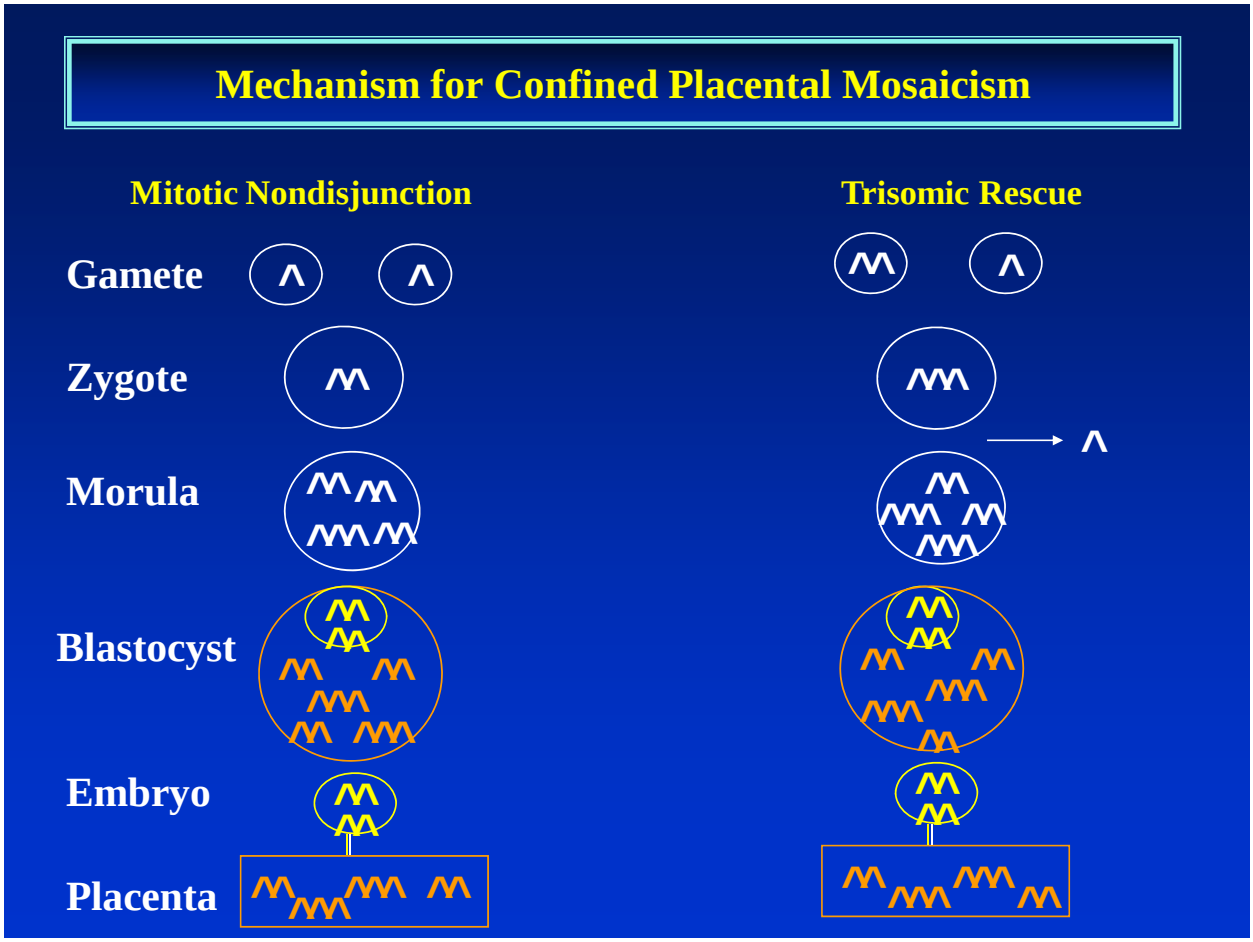
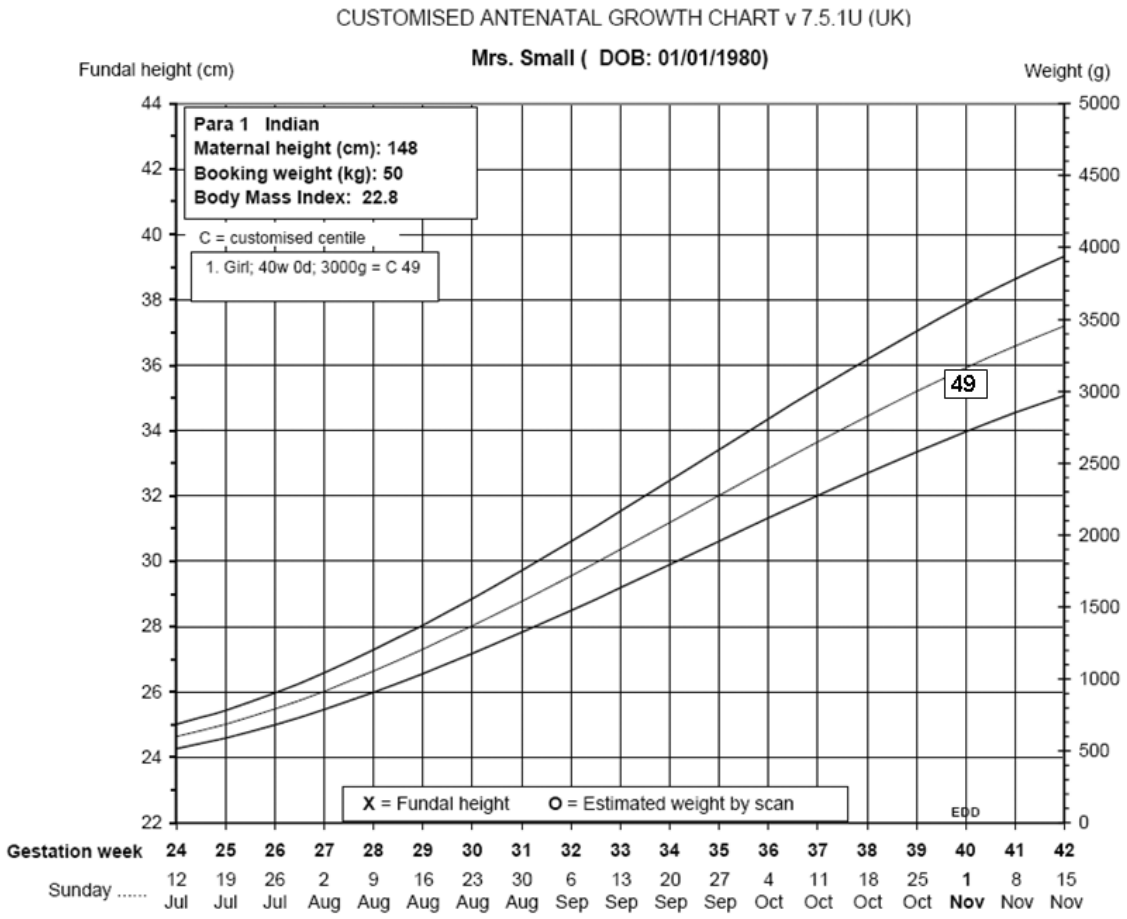


Figure 3: Mechanism for confined placental mosaicism. This figure demonstrates two mechanisms capable of causing confined placental mosaicism. Mitiotic nondisjuction early in embryo development may lead to a mosaic morula containing a normal and an aneuploid cell line. Alternatively, a meiotic error can lead to a trisomic embryo, many of which will result in a spontaneous miscarriage. However, a second error (anaphase lag) may occur, converting a trisomic cell to disomy. In both mechanisms the morula is mosaic. Subsequently, cells are then randomly distributed to various compartments. Aneuploid cells distributed to the inner cell mass will result in true fetal mosaicsim. If the aneuploid cells are distributed exclusively to the extra fetal lineage confined placental mosaicism will occur. Figure courtesy of Dr. Ronald Wapner.

Reddy UM, Goldenberg R, Silver R, Smith GCS, Pauli RM, Wapner RJ. Stillbirth classification: developing an international consensus for research. Obstet Gyncol 2009;114.



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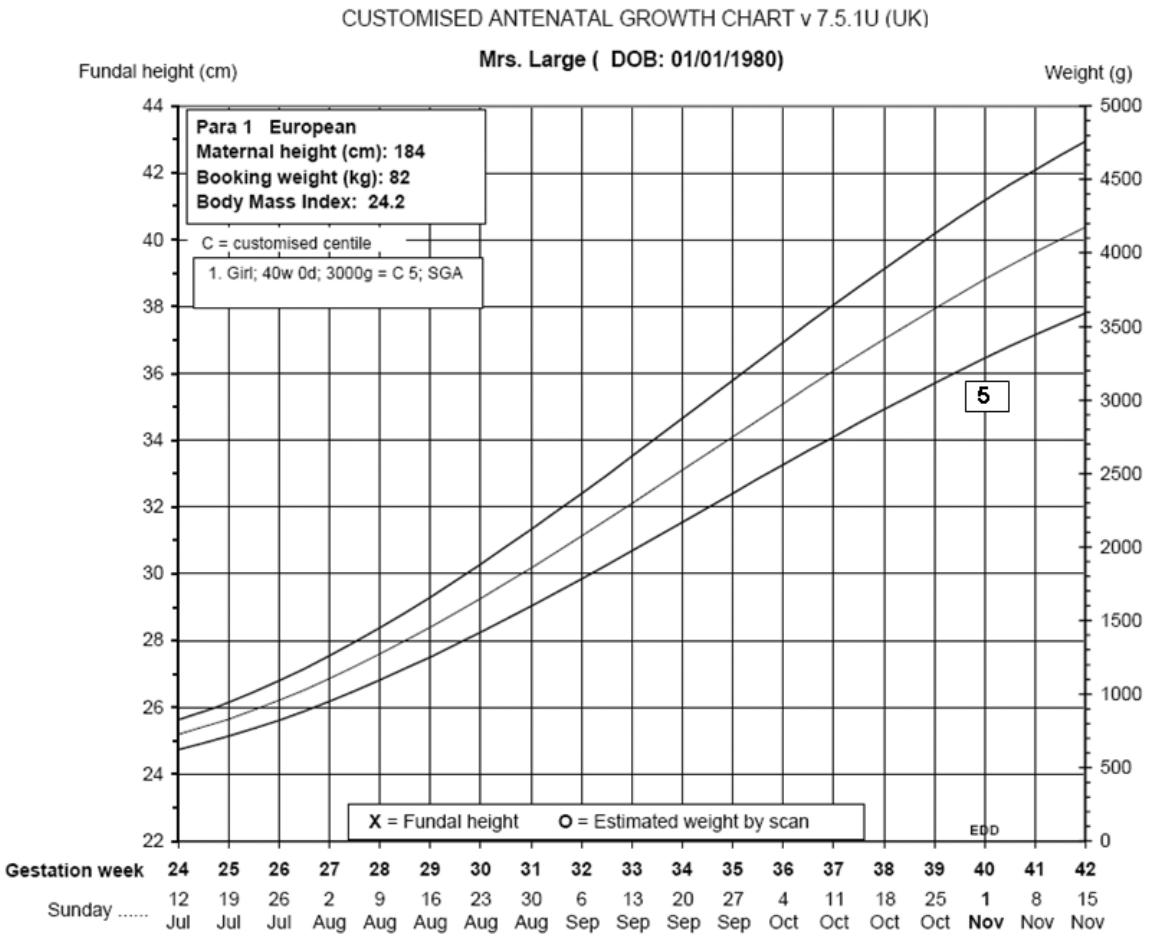

B

Figure 4: Examples of customized charts using GROW (Gestation Related Optimal Weight software v. 7.5.1, www.gestation.net). The charts can be used to plot previous baby weights and ultrasound estimated fetal weights in the current pregnancy (right Y axis) as well as fundal height measurements for serial assessment (left Y axis). The horizontal axis shows the day and month of the start of each week of gestation, calculated by the software on the basis of the estimated date of confinement. The 3 curves on the chart are the 50th centile and the 10th and 90th centile limits, representing the predicted range of optimal growth for each pregnancy, after adjustment for maternal height, weight, parity and ethnic origin. The pregnancy details are shown on the top left of the chart, with maternal height in cm, and maternal weight in kg. The example shows two mothers - 'Mrs. Small' and 'Mrs. Large', with two different sets of characteristics. A previously born baby girl weighing 3,000g at 40.0 weeks is illustrated as being of average size (49th birthweight centile) for Mrs. Small (A) , but small for gestational age (SGA, 5th centile) for Mrs. Large (Figure B). Figures courtesy of Dr. Jason Gardosi

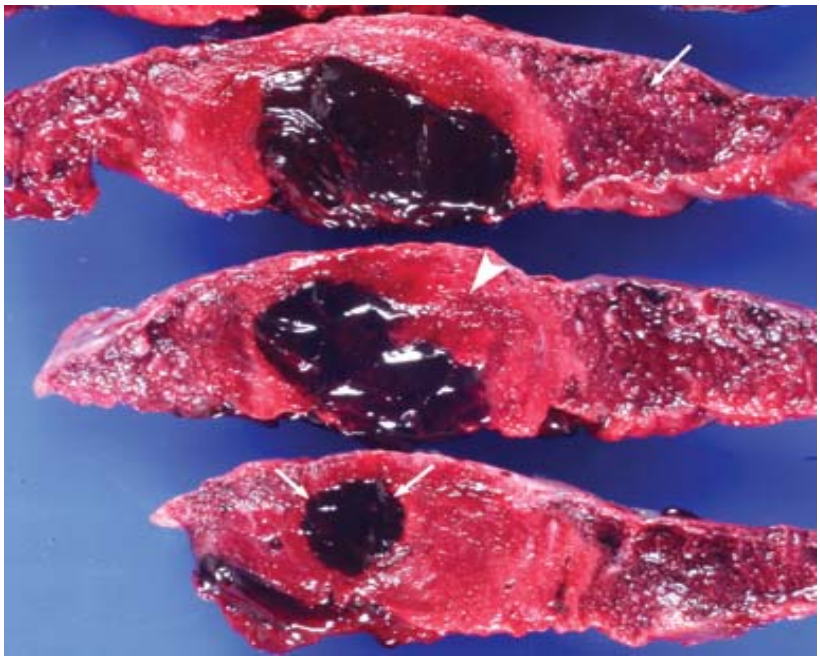

Figure 6: Abruptio placenta with parenchymal clot and surrounding infarcted parenchyma. Single arrow: Normal parenchyma. Arrowhead: Infarcted parenchyma surrounding the clot. Double arrow: Blood clot. Figure courtesy of Dr. Halit Pinar, Brown University.

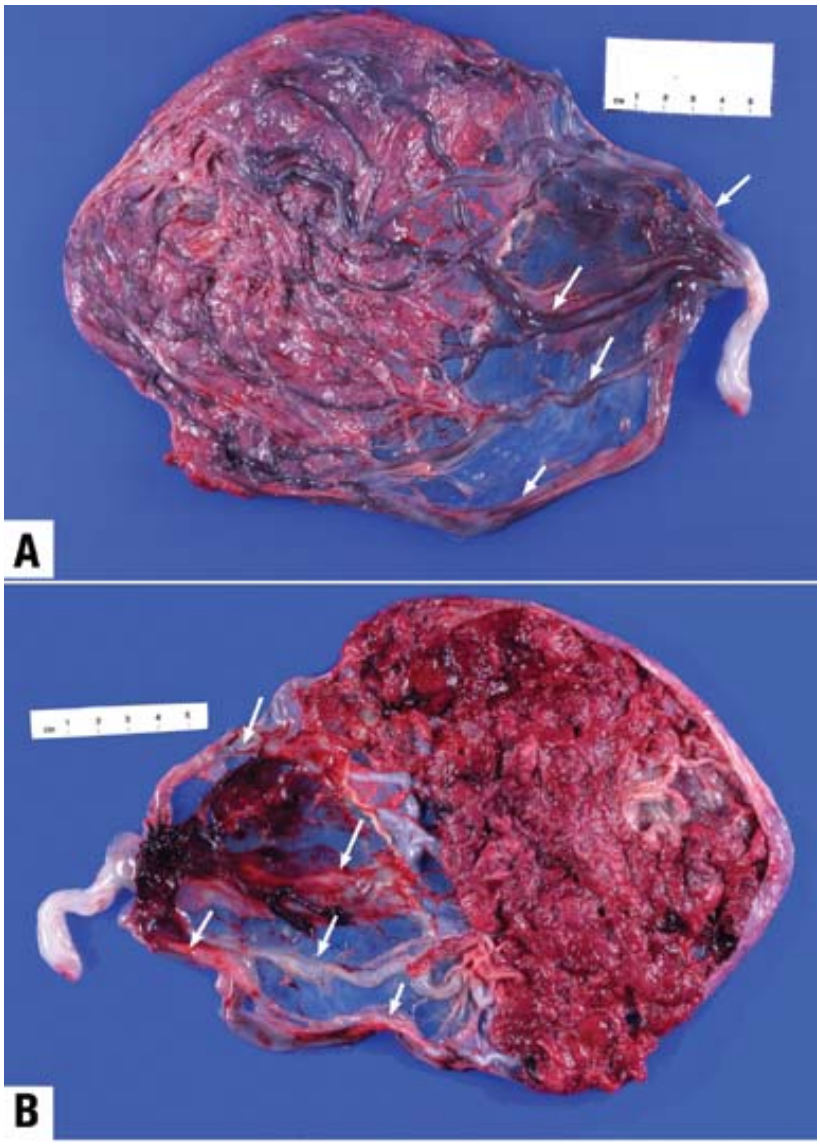

Figure 7: Velamentous insertion of the umbilical cord. A) Fetal surface. B) Maternal surface. Arrows show the fetal blood vessels travelling unprotected in the membranes before entering the placental disc. Figure courtesy of Dr. Halit Pinar, Brown University.

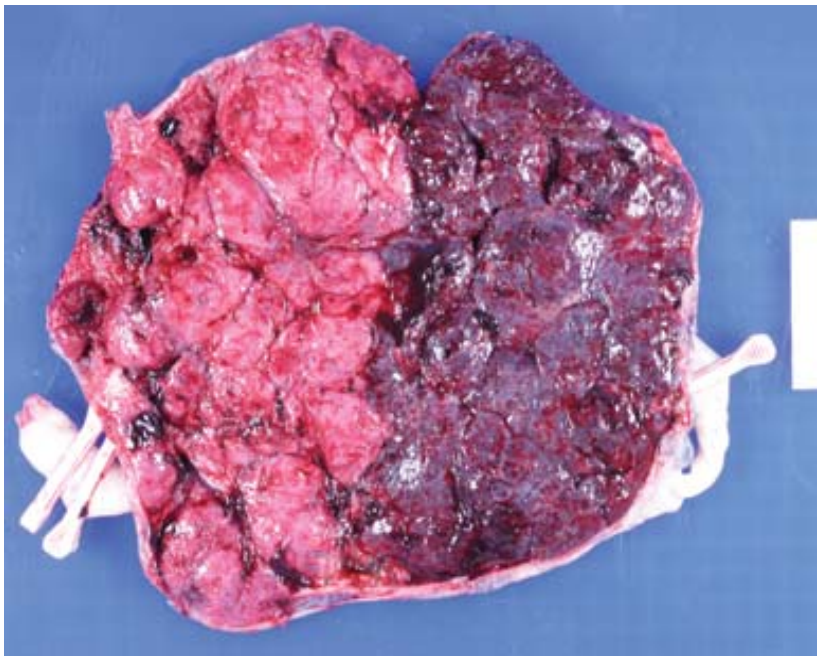

Figure 8: Placenta from a twin-twin transfusion syndrome. Figure courtesy of Dr. Halit Pinar, Brown University.

Reddy UM, Goldenberg R, Silver R, Smith GCS, Pauli RM, Wapner RJ. Stillbirth classification: developing an international consensus for research. Obstet Gyncol 2009;114.

