


I'm not robot  reCAPTCHA

**I'm not robot!**

## Hipoxia fetal intrauterina pdf

### Hipoxia intrauterina.

In current perinatology, the prevention of hypoxic damage to the organs, brain in particular, is given special emphasis. The causes of fetal hypoxia include maternal (preuterine), intrauterine, umbilical, placental and fetal causes. Hypoxia and hypoxic lesions occur prenatally in about 80%, and perinatally in 10-20% of cases. Hypoxia/ischemia induce cellular and subcellular responses in the fetal brain. Some of these are membranous phenomena such as potassium channel activation, enhanced release of excitotoxic amino acids aspartate and glutamate, activation of NMDA receptors, transmembranous calcium ion influx, and membranous lipid peroxidation. Cytosolic events include the formation of free oxygen radicals, release of eicosanoids, prostaglandins, leukotriens and cytokines, enzyme activation, and gene induction. 1. Ananth CV, Vintzileos AM. Epidemiology of preterm birth and its clinical subtypes. Journal of Maternal-Fetal and Neonatal Medicine. 2006;19(12):773-782. [PubMed] [Google Scholar]2. Irving JA, Lysiak JJ, Graham CH, Hearn S, Han VKM, Lala PK.

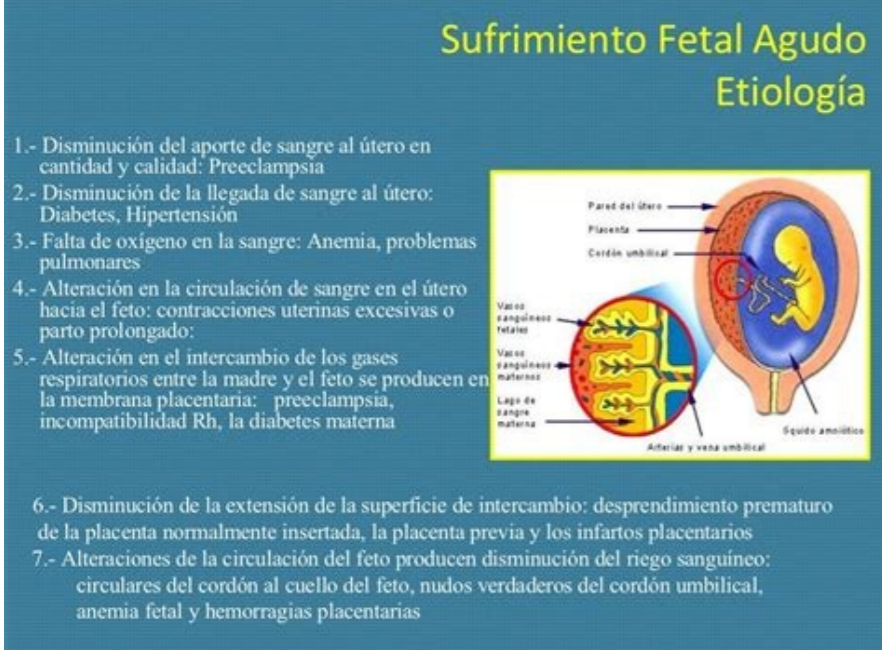


Characteristics of trophoblast cells migrating from first trimester chorionic villus explants and propagated in culture. Placenta. 1995;16(5):413-433.

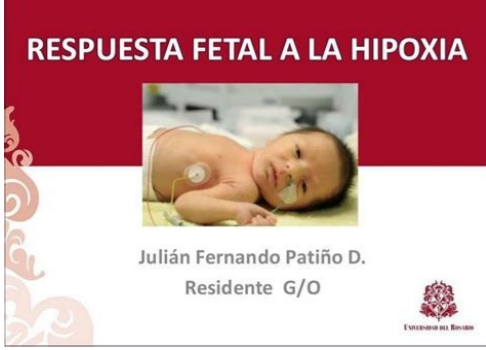
Maternal arterial connections to the periconceptual intervillous space during the first trimester of human pregnancy: the Boyd collection revisited. American Journal of Obstetrics and Gynecology. 1999;181(3):718-724. [PubMed] [Google Scholar]4. Jauniaux E, Greenwood N, Hempstock J, Burton GJ. Comparison of ultrasonographic and Doppler mapping of the intervillous circulation in normal and abnormal early pregnancies. Fertility and Sterility. 2003;79(1):100-106. [PubMed] [Google Scholar]5. Jauniaux E, Jurkovic D, Campbell S, Hustin J. Doppler ultrasonographic features of the developing placental circulation: correlation with anatomic findings. American Journal of Obstetrics and Gynecology. 1992;166(2):585-587. [PubMed] [Google Scholar]6. Rodesch F, Simon P, Donner C, Jauniaux E. Oxygen measurements in endometrial and trophoblastic tissues during early pregnancy. Obstetrics and Gynecology. 1992;80(2):283-285. [PubMed] [Google Scholar]7. Jauniaux E, Watson AL, Hempstock J, Bao Y-P, Skepper JN, Burton GJ. Onset of maternal arterial blood flow and placental oxidative stress: a possible factor in human early pregnancy failure. American Journal of Pathology. 2000;157(6):2111-2122. [PMC free article] [PubMed] [Google Scholar]8. Watson AL, Skepper JN, Jauniaux E, Burton GJ. Susceptibility of human placental syncytiotrophoblastic mitochondria to oxygen-mediated damage in relation to gestational age. Journal of Clinical Endocrinology and Metabolism. 1998;83(5):1697-1705. [PubMed] [Google Scholar]9. Palmer SK, Zamudio S, Coffin C, Parker S, Stamm E, Moore LG. Quantitative estimation of human uterine artery blood flow and pelvic blood flow redistribution in pregnancy.



Obstetrics and Gynecology. 1992;80(6):1000-1006. [PubMed] [Google Scholar]10. Cadnapaphornchai MA, Ohara M, Morris KG, Jr., et al. Chronic NOS inhibition reverses systemic vasodilation and glomerular hyperfiltration in pregnancy. American Journal of Physiology. 2001;280(4):F592-F598. [PubMed] [Google Scholar]11. Chapman AB, Abraham WT, Zamudio S, et al. Temporal relationships between hormonal and hemodynamic changes in early human pregnancy. Kidney International. 1998;54(6):2056-2063. [PubMed] [Google Scholar]12. Furuhashi N, Kimura H, Nagae H, Yajima A. Maternal plasma endothelin levels and fetal status in normal and preconcept pregnancies.

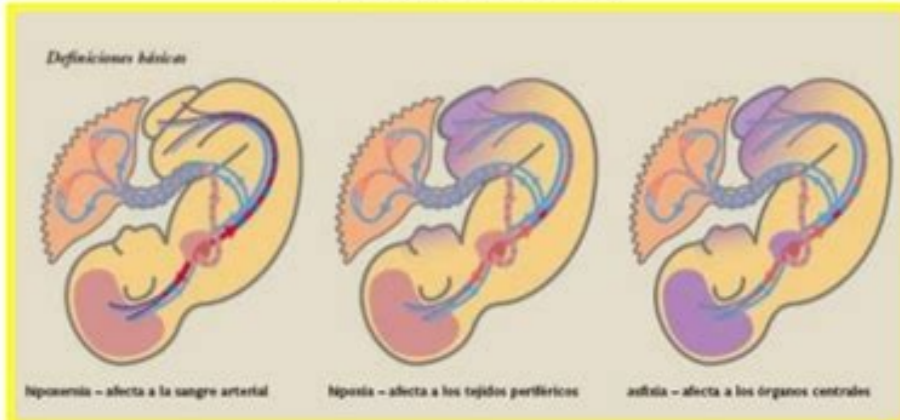


Gynecologic and Obstetric Investigation. 1995;39(2):88-92. [PubMed] [Google Scholar]13. Magness RR. Maternal cardiovascular and other physiologic responses to the endocrinology of pregnancy. In: Bazer FW, editor. The Endocrinology of Pregnancy. Totowa, NJ, USA: Humana Press; 1998. pp. 507-539. [Google Scholar]14. Abbas AE, Lester SJ, Connolly H. Pregnancy and the cardiovascular system. International Journal of Cardiology. 2005;98(2):179-189. [PubMed] [Google Scholar]15. Miller RD. Anesthesia. 5th edition. Philadelphia, Pa, USA: Churchill Livingstone; 2000. [Google Scholar]16. Siu SC, Colman JM. Congenital heart disease: heart disease and pregnancy. Heart. 2001;85(6):710-715. [PMC free article] [PubMed] [Google Scholar]17. Hu X-Q, Yang S, Pearce WJ, Longo LD, Zhang L. Effect of chronic hypoxia on alpha-1 adrenoceptor-mediated inositol 1,4,5-trisphosphate signaling in ovine uterine artery. Journal of Pharmacology and Experimental Therapeutics. 1999;288(3):977-983. [PubMed] [Google Scholar]18. MATEEV S, SILLAU AH, MOUSER R, et al. Chronic hypoxia opposes pregnancy-induced increase in uterine artery vasodilator response to flow. American Journal of Physiology. 2003;284(3):H820-H829. [PubMed] [Google Scholar]19. Xiao D, Huang X, Bae S, Duesay CA, Zhang L. Cortisol-mediated potentiation of uterine artery contractility: effect of pregnancy. American Journal of Physiology. 2002;283(1):H238-H246. [PubMed] [Google Scholar]20. Keyes LE, Moore LG, Walchak SJ, Dempsey EC. Pregnancy-stimulated growth of vascular smooth muscle cells: importance of protein kinase C-dependent synergy between estrogen and platelet-derived growth factor. Journal of Cellular Physiology. 1996;166(1):22-32. [PubMed] [Google Scholar]21. Mulvany EJ, Baumbach GL, Aalkjaer C, et al. Vascular remodeling. Hypertension. 1996;28(3):505-506. [PubMed] [Google Scholar]22. Ni Y, May V, Braas K, Osol G. Pregnancy augments uteroplacental vascular endothelial growth factor gene expression and vasodilator effects. American Journal of Physiology. 1997;273(2):H938-H944. [PubMed] [Google Scholar]23. Manner J, Pérez-Pomares JM, Macías D, Muñoz-Chápuli R. The origin, formation and developmental significance of the epicardium: a review. Cells Tissues Organs. 2001;169(2):89-103. [PubMed] [Google Scholar]24. Manner J. Does the subepicardial mesenchyme contribute myocardioblasts to the myocardium of the chick embryo heart?



A quail-chick chimera study tracing the fate of the epicardial primordium. Anatomical Record. 1999;255(2):212-226. [PubMed] [Google Scholar]25. Manner J. Cardiac looping in the chick embryo: a morphological review with special reference to terminological and biomechanical aspects of the looping process. Anatomical Record. 2000;259(3):248-262. [PubMed] [Google Scholar]26.

## Definiciones



- **HIPOXEMIA:** disminución de la concentración de oxígeno en el transporte por Hb.
- **HIPOXIA:** disminución de concentración de oxígeno tisular
- **ASFIXIA:** "Es un síndrome caracterizado por la suspensión o grave disminución del intercambio gaseoso a nivel de la placenta , que resulta en hipoxemia, hipercapnia e hipoxia tisular con acidosis metabólica".

Christoffels VM, Habets PEMH, Franco D, et al. Chamber formation and morphogenesis in the developing mammalian heart. Developmental Biology. 2000;223(2):266-278. [PubMed] [Google Scholar]27. Webb S, Kanani M, Anderson RH, Richardson MK, Brown NA. Development of the human pulmonary vein and its incorporation in the morphologically left atrium. Cardiology in the Young. 2001;11(6):632-642. [PubMed] [Google Scholar]28. Wessels A, Anderson RH, Markwald RR, et al. Atrial development in the human heart: an immunohistochemical study with emphasis on the role of mesenchymal tissues. Anatomical Record. 2000;259(3):288-300.

[PubMed] [Google Scholar]29. Kingdom JCP, Kaufmann P. Oxygen and placental villous development: origins of fetal hypoxia. Placenta. 1997;18(8):613-621. [PubMed] [Google Scholar]30. Jensen GM, Moore LG. The effect of high altitude and other risk factors on birthweight: independent or interactive effects? American Journal of Public Health. 1997;87(6):1003-1007. [PMC free article] [PubMed] [Google Scholar]31. Giussani DA, Phillips PS, Anstee S, Barker DJP. Effects of altitude versus economic status on birth weight and body shape at birth. Pediatric Research. 2001;49(4):490-494. [PubMed] [Google Scholar]32. Mortola JP, Frappell PB, Agüero L, Armstrong K. Birth weight and altitude: a study in Peruvian communities. Journal of Pediatrics. 2000;136(3):324-329. [PubMed] [Google Scholar]33. Krampal E, Lees C, Bland JM, Dorado JE, Moscoso G, Campbell S. Fetal biometry at 4300 m compared to sea level in Peru. Ultrasound in Obstetrics and Gynecology. 2000;16(1):9-18. [PubMed] [Google Scholar]34. Keyes LE, Armaza JF, Niemeyer S, Vargas E, Young DA, Moore LG. Intrauterine growth restriction, pre-eclampsia, and intrauterine mortality at high altitude in Bolivia. Pediatric Research. 2003;54(1):20-25. [PubMed] [Google Scholar]35. Sibai B, Dekker G, Kupferminc M. Pre-eclampsia. The Lancet. 2005;365(9461):785-799. [PubMed] [Google Scholar]36. Palmer SK, Moore LG, Young DA, Cregger B, Berman JC, Zamudio S. Altered blood pressure course during normal pregnancy and increased pre-eclampsia at high altitude (3100 meters) in Colorado. American Journal of Obstetrics and Gynecology. 1999;180(5):1161-1168. [PubMed] [Google Scholar]37. Moore LG, Hershey DW, Jahnhgen D, Bowes W., Jr. The incidence of pregnancy-induced hypertension is increased among Colorado residents at high altitude. American Journal of Obstetrics and Gynecology. 1982;144(4):423-429. [PubMed] [Google Scholar]38. Hu X-Q, Longo LD, Gilbert RD, Zhang L. Effects of long-term high-altitude hypoxemia on  $\alpha$ 1-adrenergic receptors in the ovine uterine artery. American Journal of Physiology. 1996;270(3):H1001-H1007. [PubMed] [Google Scholar]39. MATEEV SN, MOUSER R, YOUNG DA, MECHAN RP, MOORE LG. Chronic hypoxia augments uterine artery distensibility and alters the circumferential wall stress-strain relationship during pregnancy. Journal of Applied Physiology. 2006;100(6):1842-1850. [PubMed] [Google Scholar]40. Zhang L, Xiao D, Hu X. Effect of cAMP on pharmacomechanical coupling in the uterine artery of near-term pregnant sheep. Journal of Pharmacology and Experimental Therapeutics. 2008;327(2):425-431. [PMC free article] [PubMed] [Google Scholar]41. James JL, Stone PR, Chamley LW. The regulation of trophoblast differentiation by oxygen in the first trimester of pregnancy. Human Reproduction Update. 2006;12(2):137-144. [PubMed] [Google Scholar]42. Kitanaka T, Gilbert RD, Longo LD. Maternal responses to long-term hypoxemia in sheep. American Journal of Physiology. 1989;256(6, part 2):R1340-R1347. [PubMed] [Google Scholar]43. Kametas NA, McAuliffe F, Krampal E, Chambers J, Nicolaidis KH. Maternal cardiac function during pregnancy at high altitude. BJOG. 2004;111(10):1051-1058. [PubMed] [Google Scholar]44. Zamudio S, Palmer SK, Droma T, Stamm E, Coffin C, Moore LG. Effect of altitude on uterine artery blood flow during normal pregnancy. Journal of Applied Physiology. 1995;79(1):7-14. [PubMed] [Google Scholar]45. Moore LG, Young D, McCullough RE, Droma T, Zamudio S. Tibetan protection from intrauterine growth restriction (IUGR) and reproductive loss at high altitude. American Journal of Human Biology. 2001;13(5):635-644. [PubMed] [Google Scholar]46.

Julian CG, Wilson MJ, Lopez M, et al. Augmented uterine artery blood flow and oxygen delivery protect Andeans from altitude-associated reductions in fetal growth. American Journal of Physiology. 2009;296(5):R1564-R1575. [PMC free article] [PubMed] [Google Scholar]47. Siu SC, Colman JM, Sorensen S, et al. Adverse neonatal and cardiac outcomes are more common in pregnant women with cardiac disease. Circulation. 2002;105(18):2179-2184. [PubMed] [Google Scholar]48. Shankar R, Patel S, Sermer M, Colman JM, et al. Prospective multicenter study of pregnancy outcomes in women with heart disease. Circulation. 2001;104(5):515-521. [PubMed] [Google Scholar]49. Hameed A, Karaalp IS, Tummala PP, et al. The effect of valvular heart disease on maternal and fetal outcome of pregnancy. Journal of the American College of Cardiology. 2001;37(3):893-899. [PubMed] [Google Scholar]50. Presbitero P, Somerville J, Stone S, Aruta E, Spiegelhalter D, Rabajoli F. Pregnancy in cyanotic congenital heart disease: outcome of mother and fetus. Circulation. 1994;89(6):2673-2676. [PubMed] [Google Scholar]51. Sellman JS, Holman RL. Thromboembolism during pregnancy: risks, challenges, and recommendations. Postgraduate Medicine. 2000;108(4):71-84. [PubMed] [Google Scholar]52. ACOG technical bulletin. Pulmonary disease in pregnancy.

Number 224—June 1996. American College of Obstetricians and Gynecologists. International Journal of Gynaecology and Obstetrics. 1996;54(2):187-196. [PubMed] [Google Scholar]53. Kumar R. Prenatal factors and the development of asthma. Current Opinion in Pediatrics. 2008;20(6):682-687. [PubMed] [Google Scholar]54. Guy ES, Kirumaki A, Hanaan NA. Acute asthma in pregnancy. Critical Care Clinics. 2004;20(4):731-745. [PubMed] [Google Scholar]55. Inge LD, Wilson JW. Update on the treatment of tuberculosis. American Family Physician. 2008;78(4):457-470. [PubMed] [Google Scholar]56. Rowe SM, Miller S, Sorscher EJ. Cystic fibrosis. The New England Journal of Medicine. 2005;352(19):1992-2001. [PubMed] [Google Scholar]57.

Cheng EY, Goss CH, McKone EF, et al. Aggressive prenatal care results in successful fetal outcomes in CF women. Journal of Cystic Fibrosis. 2006;5(2):85-91. [PubMed] [Google Scholar]58. Ødegaard I, Stray-Pedersen B, Hallberg K, Haanaes OC, Storrvøsten OT, Johannesson M. Maternal and fetal morbidity in pregnancies of Norwegian and Swedish women with cystic fibrosis. Acta Obstetrica et Gynecologica Scandinavica. 2002;81(8):699-705. [PubMed] [Google Scholar]59. Rosenberg A. The IUGR newborn. Seminars in Perinatology. 2008;32(3):219-224. [PubMed] [Google Scholar]60. Goss CH, Rubenfeld GD, Otto K, Aitken ML. The effect of pregnancy on survival in women with cystic fibrosis. Chest. 2003;124(4):1460-1468. [PubMed] [Google Scholar]61. Hardin DS, Rice J, Cohen RC, Ellis KJ, Nick JA. The metabolic effects of pregnancy in cystic fibrosis. Obstetrics and Gynecology. 2005;106(2):367-375. [PubMed] [Google Scholar]62. McColgin SW, Glee L, Brian BA. Pulmonary disorders complicating pregnancy. Obstetrics and Gynecology Clinics of North America. 1992;19(4):697-717. [PubMed] [Google Scholar]63. Shapiro JM. Critical care of the obstetric patient. Journal of Intensive Care Medicine. 2006;21(5):278-286. [PubMed] [Google Scholar]64. Mahajan S, Aalinkel R, Shah P, Singh S, Kochupillai N. Nutritional anaemia dysregulates endocrine control of fetal growth. British Journal of Nutrition. 2008;100(2):408-417. [PubMed] [Google Scholar]65. Singla PN, Tyagi M, Kumar A, Dash D, Shankar R. Fetal growth in maternal anaemia. Journal of Tropical Pediatrics. 1997;43(2):89-92. [PubMed] [Google Scholar]66. Baker PN, Wheeler SJ, Sanders TA, et al. A prospective study of micronutrient status in adolescent pregnancy. American Journal of Clinical Nutrition. 2009;89(4):1114-1124. [PubMed] [Google Scholar]67. Allen LH. Pregnancy and iron deficiency: unresolved issues. Nutrition Reviews. 1997;55(4):91-101. [PubMed] [Google Scholar]68. Barker DJP, Bull AR, Osmond C, Simmonds SJ. Fetal and placental size and risk of hypertension in adult life. British Medical Journal. 1990;301(6746):259-262. [PMC free article] [PubMed] [Google Scholar]69. Lao TT, Wong WM. 1997;314(7098):1864-1868. [PMC free article] [PubMed] [Google Scholar]71. Davies SC, Cronin E, Gill M, Greengross P, Hickman M, Normand C. Screening for sickle cell disease and thalassaemia: a systematic review with supplementary research. Health Technology Assessment. 2000;4(3):1-87. [PubMed] [Google Scholar]72. Motulsky AG. Frequency of sickling disorders in U.S. blacks. The New England Journal of Medicine. 1973;288(1):31-33. [PubMed] [Google Scholar]73. ACOG practice bulletin no. 78: hemoglobinopathies in pregnancy. Obstetrics and Gynecology. 2007;109(1):229-238. [PubMed] [Google Scholar]74. Sun PM, Wilburn W, Raynor BD, Jamieson D. Sickle cell disease in pregnancy: twenty years of experience at Grady Memorial Hospital, Atlanta, Georgia. American Journal of Obstetrics and Gynecology. 2001;184(6):1127-1130. [PubMed] [Google Scholar]75. Koshy M, Burd L, Wallace D, Moawad A, Baron J. Prophylactic red-cell transfusions in pregnant patients with sickle cell disease. A randomized cooperative study. The New England Journal of Medicine. 1988;319(22):1447-1452. [PubMed] [Google Scholar]76. Kazazzian HL, Jr. The thalassaemia syndromes: molecular basis and prenatal diagnosis in 1990. Seminars in Hematology. 1990;27(3):209-228. [PubMed] [Google Scholar]77. Aessopos A, Karabatsos F, Farmakis D, et al. Pregnancy in patients with well-treated  $\beta$ -thalassaemia: outcome for mothers and newborn infants. American Journal of Obstetrics and Gynecology. 1999;180(2, part 1):360-365. [PubMed] [Google Scholar]78. Jensen CE, Tuck SM, Wonke B. Fertility in  $\beta$ -thalassaemia major: a report of 16 pregnancies, preconceptional evaluation and a review of the literature. British Journal of Obstetrics and Gynaecology. 1995;102(8):625-629. [PubMed] [Google Scholar]79.

Ong HC, White JC, Sinnathuray TA, Haemoglobin D and pregnancy in a Malaysian woman. *Acta Obstet Gynecol Scand*. 1977;58(4):229-233. [PubMed] [Google Scholar]80. Ramsay JE, Stewart F, Greer IA, Sattar N, Microvascular and maternal coronary heart disease. *BJOG*. 2003;110(11):1029-1031. [PubMed] [Google Scholar]81. Wilson BJ, Watson MS, Prescott G, et al. Hypertensive diseases of pregnancy and risk of hypertension and stroke in later life: results from cohort study. *British Medical Journal*. 2003;326(7394):845-849. [PMC free article] [PubMed] [Google Scholar]82. Haukkamaa L, Salminen M, Laiuori H, Leinonen H, Hillesmaa V, Kaja R. Risk for subsequent coronary artery disease after preeclampsia. *American Journal of Cardiology*. 2004;93(6):805-808. [PubMed] [Google Scholar]83. Barker DJP. Growth in utero and coronary heart disease. *Nutrition Reviews*. 1996;54(2):S1-S7. [PubMed] [Google Scholar]84. Barker DJP, Osmond C, Golding J, Kuh D, Wadsworth MEJ. Growth in utero, blood pressure in childhood and adult life, and mortality from cardiovascular disease. *British Medical Journal*. 1989;298(6673):564-567. [PMC free article] [PubMed] [Google Scholar]85. Barker DJP, Shiell AW, Barker ME, Law CM. Growth in utero and blood pressure levels in the next generation. *Journal of Hypertension*. 2000;18(7):843-846. [PubMed] [Google Scholar]86. Herrera EA, Pulgar VM, Riquelme RA, et al. High-altitude chronic hypoxia during gestation and after birth modifies cardiovascular responses in newborn sheep. *American Journal of Physiology*. 2007;292(6):R2234-R2240. [PubMed] [Google Scholar]87. Martyn CN, Barker DJP, Jesspersen S, Greenwald S, Osmond C, Berry C. Growth in utero, adult blood pressure, and arterial compliance. *British Heart Journal*. 1995;73(2):116-121. [PMC free article] [PubMed] [Google Scholar]88. Sartori C, Allemann Y, Trueb L, Delabays A, Nicod P, Scherrer U. Augmented vasoreactivity in adult life associated with perinatal vascular insult. *The Lancet*. 1999;353(9171):2205-2207. [PubMed] [Google Scholar]89. Ness RB, Sibai BM. Shared and disparate components of the pathophysiologies of fetal growth restriction and preeclampsia. *American Journal of Obstetrics and Gynecology*. 2006;195(1):40-49. [PubMed] [Google Scholar]90. Ray JC, Vermeulen MJ, Schull MJ, Redelmeier DA. Cardiovascular health after maternal placental syndromes (CHAMPS): population-based retrospective cohort study. *The Lancet*. 2005;366(9499):1797-1803. [PubMed] [Google Scholar]91. Lausman AY, Kingdom JC, Bradley TJ, Slorach C, Ray JC. Subclinical atherosclerosis in association with elevated placental vascular resistance in early pregnancy. *Atherosclerosis*. 2009;206(1):33-35. [PubMed] [Google Scholar]92. Roccella EJ. Report of the National High Blood Pressure Education Program Working Group on High Blood Pressure in Pregnancy. *American Journal of Obstetrics and Gynecology*. 2000;183(1):S1-S22. [PubMed] [Google Scholar]93. Sibai BM. Diagnosis and management of gestational hypertension and preeclampsia. *Obstetrics and Gynecology*. 2003;102(1):181-192. [PubMed] [Google Scholar]94. Douglas KA, Redman CWG. Eclampsia in the United Kingdom. *British Medical Journal*. 1994;309(6966):1395-1400. [PMC free article] [PubMed] [Google Scholar]95. Sibai BM. Diagnosis, controversies, and management of the syndrome of hemolysis, elevated liver enzymes, and low platelet count. *Obstetrics and Gynecology*. 2004;103(5, part 1):981-991. [PubMed] [Google Scholar]96. Redman CWG. Platelets and the beginnings of preeclampsia. *The New England Journal of Medicine*. 1990;323(7):478-480. [PubMed] [Google Scholar]97. Hauth JC, Ewell MG, Levine RJ, et al. Pregnancy outcomes in healthy nulliparas who developed hypertension. *Obstetrics and Gynecology*. 2000;95(1):24-28. [PubMed] [Google Scholar]98. Hnat MD, Sibai BM, Caritis S, et al. Perinatal outcome in women with recurrent preeclampsia compared with women who develop preeclampsia as nulliparas. *American Journal of Obstetrics and Gynecology*. 2002;186(3):422-426. [PubMed] [Google Scholar]99. Buchbinder A, Sibai BM, Caritis S, et al. Adverse perinatal outcomes are significantly higher in severe gestational hypertension than in mild preeclampsia. *American Journal of Obstetrics and Gynecology*. 2002;186(1):66-71. [PubMed] [Google Scholar]100. Zhang J, Meikle S, Trumble A. Severe maternal morbidity associated with hypertensive disorders in pregnancy in the United States. *Hypertension in Pregnancy*. 2003;22(2):203-212. [PubMed] [Google Scholar]101. Jayet P-Y, Rimoldi SF, Stuber T, et al. Pulmonary and systemic vascular dysfunction in young offspring of mothers with preeclampsia. *Circulation*. 2010;122(5):488-494. [PubMed] [Google Scholar]102. Pollack RN, Divon MY. Intrauterine growth retardation: definition, classification, and etiology. *Clinical Obstetrics and Gynecology*. 1992;35(1):99-107. [PubMed] [Google Scholar]103. Meyer K, Zhang L. Fetal programming of cardiac function and disease. *Reproductive Sciences*. 2007;14(3):209-216. [PubMed] [Google Scholar]104. Webster WS, Abela D. The effect of hypoxia in development. *Birth Defects Research Part C*. 2007;81(3):215-228. [PubMed] [Google Scholar]105. Zhang L. Prenatal hypoxia and cardiac programming. *Journal of the Society for Gynecologic Investigation*. 2005;12(1):2-13. [PubMed] [Google Scholar]106. Al-Ghazali W, Chita SK, Chapman MG, Allan LD. Evidence of redistribution of cardiac output in asymmetrical growth retardation. *British Journal of Obstetrics and Gynaecology*. 1989;96(6):697-704. [PubMed] [Google Scholar]107. Rizzo G, Arduini D, Romanini C. Doppler echocardiographic assessment of fetal cardiac function. *Ultrasound in Obstetrics and Gynecology*. 1992;2(6):434-445. [PubMed] [Google Scholar]108. Fouron J-C, Skoll A, Sonesson S-E, Pfizenmaier M, Jaeggi E, Lessard M. Relationship between flow through the fetal aortic isthmus and cerebral oxygenation during acute placental circulatory insufficiency in ovine fetuses. *American Journal of Obstetrics and Gynecology*. 1999;181(5):1102-1107. [PubMed] [Google Scholar]109. Wladimiroff JW, Tonge HM, Stewart PA. Doppler ultrasound assessment of cerebral blood flow in the human fetus. *British Journal of Obstetrics and Gynaecology*. 1986;93(5):471-475. [PubMed] [Google Scholar]110. Fouron J-C, Teyssier G, Maroto E, Lessard M, Marquette G. Diastolic circulatory dynamics in the presence of elevated placental resistance and retrograde diastolic flow in the umbilical artery: a Doppler echographic study in lambs. *American Journal of Obstetrics and Gynecology*. 1991;164(1):195-203. [PubMed] [Google Scholar]111. Rizzo G, Arduini D. Fetal cardiac function in intrauterine growth retardation. *American Journal of Obstetrics and Gynecology*. 1991;165(4):876-882. [PubMed] [Google Scholar]112. Gudmundsson S, Tulzer G, Huhta JC, Marsal K. Venous Doppler in the fetus with absent end-diastolic flow in the umbilical artery. *Ultrasound in Obstetrics and Gynecology*. 1996;7(4):262-267. [PubMed] [Google Scholar]113. Browne VA, Stiffel VM, Pearce WJ, Longo LD, Gilbert RD. Cardiac  $\beta$ -adrenergic receptor function in fetal sheep exposed to long-term high-altitude hypoxemia. *American Journal of Physiology*. 1997;273(6):R2022-R2031. [PubMed] [Google Scholar]114. Browne VA, Stiffel VM, Pearce WJ, Longo LD, Gilbert RD. Activator calcium and myocardial contractility in fetal sheep exposed to long-term high-altitude hypoxia. *American Journal of Physiology*. 1997;272(3, part 2):H1196-H1204. [PubMed] [Google Scholar]115. Garcia FC, Stiffel VM, Pearce WJ, Zhang L, Gilbert RD. Ca<sup>2+</sup> sensitivity of fetal coronary arteries exposed to long-term, high-altitude hypoxia. *Journal of the Society for Gynecologic Investigation*. 2000;7(3):161-166. [PubMed] [Google Scholar]116. Kamitomo M, Alonso JG, Okai T, Longo LD, Gilbert RD. Effects of long-term, high-altitude hypoxemia on ovine fetal cardiac output and blood flow distribution. *American Journal of Obstetrics and Gynecology*. 1993;169(3):701-707. [PubMed] [Google Scholar]117. Thompson LF. Effects of chronic hypoxia on fetal coronary responses. *High Altitude Medicine and Biology*. 2003;4(2):215-224. [PubMed] [Google Scholar]118. Barker DJP. The fetal origins of adult hypertension. *Journal of Hypertension*. 1992;10(7):S39-S44. [PubMed] [Google Scholar]119. Barker DJP. Fetal nutrition and cardiovascular disease in later life. *British Medical Bulletin*. 1997;53(1):96-108. [PubMed] [Google Scholar]120. Barker DJP, Gluckman PD, Godfrey KM, Harding JE, Owens JA, Robinson JS. Fetal nutrition and cardiovascular disease in adult life. *The Lancet*. 1993;341(8850):938-941. [PubMed] [Google Scholar]121. Barker DJ. The fetal origins of coronary heart disease. *European Heart Journal*. 1997;18(6):883-884. [PubMed] [Google Scholar]122. Barker DJP. In utero programming of chronic disease. *Clinical Science*. 1998;95(2):115-128. [PubMed] [Google Scholar]123. Barker DJP. In utero programming of cardiovascular disease. *Theriogenology*. 2000;53(2):555-574. [PubMed] [Google Scholar]124. Barker DJP, Bagby SP, Hanson MA. Mechanisms of disease: in utero programming in the pathogenesis of hypertension. *Nature Clinical Practice Nephrology*. 2006;2(12):700-707. [PubMed] [Google Scholar]125. Leon DA, Lithell HO, Vågerö D, et al. Reduced fetal growth rate and increased risk of death from ischaemic heart disease: cohort study of 15 000 Swedish men and women born 1915-1929. *British Medical Journal*. 1998;317(7153):241-245. [PMC free article] [PubMed] [Google Scholar]126. Bonamy A-KE, Bendito A, Martin H, Andolf E, Sedin G, Norman M. Preterm birth contributes to increased vascular resistance and higher blood pressure in adolescent girls. *Pediatric Research*. 2005;58(5):845-849. [PubMed] [Google Scholar]127. Johansson S, Iliadou A, Bergvall N, Tuvemo T, Norman M, Cnattingius S. Risk of high blood pressure among young men increases with the degree of immaturity at birth. *Circulation*. 2005;112(22):3430-3436. [PubMed] [Google Scholar]128. Martin H, Hu J, Gennser G, Norman M. Impaired endothelial function and increased carotid stiffness in 9-year-old children with low birthweight. *Circulation*. 2000;102(22):2739-2744. [PubMed] [Google Scholar]129. Lewington S, Clarke R, Qizilbash N, Peto R, Collins R. Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. *The Lancet*. 2002;360(9349):1903-1913. [PubMed] [Google Scholar]130. Blais L, Beauchesne M-F. Use of inhaled corticosteroids following discharge from an emergency department for an acute exacerbation of asthma. *Thorax*. 2004;59(11):943-947. [PMC free article] [PubMed] [Google Scholar]131. Bae S, Xiao Y, Li G, Casiano CA, Zhang L. Effect of maternal chronic hypoxic exposure during gestation on apoptosis in fetal rat heart. *American Journal of Physiology*. 2003;285(3):H983-H990. [PubMed] [Google Scholar]132. Snoeckx LFEH, Cornelussen RN, van Nieuwenhoven FA, Reneman RS, van der Vusse GJ. Heat shock proteins and cardiovascular pathophysiology. *Physiological Reviews*. 2001;81(4):1461-1497. [PubMed] [Google Scholar]133. Xi L, Tekin D, Bhargava P, Kukreja RC. Whole body hyperthermia and preconditioning of the heart: basic concepts, complexity, and potential mechanisms. *International Journal of Hyperthermia*. 2001;17(5):439-455. [PubMed] [Google Scholar]134. Yellon DM, Pasini E, Cargnoni A, Marber MS, Latchman DS, Ferrari R. The protective role of heat stress in the ischaemic and reperfused rabbit myocardium. *Journal of Molecular and Cellular Cardiology*. 1992;24(8):895-907. [PubMed] [Google Scholar]135. Beere HM, Green DR. Stress management—heat shock protein-70 and the regulation of apoptosis. *Trends in Cell Biology*. 2001;11(1):6-10. [PubMed] [Google Scholar]136. Hutter JJ, Mestrlil R, Tam EKW, Sievers RE, Dillmann WH, Wolfe CL. Overexpression of heat shock protein 72 in transgenic mice decreases infarct size in vivo. *Circulation*. 1996;94(6):1408-1411. [PubMed] [Google Scholar]137. Jayakumar J, Suzuki K, Sammut IA, et al. Heat shock protein 70 gene transfection protects mitochondrial and ventricular function against ischemia-reperfusion injury. *Circulation*. 2001;104(12, supplement 1):I303-I307. [PubMed] [Google Scholar]138. Li G, Xiao Y, Estrella JL, Ducsay CA, Gilbert RD, Zhang L. Effect of fetal hypoxia on heart susceptibility to ischemia and reperfusion injury in the adult rat. *Journal of the Society for Gynecologic Investigation*. 2003;10(5):265-274. [PubMed] [Google Scholar]139. Thompson LP, Dong Y. Chronic hypoxia decreases endothelial nitric oxide synthase protein expression in fetal guinea pig hearts. *Journal of the Society for Gynecologic Investigation*. 2005;12(6):388-395. [PubMed] [Google Scholar]140. Xiao R-P. Cell logic for dual coupling of a single class of receptors to Gs and Gi proteins. *Circulation Research*. 2000;87(8):635-637. [PubMed] [Google Scholar]141. Chesley A, Lundberg MS, Asai T, et al. The  $\beta$  2-adrenergic receptor delivers an antiapoptotic signal to cardiac myocytes through Gi-dependent coupling to phosphatidylinositol 3'-kinase. *Circulation Research*. 2000;87(12):1172-1179. [PubMed] [Google Scholar]