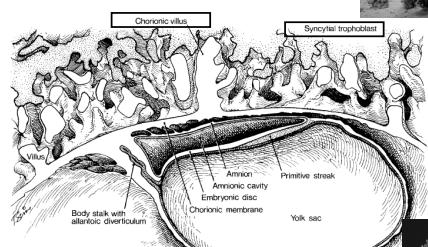


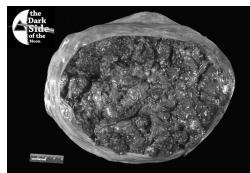
Medicine, 2015/16.

Placenta

prof. Damir Roje



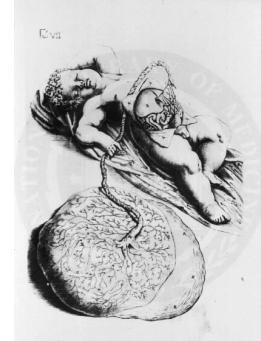
MATURE PLACENTA



mother's surface



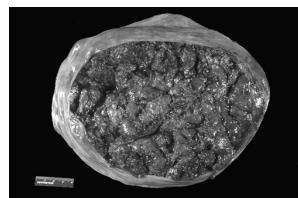
fetal surface



FETUS, UMBILICAL CORD & PLACENTA; Adrian de Spiegel, 1620.

BE CAREFUL!

- the placenta is only a temporary organ in humans
- the placenta is the only organ in humans made by two individuals



BE CAREFUL!

- The placenta is the only temporary organ in humas body

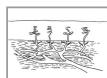
The placenta is the *de facto* fetal
“extracorporeal organ”



BE CAREFUL!

Placentation

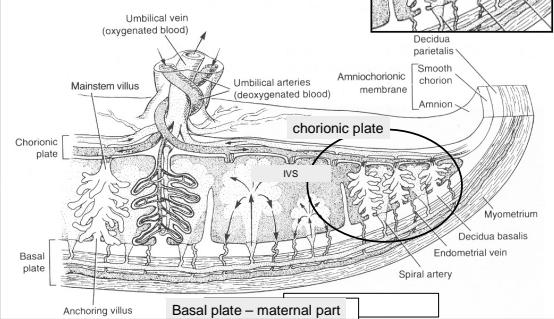
- Placentation is the process of establishing two complementary blood flow (in placenta)
- Placentation doesn't present process of placental formation (placentogenesis)



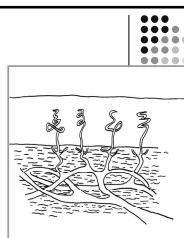
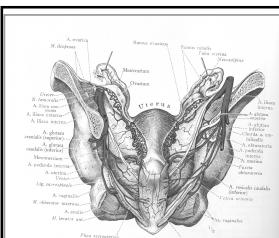
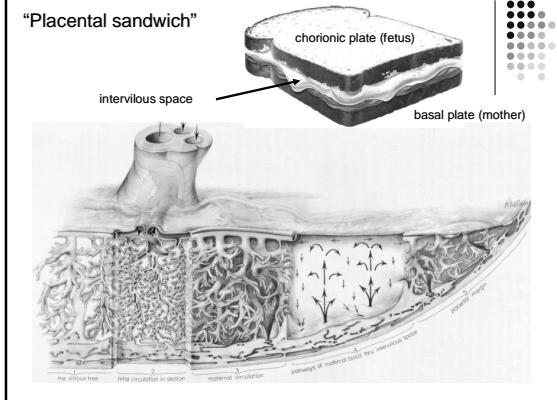
Placentation – establishment and approaching of two circulations

- MOTHER: The physiological remodeling of spiral arteries and formation of placental bed
- FETUS: Development of placental villi
- (in each lobe is a branch of fetal blood vessels branching with the villi tree)

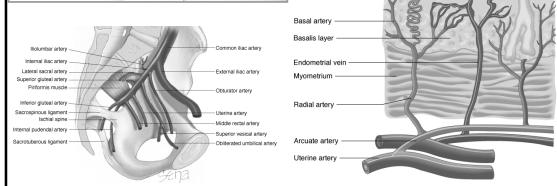
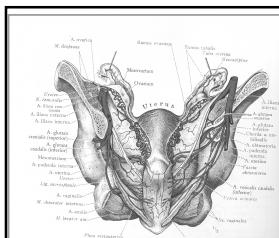
Placentation - maternal part - fetal part - intervillous space



"Placental sandwich"



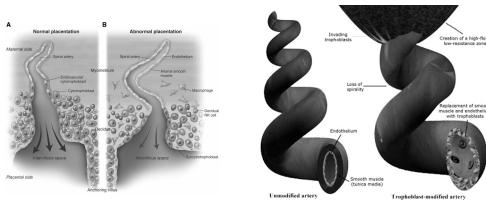
- arteria uterina 2x
- aa. arcuatae (2 x 8) ⇔ anastomosing with symmetrical one on the other side creating "rings" around the uterus
- ⇔ aa. radiales ⇔ vertically through miometrium ⇔ continuing as aa. basileres ⇔ aa. spirales
- spiral arteries are the most distal part of the maternal circulation to placenta (20µm in diameter) - not ending as capillaries !!!!
- Uterus has about 200 spiral arteries
- Spiral arteries are the equivalent of the arterioles (the smallest branches of the artery with the muscle layer in the wall)



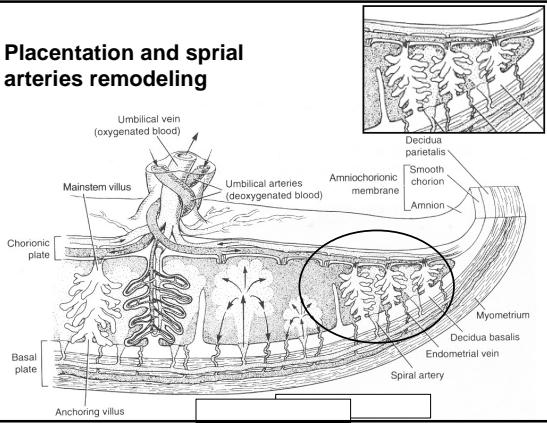
Placenta – maternal part

- intermediate trophoblast
- spiral arteries remodeling: loss of muscle layer of the wall
- replacement of endothelial cells (with the trophoblast)
- not responding to catecholamines
- a funnel shape (laminar to turbulent blood flow due to the rapid expansion of the lumen and deceleration)
- left - right shunt
- Affects approx. 120 of 200 spiral arteries

Placenta – maternal part

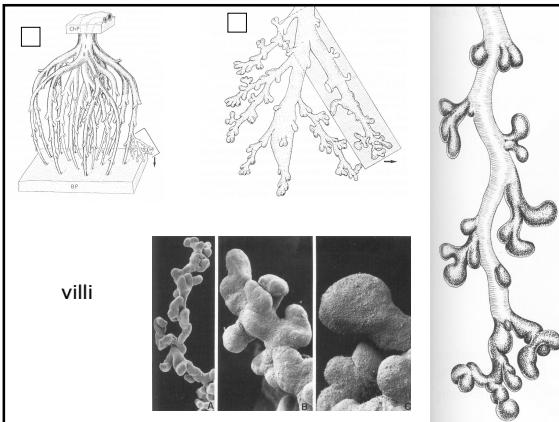
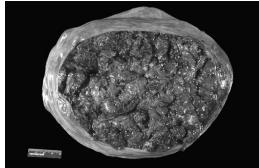


Placenta and spiral arteries remodeling

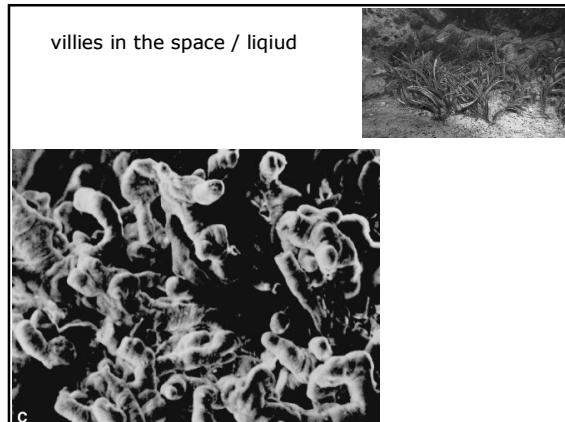


Fetal part

- placental villi



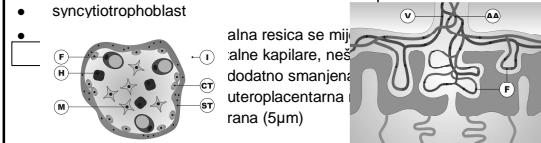
villi in the space / liquid



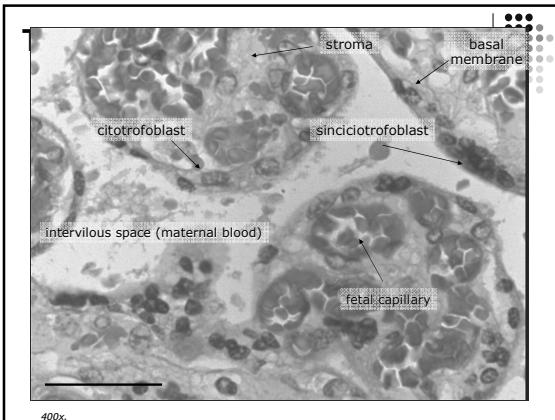
Terminal villi

The smallest branch and the basic functional unit of the placenta

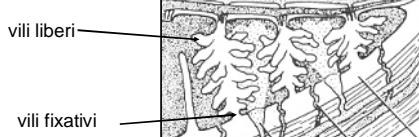
- Mature terminal villi:
- fetal capillaries
- villi stromal collagen
- basement membrane of trophoblast
- cytotrophoblasts
- syncytiotrophoblast
-



uteroplacental
membrane
(20 μ m)

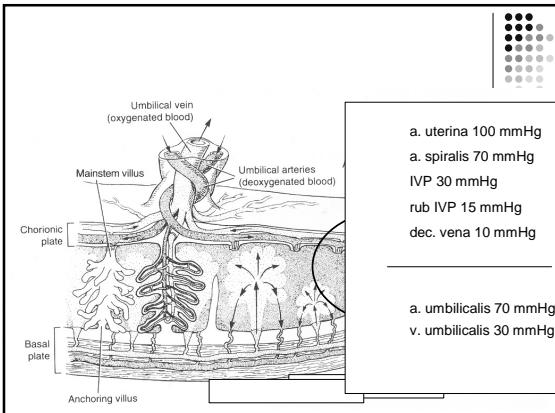
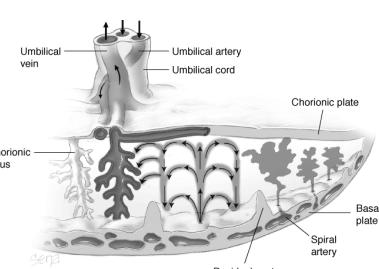


Placental villi



????

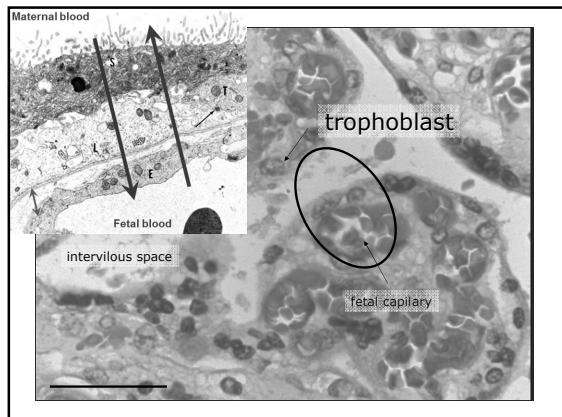
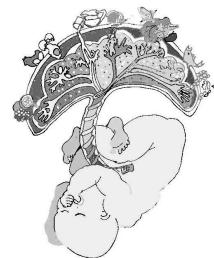
	Placenta	Fetus
10. weeks	20g	5g
40. weeks	600g	3400g



Placental functions

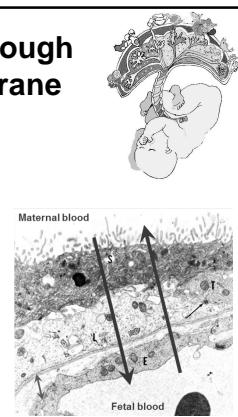
1. respiratory
2. nutritive
3. excretion
4. hormonal
5. immunological

Nutritive placental function



Transport modes through chemochorial membrane

- diffusion
- facilitated diffusion
- active transport
- ultrafiltration
- pinocytosis



Diffusion

- O₂, CO₂
- lipids
- lipid-soluble vitamins
- urea, creatinin
- drugs

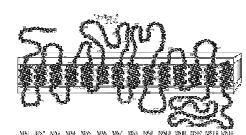
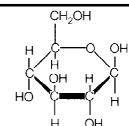
energy regardless

Fick principle:

$$T = \frac{(C_1 - C_2) \times P}{D} \times K$$

Facilitated diffusion

- glucose
- GLUT transporters in the membrane



Glucose transporters

Several glucose transporter (GLUT-1 to 7) have been identified in various tissues.

GLUT- 1	Brain, Kidney, placenta, RBC	Uptake of glucose
GLUT- 2	Liver, pancreatic β -cell, small intestine, Kidney	Rapid uptake & release of glucose
GLUT- 3	Brain, Kidney, placenta	Uptake of glucose
GLUT- 4	Heart, skeletal muscle, adipose tissue	Insulin stimulated uptake of glucose
GLUT- 5	Small intestine	Absorption of glucose
SGLT-1	Small intestine and kidney	Active uptake & reabsorption of glucose

Active transport

- opposite to concentration gradient
- energy consumption
 - amino acids
 - water-soluble vitamins
 - rare metals (Cu, Fe, S, Zn)

Ultrafiltration

- non energy consumption
- H₂O carrying electrolytes (Na, K, Cl)

Pynocytosis

- high molecular protein
- The placenta:
 - do not exceed: albumin, IgA
 - very little cross: IgM
 - easily exceed: IgG
- Polypeptides and polypeptide hormones do not cross the placenta (insulin, TSH, ACTH)

Respiratory placental function

	MOTHER		FETUS		
	arteria uterina	vena uterina	intervilozni prostor	vena umbilicalis	arteria umbilicalis
blood flow (ml/min)	700	700	400-500	300-500	300-350
pressure (mmHg)	100	10	15	30	70
pO ₂ (mmHg)	95	33	40	25	13
pCO ₂ (mmHg)	14,5	10	13	11	4
CO ₂ (vol%)	Relative fetal hypoxia ("Mount Everest in utero")				
akt. pH	7,4	7,34	/	7,38	7,35

Respiratory placental function

	MOTHER		FETUS		
	arteria uterina	vena uterina	intervilous space	vena umbilicalis	arteria umbilicalis
blood flow (ml/min)	700	700	400-500	300-500	300-350
pressure (mmHg)	100	10	15	30	70
Less differences in CO ₂ than in O ₂					
pCO ₂ (mmHg)	33	46	38	40	55
CO ₂ (vol%)	42,5	48	45	41	48
akt. pH	7,4	7,34	/	7,38	7,35

