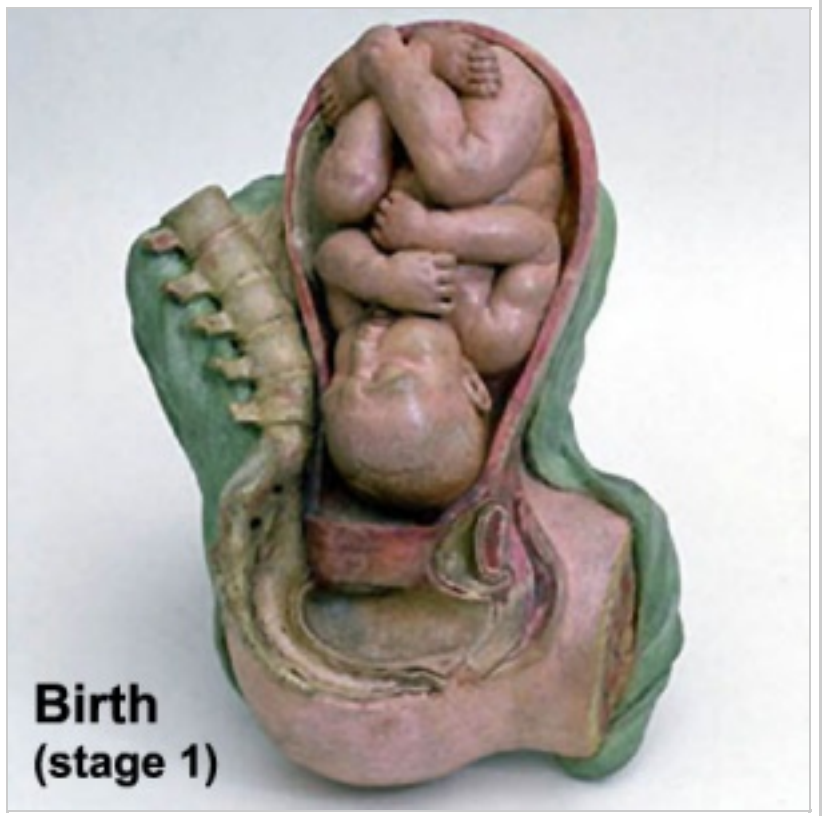
Lecture - Birth

From Embryology

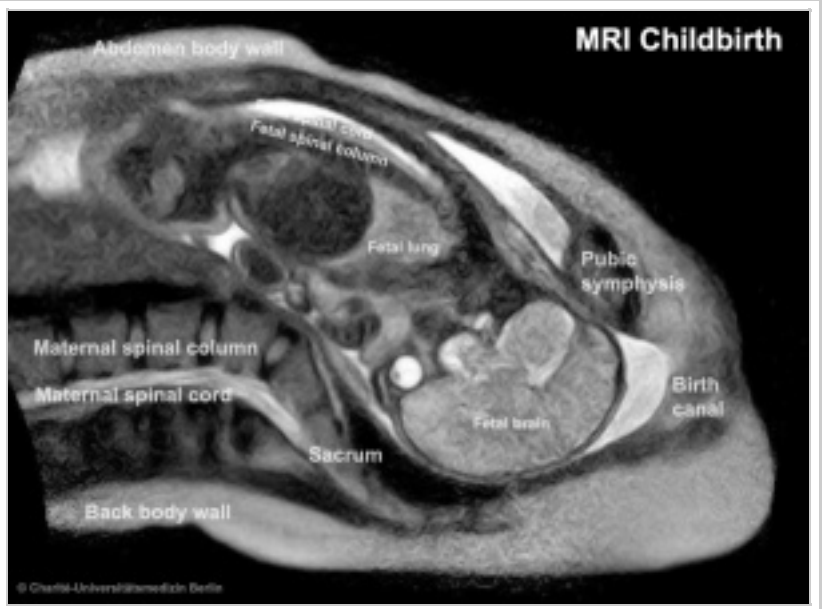
Introduction

This lecture will finish prenatal human development with birth (parturition) and also review the course lecture theory in preparation for the final theory exam.

Birth or parturition is a critical stage in development, representing in mammals a transition from direct maternal support of fetal development, physical expulsion and establishment of the newborns own respiratory, circulatory and digestive systems. This topic is not covered in a detailed chapter in your embryology textbooks.



Historic model of birth



MRI of birth today

Final Individual Assessment - Online CATEI opens on 31st October.

- Email a screenshot of the completion message to m.hill@unsw.edu.au
- Do not send the CATEI or your answers.

Lecture Objectives

1. Understanding of gestation period
2. Understanding of maternal changes at birth
3. Understanding of fetal to neonatal transition
4. Understanding of system changes
5. Understanding of abnormalities and diagnostic testing

Lecture Resources

Movies and Virtual Slides[Expand]

References[Expand]

Gestation Period

The median duration of gestation for first births from assumed ovulation to delivery was **274** days (just over 39 weeks). For multiple births, the median duration of pregnancy was **269** days (38.4 weeks).

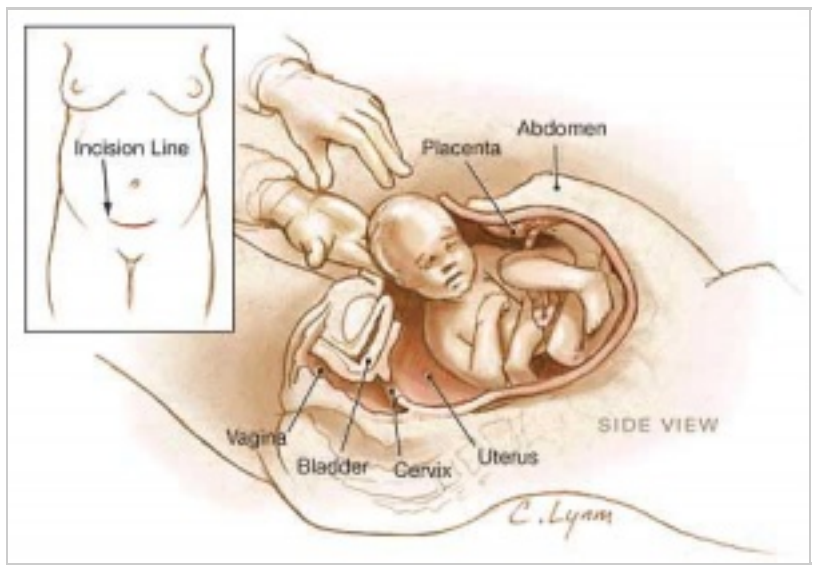
"...one should count back 3 months from the first day of the last menses, then add 15 days for

primiparas or 10 days for multiparas, instead of using the common algorithm for Naegele's rule." Reference: Mittendorf R, Williams MA, Berkey CS, Cotter PF. (http://www.ncbi.nlm.nih.gov:80/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=16547957&dopt=Abstract) The length of uncomplicated human gestation. Obstet Gynecol. 1990 Jun;75(6):929-32

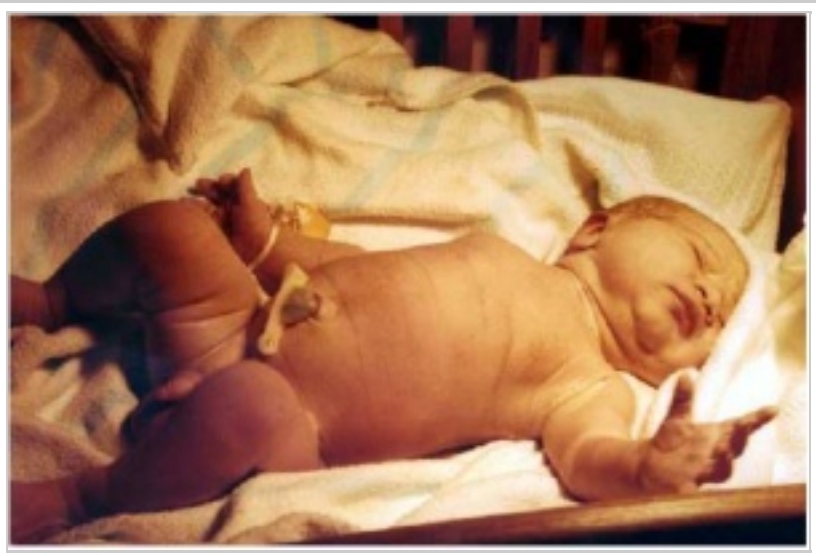
Historically, Franz Carl Naegele (1777-1851) developed the first scientific rule for estimating length of a pregnany.

Childbirth

- Parturition (Latin, *parturitio* = "childbirth") describes expelling the fetus, placenta and fetal membranes and is probably initiated by fetus not mother.
- Preterm birth - Risks of preterm birth in abnormal low birth weight (intrauterine growth restriction) and high (large for gestational age) categories are 2- to 3-fold greater than the risk among appropriate-for-gestational-age infants.
- Maternal labor - uterine contractions and dilation of cervix, process under endocrine regulation
- Placenta and fetal membranes - (Latin, *secundina* = "following") expelled after neonate birth



Birth by caesarean


Newborn

Uterine Myometrial Changes

- Smooth muscle fibers - hypertrophy not proliferation
- Stretching of myometrium - stimulates spontaneous muscular contraction, during pregnancy progesterone inhibits contraction
- Stimulating contraction - increased estrogen levels (placental secretion sensitizes smooth muscle), increased oxytocin levels (fetal oxytocin release-force and frequency of contraction), fetal pituitary prostaglandin production (estrogen and oxytocin stimulate endometrial production of prostaglandin)

Progesterone

- maintains pregnancy - initially synthesized by corpus luteum, then levels maintained by placenta
- hyperpolarizes myometrial cells (-65 mV), reduces excitability and conductivity
- Level in plasma may fall just before parturition, definitely decreases following delivery of placenta

Estrogens

- Group of steroidal hormones, peak when parturition begins
- induce increased synthesis of actomyosin and ATP in myometrial cells
- alter membrane potential (-50 Mv) enhances excitation/conduction
- act to directly increase myometrial contraction
- indirectly by increasing oxytocin from pituitary gland

- Estriol - synthesized by fetus and placenta

Oxytocin

- Peptide hormone (8aa) from maternal posterior pituitary, initiation and maintenance of labour (synthetic form labour induction)
- myometrium sensitivity to oxytocin (increased by estrogen, decreased by progesterone)
- stimulus for release - mechanical stimulation of uterus, cervix and vagina (ethanol inhibits release)

Prostaglandins

- hydroxy fatty acids - sythesized by placenta, amniotic fliud contains mainly PGF2 alpha, causes myometrial contraction (also in maternal plasma)
- PGF2 alpha and PGE2 - used to induce labour (intravenous, oral, intravaginal, intraamniotic)
- Aspirin inhibitor of PG synthesis - leads to increased duration of pregnancy

External Environment

- mainly shown in other species parturition occurs in peaceful undisturbed surroundings, stress may have an inhibitory effect on oxytocin release
- Most human births occur at night (peak at 3am) diurnal rhythm influence

Labor Stages

1. **dilatation** - 7 -12 hours - uterine contractions 10 minutes apart, function to dilate cervix fetal membranes rupture releasing amnion, (longer for first child)
2. **expulsion** - 20 - 50 minutes - uterine contractions push fetus through cervix and vagina, contractions 2-3 minutes apart
3. **placental** - 15 minutes - following child delivery contractions continue to expel placenta. haematoma separates placenta from uterine wall, separation occurs at spongy layer of decidua basalis
4. **recovery** - 2+ hours - continued myometrial contraction closes spiral arteries

Birth Stage 2

Newborn Homoeostasis

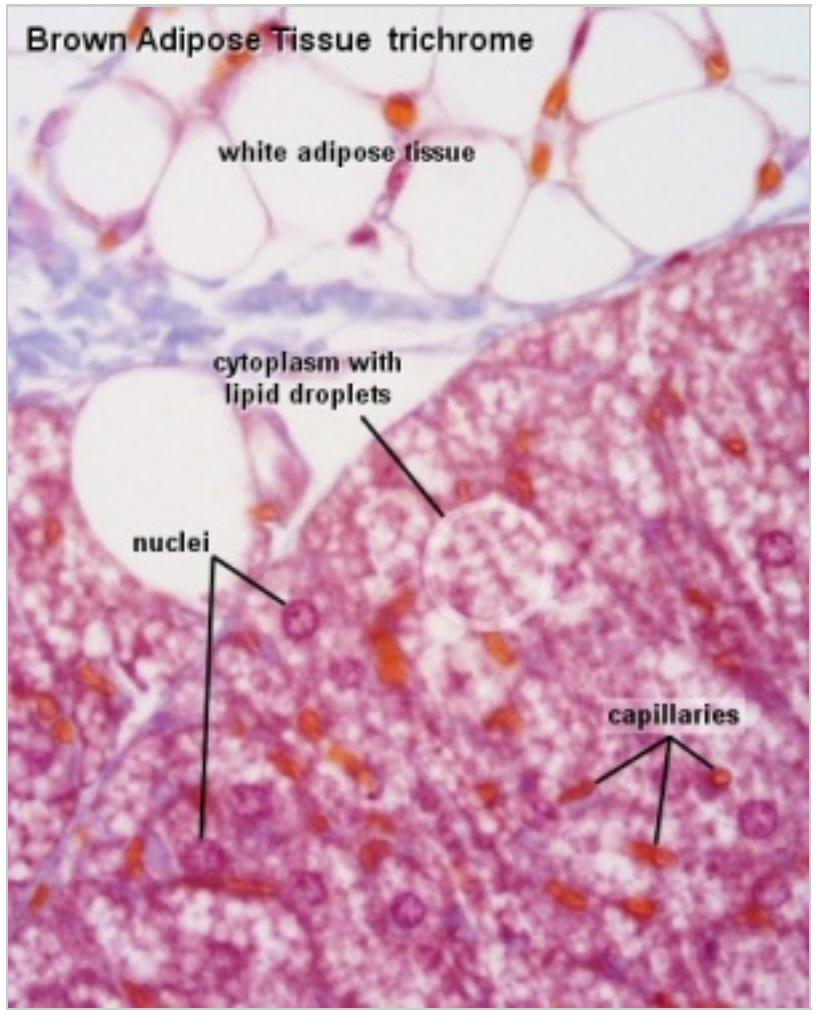
Newborn has to establish new functioning systems in a balanced and regulated manner (homoeostasis).

- lung function
- circulatory changes
- thermoregulation
- endocrine function
- nutrition
- gastrointestinal tract function
- waste
- kidney function

Glucocorticoids - have an important role in the preparation for birth, including involvement in lung and cardiac development, and the maturation of enzymes in a variety of pathways.

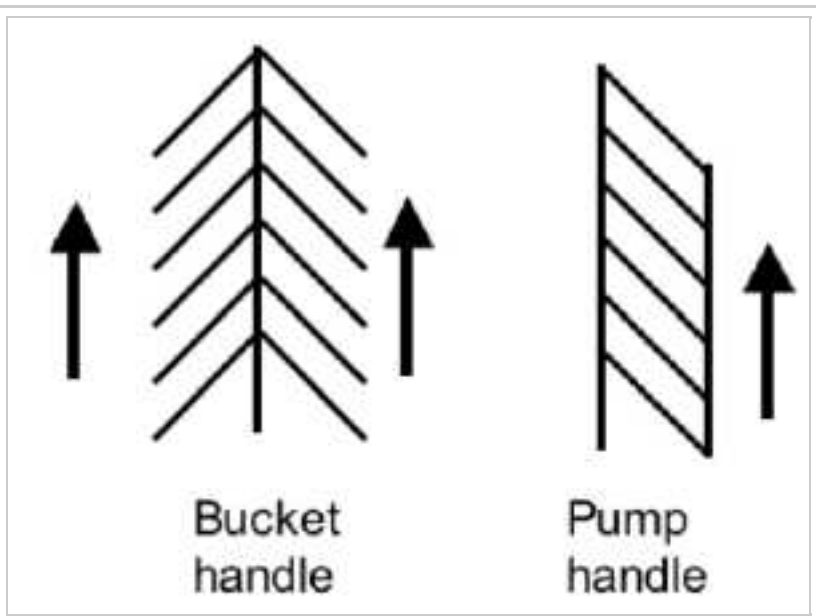
Respiration

- Lungs at birth collapsed and fluid-filled - replaced with air by powerful inspiratory movement and absorption through the alveoli
- Lung epithelia has to rapidly change from its prenatal secretory function to that of fluid absorbtion.
  - initiated by a late fetal change in alveolar epithelial cell (AEC) chloride and fluid secretion to sodium and fluid absorption.
  - absorption requires sodium-potassium ATPase (Na-K-ATPase) together with apical sodium entry mechanisms (Epithelial Sodium Channels, ENaC)
  - Fetal thyroid hormone is thought to have a hormonal role in this developmental switch
- These changes and pressure also lead to the pulmonary sytem becoming activated and changes in the circulatory shunting that existed before birth.
- During the late fetal period regular fetal breathing movements (FBM) also occur preparing both the skeletomuscular sysyem and lungs mechanically for respiration.
- Respiratory Rate is higher than adult (30 breaths/minute).
- Rib Orientation - Infant rib is virtually horizontal, allowing diaphragmatic breathing only. Adult rib orientation is oblique (both anterior and lateral views), allows for pump-handle and bucket handle types of inspiration.



Brown adipose tissue

Cardiovascular



Neonatal rib orientation

- **Umbilical Vasculature** - The umbilical blood vessel cavity is lost postnatally over the course of weeks to months after birth. The adult anatomical remnant of the umbilical vein between the umbilicus and liver is the ligamentum teres.
- **Foramen Ovale** - two separate forms of foramen ovale closure; functional and structural. Functional closure begins at the first breath and is rapid. Structural (anatomical) closure is much slower and generally occurs before the end of the first year.
- **Ductus Arteriosus** - a direct connection between the pulmonary trunk and the dorsal aorta. Postnatal closure occurs initially by by smooth muscle contraction and begins at the first breath and is rapid, completed within the first day (about 15 hr after birth). Anatomical closure is much slower occuring by 2–3 weeks after birth (33% of infants), by 2 months (90% of infants) and by 1 year (99% of infants). The adult anatomical remnant of the ductus arteriosus is the ligamentum arteriosum.
- **Ductus Venosus** - connects portal and umbilical blood to the inferior vena cava. Functional closure

occurs postnatally within hours. Structural closure commences days after birth and completes by 18 to 20 days. The adult anatomical remnant of the ductus venosus is the ligamentum venosum (a dorsal fissure on the liver).

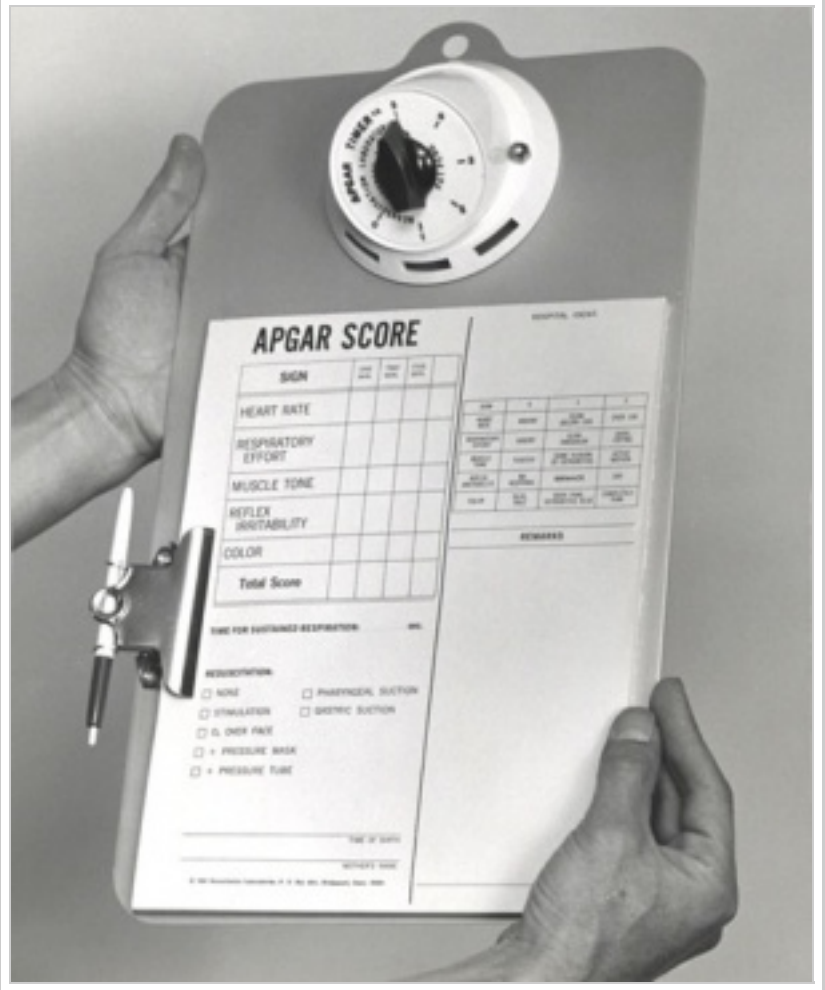
Neonatal Testing

Apgar Test

A historic neonatal test designed by Dr Virginia Apgar[1], Measured at one and five minutes after birth.

APGAR Test[Expand]

Links: Apgar test

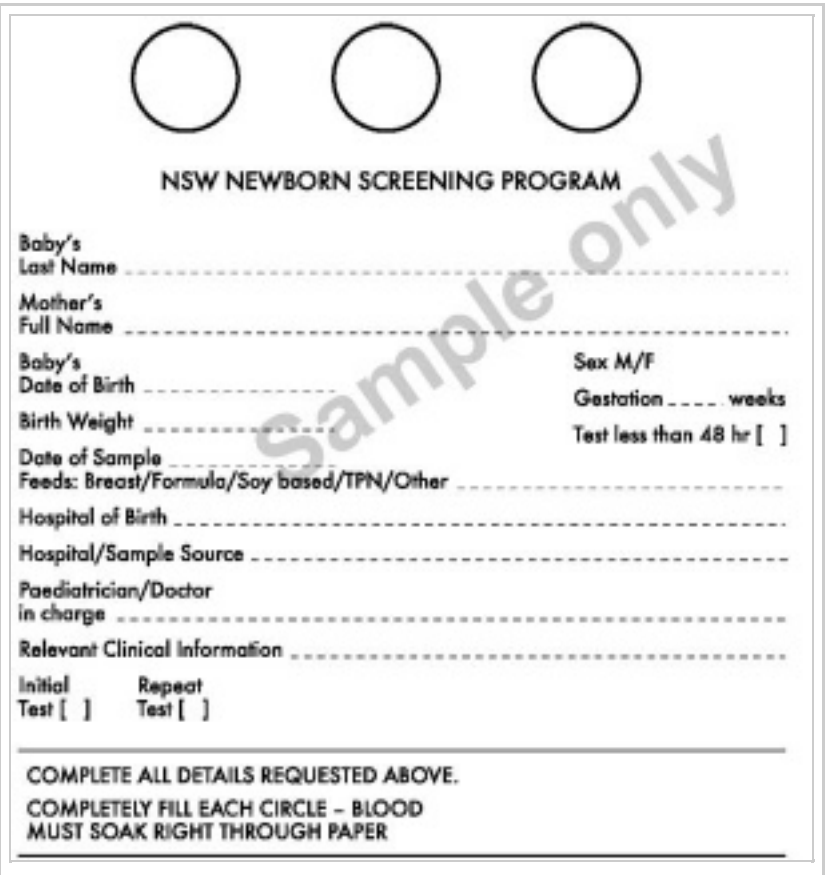


Apgar Test

Guthrie Test

A blood screening test developed by Dr Robert Guthrie (1916-95) at University of Buffalo.[2] The test is carried out on neonatal (newborn) blood detecting markers for a variety of known disorders (phenylketonuria (PKU), hypothyroidism and cystic fibrosis). In the Australian states of NSW and Victoria, the Guthrie Cards are currently stored indefinitely.

Links: Guthrie test



Guthrie card

Heart

An electrocardiogram (ECG / EKG) is an electrical recording of the heart which may identify electrical disorders including long QT syndrome.

Hip Displasia

- Non-specific hip instability is a common finding in newborns, particularly in females.
- More than 80% of clinically unstable hips at birth resolve spontaneously. Screening newborns for Developmental dysplasia of the hip (DDH) shows an incidence in infants between 1.5 and 20 per 1000 births. This incidence is influenced by several factors (diagnostic criteria, gender, genetic and racial factors, and age of the population).

Links: PMID 16770931

Hearing

- The incidence of significant permanent hearing loss is approximately 1-3/1000 newborns.
- Neonatal hearing screening is carried out in the USA, UK and in Australia (2002 NSW Statewide Infant Screening Hearing Program, SWISH) There is a general guide giving a timetable for a number of simple responses that a neonate should make if hearing has developed normally.
- State Wide Infant Screening Hearing Program (SWISH) a newborn hearing testing program using an automated auditory response technology (AABR). Program was introduced in NSW Australia in 2002 across 17 area health service coordinators. It is thought that in NSW 86,000 births/year = 86-172 babies potentially born with significant permanent hearing loss.
- Automated Auditory Brainstem Response (AABR) uses a stimulus which is delivered through earphones and detected by scalp electrodes. The test takes between 8 to 20 minutes and has a sensitivity 96-99%.

Premature Birth

Year	< 34 weeks	%	34-36 weeks	%	total preterm	%
1990	3.3		7.3		10.6	
1995	3.3		7.7		11	
2000	3.4		8.2		11.6	
2005	3.6		9.1		12.7	

Data from: Prevention of preterm birth: a renewed national priority Damus K. Curr Opin Obstet Gynecol. 2008 Dec;20(6):590-6 PMID: 18989136 (http://www.ncbi.nlm.nih.gov:80/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=18989136&dopt=Abstract)

Premature infant

Australia Recommendations

Perinatal care at the borderlines of viability: a consensus statement based on a NSW and ACT consensus workshop (February 2005) published in The Medical Journal of Australia 2006; 185 (9): 495-500.

- < 23 weeks survival is minimal and the risk of major morbidity is so high that initiation of resuscitation is not appropriate.
- 23 weeks active treatment may be discussed, but would be discouraged in NSW/ACT neonatal intensive care units.
- 23 to 25 weeks otherwise normal infant, there is an increasing obligation to treat. However, it is acceptable medical practice not to initiate intensive care if parents so wish, following appropriate counselling.
- 24 weeks antenatal transfer to a tertiary centre for fetal reasons is indicated. The option of non-initiation of intensive care/resuscitation should be offered.
- 25 weeks active treatment is usually offered, but the option of non-initiation of intensive care/resuscitation (presence of adverse fetal factors such as twin-to-twin transfusion, intrauterine growth restriction or chorioamnionitis) should also be discussed.
- 26 weeks + otherwise normal infant the obligation to treat is very high, and treatment should generally be initiated unless there are exceptional circumstances.

Fetal Origins Hypothesis

Maternal derived abnormalities relate to lifestyle, environment and nutrition and while some of these directly effect development. There is also growing evidence that some effects are more subtle and relate to later life health events. This theory is based on the early statistical analysis carried out by Barker of low birth weight data collected in the early 1900's in the south east of England which he then compared with these same babies later health outcomes. The theory was therefore originally called the "Barker Hypothesis" and has recently been renamed as "fetal origins" or "programming".

Links: Fetal Origins Hypothesis

Abnormalities

Teratology

How different environmental effects during the pregnancy may influence outcomes. A teratogen (Greek, teraton = monster) is defined as any agent that causes a structural abnormality (congenital abnormalities) following fetal exposure during pregnancy. The overall effect depends on dosage and time of exposure (see critical periods below).

- **Absolute risk** - the rate of occurrence of an abnormal phenotype among individuals exposed to the agent. (e.g. fetal alcohol syndrome)
- **Relative risk** - the ratio of the rate of the condition among the exposed and the nonexposed. (e.g. smokers risk of having a low birth weight baby compared to non-smokers) A high relative risk may indicate a low absolute risk if the condition is rare.
- **Mutagen** - a chemical or agent that can cause permanent damage to the deoxyribonucleic acid (DNA) in a cell. DNA damage in the human egg or sperm may lead to reduced fertility, spontaneous abortion (miscarriage), birth defects and heritable diseases.
- **Fetotoxicant** - is a chemical that adversely affects the developing fetus, resulting in low birth weight, symptoms of poisoning at birth or stillbirth (fetus dies before it is born).
- **Synergism** - when the combined effect of exposure to more than one chemical at one time, or to a chemical in combination with other hazards (heat, radiation, infection) results in effects of such exposure to be greater than the sum of the individual effects of each hazard by itself.
- **Toxicogenomics** - the interaction between the genome, chemicals in the environment, and disease. Cells exposed to a stress, drug or toxicant respond by altering the pattern of expression of genes within their chromosomes. Based on new genetic and microarray technologies.

Critical Periods

There are many birth associated abnormalities, only a few examples are listed below.

Labor Abnormalities

- **Premature Labor** - occurs 7 -10% in humans, contributes 75% perinatal mortalities
- **Underdeveloped Systems** - particularly respiratory, surfactant, hyaline membrane disease (see respiratory development lecture)

Placental Abnormalities

- **placenta accreta** - abnormal adherence, with absence of decidua basalis
- **placenta percreta** - villi penetrate myometrium
- **placenta previa** - placenta overlies internal os of uterus, abnormal bleeding, cesarian delivery

Breech Delivery

- Historically, breech-born children were called *agrippi*, meaning "delivered with difficulty" (aegre parti).
- Breech position - occurs in about 3% of fetuses when buttocks or lower limb are presented to the birth canal rather than normal cephalic (head-first) position (presentation).
- Associated increased - perinatal mortality, perinatal morbidity, recurrence in successive siblings

Current research suggests that genetically that both men and women delivered in breech presentation at term could also contribute to an increased risk of breech delivery in their offspring. ([#18369204 Nordtveit TI, etal., 2008])

Breech Birth

Meconium aspiration syndrome

- meconium is formed from gut and associated organ secretions as well as cells and debris from the swallowed amniotic fluid.
- Meconium accumulates during the fetal period in the large intestine (bowel). It can be described as being a generally dark colour (green black) , sticky and odourless.
- Normally this meconium is defaecated (passed) postnatally over the first 48 hours and then transitional stools from day 4.
- Abnormally this meconium is defaecated in utero, due to oxygen deprivation and other stresses. Premature discharge into the amniotic sac can lead to mixing with amniotic fluid and be reswallowed by the fetus. This is meconium aspiration syndrome and can damage both the developing lungs and placental vessels.

Breech Birth

Necrotizing Enterocolitis

Occurs postnatally in mainly in premature and low birth weight infants (1 in 2,000 - 4,000 births). The underdeveloped gastointestinal tract appears to be susceptible to bacteria, normally found within the tract,to spread widely to other regions where they damage the tract wall and may enter the bloodstream.

Stillbirth and Perinatal Death[Expand]

1. ↑ V APGAR **A proposal for a new method of evaluation of the newborn infant.** Curr Res Anesth Analg: 1953, 32(4);260-7 PubMed 13083014
2. ↑ R GUTHRIE, A SUSI **A SIMPLE PHENYLALANINE METHOD FOR DETECTING PHENYLKETONURIA IN LARGE POPULATIONS OF NEWBORN INFANTS.** Pediatrics: 1963, 32;338-43 PubMed 14063511

3. ↑ Danny Dorling **Worldmapper: the human anatomy of a small planet.** PLoS Med.: 2007, 4(1);e1 PubMed 17411312 | PLoS (http://medicine.plosjournals.org/perlserv/?request=get-document&doi=10.1371/journal.pmed.0040001)

Birth Terms

- **amniotomy** - birth medical procedure thought to speed labor, where the amniotic sac is artificially ruptured using a tool (amniohook).
- **birth** - (parturition, partus, childbirth, labour, delivery). expulsion of the foetus from the uterus. (More? Birth)
- **birth weight** - (birth-weight) the weight of the neonate measured as soon as possible after birth. (More? Birth Weight)
- **breech** - fetal buttocks presented first and can also occur in different forms depending on presentation (complete breech, frank breech, footing breech, knee breech).
- **decidual activation** - increased uterine proteolysis and extracellular matrix degradation.
- **dilatation** - opening of the cervix in preparation for birth (expressed in centimetres).
- **effacement** - shortening or thinning of the cervix, in preparation for birth.
- **forceps** - mechanical "plier-like" tool used on fetal head to aid birth.
- **labor** - the maternal physiological process of birth. (More? Birth)
- **macrosomia** - clinical description for a fetus that is too large, condition increases steadily with advancing gestational age and defined by a variety of birthweights. In pregnant women anywhere between 2 - 15% have birth weights of greater than 4000 grams (4 Kg, 8 lb 13 oz). (More? Macrosomia)
- **membrane rupture** - breaking of the amniotic membrane and release of amniotic fluid (water breaking).
- **morbidity** - (Latin, *morbidus* = "sick" or "unhealthy") refers to a diseased state, disability, or poor health due to any cause.
- **neonatal** - the early postnatal period relating to the birth, it includes the period up to 4 weeks after birth.
- **perinatal** - the early postnatal period relating to the birth, statistically it includes the period up to 7 days after birth.
- **presentation** - how the fetus is situated in the uterus.
- **presenting part** - part of fetus body that is closest to the cervix.
- **second stage of labour** - passage of the baby through the birth canal into the outside world.
- **vacuum extractor** - (ventouse) rubber or metal suction cap device used on fetal head to aid birth.
- **vertex presentation** - (cephalic presentation) where the fetus head is the presenting part, most common and safest birth position.

Theory Revision

Please send me any specific lecture material/content you would like to be revised before the lecture.

Theory Exam

- 12 question in 2 parts (60% or final mark).
- Answer **only 6 questions** - 3 from Part 1 and 3 from Part 2.
- Each question an equal mark.
- Based on lecture content, including lecture presented in practical time due to public holiday.
- Not in the order of presentation.

Lecture Objectives

Week	Week Start Monday Date	Lecture 1 Mon 1:00 - 2:00pm Wallace Wurth LG02	Lecture 2 Wed 3:00 - 4:00pm Wallace Wurth LG02
2	4 Aug	Embryology Introduction	Fertilization 1. Broad understanding of reproductive cycles. 2. Understand the key features of gametogenesis. 3. Understand the differences in male and female gametogenesis. 4. Brief understanding of the differences between mitosis and meiosis. 5. Understanding of the events in fertilization.
3	11 Aug	Week 1 and 2 Development 1. Understand the events during week 1 of development (Zygote, Blastomeres, Morula, Blastocyst) 2. Understand the events during week 2 of development (Trophoblast, Syncytiotrophoblast, Cytotrophoblast, Embryoblast, Implantation) 3. Brief understanding of early placentation 4. Brief understanding of maternal changes	Week 3 Development 1. Understand the process early placentation, villi formation 2. Understand broadly the events of week 3 of human development 3. Understand the process of gastrulation 4. Understand the process of axis formation 5. Brief understanding of embryo folding
4	18 Aug	Mesoderm Development 1. Understanding of events during the third week of development 2. Understanding the process of early somite development 3. Understanding the process of body cavity formation 4. Brief understanding of the future fate of mesoderm components 5. Brief understanding of early heart formation	Ectoderm, Early Neural, Neural Crest 1. Understanding of events during the third and fourth week of development 2. Understanding the process of early neural development 3. Brief understanding of neural crest formation 4. Brief understanding of epidermis formation 5. Understanding of the adult components derived from ectoderm 6. Brief understanding of early neural abnormalities

5	25 Aug	Early Vascular Development 1. Understanding of mesoderm development 2. Understanding of heart tube formation and early development 3. Understanding of early blood vessel and blood development 4. Brief understanding of vascular growth and regression 5. Brief understanding of vascular growth factors	Placenta 1. Understanding of placental villi development 2. Understanding of placental structure 3. Understanding of placental functions 4. Brief understanding of placental abnormalities
6	1 Sep	Endoderm, Early Gastrointestinal 1. Understanding of germ layer contributions to the early gastrointestinal tract (GIT) 2. Understanding of the folding of the GIT 3. Understanding of three main GIT embryonic divisions 4. Understanding of associated organ development (liver, pancreas, spleen) 5. Brief understanding of mechanical changes (rotations) during GIT development 6. Brief understanding of gastrointestinal abnormalities	Respiratory Development 1. Understanding of embryonic lung development 2. Understanding of the stages of lung development 3. Understanding of diaphragm development 4. Brief understanding of respiratory vascular development 5. Brief understanding of respiratory abnormalities 6. Brief understanding of molecular mechanisms
7	8 Sep	Head Development 1. Understand the main structures derived from the pharyngeal arches, pouches and clefts. 2. Understand the stages and structures involved in the development of the face. 3. Understand the development of palate and tongue. 4. Briefly understand special sensory early development. 5. Briefly understand the abnormal development of the face and palate.	Neural Crest Development 1. Understand the structures derived from ectoderm. 2. Identify the initial location of neural crest cells and pathways of neural crest migration throughout the embryo. 3. To know the major tissues to which neural crest cells contribute. 4. To know how abnormalities associated with neural crest cell.
8	15 Sep	Endocrine Development 1. Understanding of hormone types 2. Understanding of endocrine	Integumentary Development 1. Skin function and anatomy 2. Skin origins 3. Development of the overlying epidermis

		gland development 3. Understanding of endocrine developmental functions	4. Development of epidermal appendages - Hair follicles Glands Nails Teeth 5. Development of melanocytes 6. Development of the Dermis
9	22 Sep	Renal Development 1. Understand the 3 main stages of kidney development. 2. Understand development of the nephron and renal papilla. 3. Brief understanding of the mechanisms of nephron development. 4. Understand the development of the cloaca, ureter and bladder. 5. Brief understanding of abnormalities of the urinary system.	Genital 1. Understand the development of the gonads in males and females 2. Understand the chromosomal basis of sex determination 3. Understand the differences in male/female internal duct develpoment. 4. Understand the origins of the external genitalia 5. Understand the developmental abnormalities in male and female development.
10	6 Oct	Musculoskeletal Development 1. Understanding of mesoderm and neural crest development. 2. Brief understanding of connective tissue development. 3. Understanding of cartilage, bone and muscle development. 4. Understanding of the two forms of bone development. 5. Brief understanding of molecular bone development. 6. Brief understanding of bone abnormalities.	Limb Development 1. Review of the subdivisions of mesoderm development. 2. Understanding of differentiation of somites 3. Understanding of limb patterning (axes) 4. Understanding of tissues - cartilage, bone, skeletal muscle
13	14 Oct	Neural 1. Understand early neural development. 2. Understand the formation of the brain; grey and white matter from the neural tube. 3. Understand the formation of spinal cord. 4. Understand the role of migration of neurons during neural development.	Sensory 1. Understanding of sensory placode development 2. Understanding of inner, middle and external ear origins 3. Understanding of timecourse of auditory development 4. Understanding of abnormalities of auditory development 5. Brief understanding of other sensory development
		Heart 1. Review early vascular development 2. Understanding of heart	Fetal 1. Understanding of fetal growth - length and weight

12	20 Oct	embryonic origins 3. Understanding of heart folding 4. Understanding of heart septation 5. Understanding of heart changes and abnormalities	2. Understanding of fetal systems development/changes 3. Understanding of fetal abnormalities
13	27 Oct	Stem Cells 1. Tissue development and regeneration Stem cell biology 2. Stem cell niches 3. Stem cell regulation 4. Stem cells and cancer Regenerative medicine 5. Stem cell sources 6. Future of regenerative medicine	**Birth and Revision** 1. Understanding of gestation period 2. Understanding of maternal changes at birth 3. Understanding of fetal to neonatal transition 4. Understanding of system changes 5. Understanding of abnormalities and diagnostic testing

---

2015 Course: **Week 2** Lecture 1 Lecture 2 Lab 1 | **Week 3** Lecture 3 Lecture 4 Lab 2 | **Week 4** Lecture 5 Lecture 6 Lab 3 | **Week 5** Lecture 7 Lecture 8 Lab 4 | **Week 6** Lecture 9 Lecture 10 Lab 5 | **Week 7** Lecture 11 Lecture 12 Lab 6 | **Week 8** Lecture 13 Lecture 14 Lab 7 | **Week 9** Lecture 15 Lecture 16 Lab 8 | **Week 10** Lecture 17 Lecture 18 Lab 9 | **Week 11** Lecture 19 Lecture 20 Lab 10 | **Week 12** Lecture 21 Lecture 22 Lab 11 | **Week 13** Lecture 23 **Lecture 24** Lab 12 | **2015 Projects**: Three Person Embryos | Ovarian Hyper-stimulation Syndrome | Polycystic Ovarian Syndrome | Male Infertility | Oncofertility | Preimplantation Genetic Diagnosis | Students | Student Designed Quiz Questions | Moodle page (http://moodle.telt.unsw.edu.au/course/view.php?id=15814)

Categories: 2015 | Science-Undergraduate | Birth | Postnatal
