Introduction to Cells and Disease

Lecture 1
Pathology and Clinical Science 1 (BIOC211)
Department of Bioscience

Text Reference:
Porth's Pathophysiology: Concepts of Altered Health States
Ninth Edition.
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Session Learning Outcomes

This session aim to understand:

- The definition of disease process
- The concept of clinical medicine
- The role of clinical medicine in natural medicine studies
- Review of normal immune responses of the body
- Common clinical terminology
What is Health?

- Health and disease may be considered two extremes of a continuum.

- Health is defined as a state of complete physical and mental well-being.

- The healthy person is emotionally and physically capable of leading a full, happy and productive life that is free of anxiety, turmoil, and physical disabilities that limit activities.
What is Disease?

- An “acute or chronic illness that one acquires or is born with that causes physiological dysfunction in one or more body systems”.
- Generally has “specific signs and symptoms that characterize its pathology and identifiable etiology” Porth’s Pathophysiology. 9th edition.
- Diseases are conventionally classified in the following large groups:
  - Congenital and hereditary diseases
  - Inflammatory diseases
  - Degenerative diseases
  - Metabolic diseases
  - Neoplastic diseases
What is Clinical Medicine?

**Clinical**
- Pertaining to the bedside or to the clinic
- Founded on actual observation and treatment

**Medicine**
- The art and science of the diagnosis, treatment of disease and the maintenance of health
  - The treatment of disease by non-surgical means
- Founded on actual observation and treatment
Clinical Medicine & Natural Medicine Principles

- **Vis medicatrix naturae** - the healing power of nature
- **Tolle causam** - identify and treat the causes
- **Primum non nocere** - first do no harm
- **Docere** - Doctor as teacher
- **Holistic** - treat the whole person
- **Prevention**
Why we need to learn Human Clinical Science?

- Understand how the body responds to disease
- Understand how modalities applied will interact with normal bodily processes
- Understand the western modalities and treatments to be able to assess how natural medicine modalities will interact with them
- Communicate with other health care professionals
### Lines of Defence - Revision

#### First line of defence:
- skin and mucous membranes

#### Second line of defence:
- Antimicrobial proteins (interferons, complement, Transferrins)
- Macrophages, NK cells, neutrophils
- Non specific cellular responses
- Fever
- Inflammation

#### Third line of defence
- T cells – cell mediated immunity
- B cells – humoral or antibody mediated immunity
Structure of Antibody

Diagram of IgG heavy and light chains

Model of IgG molecule
### Antibody Isotypes

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IgG</strong></td>
<td>Most abundant antibody in the blood – 80%</td>
</tr>
<tr>
<td><strong>IgM</strong></td>
<td>About 5-10% of all antibodies in blood and lymph</td>
</tr>
<tr>
<td><strong>IgD</strong></td>
<td>Represents only 0.2% of all antibodies</td>
</tr>
<tr>
<td><strong>IgA</strong></td>
<td>Makes up 10-15% of all antibodies</td>
</tr>
<tr>
<td><strong>IgE</strong></td>
<td>Represents only 0.01% of all antibodies</td>
</tr>
</tbody>
</table>

## Action of Antibody

- **How do antibodies work?**

  - Neutralising
  - Immobilizing
  - Agglutination and Precipitation
  - Initiating the complement system
  - Enhancing phagocytosis
## Immunological Memory

- Memory T-cells and memory B-cells form

- Memory cells respond rapidly on second exposure
Immunological Memory

- Measured through antibody titre (amount of antibodies in the serum)

- **Primary response:**
  slow rise first in the levels of Ig M and then Ig G after a period of several days.

- **Secondary response:**
  Accelerated, more intense response of the memory cells to subsequent encounters with the antigen.

Provides basis for vaccination against certain diseases
Immunological Memory

![Graph showing primary and secondary immune responses](image)

- **Primary response**
  - Antibody titer (arbitrary units)
  - First exposure
  - Second exposure

- **Secondary response**
  - IgG
  - IgM
  - Days

Figure 22-19 Principles of Anatomy and Physiology, 11/e © 2006 John Wiley & Sons

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Types of Immunity that develops upon encounter with various types of antigens

<table>
<thead>
<tr>
<th>Type of Immunity</th>
<th>How Acquired</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naturally acquired active immunity</td>
<td>Following exposure to a microbe, antigen recognition by B cells and T cells and costimulation lead to antibody-secreting plasma cells, cytotoxic T cells, and B and T memory cells.</td>
</tr>
<tr>
<td>Naturally acquired passive immunity</td>
<td>Transfer of IgG antibodies from mother to fetus across placenta, or of IgA antibodies from mother to baby in milk during breast-feeding.</td>
</tr>
<tr>
<td>Artificially acquired active immunity</td>
<td>Antigens introduced during a vaccination stimulate cell-mediated and antibody-mediated immune responses, leading to production of memory cells. The antigens are pretreated to be immunogenic but not pathogenic; that is, they will trigger an immune response but not cause significant illness.</td>
</tr>
<tr>
<td>Artificially acquired passive immunity</td>
<td>Intravenous injection of immunoglobulins (antibodies).</td>
</tr>
</tbody>
</table>

Table 22-4 Principles of Anatomy and Physiology, 11/e © 2006 John Wiley & Sons
Medical & Clinical Terminology

**Signs**
- Objective evidence of a disease

**Symptoms**
- Subjective evidence of a disease
Medical & Clinical Terminology

Symptoms

- Evidence perceived by the patient

There are seven attributes of a symptom
- Its location
- Its quality
- Its quantity or severity
- Its timing
- Factors that make it better or worse
- The setting where it occurs
- Associated manifestations
Medical & Clinical Terminology

Disorder
- A disruption of or an interruption with normal functions or established systems

Disease
- A condition of abnormal vital function involving any structure, part, organ, or system of the body. A specific illness or disorder characterised by a recognisable set of signs and symptoms attributable to heredity, infection, diet or environment.
Medical & Clinical Terminology

**Condition**
- A state of being specifically in reference to physical or mental health and wellbeing

**Syndrome**
- A set of symptoms occurring together resulting from a common cause or appearing in combination to present a clinical picture of a disease or inherited abnormality
  - e.g. Acquired Immunodeficiency syndrome, Syndrome X

**Diagnostics**
- Tests, observations or procedures providing information about a disease process
Medical & Clinical Terminology

Diagnosis
- Identification of a disease or condition
- The art of naming a disease or condition

Differential diagnosis
- Determining the difference and establishing the presence of a particular disease by elimination or exclusion.
- Is dependent on:
  - Signs
  - Symptoms
  - Assessment: Physical, Emotional
Medical & Clinical Terminology

**Aetiology**
- The study of all factors that may be involved in the development of a disease
- idiopathic
- iatrogenic

**Pathogenesis**
- development or sequence of events in a disease process

**Pathophysiology**
- The physiology of the disease process changing normal function
Medical & Clinical Terminology

**Epidemiology**
- The study of the determinants of disease events in populations (patterns and occurrences)
- Mortality - death rates
- Morbidity - disease rates
Medical & Clinical Terminology

Risk Factor
- Increase your chance of getting an illness?
- A factor that causes a person or group of people to be particularly susceptible to an unhealthy event
- Example
  - Immunosuppression - increases the incidence and severity of infection
  - Cigarette smoking - increases the risk of developing a respiratory or cardiovascular disease
## Descriptive Terms in Clinical Medicine

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute</td>
<td>Short term</td>
</tr>
<tr>
<td>Chronic</td>
<td>Long term</td>
</tr>
<tr>
<td>Prognosis</td>
<td>What is likely to happen</td>
</tr>
<tr>
<td>Exacerbation</td>
<td>Worsening / flare-up</td>
</tr>
<tr>
<td>Remission</td>
<td>Signs &amp; symptoms regress</td>
</tr>
<tr>
<td>Endogenous</td>
<td>Internal source</td>
</tr>
<tr>
<td>Exogenous</td>
<td>External source</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apoptosis</td>
<td>Programmed cell death without inflammation</td>
</tr>
<tr>
<td>Atrophy</td>
<td>Decrease in cell tissue, or organ size or function</td>
</tr>
<tr>
<td>Cyanosis</td>
<td>Blue tinge to the skin or mucus membranes</td>
</tr>
<tr>
<td>Dysplasia</td>
<td>Disorganisation of tissue or change in cell size or shape</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>Breathlessness, laboured or difficult breathing</td>
</tr>
<tr>
<td>Granuloma</td>
<td>A small nodular delimited aggregation of mononuclear inflammatory cells, or a collection of modified macrophages resembling epithelial cells, usually surrounded by a rim of lymphocytes.</td>
</tr>
</tbody>
</table>
# Medical Terminology

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gangrenous</td>
<td>Ischaemic injury (dry necrosis) often followed by infection (wet necrosis)</td>
</tr>
<tr>
<td>Caseous</td>
<td>Like cream cheese e.g Ghon complex in TB</td>
</tr>
<tr>
<td>Non-caseous</td>
<td>Liquifactive, haemorrhagic</td>
</tr>
<tr>
<td>Hyperplasia</td>
<td>Increase in cell numbers</td>
</tr>
<tr>
<td>Hypertrophy</td>
<td>Increase in cell size</td>
</tr>
<tr>
<td>Hypoxia</td>
<td>Lack of or decreased oxygen to the tissues</td>
</tr>
<tr>
<td>Infarction</td>
<td>Death of the tissues from irreversible hypoxia</td>
</tr>
<tr>
<td>Ischaemia</td>
<td>Inadequate delivery of oxygen to the tissues</td>
</tr>
<tr>
<td>Lesion</td>
<td>A zone of tissue with impaired function as a result of damage by disease or injury</td>
</tr>
</tbody>
</table>
# Medical Terminology

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Metaplasia</strong></td>
<td>Change of one mature tissue type into another e.g Barretts oesophagus</td>
</tr>
<tr>
<td><strong>Oedema</strong></td>
<td>Accumulation of fluid in the interstitial tissue spaces</td>
</tr>
<tr>
<td><strong>Syncope</strong></td>
<td>A temporary suspension of consciousness, faint or swoon</td>
</tr>
<tr>
<td><strong>Tachycardia</strong></td>
<td>Rapid heart rate. Generally over 100 beats per minute in an adult.</td>
</tr>
<tr>
<td><strong>Tinnitus</strong></td>
<td>A perceived sound with no external stimulus. Ringing, rushing or roaring noise in the ears.</td>
</tr>
</tbody>
</table>
Cellular Adaptation - Overview

**Normal cells**

**Atrophy**

**Hyperplasia**

**Hypertrophy**

**Metaplasia**

**Dysplasia**

**Neoplasia (malignancy)**

**Figure 1-1**
Abnormal cellular growth patterns.

Cellular Responses - Atrophy

A decrease or shrinkage in cell size

Common cell type:
Skeletal and cardiac muscle, secondary sex organs and the brain

Causes:
Aging, lack of hormonal stimulation, HIV infection, disuse
Cellular Responses - **Hypertrophy**

An increase in the size of cells and consequently in the size of the affected organ

**Common cell type:**
Cardiac muscle, kidney cells

**Causes:**
- Increase in protein synthesis, decrease in protein degradation or both.
- Excess workload

Cellular responses - **Hyperplasia**

An increase in the number of cells resulting from an increased rate of cellular division

**Common cell type:**
- Epithelial, kidney cells, hepatocytes

**Causes:**
- Increased mitosis, growth factors, hormones

Cellular responses - **Dysplasia**

Often reversible abnormal changes in the size, shape and organisation of mature cells

**Common cell type:**
- Epithelial tissue of cervix, respiratory tract

**Causes:**
- As for hyperplasia

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Cellular responses - **Metaplasia**

The reversible replacement of one mature cell by another, sometimes less differentiated, cell type

**Common cell type:**
- Epithelial cells

**Causes:**
- Irritants

Cellular responses - Neoplasia

The uncontrolled progressive multiplication of cells

Common cell type:
- Any fast dividing cells

Causes:
- Carcinogens
- Increased mitosis; loss of tumour suppressor genes that control cell division


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Cellular responses - Anaplasia

The loss of differentiation of cells and their orientation to one another and their axial framework and blood vessels

Common cell type:
• Usually fast dividing cells, eg: hepatocytes

Causes:
• Loss of control of suppressor genes and the cellular differentiation process
Tissue & Organ Responses

- **Changes in tissue types**
  - Scar formation
  - Necrosis

- **Organ Responses**
  - Hypertrophy or atrophy of the organ
  - Altered function
  - Hyper or hypo-secretion of products
  - Overwork, exhaustion and organ failure
  - Loss of function
## The Effects of Cellular Adaptation

<table>
<thead>
<tr>
<th>Cellular Adaption</th>
<th>Organ</th>
<th>Effect on the Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrophy</td>
<td>Brain</td>
<td>Multiple effects</td>
</tr>
<tr>
<td>Hypertrophy</td>
<td>Heart</td>
<td>Weakens</td>
</tr>
<tr>
<td>Metaplasia</td>
<td>Trachea</td>
<td>Increased mucous etc.</td>
</tr>
<tr>
<td>Hyperplasia</td>
<td>Liver</td>
<td>Loss of metabolic processes</td>
</tr>
<tr>
<td>Neoplasia</td>
<td>Pituitary</td>
<td>Multiple effects</td>
</tr>
<tr>
<td>Hyperplasia</td>
<td>Prostate</td>
<td>Urinary retention</td>
</tr>
<tr>
<td>Dysplasia</td>
<td>Cervix</td>
<td>Painful intercourse</td>
</tr>
<tr>
<td>Anaplasia</td>
<td>Ovary</td>
<td>Infertility, low hormones</td>
</tr>
</tbody>
</table>
Atrophy

Hypertrophy
Epidermal Hyperplasia

http://casereports.bmj.com/content/2009/bcr.09.2008.0845/F2.large.jpg
Prostatic Hyperplasia

http://www.uaz.edu.mx/histo/pathology/ed/ch_17/c17_51.jpg
Uterine Dysplasia

http://library.med.utah.edu/WebPath/jpeg4/FEM008.jpg
Normal – Dysplasia – Neoplasia

A Normal Epithelium

B Squamous Metaplasia

C Mild Dysplasia

D Moderate Dysplasia

E Severe Dysplasia

F Carcinoma in situ

Barrett’s Oesophagus

[Diagram showing normal squamous oesophageal epithelium and metaplastic Barrett’s oesophagus]

http://www.nature.com/nrc/journal/v3/n9/images/nrc1166-f1.gif
Barrett’s Oesophagus

http://www.memorialhermann.org/uploadedimages/edc/editslide9.jpg
Liver neoplasia

http://www.ajronline.org/content/193/1/W7/F15.large.jpg
Abbreviations

- **Hx** History
- **Dx** Diagnosis
- **Rx** Treatment
- **c/o** complains of
- **pt** patient
- **cl** client

- **N/A** not applicable
- **1/7** 1 day
- **1/52** 1 week
- **1/12** 1 month
- **OTC** over the counter
- **Qd or die** every day
- **Bid or bd** twice a day
- **Tds** three times a day
- **qid** four times a day
- **Qod** every other day
- **ac** before meals
- **pc** after meals

Search the internet under common medical abbreviations.
Readings and Resources

Resources:

- **Set Textbooks:**

- **Additional textbooks:**
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