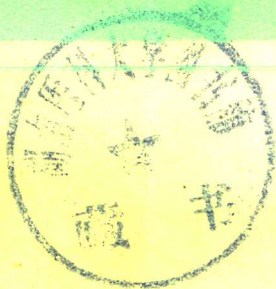


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Edited by  
**Kong Xianshou**

# **Aids to Pathophysiology**



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# Aids to Pathophysiology

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## PREFACE

Pathophysiology is an important course in medical college, which explains the underlying mechanisms of disease. It lies at a very critical point at the crossroads between basic medical science and clinical medicine. Now the concepts of pathophysiologic mechanisms have broad applications to the areas of medicine.

This book is mainly written for medical students and medical workers who are studying the pathophysiology. The contents of this book are based on the late textbooks and authoritative reference books. This book is divided in 20 chapters. The headings of the chapters and factual information are very closed to the textbook. The characteristics of this book is to present most of the facts in note form including a lot of tables and diagrams on the hope that concentrated products will be more readily absorbed. In some chapters of this book an introduction to normal related physiology and biochemistry designed for overview precedes the elucidation of pathophysiology. In writing this book it is to try to summarize my own teaching experiences of pathophysiology with English in our university and to reflect some recent advances in related fields of pathophysiology, so this book is also useful for medical teachers particularly who are teaching the pathophysiology.

The purpose of this book is to offer an aid to medical students and medical workers who are learning the pathophysiology. For medical students, using this book may save the student's time to make a note of lecture on class and help students to review lectures after class. Reading this book will also help students to prepare examination of pathophysiology and to raise the special English level of medicine quickly. In addition, this book can be as a reading materials outside class. Medical workers including clinical practitioners who want to understand pathophysiology in conjunction with clinical theory may find this book will also be useful for them.

Finally it is hoped that this book will be beneficial to the medical students and medical workers who are interested in the pathophysiology. For readers any criticisms regarding errors and suggestions for improving this book are most welcome.

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# CHAPTER 1 DISEASE

## The Contents of Pathophysiology and Its Position in Medicine

Pathophysiology is the study of mechanism by which disease occurs in living organisms. It is concerned with the causes and the responses of the body to disease process, and with the effects of pathophysiologic alterations on normal function and metabolism, and with the descriptions of the manifestations and sequel of disease. Therefore pathophysiology is one of the important sciences on which the practice of clinical medicine is based. Much pathophysiologic research has led to broad clinical applications in the understanding, diagnosis and treatment of disease.

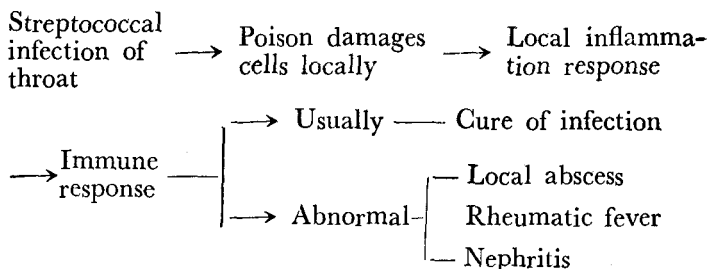
## Concept of Disease

Disease is defined as a form of life beyond the limits of normal under the actions of certain cause and condition. It has the disturbances of the function, metabolism and structure and / or the abnormal state of mentality and social adaptation in the body, which are manifested by a serious of symptoms and signs, and it may affect the whole body or any of its parts.

In other words, disease occurs when there are variations

of structure, function and/or metabolism outside normal range. Manifestation of disease is essentially a summation of the damage done by a harmful agent and body's response to it. However, in many diseases the harmful agents are multiple and the manifestations and progress of the disease are very complex.

Streptococcal sore throat is an example of a disease process caused by a single harmful agent — streptococcus. The progress of this disease process is as follows:



In conclusion, DAMAGE done by HARMFUL AGENT + BODY'S REACTION = DISEASE.

The relationships between disease, pathophysiology and clinical medicine are as follows:

DISEASE	PATHOPHYSIOLOGY	CLINICAL MEDICINE
Variation outside normal range →	Studies: the disease's <ol style="list-style-type: none"> <li>1. Causes (etiology)</li> <li>2. Mechanisms (pathogenesis)</li> <li>3. Manifestation</li> <li>4. Progress and sequel</li> </ol>	Studies: the disease's <ol style="list-style-type: none"> <li>1. Diagnosis</li> <li>2. Prophylaxis</li> <li>3. Therapy</li> </ol>

## Causes of Disease

Etiology is to study the causes of diseases that acting in concert provoke the particular disease. In the etiology of a particular disease a range of extrinsic or intrinsic factors in the environment must be considered

### Etiological Factor

#### 1. Extrinsic factor

- (1) Biological agents — Viruses, bacteria, fungi, rickettsia, spirochete, parasites all can cause diseases. They may do so by causing cell destruction directly or by toxins released from the infecting agents indirectly.
- (2) Physical agents — Among these there are trauma, mechanical force, radiation, extremes of heat and cold, severe or sudden change of atmosphere pressure, electrical current, etc..
- (3) Chemical poisons — Some act in a general manner such as cyanide which is toxic to all cells, other act locally, for example, strong acids and alkalis. Another groups exhibit an affinity for certain organs, for example, organic phosphorus, arsenic, mercury and lead cause damage especially in the liver and kidneys.
- (4) Nutritional deficiencies and excess — These may arise as a result of abnormal supply, absorption or defective utilization within the body. These may cause malnutrition, fat disease, vitamin deficiency

or intoxication, and deficiency of trace elements (Fe, Cu, Zn, Se, I, and F etc.),

## 2. Intrinsic factor

- (1) Abnormal immunological responses — Hypersensitivity to various substances may lead to shock, asthma, etc.. In other circumstances the immune process may act against the body cells, autoimmunity, to induce autoimmune diseases, and the nonspecific and specific depressed immune function may lead to the immunodeficiency diseases, e. g., acquired immunodeficiency syndrome (AIDS).
- (2) Psychological factors — Anxiety, strong or persistent psychological stimulation and psychological stress may lead to mental illness and may be related to such diseases as hypertension, peptic ulcer and, coronary arterial thrombosis.
- (3) Inherited factors — Abnormalities of the number and structure of chromosome and component gene may cause the disease or increase in susceptibility to some diseases, e. g., Down's syndrome (trisomy-21).
- (4) Congenital factors — Abnormal development in fetus stage is present at birth. It can either be genetically determined or acquired, e.g., congenital heart disease.

## Predisposing Factor

Predisposing factor refers to the factors that influence

the resistance or susceptibility to disease for body.

1. Genetic constitution — e.g., type of HLA (human leukocyte antigen) and group of blood of individuals.
2. Physiological make up — e.g., structure and function of critical systems in body.
3. Psychological characteristics — e.g., type of nerve system.

Precipitating factor

Precipitating factor refers to the factors that intensify the roles of etiological factors to promote the development of disease or pathological process.

1. Nature conditions — e.g., weather conditions and geographical environment.
2. Social factors — e.g., labour and hygiene conditions, and living style.
3. Body's conditions — e.g., fatigue, anxiety, etc..

Some diseases are single factorial in origin, but in most diseases the multiple factors are usually involved.

## Pathogenesis of Disease

Pathogenesis of disease refers to the development or evolution of the disease. The pathogenesis studies how the primary pathogenic agent can cause the disease in the body. The basic mechanisms of pathogenesis in disease include neural, humoral and cellular mechanisms. The general rule of pathogenesis in disease are the damage of homeostasis state of the body, the body's responses to damage and anti-damage,

and the reverse of cause-result in disease process.

## Manifestations of Disease

During disease, the disturbances of the function, metabolism and structure in the body are manifested by a serious of symptoms and signs.

“Symptom” is regarded as a subjective complaint that is noted by the person afflicted with disorder and can only be reported by the patient to an observer, e. g., pain, nausea, dizziness, and malaise.

“Sign” is a manifestation of disease that is noted and discovered by observers and examiners, e.g., fever, jaundice, palpable mass, dilated pupils, and cardiac murmur.

“Syndrome” is a set of signs and symptoms that occur together and connect each other, which are present in a specific disease state, e. g., adult respiratory distress syndrome (ARDS), Cushing’s syndrome, and hepatorenal syndrome.

“Pathological process” is a process in which some common and regular alterations of function, metabolism and morphology appear in many diseases. One disease may involve several pathological processes such as “hypoxia”, “fever”, “edema”, and “inflammation”, etc..

## Adaptation to Alteration of Body

Adaptation is an ability of human body to withstand

exposure to a variety of environmental stresses for maintaining its internal environment within the normal confines. Adaptation is affected by the following factors: age, function of critical system, and time for adaptation.

## **The Process of Disease**

Disease often progresses through several following stages:

1. Latent period — an interval occurring between exposure of a tissue to an injurious agent and prior to the earliest symptoms.
2. Prodromal period — the period between appearance of the first symptom and the main symptoms of the disease.
3. Period of manifest illness — the disease reaches its full intensity of signs and symptoms in the stage.
4. Resultant period — the result of disease may be recovery or exacerbation so as to death.

## **Outcome of Disease**

There are three outcomes of the disease:

1. Complete recovery

Complete recovery means the pathological changes and manifestations both disappear in the body.

2. Incomplete recovery

Incomplete recovery means the main symptoms disappear but some pathological changes are still present in

the body.

### 3. Death

The mark of death is the brain death. There are four criteria for the brain death.

- (1) Irreversible coma and cerebral unresponsivity
- (2) Absence of cephalic reflexes and dilated pupils
- (3) Absence of vital functions — heart arrest and breathing stop
- (4) Absence of any electrical activity of the brain — appearance of linear EEG.

**(Kong Xianshou)**

# CHAPTER 2 WATER AND SODIUM DISORDERS

## Normal Metabolism of Water and Sodium

### Water Function

1. Water is a good solvent for many body chemicals.
2. Water is essential to metabolism.
3. Water is necessary for body temperature regulation and body fluid osmotic pressure regulation.

### Volume and Distribution of Body Fluid

**Tab. 2-1 Normal water distribution in the body**

Water distribution	% of body weight
Total Body Water (TBW)	50~80
Intracellular fluid (ICF)	30~45
Extracellular fluid (ECF)	20~35
Interstitial fluid	15~30
Intravascular fluid	5

## Maintenance of Fluid Volume

**Tab. 2-2 Water intake and loss per day in normal adult**

Water intake (ml/d)		Water loss (ml / d)	Lowest water loss (ml/d)	
Drink	1000~1500	Urine	1000~1500	Urine 500
Food	700	Feces	100	Feces 100
Oxidation water 300		Respiration	400	Respiration 400
		Skin	500	Skin 500
Total	2000~2500	Total	2000~2500	Total 1500

### Distribution and Function of Body Sodium

#### 1. Distribution of body sodium

90% of body  $\text{Na}^+$  is in the ECF and determines the osmotic pressure and volume of the ECF. The ECF or blood concentration of  $\text{Na}^+$  is 130-150 mmol / L (mEq / L). The osmotic pressure of ECF or blood is 280-310 mOsm / L.

#### 2. Functions of sodium

- (1) Maintaining the osmotic pressure and volume of ECF.
- (2) Maintaining the excitability of nerve and muscle.
- (3) Maintaining the acid-base balance of the body.

### Regulation of Volume and Osmolarity of Body Fluids

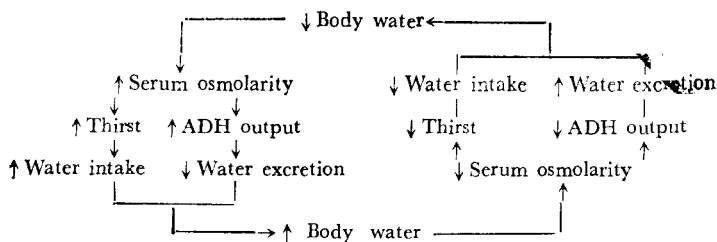


Fig. 2-1 Regulation of water balance in body

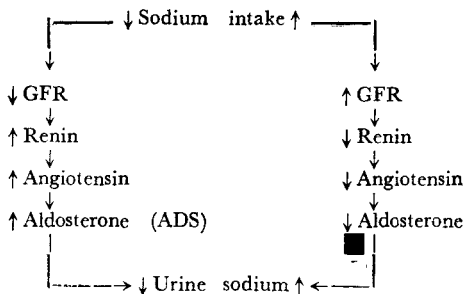


Fig. 2-2 Regulation of sodium balance in body

## Dehydration

An excessive loss of body fluid is often referred to as dehydration. So the term dehydration describes a state of body fluid deficit in body. The water loss is usually accompanied by a loss of sodium, so there are three types of dehydration.

### 1. Hypertonic Dehydration

Concept

(1) Water loss > Salt loss