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How Our Bodies Fight Disease

Marion D.Kendall

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——人体如何抵御疾病

剑桥英语科普注释读物系列

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出 版 说 明

随着我国改革开放的深入和对外科技交流的发展，广大科技工作者迫切需要通过英语媒介获取专业科技知识，了解相关学科领域的最新发展动态；而有一定英语基础的普通读者则亟需通过阅读大量英语版的科普文章来扩大知识面，获取信息，同时提高英语水平。因此，引进一批国外原版的优秀科普读物，满足广大读者的需要，是改革开放进一步深化的需要，是当务之急。

我社从英国剑桥大学出版社引进的这本《以死亡求生存：人体如何抵抗疾病》（*Dying to Live*：*How Our Bodies Fight Disease*）就是这样一部优秀的科普作品，所涉及的医学免疫学是发展很快的学科，内容浩瀚，但是作者通过生动、形象的语言和翔实的例子，介绍了人体免疫系统识别和清除病原体的过程、免疫系统的组成及其功能、免疫反应的过程等等内容，并将大量的比喻手法运用其中，有助于读者形成科学、理性的认识。本书还提供精心绘制的插图，能使读者兴趣倍增。

本书可作为大专院校生物、医学专业学生的专业英语教材或课外读物，也可用作提高科普阅读能力的读物。

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Introduction

Acquired Immunodeficiency Syndrome (AIDS) AIDS patients are severely immunocompromised, since the human immunodeficiency virus (HIV) attacks many of the immune system cells and destroys them. As a result, the patient cannot fight off any pathogens that enter the body through the skin or other major ports of entry, such as the mouth, anus, eyes and sweat glands. Nor can the patient combat uncontrolled growth of cancerous cells within the body. In the initial stages of an HIV infection, before any serious problems are suspected, the skin may have a transient rash. As the disease progresses, patients may develop a number of skin conditions, such as dermatitis around the sebaceous glands of hairs, persistent genital ulcers, and eczema. Fungi such as *Candida albicans*, which can affect many healthy people without harming them, become a problem and cannot be controlled. Later on in the HIV infection, many patients have shingles, and the serious skin and connective tissue cancer, Kaposi's syndrome, takes hold. This is seen as pink/purple blotches on the skin which may ulcerate, and swellings caused by enlarged lymph nodes. As many as 40% of homosexual patients with AIDS develop Kaposi's syndrome, yet in healthy men that are not infected with HIV it is rare and only occurs in older men of certain Mediterranean origins. In Africa, both men and women may develop Kaposi's syndrome in AIDS. Over 70% of patients get infections in the eyes, and these problems are often the first reason for patients seeking help from the medical profession.

Thus, observing the problems that arise in AIDS, and other more commonly encountered diseases that are totally unrelated to AIDS, demonstrates how the normal, healthy body tries to combat disease. The immune system often wins, but if it cannot cope then many conditions can get out of control and become life-threatening.

It was the publicity surrounding the shocking news that millions of people could die from a disease caused by HIV that doctors were unable to cure that made so many people, from a very wide spectrum of backgrounds and lifestyles, stop and think about immunity. The science of immunology is relatively new to medicine compared to other disciplines such as surgery. It is evolving so rapidly that even those involved in immunology every day have to read widely to keep abreast of developments. The more that is known about the processes governing the immune reactions, the more the pathways are found to be astoundingly intricate. Immunologists use a very large vocabulary of specialist words, and often shorten the terms to a series of capital letters; thus, the jargon is impossible for the uninitiated to understand.

This book was conceived to appeal to the very many people who, during their lifetime, have relatives or friends who suffer(ed) from diseases involving the immune system. It is about the modern science of immunology that has grown up around disease and how the body copes with it. Most people will have only a rudimentary idea of how the body functions, so I have started quite simply. As the story unfolds, the descriptions of the various interactions get more complicated, so each chapter can be read on its own and, if the details are not understood, a few paragraphs here and there can be skipped over, and a new aspect of immunology explored with the next chapter (see figure on p. 21).

Immunology is about combating disease. Most people have a knowledge of certain aspects, perhaps of childhood measles, or the concept of vaccination and immunisation in childhood, or before travel. Very few, other than interested specialists, try to grapple with the breadth of the subject. Yet we would all benefit from understanding more about the body's defences to viruses, bacteria and other pathogens in order to cope with life-threatening situations such as cancers, AIDS and autoimmunity. Firstly one needs an understanding of the principles of the processes involved, then to be alerted to the possible interactions with daily life, pollution, diet, etc., before appreciating how immune status affects the quality of life and its outcome. Much of immunology relies upon three tenets: recognition, reaction and recovery. Each of these topics forms a section of this book, and one leads on naturally to the next. Reading the whole book will not allow the diagnosis or treatment of immune diseases, but it may enable a better understanding. I hope that in so doing, the reader will be fascinated to discover the ingenuity of the human body and of pathogens.

The human body is made up of millions of cells. A stereotyped cell was explained to most of us in school, but there is a major step between knowing what a basic building block is, and understanding how cells interact to allow the whole body to function. We all know that an egg can be fertilised, after which it divides and new cells are created that can develop into bone, nerve or muscle, or systems that can allow sights to be memorised and thoughts processed. Furthermore specialised cells can roam the body, recognise invaders in the form of viruses, bacteria or foreign proteins and initiate a chain of reactions that may result in the invader being eliminated. But how do cells recognise each other, interact, pass messages and respond to signals from other cells? Why do cells die, and what effect does the death of one cell have on our own death? How is it that we can live and cope with some harmful interactions from the environment, but others kill or debilitate us?

Such thoughts have puzzled mankind since microscopy revealed cells, so scientists have striven to unravel the mysteries in all ways possible. Today we have an intimate knowledge of cell structure, composition and its genetic potential, and scientists think an ultimate understanding is within our grasp. Even then, we shall only have partial answers to these questions because life processes are not static. With every cell division comes an opportunity to change the building blocks and, in reproduction, genetic recombination allows evolution. This is not unique to Man but also happens to all plants and animals around us.

Major contributions to advancing knowledge in areas that might lead to answering some of these questions have come through the growth in the study of disease through immunology. The progress of this science has enabled giant steps to be made in understanding the life of cells. Immunology is very basic to all life. Not only do the most primitive animals, those without brains or complex sense organs such as eyes, have the ability to mount a protection against foreign (or 'non-self') invaders, but many principles employed are remarkably similar throughout the whole animal kingdom. Such 'conservation', as it is called, is generally recognised as being of utmost importance, as its presence indicates that a basic problem exists which has to be dealt with by many different life forms. It is not surprising then that evolution has allowed the development of many different ways of combating disease, for to fail to overcome infection and illness leads to death or lasting disabilities.

The many ways that are utilised by the cells of the body to control foreign invaders such as bacteria or viruses ultimately result in the death of the invader, or the cells that contain them. Thus the targeted death of cells is a life-giving event. Failure to control invaders means uncontrolled disease and ultimately death of the individual. Because the act of death is so final, and often psychologically painful for those left alive, society often regards death as bad. Inside our bodies, it is rarely destructive to life itself, and is generally the means of saving life. Hence the title of the book — Dying to Live.

Contents

PART I — RECOGNITION

1

Molecules[①] *of Distinction*[②]

Rejecting transplants The techniques involved with modern transplantation[③] surgery[④] are very good today, allowing a wide range of organs to be successfully replaced. However, the patient's own body has unique methods of recognising and acting against bacteria[⑤], viruses[⑥] or many foreign invaders in order to overcome them. The same reactions take place against donor[⑦] organs since they come from a different body, so powerful drugs are used to reduce these natural, usually beneficial, reactions that are potentially harmful in transplantation surgery. Of great importance is the genetic similarity[⑧] or dissimilarity between donor and recipient[⑨]. If a group of genes[⑩], known as the histocompatibility[⑪] genes, are identical in both donor and recipient, then there would be no problems of transplant tissue[⑫] being rejected. Since all individuals inherit[⑬] some genes from each parent, the resultant[⑭] genes in the child will not exactly match those of either parent or any brothers and sisters. So, no

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① molecule: smallest unit into which a substance could be divided without a change in its chemical nature 分子(物质不改变其化学性质的最小单位)

② distinction: point of difference; that which makes one thing different from another 特性;不同之处;差别之处

③ transplantation: 移植

④ surgery: the science and practice of treating injuries and diseases by operations 外科

⑤ bacteria: 细菌

⑥ virus: 病毒

⑦ donor: person who gives something 供体;捐赠者

⑧ similarity: likeness 相似;相像

⑨ recipient: person who receives something 受体

⑩ gene: one of the factors controlling heredity 基因

⑪ histocompatibility: 组织不相容性

⑫ tissue: 组织

⑬ inherit: derive(qualities, etc.) from ancestors 由遗传而得;继承

⑭ resultant: coming as a result, esp. as the total outcome of forces or tendencies from different directions 作为结果而生的

two individuals, except identical twins where the fertilised egg① was split② into two, will have the same set of genes (their genetic make-up). Surprisingly, the immune system's③ cells can recognise the differences and, as a result, the transplant can be destroyed. In order to ensure success after surgery, the body's own immune system must be dampened④ down to minimise the chances of any cells reacting to the graft⑤ and causing rejection. The patient is therefore very susceptible to⑥ infections and diseases during this period, and to cancers in the longer term. Thus, treatments must be finely judged to balance between combating⑦ disease and allowing the natural processes to reject the transplant.

How is it that animals know their own species⑧, their mates, and their own young? Whilst sending signals through behaviour is one approach, there are more subtle mechanisms operating on individual cells that allow the uniqueness of the individual to show. The immune system uses these molecules in controlling invaders, and in keeping the whole body healthy. To do this the immune system's cells distinguish 'self' from 'non-self', and so avoid the problems of attacking one's own body in mistake for invading organisms. Key players in immunity are antigens⑨ and antibodies⑩. Antigens are signals from bacteria, viruses, fungi⑪, parasites⑫ or even plant components such as pollen⑬. Some are recognised immediately, but other signals have to be processed inside our body before the immune system will react to them. The signals are usually given to the immune system in combination with other signs, often from our own cells, to ensure that they are reacted to as required. The

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① fertilised egg: 受精卵
② split: divide or burst; divide into parts 分裂
③ immune system: 免疫系统
④ dampen: suppress 抑制
⑤ graft: 移植物
⑥ be susceptible to: be sensitive to; easily affected by 易感的
⑦ combat: fight; struggle 斗争
⑧ species: group having some common characteristics; division of a genus 种类
⑨ antigen: 抗原
⑩ antibody: 抗体
⑪ fungi: 真菌
⑫ parasite: animal or plant living on or in another and getting its food from it 寄生虫;寄生物
⑬ pollen: 花粉

antibodies are made by us to fit small parts of the antigen so that the antigen is bound in an antigen-antibody complex. Thus the antigen is inactivated and controlled. Subtle alterations to any of these interactions can cause the reactions to go wrong and result in disease.

This sophisticated use of antibody is a hallmark① of a highly evolved② immune system that we and other warm-blooded animals have developed over millions of years. Simpler animals use simpler systems. These too need signalling molecules, but they are often very general ones that can be recognised without the need for antibodies. Such systems are quick to respond, and very effective, so we have kept them alongside the antigen/antibody responses, or incorporated them into the whole set of immune reactions that we use.

Today, the greatest need is to exploit these immune reactions of the body to help us control disease. Even when an immune reaction is clearly defined, one finds that the body and the invader can, and do, use alternative methods of achieving the same end. Thus, a new vaccine③, for example, may only work in some cases, or against the disease as it exists at that point in time. The result is that drug development is very expensive and rarely, if ever, gives perfect results. The most advanced approaches to drug development now use manipulations of genes. These tiny fragments④ of protein exist in all living cells and contain millions of instructions for making cellular components; therefore, the instructions are, of necessity, very precise. Changing instructions in genes can now be achieved and, at the end of this book, some ways in which these molecular biology techniques, as they are called, are described. Most of us are afraid of gene manipulation in case irretrievable⑤ mistakes are made, but the understanding of genes has gone so far now that we cannot escape the fact that genetic manipulations will be used in future. The more we know about how the immune response works, the more safe and effective new techniques will be.

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① hallmark: 标志

② evolve: be developed, naturally and gradually 自然而逐渐地发展、进化

③ vaccine: 疫苗

④ fragment: part broken off; separate or incomplete part 碎片;断片

⑤ irretrievable: that cannot be retrieved or remedied 不可挽回的;不能补救的

Similarity and Dissimilarity

One of the extraordinary facts about people is that we are all different, physically and mentally, yet we are sufficiently alike to be able to communicate even when there is no common language. If we need to describe another person, or make an 'Identikit', the physical differences between us all may be so slight that it is hard to pinpoint the uniqueness of an individual. Yet our mental, emotional and inner strengths can vary enormously. This is because each person, and indeed every plant or animal, uses the same building blocks, which are called cells, to make their physical form. The result of the construction process depends on the specific plans we have acquired from our parents and also the environment in which we grew up.

The cell itself is amazingly similar in most animals, and shares many of its features with those of plants. However, although built along a basic plan, the outsides of cells can be varied to make a variety shapes and sizes, and the insides adapted to perform different functions. Thus, the human body contains dozens of types of cells. Some make pigment① to give the skin its colour, others are able to stretch and contract to make muscles, whilst others are adapted to capture light and allow us to see. All cells, whether they come from the heart, brain, lungs or eye, have a nucleus②, which floats in a liquid soup named the cytoplasm③, all held together in a bag or plasma membrane which lets nutrients④ in and waste out in a controlled way (Fig. 1.1). Each cell contains information inherited from both the mother and the father. Since there is so much information concerning the body that has to be passed from the parents to the newly created child, the information is tightly packed together and stored in structures called chromosomes⑤ that are contained within the nucleus. Humans have 23 pairs of chromosomes, one set from the mother

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① pigment: the natural coloring matter in the skin, hair, etc., of living beings 色素

② nucleus: 细胞核

③ cytoplasm: 胞浆

④ nutrient: serving as or providing nourishment 养分

⑤ chromosome: 染色体