NORMAL CELLULAR FUNCTIONS, DISEASE AND IMMUNOLOGY

2

David J Harrison and Stewart Fleming

INTRODUCTION

Disease may result from an abnormality in structure or function within a single cell, for example in cancer, but more often than not it manifests itself because of the way in which other cells and tissues are affected and take part in the response to the original cause.

Understanding the normal function of cells and tissues gives insight into both the cause and effect of disease, as well as beginning to allow rational design of therapy. Normal cellular function is encapsulated in the reproductive cycle. The body originates from a single fertilized ovum and generates different tissues, including germ cells in the gonads that ensure the survival of the species. This involves many processes: cell proliferation, cell deletion, intercellular communication, basic energy supply and use, oxygen delivery and combustion, protective mechanisms that may be active or passive and complex gene programming which can be overridden in certain circumstances by the environment in which a cell finds itself. For this complex organization to function there must be many checks and balances, and ways in which different cells and tissues can communicate with each other. At the heart of understanding the pathogenesis of disease is recognizing how different injuries and insults can subvert or overwhelm these normal physiological processes and lead to an imbalance in homeostasis. This principle is well illustrated by the normal and abnormal function of the immune system, which comprises the latter half of this chapter.

COMPONENTS OF THE CELL: STRUCTURE

With the exception of the red blood cells, all living cells in the human body contain a nucleus in which resides the majority of genetic information; the mitochondria harbour 37 genes, 13 of which code for proteins. The nucleus is not an inert structure cut off from the rest of the cell (Figure 2.1). The nuclear membrane is constantly crossed by factors which regulate the expression of genes and may repair DNA damage as soon as it occurs. The chromatin material that is the scaffold for the double-stranded DNA is packaged very tightly. It is critically important that this wrapped

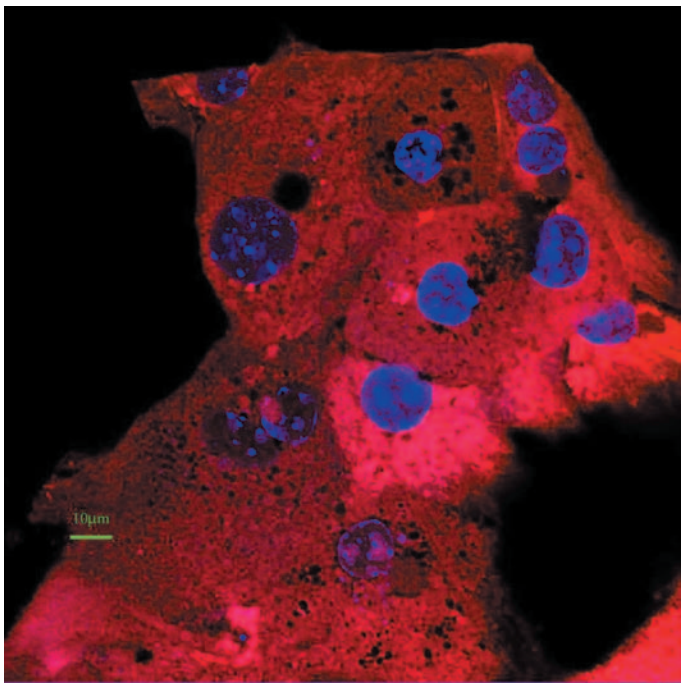

FIGURE 2.1 Nuclei in liver cells stained blue within cytoplasm. Nuclei communicate with cytoplasm, and cells connect intimately with one another through a variety of cell junctions. (Confocal fluorescence microscopy.)