Chapter 3
Endocrine Disruptors and DNA Damage: Mechanisms, Risks, and a Public Health Implications

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ABSTRACT

Endocrine disruptors, which are environmental chemicals, interfere with hormone regulation and increase health risks. This chapter examines the DNA-damaging effects of EDs, which lead to mutations, genomic instability, and the development of cancer. Key molecular mechanisms include oxidative damage, epigenetic alterations, and receptor-mediated abnormalities that result from EDs exposure and associated health issues. It also discusses the risks of endocrine disruptors for pregnant women and children, as well as other vulnerable population groups. The discussion encompasses public health implications as well as regulatory standards for risk evaluation and methods to minimize exposure. Future directions include advancing biomarker development, refining risk assessment models, and designing safer chemical alternatives to reduce exposure.

1. INTRODUCTION

Environmental chemicals in the class of endocrine disruptors function as hormone mimics while blocking hormone production, transport, and binding and removal. The industrial and pesticide products, along with plastics, cosmetics, and domestic use products, contain BPA (Bisphenol A), phthalates, DDT (Dichlorodiphenyltrichlo-

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roethane), PCBs (Polychlorinated Biphenyls), and phytoestrogens. These harmful substances remain in the environment and human bodies, leading to severe health problems. Multiple observational studies, together with experimental findings, have shown that EDs trigger carcinogenesis while causing metabolic disorders, reproductive issues, and neurodevelopmental disorders.

1.1. Endocrine Disruptors (EDs) and DNA Damage

The exposure to Endocrine Disruptors results in DNA damage, which occurs either directly or indirectly by producing reactive oxygen species that affect DNA bases and chromosomes. Certain EDs modify DNA methylation patterns as well as histone modifications while keeping the DNA sequences unaltered. The simultaneous occurrence of epigenetic modifications and DNA damage results in cancer development and diseases. Breast cancer cells grow faster when exposed to BPA along with other EDs through mechanisms that activate estrogen receptors. Phthalates serve as a prevalent ED that results in testicular dysgenesis while producing cancer-causing effects. The development of cancer occurs when DNA damage pairs with hormone disruption caused by Endocrine Disruptors.

1.2. Structure and Scope of the Chapter

This chapter starts with a brief overview of Endocrine Disruptors and their origins. The following section explains EDs and DNA damage and their effects on human health. The following section investigates how DNA repair mechanisms work in cancer formation and their impact on fertility and metabolic syndrome. The chapter analyzes how EDs contribute to disease development in vulnerable patient groups. The chapter section addresses how the reader can implement public health policies, regulatory standards, and prevention measures for ED production.

2. ENDOCRINE DISRUPTOR: DEFINITION, ED SOURCES, AND EXPOSURE ROUTES

2.1. Definition

According to the World Health Organization/IPCS (2002), Endocrine disruptors (EDs) are exogenous substances or mixtures that interfere with hormone action and cause adverse health effects in the whole organism, its progeny, or (sub)population.

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