

## Mechanisms of Hepatotoxicity Induced by Novel Pharmaceuticals: An Integrative Review

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### Abstract

Hepatotoxicity, a critical adverse effect observed with various pharmaceuticals, poses significant challenges in drug development and clinical practice. This integrative review explores the diverse mechanisms through which novel pharmaceuticals induce liver toxicity. Key mechanisms include direct hepatocyte injury via oxidative stress, mitochondrial dysfunction, and covalent binding; immune-mediated responses such as allergic and autoimmune-like reactions; and cholestasis resulting from BSEP inhibition and canalicular damage. The review also highlights the role of molecular pathways, including cytochrome P450 enzymes, nuclear receptors, and signaling pathways.

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### I

Hepatotoxicity is a complex phenomenon involving multiple mechanisms. It can be induced by various factors, including direct hepatocyte injury, immune-mediated responses, and cholestasis. The review explores the diverse mechanisms through which novel pharmaceuticals induce liver toxicity. Key mechanisms include direct hepatocyte injury via oxidative stress, mitochondrial dysfunction, and covalent binding; immune-mediated responses such as allergic and autoimmune-like reactions; and cholestasis resulting from BSEP inhibition and canalicular damage. The review also highlights the role of molecular pathways, including cytochrome P450 enzymes, nuclear receptors, and signaling pathways.

### D

Detailed description of the mechanisms of hepatotoxicity induced by novel pharmaceuticals. This section discusses the various pathways and factors involved in liver damage, including oxidative stress, mitochondrial dysfunction, and immune-mediated responses. It also covers the role of cytochrome P450 enzymes and nuclear receptors in drug metabolism and toxicity. The review highlights the importance of understanding these mechanisms for the development of safer pharmaceuticals.

### I

Integrative review of the mechanisms of hepatotoxicity induced by novel pharmaceuticals. This review synthesizes the current knowledge on the diverse mechanisms through which novel pharmaceuticals induce liver toxicity. Key mechanisms include direct hepatocyte injury via oxidative stress, mitochondrial dysfunction, and covalent binding; immune-mediated responses such as allergic and autoimmune-like reactions; and cholestasis resulting from BSEP inhibition and canalicular damage. The review also highlights the role of molecular pathways, including cytochrome P450 enzymes, nuclear receptors, and signaling pathways.



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