Introduction

Drug toxicity can arise from several factors, each influencing the severity and nature of adverse effects. One primary cause is the inherent chemical properties of the drug itself. Some substances may have toxic metabolites or may accumulate in specic organs or tissues, leading to harm over time. For example, certain chemotherapy drugs can damage the liver or kidneys due to their chemical structure or metabolites [1-3].

Methodology

Another factor contributing to drug toxicity is individual variability in drug metabolism and response. Genetic variations can affect how drugs are absorbed, metabolized, and excreted from the body, influencing their efficacy and toxicity. Age, sex, underlying health conditions, and concurrent use of other medications also play crucial roles in determining an individual's susceptibility to drug toxicity [4,5].

Mechanisms of drug toxicity

Understanding the mechanisms by which drugs exert toxic effects is essential for predicting and managing toxicity. Some common mechanisms include:

Certain drugs can directly damage tissues or organs they come into contact with. For instance, non-steroidal anti-inflammatory drugs (NSAIDs) can cause gastrointestinal ulcers and bleeding due to their direct irritant effect on the stomach lining.

Drugs may interfere with essential cellular processes, such as mitochondrial function or protein synthesis, leading to dysfunction or cell death. This mechanism is seen in drugs like chemotherapy agents that target rapidly dividing cancer cells but can also affect normal cells.

Drugs can trigger immune responses in the body, leading to allergic reactions or autoimmune diseases. These reactions can range from mild rashes to life-threatening anaphylaxis.

Some drugs are metabolized into toxic byproducts that can accumulate in the body, particularly in patients with impaired liver or kidney function. This accumulation can lead to systemic toxicity over time [6-8].

Concurrent use of multiple medications can alter the metabolism or effects of drugs, increasing the risk of toxicity. For example, combining certain antidepressants with monoamine oxidase inhibitors can lead to serotonin syndrome, a potentially fatal condition.

Mitigating drug toxicity

Efforts to mitigate drug toxicity focus on several strategies:

Rigorous testing in laboratory settings helps identify potential toxic effects before drugs are tested in humans. This includes studying the drug's pharmacokinetics (absorption, distribution, metabolism, and excretion) and pharmacodynamics (mechanism of action and effects on the body).

During clinical trials, drugs are tested in carefully monitored populations to assess both efficacy and safety profiles. These trials help identify common and rare adverse effects, guiding prescribing practices and patient management.

Advances in pharmacogenomics allow healthcare providers to tailor drug therapies based on an individual's genetic profile, minimizing the risk of adverse reactions and optimizing treatment outcomes.

Post-marketing surveillance and pharmacovigilance programs monitor drug safety in real-world settings, identifying rare or long-term adverse effects that may not have been evident during clinical trials.

Healthcare providers and patients play crucial roles in recognizing