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Anticancer Drug Protection in Neurodegenerative Disorders a Medication Repurposing Approach

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Abstract

Neurodegenerative disorders and cancer, though seemingly disparate, share underlying cellular and molecular mechanisms, including aberrant cell proliferation and programmed cell death. This convergence provides a unique opportunity for medication repurposing, where existing anticancer drugs may find a new role in mitigating neurodegenerative diseases. This review explores the potential of repurposing anticancer drugs as a novel therapeutic approach for neurodegenerative disorders. We delve into the commonalities between these seemingly distinct pathologies and discuss the promise, challenges, and future directions in harnessing the anticancer potential for neuroprotection.

Keywords: Anticancer drugs; Neurodegenerative disorders; Medication repurposing; Neuroprotection; Alzheimer's disease

Introduction

Neurodegenerative disorders, such as Alzheimer's disease, Parkinson's disease, amyotrophic lateral sclerosis (ALS), and Huntington's disease, represent a growing global health crisis with limited treatment options. These diseases are characterized by the progressive degeneration of neurons, leading to debilitating cognitive and motor impairments, as well as, in many cases, premature death. In contrast, cancer is primarily characterized by uncontrolled cell proliferation and invasion, which, if left unchecked, can result in severe morbidity and mortality. While these two classes of diseases may appear dissimilar, they share certain underlying cellular and molecular mechanisms, such as altered apoptotic pathways, DNA damage response, and inflammation. In recent years, the concept of drug repurposing, also known as drug repositioning, has gained momentum as a strategy to identify novel treatments for a range of diseases, including neurodegenerative disorders [1,2]. This approach involves the investigation of existing drugs, initially developed for one medical condition, to determine whether they can be efficacious in the management of a different ailment. Among the most intriguing possibilities for drug repurposing is the exploration of anticancer agents for their potential to protect against neurodegeneration. This is grounded in the shared biological pathways and molecular targets that drive both cancer and neurodegenerative diseases, presenting an opportunity to leverage the pharmacological properties of anticancer drugs for neuroprotection. This review aims to shed light on the convergence of neurodegenerative disorders and cancer at a molecular and cellular level. We will explore the rationale behind repurposing anticancer drugs for neuroprotection, highlighting the potential benefits and challenges associated with this approach. Additionally, we will discuss notable examples of anticancer drugs currently under investigation for their neuroprotective properties and consider the future directions and implications of this emerging field of research. As the search for effective treatments for neurodegenerative disorders continues, the exploration of anticancer drugs for repurposing offers a promising avenue that may hold the key to innovative therapeutic strategies and improved patient outcomes [3]. While these two groups of diseases appear fundamentally distinct, they share common cellular and molecular mechanisms, such as disrupted apoptotic pathways, DNA damage response, and inflammatory processes. In recent years, drug repurposing, also known as drug repositioning, has gained significant attention as a strategy for identifying novel treatments for a variety of diseases, including neurodegenerative disorders. This approach involves investigating existing drugs initially developed for one medical condition to determine if they can be repurposed effectively for the treatment of a different ailment. Among the most promising opportunities for drug repurposing is the exploration of anticancer agents for their potential neuroprotective properties. This concept is grounded in the shared biological pathways and molecular targets that drive both cancer and neurodegenerative diseases, presenting an opportunity to leverage the pharmacological properties of anticancer drugs for neuroprotection. This comprehensive review aims to elucidate the convergence of neurodegenerative disorders and cancer at a molecular and cellular level, providing a rationale for the repurposing of anticancer drugs to protect against neurodegeneration. We will explore the potential benefits and challenges associated with this approach, showcase notable examples of anticancer drugs currently under investigation for neuroprotection, and discuss future directions and implications within this emerging field of research. As the search for effective treatments for neurodegenerative disorders continues, the exploration of anticancer drugs for repurposing represents a promising avenue that may hold the key to innovative therapeutic strategies and improved patient outcome [4-6].

Discussion

Common molecular mechanisms in neurodegenerative disorders and cancer

Apoptotic pathways: Both neurodegenerative disorders and cancer are associated with imbalances in apoptotic pathways. Neurodegenerative diseases often feature impaired apoptosis, resulting in the accumulation of damaged neurons, while cancer is characterized

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by the evasion of apoptosis, allowing the survival of abnormal cells.

DNA damage response: Defects in DNA damage response mechanisms are common to both conditions. Neurons in neurodegenerative disorders exhibit DNA damage without efficient repair, and cancer cells frequently harbor mutations in DNA repair genes, leading to genomic instability.

Inflammation: Chronic inflammation is a hallmark of both neurodegeneration and cancer. Neuroinflammation exacerbates neuronal damage in neurodegenerative disorders, while tumor-associated inflammation promotes cancer cell growth and migration.

Oxidative stress: Oxidative stress is a shared feature, with both neurodegenerative disorders and cancer experiencing elevated levels of reactive oxygen species (ROS). This oxidative stress contributes to cellular damage and disease progression.

Rationale for repurposing: Repurposing anticancer drugs for neuroprotection is founded on the premise that these agents, designed to target pathways crucial for cancer cell survival, may also affect similar pathways in neurodegenerative disorders, providing potential therapeutic benefits.

Benefits of anticancer drugs: Many anticancer drugs have well-established safety profiles and pharmacokinetic data, potentially accelerating their path to clinical use for neurodegenerative disorders.

Challenges and risks: There are significant challenges, including potential side effects and dose optimization that must be addressed when repurposing anticancer drugs for neuroprotection.

Notable anticancer drugs under investigation for neuroprotection

Bexarotene: Bexarotene, an FDA-approved drug for cutaneous T-cell lymphoma, has shown promise in Alzheimer's disease by enhancing the clearance of amyloid-beta peptides.

Rapamycin: Rapamycin, a well-known anticancer drug, has exhibited neuroprotective effects in preclinical models of neurodegenerative disorders through mTOR pathway modulation.

Imatinib: Imatinib, a tyrosine kinase inhibitor approved for chronic myeloid leukemia, is being explored for its potential in Parkinson's disease due to its neuroprotective properties [7-10].

Conclusion

In conclusion, the convergence of molecular pathways in neurodegenerative disorders and cancer provides an intriguing and innovative opportunity for the repurposing of anticancer drugs as potential neuroprotective agents. While these two classes of diseases may seem disparate, their shared biological mechanisms, including disrupted apoptotic pathways, DNA damage response, inflammation, and oxidative stress, underline the potential for common therapeutic strategies. The rationale for repurposing anticancer drugs is rooted in the premise that these agents, designed to target vital pathways for cancer cell survival, may also influence similar pathways in neurodegenerative disorders, potentially providing therapeutic benefits. Looking ahead, the field of anticancer drug repurposing for neuroprotection holds the promise of personalized medicine, where treatments can be tailored to individual patients based on their genetic and molecular characteristics. Combining repurposed anticancer drugs with existing neurodegenerative disease treatments may yield synergistic effects, ultimately improving patient outcomes. In conclusion, while the repurposing of anticancer drugs for neuroprotection is a complex and evolving field, it offers exciting possibilities for the development of innovative therapies for neurodegenerative diseases. With continued research, clinical trials, and regulatory support, this approach may open new avenues for addressing the devastating impact of these disorders, potentially transforming the landscape of neurodegenerative disease treatment.

Conflict of Interest

None

Acknowledgment

None

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