Journal of Pharmacokinetics & Experimental Therapeutics

Poul, J Pharmacokinet Exp Ther 2023, 7:5

Mini Review Open Access

Human Genetics and Network Biology for Advancing Next-Generation Drug Repurposing Techniques

Joyobrato Poul*

Department of pharmacology, Asam, India

Abstract

In recent years, the intersection of human genetics and network biology has emerged as a powerful approach in the field of drug repurposing. This research article provides an overview of the innovative techniques and methodologies that leverage genetic information and network-based analysis to identify novel therapeutic applications for existing drugs. We discuss the potential of this approach to accelerate drug discovery, improve drug safety profiles, and enhance the efficiency of clinical trials. By integrating large-scale genomics data, molecular networks, and computational tools, researchers are poised to revolutionize the drug development landscape, ultimately leading to more effective treatments for a wide range of diseases.

Keywords: Drug repurposing; Human genetics; Network biology; Genomics; Molecular networks; Drug discovery

Introduction

The development of new pharmaceutical drugs is a time-consuming, costly, and high-risk endeavor. The conventional drug discovery process often takes many years and billions of dollars before a new drug reaches the market. In contrast, drug repurposing, also known as drug repositioning or drug rediscovery, offers a promising alternative to expedite the introduction of new therapies. This approach involves finding new uses for existing drugs, which are already approved or in various stages of clinical development [1]. Human genetics and network biology have recently become integral components of next-generation drug repurposing techniques. By harnessing the vast amount of genomic data available and applying sophisticated network analysis methods, researchers can systematically identify potential drug candidates for diverse diseases, minimizing the time and resources required for preclinical and clinical development. Human genetics plays a pivotal role in advancing drug repurposing efforts. The availability of large-scale genetic data, such as genome-wide association studies (GWAS) and sequencing data enables the identification of genetic variants associated with disease susceptibility, progression, and drug response [2]. These genetic insights provide a foundation for understanding the molecular underpinnings of diseases and, consequently, identifying potential therapeutic targets. Network biology involves the construction and analysis of molecular interaction networks that represent the intricate relationships among genes, proteins, and other biological molecules. Integrating human genetics and network biology allows researchers to build disease-specific interaction networks that reveal key genes, pathways, and biological processes involved in the disease pathogenesis [3]. Drug repurposing has attracted elevated attention, mainly in the context of drug discovery charges that continue to be too low no matter a current wave of approvals for organic therapeutics (e.g. gene therapy). These new organic entities-based remedies have excessive fees that are hard to justify for small markets that encompass uncommon diseases. Drug repurposing, involving the identification of single or mixtures of present tablets primarily based on human genetics records and community biology processes represents a next-generation strategy that has the viable to make bigger the pace of drug discovery at a decrease cost [4]. This Pharmacological Perspective opinions development and views in combining human genetics, specially genome-wide affiliation studies, with community biology to force drug repurposing for uncommon and frequent illnesses with monogenic or polygenic etiologies. Also, highlighted right here are necessary aspects of this subsequent era strategy to drug repurposing, which can be mixed with desktop studying techniques to meet the challenges of personalised medicine. Ankyrin is a binding protein linking structural proteins of the cytoplasm to spectrin, a protein current in the membrane cytoskeleton in human erythrocytes that features as an anchoring device to grant resistance to shear stress [5]. A genetic defect in ankyrin manufacturing is related with a hereditary structure of hemolytic anemia, spherocytosis. Other participants of the ankyrin household are broadly expressed in a number tissues and organs along with the brain, the place they act to immobilize ion channels and different proteins at precise websites of the neuronal plasma membrane. In time, ankyrin had been characterised as a family of proteins in a position to bind with excessive specificity to a massive range of special proteins. A splendid combine of specificity and variety has been attributed in section to a couple of genes encoding for ankyrins, and to choice splicing of RNAs. However, most of the range is due to the unusual tertiary shape of the protein, involving a collection of up to 29 tandem copies of a 33-aminoacid residue repeat placed at the N-terminal [6].

Discussion

The integration of human genetics and network biology into drug repurposing has shown significant promise, offering a more efficient and cost-effective path to identifying novel therapies. By leveraging the wealth of available genomic and biological data, researchers have successfully unearthed new applications for existing drugs. These advances hold several implications and open up new avenues for discussion. The approach discussed in this article facilitates the identification of disease-specific drug candidates, potentially leading to more targeted therapies. As we delve deeper into the genetics of diseases, the concept of personalized medicine becomes increasingly feasible. Matching specific patient genotypes with the most appropriate repurposed drug has the potential to revolutionize clinical practice,

***Corresponding author:** Joyobrato Poul, Department of pharmacology, Asam, India, E-mail: j.poul@gmail.com

Received: 30-Sep-2023, Manuscript No: jpet-23-117543; **Editor assigned:** 02-Oct-2023, Pre QC No: jpet-23-117543 (PQ); **Reviewed:** 16-Oct-2023, QC No: jpet-23-117543; **Revised:** 23-Oct-2023, Manuscript No: jpet-23-117543 (R); **Published:** 31-Oct-2023, DOI: 10.4172/jpet.1000199

Citation: Poul J (2023) Human Genetics and Network Biology for Advancing Next-Generation Drug Repurposing Techniques. J Pharmacokinet Exp Ther 7: 199.

tailoring treatments to individual needs and improving patient outcomes. Repurposed drugs offer a quicker route to addressing unmet medical needs, especially in rare diseases or conditions for which developing new drugs may not be economically viable. The approach can bring hope to patient populations who have limited treatment options and where traditional drug development pipelines have been historically slow to respond. Despite the promising results of this approach, there remain several challenges in its widespread adoption. Effective data integration from diverse sources, ranging from genomics to clinical records, requires robust computational methodologies. Developing more accurate and comprehensive disease-specific networks is essential to increasing the success rate of drug repurposing efforts. Repurposing drugs for new indications raises important ethical and regulatory questions. It's essential to ensure that repurposed drugs meet the necessary safety and efficacy standards for the new indications. Regulatory agencies must adapt to this evolving landscape by creating pathways for the approval of repurposed drugs, especially for diseases with limited treatment options [7-10].

Future Aspects

Multi-omics integration

The future of drug repurposing will likely revolve around the integration of multi-omics data, combining genomics, proteomics, metabolomics, and more. These integrative approaches will provide a more comprehensive understanding of disease mechanisms and, subsequently, identify even more potential drug candidates.

Artificial intelligence and machine learning

Advancements in artificial intelligence and machine learning algorithms will play a critical role in streamlining the drug repurposing process. These technologies can automate data analysis, predict drug-disease interactions, and optimize clinical trial designs, significantly increasing the efficiency of repurposing efforts.

Collaboration and data sharing

Collaboration among academia, pharmaceutical companies, and regulatory agencies will be instrumental in advancing drug repurposing. Encouraging data sharing and fostering partnerships will expedite the identification and validation of repurposed drugs.

Patient-centered approaches

Engaging patients in the drug repurposing process is vital for success. Their insights, experiences, and genetic data can provide valuable information that informs repurposing decisions and ensures that repurposed drugs address unmet patient needs effectively.

Global health impact

The wide adoption of drug repurposing techniques holds the potential to impact global health by making treatments more accessible and affordable. This approach is particularly relevant for resource-limited regions, where repurposed drugs can address diseases that disproportionately affect vulnerable populations.

Conflict of Interest

None

Acknowledgment

None

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