Commentary

iMedPub Journals
www.imedpub.com

Journal of Clinical & Experimental Nephrology
ISSN 2472-5056

2024
Vol.9 No.2:241

Comparative Study of Renal Organoid Development from Human Induced Nephron Progenitors: Techniques and Outcomes

John Smith*

Department of Nephrology, University Hospital, New York, USA

Corresponding author: John Smith, Department of Nephrology, University Hospital, New York, USA, E-mail: Smith_J@gmail.com

Received date: March 12, 2024, Manuscript No. IPJCEN-24-19001; **Editor assigned date:** March 15, 2024, PreQC No. IPJCEN-24-19001 (PQ); **Reviewed date:** March 29, 2024, QC No. IPJCEN-24-19001; **Revised date:** April 05, 2024, Manuscript No. IPJCEN-24-19001 (R); **Published date:** April 12, 2024, DOI: 10.36648/2472-5056.9.2.241

Citation: Smith J (2024) Comparative Study of Renal Organoid Development from Human Induced Nephron Progenitors: Techniques and Outcomes. J Clin Exp Nephrol Vol.9 No.2: 241.

Description

The kidneys perform the essential functions of filtering, selectively reabsorbing and secreting urine from the blood to maintain the body's cellular environment by eliminating salts and water. This helps regulate the composition and volume of extracellular fluid, crucial for controlling blood pressure. Nephrons, the kidney's functional units consisting of a glomerulus and a tubule lined with epithelial cells, number around 0.30–1.4 million per human kidney. Nephrons play a vital role in complex kidney processes, including the Tubuloglomerular Feedback (TGF) mechanism, which responds to flow rate-dependent electrolyte changes in the loop and the myogenic mechanism, which manages vascular pressure in arterioles. The TGF mechanism communicates vascular signals among neighboring nephrons, while myogenic mechanism oscillations synchronize frequencies. These mechanisms exhibit nonlinear behaviors and interact intricately. Studies focus heavily on cortical nephrons at the kidney's surface; however, deeper nephrons receive signals with varying time delays, leading to complex interactions and phenomena like synchronization, chimera states, spiral waves and stochastic resonance. The field of fractional order calculus has gained popularity because fractional derivatives exhibit infinite memory, allowing for more flexible modeling and increased nonlinear behavior compared to integer-order derivatives. Conversely, derivative presents challenges in implementing initial values that lack physical significance and measurability, rendering it unsuitable for complex systems with chaotic regions. The Caputo derivative is more appropriate for discussing chaotic systems since the initial values required by this definition correspond to identifiable physical states in the system. Nevertheless, it's important to acknowledge that while the Caputo derivative is widely used in modeling complex systems, concerns have been raised by some researchers regarding its application.

Computational methods

For example, certain investigations have revealed that applying the Caputo derivative to specific systems can yield non-physical outcomes. Additionally, the choice of fractional derivative and its order significantly influences system behavior, underscoring the need for careful consideration in modeling complex systems. Fractional calculus is increasingly recognized for its capacity to represent highly nonlinear systems, necessitating the use of effective and dependable computational methods for solving fractional differential equations. The discussed article presents a survey of literature on synchronization within networks characterized by fractional orders, multiple delays and nonlinear interactions. They highlight disparities in synchronization between integer-order and fractional-order networks and identify challenges unique to fractional systems.

Dysfunctional kidneys

Research has identified that cardiovascular diseases can be linked to irregular blood pressure, which in turn may stem from dysfunctional kidneys responsible for blood pressure regulation; this connection underscores the significance of studying the intricate oscillations in the kidney's mechanisms regulating blood pressure. This investigation employs well-established physiological principles and previous autoregulation models to develop a fractional order nephron autoregulation model, delving into the model's dynamical behavior through bifurcation plots that unveil patterns such as periodic oscillations, chaotic regions and multistability. Furthermore, the study explores the collective dynamics by simulating a lattice array of the model, demonstrating the occurrence of chimeras within the network structure. Additionally, a ring network configuration of the fractional order model is examined with a focus on diffusion coupling strength, revealing a basin of synchronization influenced by parameters such as coupling strength, fractional order, or number of neighbours and gauging the degree of incoherence. In essence, this research offers valuable insights into the nuanced dynamics of the nephron autoregulation model and its potential implications for understanding cardiovascular diseases.