Innovations
UNIVERSITY OF COLORADO
ANSCHUTZ MEDICAL CAMPUS

Automated iPSC to Cardiac Muscle Differentiation

Product

Scalable and robust cardiomyocytes from iPSCs

Indication

Abundant and expandable cell source for cardiomyopathy research and treatment

Value Propositions

- Standardized & controlled method with reduced errors due to limited operator intervention
- Cell source for cardiac diseases and/or injuries
- Abundance, scalability, and controlled differentiation of human pluripotent stem cells

Market (via GlobalData)

- Cardiomyopathy
  - $9.3 B (2031)
  - CAGR = 12.4% (2021-2031)

Intellectual Property

- US Application: 16/964,548

Key Documents

- Controlled Release of Small Molecules for Cardiac Differentiation of Pluripotent Stem Cells

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Cardiomyocytes

Cardiomyopathies disrupt heart muscle function, causing irreversible, enduring issues. Current treatment mainly alleviates symptoms, often necessitating heart transplants. The specialized muscle cells of the heart, known as cardiomyocytes (CM), have limited capacity for replication and are in a terminal state of differentiation. This inherent limitation hampers the natural regeneration of damaged cardiac tissue. To address this unmet need, induced pluripotent stem cells (iPSC) offer a scalable solution for cardiac tissue engineering. However, current methods have limitations, including scarce functional CM and complex processes. Streamlining CM production from stem cells is vital for advancing clinical iPSC-based cardiac therapies.

Standardized & Controlled Differentiation of iPSCs to CMs

At its core, the groundbreaking innovation lies in a method that achieves a precise and consistent transformation of induced pluripotent stem cells (iPSC) into fully functional cardiac muscle cells (**Figure**), without the need for operator intervention. This achievement is made possible by loading porous silica particles with stem cell differentiation factors, coating them with a biodegradable polymer, and exposing them to iPSCs. Furthermore, this pioneering technology seamlessly integrates the silica nanoparticles with the inventor's 3D hydrogels and a specially designed bioreactor. The result is a self-contained system with the potential for deployment in a hospital setting, where it could generate fully functional beating cardiomyocytes. This breakthrough has far-reaching applications, extending into the fields of tissue engineering and beyond.

Advantages:

- **Standardized** = Silica nanoparticles temporally release stem cell differentiation factors for cardiac iPSC transformation, without manual intervention.
- **Controlled & Scalable** = cardiomyocyte-inducing methods can occur in a bioreactor. Added fluids through an inlet and removal of cell culture media through an outlet, ensures a stable fluid volume during cardiomyocyte differentiation.

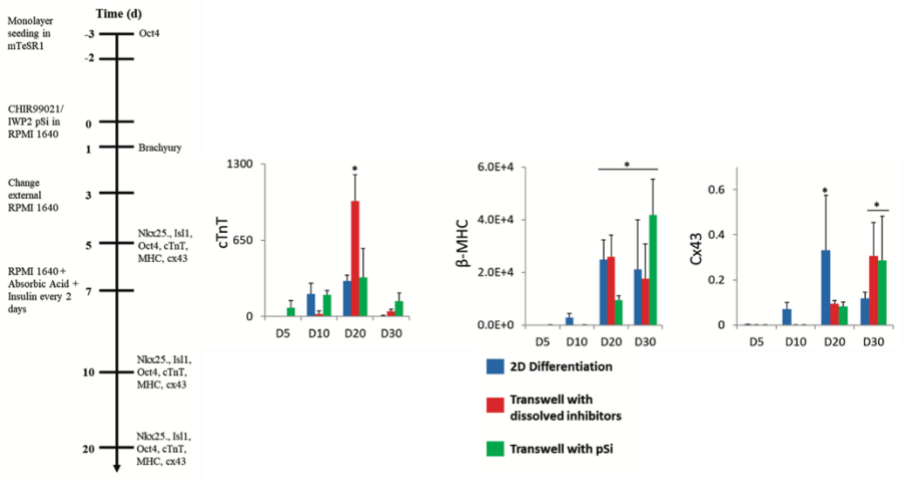

Figure. Timeline of porous silica particles (pSi) differentiation (left) and comparing late cardiac differentiation markers (cTnT, β-MHC, Cx43) with those at Day 0 (D0) (right).

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