Cell-In-Gel System to Control Mechanical Stress at the Single Cell and Molecular Level

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ABSTRACT

Excessive mechanical stress leads to heart disease and the cellular and molecular mechanisms that transduce mechanical stress in heart cells still remain poorly understood. Researchers at the University of California, Davis have developed a novel Cell-in-Gel system that will enable scientists to investigate the effects of mechanical stress on biological cells as well as the mechano-chemo-transduction mechanisms that allow cells to sense and respond to mechanical stresses.

FULL DESCRIPTION

Effective therapies for mechanical stress induced heart diseases are lacking. Normally, the heart can sense mechanical stress and adjust contractility to counter these stresses; however, excessive strain and stress can lead to cardiac dysfunction and development of heart disease.

Currently, mechano-chemo-transduction (MCT) mechanisms, the cellular and molecular mechanisms that transduce mechanical stress to biochemical reactions in heart cells remain poorly understood. This knowledge gap in the MCT mechanisms is largely due to the lack of research technology that can effectively control mechanical stress at a single cell level. Current technologies used include 1-D techniques that stretch cells, but this differs from the 3-D environment in vivo. 2-D techniques to stretch cells that are cultured on membranes or microposts are also used but it is often difficult to attach the cells to the membranes. Some 3-D agar techniques exist; however, the agar does not easily adhere to the cell surface. Additionally, none of the current technologies allow targeted control of mechanical stress applied to specific cell-surface mechanosensors which is critical for studying MCT mechanisms.

Researchers at the University of California, Davis have developed a Cell-in-Gel system capable of controlling mechanical stress at single cell and molecular levels. The system consists of embedding single living heart cells in a 3-D elastic gel that mimics the mechanical environment of heart muscle tissue. The systems also allows for tethering of specific cell-surface molecules that allow the researcher to control mechanical stress on distinct cell mechanosensors. Novel advantages of this technology include the ability to impose longitudinal tension, transverse compression as well as shear stress on the cell during contraction mimicking mechanical stress in heart muscle tissue. Additionally, the tethering of mechanosensors on the cell surface allows for targeted control of mechanical stress application. This new tool will enable scientists to effectively

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OTHER INFORMATION

CATEGORIZED AS

- **Biotechnology**
  - Health
- **Medical**
  - Devices
  - Diagnostics
- **Research Tools**
  - Screening Assays

RELATED CASES

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study the effects of mechanical strain and stress on heart cells and the MCT mechanisms that enable cells to respond to these stresses.

APPLICATIONS

- Research tool for studying mechanical stress effects on biological cells and molecules
- High throughput drug effect screening for mechanical-induced heart diseases

FEATURES/BENEFITS

- The components are non-toxic to living cells.
- It is fast and easy to embed cells in the gel.
- The stiffness of the gel is tunable to control mechanical strain and stress.
- The transparency of the gel allows for high-resolution imaging on microscopes.
- 'Hooks' in the gel allow for controlling stress on distinct cell-surface mechanosensors.
- Gel is made with pure synthetic components.
- User friendly software is available to measure and control the mechanical strain and force applied to the cell.
- The system can be scaled for use in a high throughput drug effect screens.
- The gel is porous and allows for rapid solution exchange for experiments and drug screening.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,539,552	01/21/2020	2014-330

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