Global Journal of Medical Research: C
Microbiology and Pathology
Volume 21 Issue 2 Version 1.0 Year 2021
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4618 & Print ISSN: 0975-5888

Mechanosensors, and Mechanosensing: Mechanosensation, a Perception of the Force and Response

By Rajiv Kumar

Opinion- According to the law of motion, reflex or a reflex action is an uncontrollable phenomenon in response to any induced forces. The same also applies to the cellular processes. Force and response are the two factors of a perception that generates mechanical force and alter cellular behaviors. This phenomenon defined as mechanosensing. Here. The mechanical force originates changes in the conformation of mechanosensory and heaved extracellular matrix or cytoskeletons toward mechanical force.[1] The mechanical force-driven tension instigated in a lipid bilayer and initiated conformational changes in the entrenched sensors. The process of mechanotransduction, cell response toward a mechanical force, translated conformational changes that were generated via mechanical force into a signal having a biochemical message.[2] Overall, mechanosensory are molecules that perform interactions or enzymatic events and can directly sense mechanical dynamics.[3]

GJMR-C Classification: NLMC Code: QW 4

Strictly as per the compliance and regulations of:

Mechanosensors, and Mechanosensing: Mechanosensation, a Perception of the Force and Response

Rajiv Kumar

Opinion

According to the law of motion, reflex or a reflex action is an uncontrollable phenomenon in response to any induced forces. The same also applies to the cellular processes. Force and response are the two factors of a perception that generates mechanical force and alter cellular behaviors. This phenomenon defined as mechanosensing. Here. The mechanical force originates changes in the conformation of mechanosensory and heaved extracellular matrix or cytoskeletons toward mechanical force.[1] The mechanical force-driven tension instigated in a lipid bilayer and initiated conformational changes in the entrenched sensors. The process of mechanotransduction, cell response toward a mechanical force, translated conformational changes that were generated via mechanical force into a signal having a biochemical message.[2] Overall, mechanosensory are molecules that perform interactions or enzymatic events and can directly sense mechanical dynamics.[3] Such a mechanism needs a sense or natural ability to generate and recognize a reflex or reflex action. In the cellular mechanism, these senses operate through mechanical forces (vibration and pressure) recognized by sensory neurons, and the process defined as mechanosensing (Fig. 1). So the physiology of these senses linked directly to cellular behavior.[4] Mechanosensors are the linkages between sense and cellular responses or functioning. The mechanical force is the component of the blueprint of the cell mechanotransduction process to induce changes in cellular behavior or responses. Identifying these processes or changes in cellular responses and pathways as a route for the theranostics will be the key. It will be an important source for early diagnosis, in situ disease monitoring, and prevention.[5] This mechanism is like an evenness process with two phases, forward and backward, simultaneously to represent transformations in the system. Here, "the perception of the force and response to it" has similarities with the symmetry phenomenon of the cellular environment. In cellular processes, conformational changes induced by mechanical forces regulate the mechanosensory via mechanosensing phenomenon, as explained by referring to the law of motion.

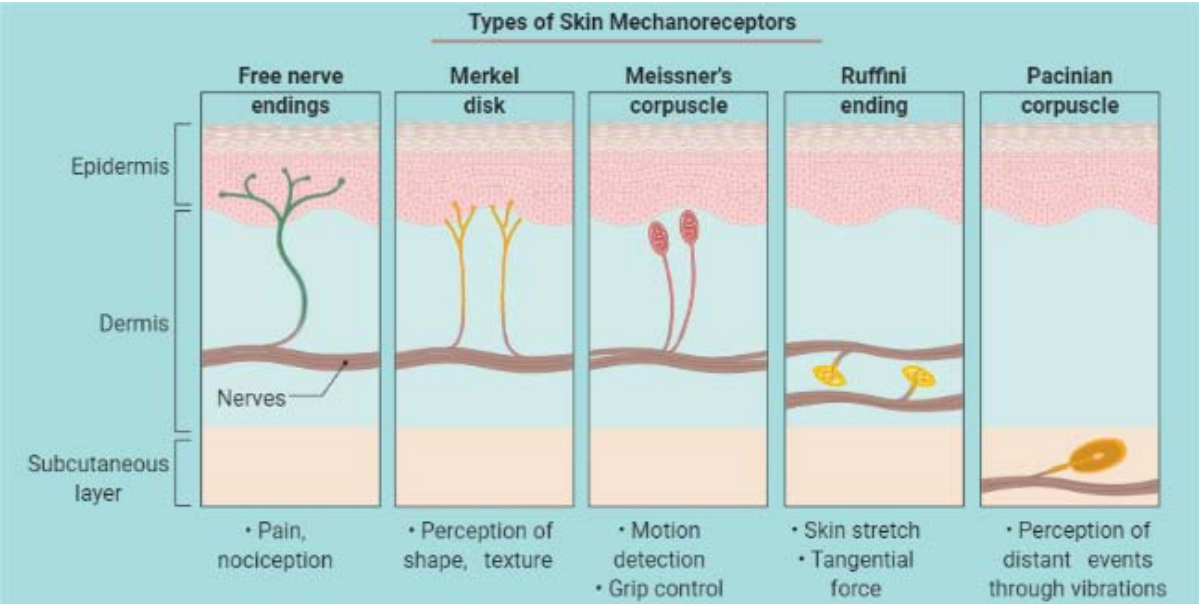

Fig. 1: Illustrate the phenomenon of mechanosensors, and mechanosensing: mechanosensation, a perception of the force and response. "Adapted and created with permission from [biorender.com] and acknowledged.

Author: NIET, National Institute of Medical Science, India. e-mail: chemistry_rajiv@hotmail.com

The mechanosensory are there in lipid bilayers with two ends, one of them surrounded by extracellular matrices or the cytoskeleton, and the opposite end is available for pulling toward the mechanical force.[6] These processes happening on the surfaces of the lipid bilayers will generate vibrations within it. The reaction or any action of the cells toward such activities is governed through cellular response and outlined as mechanotransduction.[7] The chain of the processes proceeds further for translating the earlier proceeding into biochemical signals. Finally, the conformational changes generated by mechanical forces get converted into signaling pathways biochemically. During these biological signaling processes, many chemical changes have occurred[8] It may be the protein-protein interactions or enzymatic activities modulated as force-induced structural changes. For the proof of such chemical transformations, there is a need to identify and discover the molecules successfully having the senses exists in the cellular environment.[9] Therefore, their outputs are implemented to utilize these chemical transformations during the design and architecture of preventive and regenerative therapies. The phenomenon of these transformations occurred by the involvement of the chemicals (molecules) along with their mechanical action as illustrated. It is pointed out that the mechanical stresses or forces originating within the cellular environment and active cytoskeleton can be stimulated by external and endogenous forces.

Generally, cells have focal adhesion proteins and can transmit external forces with their assistance and finally generate cytoskeletal tension and be marked as mechanosensors. Various techniques, including a magnetic tweezers, nanoscale particle tracking, traction microscopy, atomic force microscopy, applied for detecting changes done. The aforementioned techniques used to expose various steps and routes of force transmission and structural remodeling.[10] The approach of force sensing can be applied further to understand the various features of cell division and differentiation and recommended for investigation and innovations in medicine and biology.

Understanding in these blueprints of cell mechanotransduction machinery will nourish the strategies by including these facts. In last, these strategies implemented in the innovation of preventive and regenerative therapies, for enhancing the therapeutic values and initiating the use of nanoscale tools for healing. To achieve these goals, a necessity is there to understand the mechanism of the physiology of multicellular tissues, how do they transmit mechanical forces-induced signals between cells.[11] The understanding of the mechanism of mechanosensing which occurred via mechanosensor is an important aspect, and utilized during the trials of nanoscale therapeutics and theranostics tools in drug delivery and diagnosis.

References Références Referencias

1. Rajiv, K. Cell Shrinkage, Cytoskeletal Pathologies, and Neurodegeneration: Myelin Sheath Formation and Remodeling. Arch. Med. Clin. Res.1, 1–5 (2021).
2. Maurer, M. & Lammerding, J. The Driving Force: Nuclear Mechanotransduction in Cellular Function, Fate, and Disease. Annual Review of Biomedical Engineering vol. 21 (2019).
3. C., S. et al. Repurposing dasatinib for ibrutinib-resistant diffuse large B-cell lymphoma. Blood130, (2017).
4. Hendry, C., Farley, A. & McLafferty, E. Anatomy and physiology of the senses. Nursing standard (Royal College of Nursing (Great Britain) : 1987) vol. 27 (2012).
5. Venugopal, J. & Ramakrishna, S. Nanotechnology: A challenge in health care. in 2007 INTERNATIONAL FORUM ON BIOMEDICAL TEXTILE MATERIALS, PROCEEDINGS 121–128 (2007).
6. Lele, T. P., Brock, A. & Peyton, S. R. Emerging Concepts and Tools in Cell Mechanomemory. Ann. Biomed. Eng. (2019) doi: 10.1007/s10439-019-02412-z.
7. Kumar, R., Chhikara, B. S., Gulia, K. & Chhillar, M. Cleaning the molecular machinery of cellsviaproteostasis, proteolysis and endocytosis selectively, effectively, and precisely: intracellular self-defense and cellular perturbations. Molecular Omics vol. 17 11–28 (2021).
8. Selimkhanov, J. et al. Accurate information transmission through dynamic biochemical signaling networks. Science (80-.). (2014) doi:10.1126/science.1254933.
9. Meng, Y. et al. Orthodontic mechanical tension effects on the myofibroblast expression of alpha-smooth muscle actin. Angle Orthod.80, 912–918 (2010).
10. Rajiv, K. Elucidation of the origin of autoimmune diseases via computational multiscale mechanobiology and extracellular matrix remodeling: theories and phenomenon of immunodominance. Curr. Med. Drug Res.5, Art. ID 215 (2021) (2021).
11. Dorland, Y. L. & Huveneers, S. Cell–cell junctional mechanotransduction in endothelial remodeling. Cellular and Molecular Life Sciences (2016) doi: 10.1007/s00018-016-2325-8.