SHORT COMMUNICATION

Membrane Potential: An Emerging and Important Player in Cancer Metastasis

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The voltage across the plasma membrane which emanates due to the presence of different ion channels/transporters with specific ion selectivity and permeability is known as membrane.[1] It is the main biophysical indication in non-excitable cells controlling some essential cellular activities, such as proliferation and differentiation. Hence, the plurality of different ion channels/transporters indicated on various cells is finely tailored toward maintaining the membrane potential.[2] Bioelectrical activities are characteristics of cancer cells. The depolarization of membrane potential creates a fertile environment for cancer metastasis or proliferation. The cell volume and migration tend to real that the level of membrane potential has functional relevance in cancer cell migration controlled by ion channels/transporters.[3] Hence, in the context of cancer, membrane potential may be necessary for the emergence and maintenance of cancer stem cells resulting to subsistence of tumor growth. Some mechanism may be responsible for cancer metastasis based on the understanding of the membrane potential as a bioelectrical signal in cancer cells. Therefore, membrane potential may be an important valuable clinical marker for tumor test.[4]

Membrane potential is referred to a voltage difference between the internal and external environment following an imbalance in ions.[5] The ion channels and transporters provide the permeability for the ions for instance sodium, potassium, calcium, and chloride. It is expressed relative to the extracellular environment. A poor membrane potential is depolarized which is linked to changes in the conductance of one or more forms of ion.[6] It is affected by difference between intra- and extracellular ion concentration, Na-K pump, and permeability of the cell membrane for ions.[7]

There are some evidences that revealed that membrane potential is involved in functional roles in cells that are not excitable.[8] Some studies indicated that membrane hyperpolarization can affect DNA synthesis and directly linked with the level of differentiation. It has been postulated that membrane potential can directly or indirectly regulate healing of wound and repair.[9]

Membrane potential has been implicated in cancer progression due to the participation of ion channels/transporters in cancer progression. Hence, membrane potential could serve as a bioelectric cancer regulator.[10]

According to some research, there is general correlation between membrane potential and proliferation of cells. This is witnessed in depolarization membrane potential in breast cancer during malignant transformation of normal cells. The cells of cancer cells experience increased depolarization more than the normal tissues.[11]

It has been shown that metastasizing cells indicated a depolarized membrane potential. It is believed that membrane depolarization seems to be a signal that may generate synthesis of deoxyribonucleic acid. Hence, the depolarized membrane potential is common in different cancer.[12]

Furthermore, metastasis results to absence of adhesion at the main site. It can be associated with higher migration and attack circulation through the vascular systems.[13]

It is a fact that cell migration is strictly regulated by ions and water movement.[14] The fluctuation of membrane potential may be exploited in controlling differentiation, metastases, and promote cancer progression.

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REFERENCES

1. Binggeli R, Weinstein RC. Membrane potentials and sodium channels: Hypotheses for growth regulation and cancer formation based on changes in sodium channels and gap junctions. J Theor Biol 1986;123:377-401.
2. Canady KS, Ali-Osman F, Rubel EW. Extracellular potassium influences DNA and protein syntheses and glial fibrillary acidic protein expression in cultured glial cells. Glia 1990;3:368-74.
3. Nnodim J, Nwanguma E, Ohalete C, Njoku-Obi T, Bako H, Aloy-Amadi O. Pathobiological significance and evaluation of membrane potential and selenium in stroke patients. Int J Med Pharm Res 2020;1:46-8.
4. Nnodim J, Nwaokoro JC, Edward U, Oly-Alawuba N. Evaluation of selectins, membrane potential and antioxidant vitamins in diabetic patients attending general hospital Owerri. EC Diabetes Metab Res 2020;4:26-30.
5. Nnodim JK, Meludu SC, Dioka CE, Onah C, Chilaka UJ, Obi PC. Altered membrane potential and electrolyte in sickle cell anemia. J Krishna Inst Med Sci Univ 2020;3:70-3.
6. Nnodim JK, Nwobodo E, Nwadike C, Edward U, Okorie H, Obi P. Membrane depolarization in stroke patients. Acta Med Sci 2016;3:9-11.
7. Adams DS, Levin M. General principles for measuring resting membrane potential and ion concentration using fluorescent bioelectricity reporters. Cold Spring Harb Protoc 2012;2012:385-97.
8. Arcangeli A, Wanke E, Olivotto M, Camagni S, Ferroni A. Three types of ion channels are present on the plasma membrane of friend erythroleukemia cells. Biochem Biophys Res Commun 1987;146:1450-7.
9. Choi J, Chiang A, Taulier N, Gros R, Pirani A, Husain M. A calmodulin-binding site on cyclin E mediates Ca^{2+}-sensitive G1/s transitions in vascular smooth muscle cells. Circ Res 2006;98:1273-81.
10. D'amico M, Gasparoli L, Arcangeli A. Potassium channels: Novel emerging biomarkers and targets for therapy in cancer. Recent Pat Anticancer Drug Discov 2013;8:53-65.
11. Becchetti A. Ion channels and transporters in cancer. 1. Ion channels and cell proliferation in cancer. Am J Physiol Cell Physiol 2011;301:C255-65.
12. Binggeli R, Weinstein RC. Deficits in elevating membrane potential of rat fibrosarcoma cells after cell contact. Cancer Res 1985;45:235-41.
13. Chernet BT, Levin M. Transmembrane voltage potential is an essential cellular parameter for the detection and control of tumor development in a *Xenopus* model. Dis Model Mech 2013;6:595-607.
14. Chifflet S, Correa V, Nin V, Justet C, Hernandez JA. Effect of membrane potential depolarization on the organization of the actin cytoskeleton of eye epithelia. The role of adherens junctions. Exp Eye Res 2004;79:769-77.

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