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Editorial

Bioelectricity of Cancer

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It has been a great pleasure and honor to have guest edited this first special issue of *Bioelectricity* on cancer! It is well known that cancer is one of the biggest killers of humans. Although billions of dollars have been spent on finding cures for it, however, many problems remain across the board—functional diagnosis, long-lasting effective treatments, undesirable side effects, and cost! Starting ~20 years ago, cancer cells' bioelectricity has emerged formally as a new concept in the pathophysiology of the disease. We now know that a plethora of ion channels and associated regulatory mechanisms, such as ion exchangers and pumps, are expressed in all cancers and contribute dynamically to every stage of the cancer process from initiation of the primary tumor to metastasis. Furthermore, the ion channels are an integral part of ''mainstream'' cancer mechanisms, especially steroid hormones and growth factors. It is not surprising, therefore, that ion channels are increasingly being validated as novel anticancer targets exploiting the already available wide range of drugs that could control cancer without killing cells!

This issue comprises eight articles. We open with a timely review by Payne et al. on the mechanisms of metastasis operating in solid tumors. This is followed by a technical article by Rocha et al. on microelectrode arrays that can record the electrical activities of cancer cells less invasively than conventional microelectrodes and give information on the behavior of populations of cells. This technique is revealing how normally quiescent cells such as epithelial and glial cells express voltage-gated K^+, Na^+, and Cl^- channels, and become electrically excitable once they become cancerous.

One of the promising discoveries in the ''bioelectricity of cancer'' field is the embryonic nature of some of the ion channels expressed. This is most apparent for the voltage-gated Na^+ channel subtype Nav1.5 expressed in numerous carcinomas, especially in breast cancer and colon cancer. Onkal et al. present two articles comparing the effects of multivalent cations on neonatal and adult Nav1.5. In particular, the two splice variants differ markedly in response to pH, consistent with the impact of acidification on tumor progression and laying the grounds also for selective pharmacological distinction of the cancer-specific neonatal Nav1.5. The role of Nav1.5 in cancer (colon cancer) is continued in the following article by Palmer and Aydar who demonstrate that neonatal Nav1.5 can associate with the sigma-1 receptor, a chaperone protein, to promote trafficking of the channel to plasma membrane wherein it becomes functional.

The article by Ong et al. opens a new chapter by extending the cancer bioelectricity to cells of the immune system and demonstrating that extracellular K^+ (released into the tumor microenvironment from dying necrotic cancer cells) dampens their functioning. The last two articles discuss the anticancer potential of antibodies against voltage-gated K^+ channels, Kv10 (Hernandez-Resendiz et al.) and Kv11.1 (Iorio et al.). The emphasis of Iorio et al. is broadly on the role of K^+ (and Na^+) channels in cancer metabolism, including the all-important Warburg effect with the proposal of a ''unifying landscape.''

Finally, three points. First, there is more to bioelectricity than ion channels and transporters (including cell surface charge, transepithelial potentials, effect of endogenous and exogenous electric fields, body electrolytes, and tissue bioimpedance), and much more than we could cover here. We would like such topics cultivated more and more in future issues of *Bioelectricity*. Second, in fact, the ''bioelectricity of cancer'' theme will continue as a special subsection in the forthcoming issues of *Bioelectricity*. There are already several exciting articles in the pipeline and a lot is going on in the field (see the ''Executive Editor's Picks'' at the end of the issue). So, we would welcome more submissions. Third, the realization of this special issue would not have been possible without the enormous help of the administrative and production staff at the publishers, Mary Ann Liebert. In particular, we are grateful to Lisa Brodsky and Sophie Reisz (née Mohin) for their unfailing support (24/7)!

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This article has been cited by:

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