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Editorial

Atmospheric Plasma and Prostate Cancer

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HIGHLIGHTS

- Plasma, a semi-ionized gas, is a unique tool in cancer therapy due to its reactive oxygen and nitrogen species.
- Most plasma medicine research implemented is on a cellular scale, showing an anti-cancer effect in different cell lines.
- Despite the great ideas proposed, such as focal local prostate cancer therapy, there is not any clinical trial due to a lack of accurate and comparable information.

ABSTRACT

Plasma semi-ionized gas is a novel tool with various applications, from engineering to medicine. In light of improved plasma devices and the invention of cold plasma at room temperature in recent years, plasma medicine has gained much attention from researchers. CAP can halt a wide variety of cancer cell growth. Moreover, it can kill cancer cells selectively with the most minor side effects for normal tissue. Plasma can be utilized alone or in combination with other treatment agents. There are several clinical trials in which plasma has been chosen as an anticancer tool. Specifically, in urology, using plasma for localized prostate cancer focal therapy seems rational and applicable. However, before any step, there is a need to propose a more precise definition of plasma dose generated by different devices. The ability to compare studies can shed light on how to introduce plasma devices for clinical application in cancer treatment.

Keywords: Cold Atmospheric Plasma; Prostate Cancer

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Editorial: Plasma term was coined in 1927 for the first time by Irvin Langmuir (1). Plasma, the fourth state of matter, is a semi-ionized gas comprising ions, radicals, photons, and excited atoms (2). Thanks to the improvements in plasma technology in creating cold atmospheric plasma (CAP) at room temperature (not higher than 40˚C), utilizing CAP for different applications has become a popular topic in medical science and finally led to the emerging plasma medicine Field. This multidisciplinary field combines chemistry, plasma physics, and biomedical sciences with engineering (3-5). CAP can be used for wound healing, dental caries, and the inactivation of microorganisms (3, 4). Hitherto, research showed CAP might better be considered as a combinational therapy strategy along with surgical tumor resection, immunotherapy, radiotherapy, pulsed electric fields, and chemotherapy (6-8). Intriguingly, a study showed that in comparison with docetaxel, which is a clinically well-established chemotherapy drug for metastatic prostate cancer, CAP showed comparable results (9).

The efficacy of CAP on cancer cell lines and xenografts by inducing apoptosis through DNA damage and curtailing cancer cell viability has been shown by many studies (10). Particularly in the field of urology, prostate cancer cells like PC3, LNCaP, and DU-145 are successfully treated by CAP treatment (9, 11). It is suggested that the principal cellular mechanism of CAP efficacy in these cells lies in the morphological changes of cell architecture and pro-apoptotic modulation of caspase-3, Bax, anti-apoptotic proteins like surviving, and cell cycle regulators such as p21, p53. Accordingly, Caspase will be activated after activating the apoptotic pathway, and DNA and nucleus damage will occur (9, 12, 13). Evidence shows that activation of redox signaling cascades is another event that happens after CAP treatment (14). On a larger scale, it is recommended that low-temperature plasma be used with the help of accurate imaging techniques for focal prostate therapy (10). The most critical challenge in establishing this device is assessing the accurate dose of plasma, as lower and higher doses have different results and can even stimulate cell proliferation. Defining plasma dose in vitro and in vivo studies can give the researcher a better scale for precisely comparing the results. This definition should encompass all plasma devices, specifically DBD and jet devices, which are more utilized in studies. This predicament is one of the principal obstacles to introducing plasma to clinical trial studies.

Conclusion

In retrospect, a vast array of studies focused on the usage of plasma on different cell lines, mice, and xenograft tumors. Although most of them used DBD or Plasma jet in their studies, there is no steady definition of plasma dose among them. There is the same situation in prostate cancer research in which plasma is used as the therapy. Indeed, this problem might be one of the essential reasons why researchers who intend to utilize plasma for focal localized prostate cancer or more clinical trial research have a slow speed of progress in their work since no milestone helps the better comparison of research results.

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Conflict of interest

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Data availability

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Abbreviations

CAP Cold Atmospheric Plasma

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