REVIEW ARTICLE

Improvisation of Conventional Techniques: The Future of Oncology Research

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ABSTRACT

Since the past 2 ½ months, the medical science has been experiencing a paradigm shift with the monumental effects of the ongoing global pandemics, irrespective of the geographical periphery, ethnicity, and races. However, within this global crisis, we might lose the focus on another deadly foe of humankind, taking millions of lives for the last few centuries, that is, none other than cancer. The scientific fraternity across the world has been thoroughly intervening in the various wings of cancer research to secure the best possible outcome. Off late, a cascade of improvised tools has been taken into consideration in cancer research. In this paper, two of the most innovative protocols have been discussed those might be the potential boom in future oncology research if the mentioned methods could be implemented with proper vigilance, realistic outcome, and off course patience.

Key words: Cancer, harmonic excitation, oncotripsy, resonance, ultrasound

INTRODUCTION

Amidst the ongoing global pandemic that has rattled every facet of the human activities across the globe, virtually made everything into a standstill, we might overlook one of the deadly enemies of medical sciences and that off course none other than cancer. Just even few months back, at the onset of Covid-19 pandemics, the scientific fraternity was extremely engrossed with the various attributes of cancer, including the mechanisms, epidemiology, and the best possible remedies, therapeutics to overhaul this deadly enemy. However, it would be a harsh call to say, the cancer research has been stunted, but it is fair enough that the mindset has been shifted toward the first global pandemic of the 21st century to a considerable extent; as far as, the ongoing medical research is concerned.

Over the decades, cancer has been the center of attraction as far as the overwhelming effects, the inexplicable diversity in terms of the mechanisms, both at the clinical and molecular levels. To be honest, the crucial part of cancer research has been to sort out the potential therapeutics to derail the invasion of the cancerous cells within the host body; in fact, the scientific community is trying their best to achieve the target with an array of advanced innovations.

In the context of cancer research in modern-day practice, the principle thing is to focus on the tools and techniques that might be instrumental to diminish the progression of the carcinomic growth within the host. Oncology experts across the world have thrown caution to the winds to achieve the best possible layouts since the several decades till date.

Since the advent of medical genetics and the subsequent implications in the clinical practice, a cascade of advanced techniques has been emerging in modern oncology research. In reality, these modern tools have escalated the oncology research to the greater heights with their respective applications in assessing the various kinds of carcinomas.

ADVANCED TECHNIQUES USED IN THE ONCOLOGY RESEARCH OFF LATE

Starting from high throughput omics (intercalation of genomics, proteomics, metabolomics, and transcriptomics),[1]

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routine monitoring techniques such as magnetic resonance imaging, computed tomography, and positron emission tomography in combination with immunochemical setups such as radiomics and pathomics[2,3] have been successfully implemented to evaluate various carcinomic invasions. In the later part, the concept of nanotechnology and nanomedicines, along with the modern-day theranostics, has shown a tremendous potential to diagnose the carcinomas at the onset.[4,5]

Moving forward, the usage of intercellular RNA, DNA, and protein carriers[6] in the field of cancer diagnostics, therapeutics in tandem with novel protocols such as BH3 profiling have considerably increased to predict the cellular feedback to the respective chemotherapeutics.[7]

Meanwhile, a completely new dimension has been added to the oncology research with the introduction of resonant harmonic excitation[8] and followed by low-intensity pulsed ultrasound to selectively kill cancer cells.[9]

In this paper, the last two techniques have been discussed, as both are highly sequential to the modern-day oncology research, especially regarding the selective necrosis of the cancer cells is concerned.

RESONANT HARMONIC EXCITATION

We do know the concept of cellular lysis or cytolysis. This technique has been used to selectively kill the cancer cells from the mixed population comprised both normal and cancerous cells. In other words, this is the tool that has been specifically designed to burst out only cancerous cells (Oncolysis) without damaging the activities of normal cells. In practice, it has been used to precisely kill the cancerous cells by tuning the ultrasound harmonic excitation at the chosen frequency, making sure the functional attributes of the normal cells which remain untouched.[8] To be more precise, in this method, nucleolar envelop of the cancer cells that are selectively ruptured, giving no harm to the healthy cells in close proximity.

CONTEMPORARY STUDIES IN SUPPORT TO THE RESONANT HARMONIC EXCITATION

Plenty of *in vitro* as well as *in vivo* setups have been formulated during the course of time those are perfectly in line with the method of resonant harmonic excitation. One of the relevant contemporary works is the protocol that has been designed to assess the inhomogeneity with respect to stiffness of a healthy nucleus among the human osteoblast cells. It has been found that the proportion of stiffness of the nucleolus is sizably greater in comparison to the adjacent nuclear domains.[10]

Likewise, another study reveals the significant variation between nucleolus and nucleoplasm in Xenopus oocytes in relevance to refractive indices.[11]

Similar work depicts the elastic potential of cytoplasm as well as of nucleus among the hepatocellular carcinoma cells by force-displacement curves, obtained from atomic force microscopy.[12]

In continuation, another study showcases, there is a significant amount of depletion in Young's modulus while comparing the mechanical stiffness of healthy, metaplastic, and dysplastic cells within the same population.[13]

LOW-INTENSITY PULSED ULTRASOUND

Among all the contemporary tools, used off late, the low-intensity pulsed ultrasound comprehends the most in terms of the concept, feasibility, and applications in future oncology research. This method is quite unique. Carcinoma cells are assorted with normal blood cells and neighboring healthy ones. Thereafter, the entire group of cells are subjected to the suspended liquid, where short pulses of low-intensity ultrasound have been bombarded to the same [Figure 1].

This technique is the combination of various ultrasound frequencies (from 300,000 to 650,000 hertz) in tandem with a variety of pulsed durations (from 2 to 40 ms). It is quite astonishing that the combination of 500,000-hertz ultrasound with 20 ms decays almost all the cancerous cells, leaving the healthy counterparts untouched. In fact, this specially designed protocol produces microbubbles that oscillate back and forth. First, they proliferate and then suddenly fuse. This is the principle concept of the technique as during the precise oscillations, only cancerous cells are decayed, but the normal ones remain viable. However, the best outcome is achieved when the ultrasounds bombard back to the cancerous cells more than once.[9]

DISCUSSION

Cancer has been one of the leading foes; as far as, the medical science is concerned for centuries. Scientific fraternity has been trying their heart out, but convincing outcome is still elusive especially when it comes to cancer diagnostics and therapeutics. Both resonant harmonic excitation and low-intensity pulsed ultrasound have opened a new dawn in the oncology research regarding the innovative approach and the subsequent applications. However, both the techniques

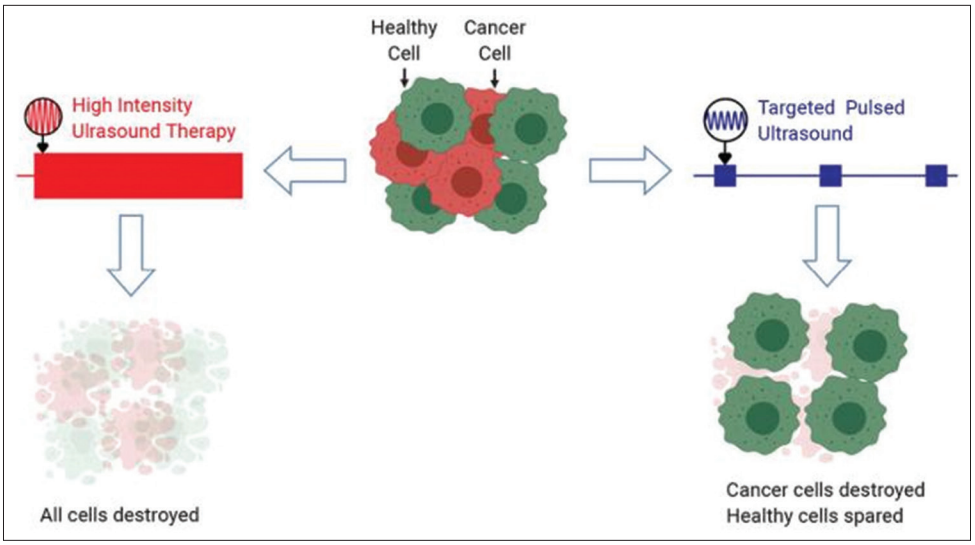

Figure 1: The efficacy of low-intensity pulsed ultrasound to kill cancer cells in comparison to the conventional high-intensity ultrasound therapy[9]

are relatively new; furthermore, these are yet to be tested in human models on a consistent basis. Therefore, it is too early to say about the efficacy, but compared to conventional chemotherapy and high-intensity ultrasounds, the advent of low-intensity pulsed ultrasounds appear realistic if it could be materialized in future days to come.

CONCULSION

Medical science has been galloping every day from one level to the next. However, renowned foes of the scientific fraternity such as, cancer is also showing the true colors. In line with that, improvisation of the traditional techniques might be the best possible frame works to combat the deadly enemies. The above mentioned innovations, especially the advent and subsequent practice of pulsed-ultrasound might be the eye-opener in future oncology research. Sizable number of clinical trials involving human samples, however, should be recommended in order to stamp the authority of these improvised protocols.

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