Physiological ideas and concepts, studied today had their beginning over some hundred years ago. Developments in industry and technological basis of cell and tissue mechanics in the nineteenth century, arises “a need of understanding of mechanical and structural testing and theory (indentation, beam bending, the Hertz model of macroscale material such as engines, boats and bridges”, [1]. Variety of techniques based upon these macroscale engineering mechanics, have been used for experimentally examining and analyzing of mechanical properties of the living cells. Now almost a century after “our current nanoscale testing and modeling of biological materials is still fundamentally based on nineteenth century practice, [2]. In the work [1], authors attempted to describe very early studies on the mechanical properties of living cells, to modern approaches, including atomic force microscopy (AFM), [3]. Models, which include a viscoelastic continuum, a combination of discrete mechanical elements or a combination of viscoelastic fluid, have been developed as well, [4]. It is clearly that “the field of cell mechanics and especially its relation to cell physiology or nanophysiology is vital and growing” exist to explore the micro-and-nanoscopic cellular world. Following the aim of the work, to give some most important concepts, based on mechanics and mathematics classical theories for modeling of stem cells we develop the presentation in the next steps:

(i) Modern microscopy (AFM imaging; High resolution of AFM imaging providing information about structure, function and mechanics of nucleic acids); several types of membrane proteins; molecular motors and cell wall surfaces etc. have been presented, [5,6,7,8].

(ii) Early stages of studies on Protoplasm (early microscopes used in the study of cellular mechanics, a quantitative measure of the protoplasmic viscosity,
cell indentation as means of measuring mechanical properties in the early 1900), have been analyzed too, [9,10].

(iii) Theoretical Considerations (calculation of changes in protoplasmic viscosity in response to the action of temperature, radiation, electric currents and several chemicals –anaesthetics, salt, organic solvents, and even the early chemotherapy agent developed in the 1940, have been measured, [11,12]. A main parameter in mechanical measurements by AFM of living cells, has been taken –to be elasticity. Also rheological parameters of living cells by various approaches, have been extracted too, [13]).

(iv) Methods for Estimation of Mechanical Properties of Protoplasm (indentation experiments on living cells employed “the use of glass microneedles which were slowly inserted into many cell types to estimate viscosity, [14], a modern technique by AFM for mechanical properties of plant cells [15], and relating the work “towards investigating multi-cellular assemblies, monolayers and tissue” has been studied.

(v) Mathematical Modeling of Stem Cells (“Stem Cells Biology meets Systems Biology”, [16]; mathematical models of cellular state transition; programming and reduced pluripotency of inducing cell state transitions; functional relationship between thymic epithelial cells and multipotent keratinocyte stem cells of the skin using clonal analysis and transplantation assays have been reported, [17,18]).

(vi) Mathematical Models of Stem Cell Dynamics (Hematological Diseases, Basic Assumptions, Local Stability of Hopf Bifurcation; Stability of positive delay; an analytical model describing the blood’s diseases, [19.20]) have been discussed.

Computational model, based on the classical analytical model developed in [19], has been proposed by author. In the analytical model, have been derived “simple formulas for the expected values associated with the probability that starting from a single cancer stem cells (CSC), a given number of CSC, is reached as well the expected time”, and the general probability reflecting relationship between transition probability, the relative fitness $r$ parameter and parameter $k$. By numerical Fortran programs will be calculate some numerical experiments to obtain, graphics reflecting the probability $p$, versus $r$, at different $k$. Comparison of the results in [19] and data in the report, presented shows a very good agreement.

Key words: living cells; mechanics and mathematical theories; protoplasm; cell physiology; stem cells; stem cells dynamics; computational model


[10] Herlbrunn LV (1926), Ann Nat. 60: 143-156


