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Comment

Biophysical processes in fibrosis Comment on: "Towards a unified approach in the modeling of fibrosis: A review with research perspectives" by Carlo Bianca and Martine Ben Amar

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The process of inflammation tries to protect the body after an injury due to biological causes such as the presence of pathogens or chemicals, or to physical processes such as burns or cuts. The biological rationale for this process has the main goal of eliminating the cause of the injury and then repairing the damaged tissues. We can distinguish two kinds of inflammations: acute and chronic. In acute inflammation, a series of events involving the local vascular systems, the immune system and various cells within the injured tissue work together to eradicate the harmful stimuli. If the inflammation does not resolve the problem, it can evolve into a chronic inflammation, where the type of cells involved changes and there is a simultaneous destruction and healing of the tissue from the inflammation process.

There are many examples of disorders associated with inflammation, including autoimmune diseases, celiac disease as well as non-immune disorders such as cancer and atherosclerosis.

To avoid tissue damage, it is therefore very important that the inflammation process is actively terminated when the cause of injury is eliminated. Failure of this important repair process results in chronic inflammation as described above. A resolution of the inflammation occurs by different mechanisms in different tissues and leads to the complete restoration of the inflamed tissue. When a large amount of tissue is destroyed or damaged, however, the tissue is unable to properly regenerate, leading to the formation of a scar, mainly composed by collagen, in the damaged area. This process is known as fibrosis and can lead to an impairment of the function of the tissue since the elastic properties of the scar differ from those of the normal tissue.

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The review by Martine Ben Amar and Carlo Bianca summarizes mathematical and physical models proposed in the literature to describe different aspects of fibrosis at various time and length scales [1]. It is an interesting perspective that highlights the importance of an interdisciplinary approach to tackle physical and dynamical aspects of the process of fibrosis. The main goal stated by the author is to obtain a comprehensive multiscale model for the entire process. This is still an open challenge for the coming years, since the process is extremely complex, involving molecular events, cellular processes and finally mechanical and geometrical issues. We think that two interesting processes that are worthy of further studies from the physical point view are: i) the front propagation dynamics during wound healing and ii) the role of geometry in the mechanical properties of the scar. The first process is connected to the vast literature on wound healing experiments in vitro that have received major attention in the physics community [2,3]. A large effort is currently being devoted to study the glassy properties of cell front propagation and the role of cell–cell interactions [2,3]. It would be interesting to further explore the consequences of these studies to the process of fibrosis in vivo. The second aspect could be related to the vast literature on the mechanics of collagen networks both experimental [4,5] and computational [6,7]. In this respect, we think that discrete element models of interacting flexible fiber networks [6,7] can help devise constitutive laws to be used in more macroscopic effective medium models.

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