Letter

Sepsis and multiple organ failure represent a chaotic adaptation to severe stress which must be controlled at nanoscale

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Sepsis is a major healthcare problem causing significant mortality, morbidity and costs. Despite enormous efforts, a safe and reproducibly effective therapy for sepsis could not be found to date.

Processes within the course of severe sepsis and multiple organ failure have always been regarded as dysfunction at the cellular or organ level. On the contrary, some mechanisms point to the possibility of a chaotic adaptive response that targets a survival advantage [1,2]. Cellular hibernation may represent an effort that decreases cellular oxygen consumption in the face of reduced oxygen delivery to decrease the possibility of cell death. Similarly, microcirculatory changes and induced apoptosis may be pre-programmed responses to severe stress that sacrifice a portion of cells to save the whole progeny, which can recover organ function after the septic challenge is overwhelmed.

The nonlinear behavior of sepsis has been regarded as a complex and chaotic process by some investigators, including us [1,3]. There are major genetic polymorphisms that cause individual variances in the response to septic challenge. Additionally there is a dynamic and temporal relation between the failing organ systems and therapeutic interventions [4]. Within this concept, the term chaos has been regarded as a disordered, uncontrolled, random process. But actually chaos and complexity refer to processes that aim to settle a balance by generating order and strength within the system. Chaotic systems consist of multiple components that interact with each other and with their environment in a nonlinear pattern. The result of this interaction is highly dependent on the initial conditions and can produce unpredictable emergent behaviors of the complex system, which cannot be predicted by studying the discrete components of the system. That is why the reductionist approach that we use in experimental and clinical studies is far from being able to explain such chaotic systems. We believe that remodeling the pathophysiology of sepsis and multiple organ failure within the context of chaos and complexity theories will result in a better understanding and in more effective therapies. In that regard, fuzzy logic – which is used for modeling nonlinear systems – could be a useful tool.

The complex pathophysiology of sepsis actually provides many opportunities for treatment at a cellular level, and even at a molecular level. But since these therapies aiming a target at the molecular or cellular level are applied at a systemic level, they generally cannot be translated to safe and effective therapies. Applications of nanotechnology may serve to design better therapies that can apply treatment and can monitor results at the level of the proposed effect, and may instantly modify the amplitude and direction of therapy accordingly at the molecular or cellular level [5].

Competing interests

The authors are members of Bilgitay Study Group which is an academical research group.

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