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Letters to the editor

Development of a biodegradable prosthesis through tissue engineering: the lack of the physiological abstractions prevents bioengineering innovations

Dear Editor,

We read with the great interest the article by Valderrama-Treviño et al. (2024) on the development and evaluation of a Poly (D,L-lactide-co-glycolide) (PGLA) - Polycaprolactone (PCL) - Gelatin (Gel) electrospun scaffold for extrahepatic bile duct replacement [1]. The study's promising results in a porcine model pave the way for significant advancements in tissue engineering and regenerative medicine, as we believe.

Once upon a time, a century ago, the famous surgeons William Mayo and Hans Kehr noted that extrahepatic biliary surgery was a special field of repair surgery that required novel approaches and techniques [2]. Since then, antibiotics, synthetic materials and laparoscopy have changed the face of hepatobiliary surgery. However, one thing that distinguishes tissue engineering from other engineering fields is that bioengineers and surgeons still work in terms of essentials of medical physiology without any abstraction. Why do the abstractions matter?

Medical physiology is inherently complex, involving many interacting systems and variables. Only some aspects of physiology are translated into quantitative physiology [3]. Abstractions help to distill this complexity into more manageable models, making it easier to understand, predict, and manipulate biological processes. Abstractions allow for the development of scalable solutions that can be generalized across different contexts. For example, a tissue engineering approach that works for one type of tissue can potentially be adapted for other types, thanks to the abstraction principles underlayered dynamics of the living organism. The field remains deeply rooted in manual manipulation and hands-on experimentation, where each step is meticulously executed without the guiding principles that other scientific disciplines might rely on. There are no Conservation Laws, no Lagrangians, no Forecasting models that go beyond empirical observations, only the tissue's '*crafting*'.

Are there any approaches for abstraction? Some research groups are beginning to explore the potential of integrating computational models and machine learning algorithms to predict tissue behaviors and streamline manufacturing [4,5]. However, the most valuable modern work in the construction of physiological abstractions is morphological patterns, which found that division of labor theory predicts distinct, mechanism-dependent spatial patterns. In this model, the spatial proximity of specialist cells suggests the involvement of cell interactions, with crosstalk networks revealing patterns of interactions between specialist cells [6]. These pioneering efforts aim to bridge empirical data and theoretical frameworks in the hope of eventually reducing reliance on purely manual techniques. We continue to dream that we are not destined to do everything manually, but through intelligent design.

Declaration of interests

None.

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