Decellularized tissues as platforms for digestive system cancer models

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Introduction

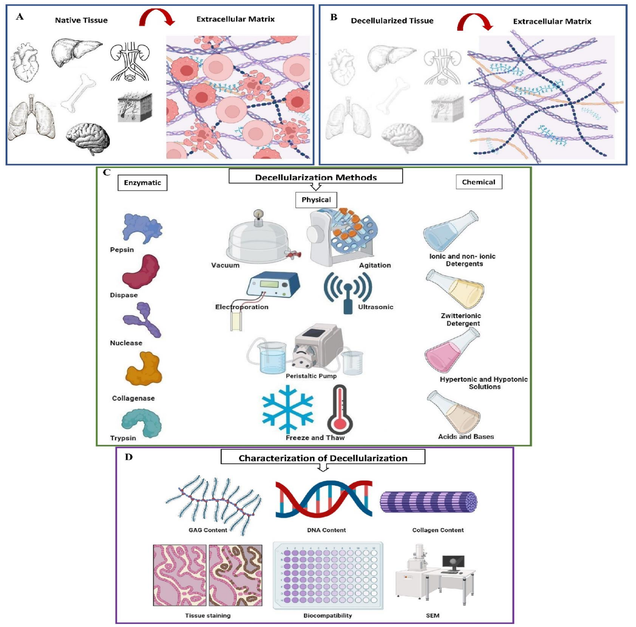
Tumor tissues undergo significant extracellular matrix (ECM) remodeling, resulting in a loss of structural organization and increased stiffness. This affects cancer-related processes such as invasion, metastasis, and immune evasion, contributing to disease progression and poor prognosis. Therefore, considering the non-ECM is crucial for understanding tumor microenvironment interactions and developing effective therapies. Most cancer research relies on in vitro 2D cell cultures, which lack the 3D cellular organization and supportive microenvironment found in vivo. To overcome these limitations, researchers are developing 3D culture systems, providing valuable insights into the changes and interactions during malignant transformation. This review summarizes 3D models of colorectal, gastric, and esophageal cancers, focusing on decellularization techniques that enhance our understanding of cancer cell behavior.

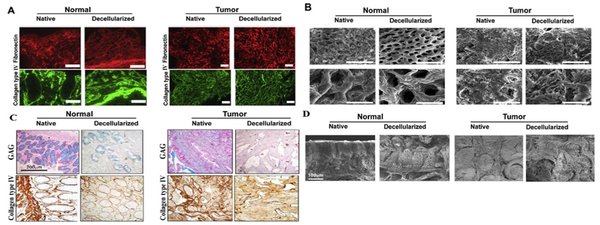
Methods

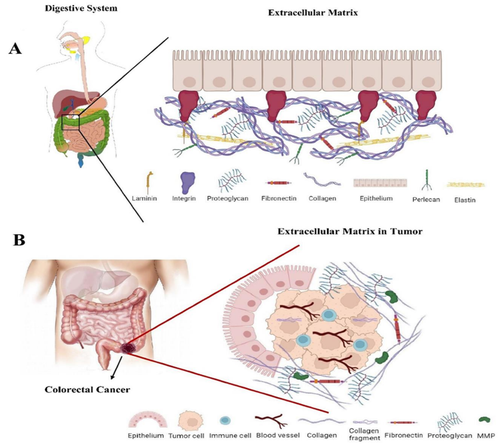
In this comprehensive review, we will delve into the intricacies of decellularization and its pivotal role in the development of ECM-based solutions. Our exploration will focus on decellularized tissues and scaffolds, particularly in the context of colorectal, esophageal, and gastric cancers. To achieve a thorough understanding, we will employ a variety of strategic approaches to search esteemed scientific databases, including PubMed, Scopus, and Google Scholar. This meticulous research will allow us to gather a wide array of studies and insights. Ultimately, we aim to categorize and present the multifaceted roles of decellularized tissues in advancing our understanding of gastrointestinal cancers, shedding light on their therapeutic potential and implications for future research.

Results

Current preclinical research on cancer characteristics and drug resistance predominantly relies on 2D cell cultures cultivated in artificial in vitro settings. However, these 2D models are inherently limited in their ability to accurately mimic in vivo conditions, primarily because they lack the intricate 3D architecture essential for authentic cell–cell and cell–matrix interactions. Consequently, 2D cultures often struggle to replicate the complex native tissue architecture, biochemical gradients, and the multifaceted pathological processes that characterize actual tumors. To address these significant limitations, researchers are increasingly turning to decellularized tissues and extracellular matrix-based scaffolds. These tissues retain the native ECM structure, which serves as a robust and bioactive scaffold for culturing cancer cells. By utilizing these biologically derived scaffolds, scientists can recreate more physiologically relevant cancer models that better reflect the intricate microenvironments and mechanical cues found within the body. This innovative approach facilitates the development of patient-specific or customized tumor models that cater to unique research needs, thereby enhancing the potential for precision oncology and personalized medicine. Moreover, these sophisticated models provide an advanced platform for exploring the complexities of the tumor microenvironment, including vital endocrine interactions, immune cell infiltration, and angiogenic processes. They also enable a more precise evaluation of the efficacy and mechanisms of various anticancer therapies, ultimately fostering a deeper and more comprehensive understanding of cancer behavior, progression, and treatment responses







Conclusions

The primary benefit of decellularized matrices is their remarkable resemblance to the original tissues. In addition, decellularized tissues can be utilized to create cancer models by repopulating them with various cell lines. This technique is highly advantageous in the field of research as it allows for the study of cancer without the need for live subjects. The process also enables the creation of customized cancer models that can be tailored to specific research needs. Overall, the use of decellularized tissues in cancer research is an important and rapidly advancing area of study. By utilizing these models, we can thoroughly examine the interactions within the TME and accurately assess the effectiveness of various cancer treatments.