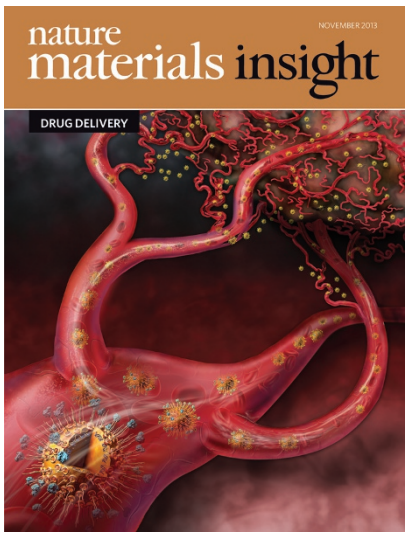

COVER IMAGE

Polymer-based nanoparticles loaded with therapeutic siRNA and decorated with targeting ligands are delivered to a tumour by exploiting the enhanced permeability of the tumour vasculature and the ligand–receptor interactions at the surface of the tumour cells.

IMAGE: NICOLLE FULLER, SAYO-ART LLC

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Materials for drug delivery

The parcelling-up and delivery of drugs to specific locations in the human body using materials-based systems has been approaching the forefront of biomedical research for the past few decades. The concept has arisen from our advancing knowledge of materials — for example, biocompatible nanoparticles that encapsulate drugs and respond to environmental stimuli, biodegradable hydrogels with tunable drug-release profiles, and implanted depots that control the spatiotemporal presentation of a therapeutic — and has been enabled by our increased understanding of disease and the biochemical pathways involved. The complexity of the *in vivo* and clinical settings has been tackled with the elegant engineering of materials of various sizes, shapes, compositions and physicochemical properties. As a result, a handful of clinically available materials-based therapies have been demonstrated, and their potential to improve survival and lower side effects for patients is beginning to become apparent.

For the chemist, materials-based therapies have radically changed the challenges faced in the laboratory — natural products or small molecules are now overshadowed by complex, highly functional macromolecules. For the biologist, delving into the vast realm of materials to find those that minimize toxicity, preserve the bioactivity of the drug, target the relevant receptors or integrate with the target tissue, is no small feat. We hope that this collection of articles, discussing advances and challenges in the design of materials for the delivery of therapeutics, siRNA and vaccines, will inspire chemists, biologists, medical doctors and materials scientists alike. Some common themes emerge: the benefits and translational issues of the enhanced permeability and retention effect, the influence of nanoparticle size and shape on tumour-cell targeting, strategies for the spatiotemporal control of drug presentation, integration with existing medical devices and, above all, challenges in the clinical translation of drug-delivery vehicles.

Clearly, making the ideal delivery package is not straightforward. Our limited understanding of the interactions between biomaterials and the body, and the diseased environment itself, presents hurdles. The complexity of the materials contemplated for use in the body creates regulatory challenges. The field sits at an almost pivotal point with some approved drugs, yet with the translation of many effects observed in the laboratory to efficacy in humans remaining problematic.

The unique selling point of materials-based therapeutics that could greatly influence the future direction of the field is its potential in personalized medicine. This strategy could benefit from using bioinformatics tools and genetic information from the patient. Certainly, the scope for marrying advances in materials science with clinical therapeutic reality is astonishingly large.

Pep Pàmies and Alison Stoddart,
Senior Editors

CONTENTS

COMMENTARY

REVIEW ARTICLES