Overview

What is Biocompatibility?

Definition and significance

In biomaterials literature one often meets the term biocompatibility. The definition is, however, somewhat vague and ambiguities about what biocompatibility is are common. So, how is biocompatibility defined and what does this property entail?

Biocompatibility refers to the contextual host-response

Already early in biomaterials research, attempts were made to define a material's biocompatibility. Today, the most commonly used definition is "the ability of a material to perform with an appropriate host response in a specific application"[1]

Taking a closer look at this definition, "appropriate host response" means that the material, as a minimum requirement does not induce any unwanted responses, such as toxic reactions, in the tissue where the material is placed. 'Appropriate' could, however, also refer to a desire to have some positive responses, such as promoting the healing in process and reducing the time until the material or device is functional.

The definition above also refers to "a specific application", which means that biocompatibility is contextual. For example, a biomaterial may be biocompatible in bone but not in blood and vice versa, or it may be biocompatible for short-time use in a specific tissue, but not in a long-term application in the same tissue.

How biocompatible is the material?

It is notable that the quality of "being biocompatible" can be a grey area, where it is not necessarily a matter of either-or. One material can be more biocompatible than another in a specific application, but both can be classified as biocompatible. For example, if two specific materials are working well as bone-anchored materials, but one of them also heals-in faster to a functional state than the other, we can say that the latter one is more biocompatible.

Biocompatibility of devices

The discussion above refers to individual (bio)materials. It is appropriate to extend the biocompatibility concept to also include devices, like implants, pacemakers, and drug release devices that consist of more than one material, and talk about the biocompatibility of these. For example, in a device consisting of two materials, both materials must be biocompatible in the tissue(s) where they are placed. Also, there must not be any negative cross-talk between the materials or the tissue responses that they induce. We can then talk about a biocompatible device.

Biocompatibility in tissue engineering and other contexts

Usually, when we talk about biocompatibility, we implicitly have in mind materials or devices intended for medical use in humans. But the definitions and discussion above are also extendable to other areas, like veterinary medicine or to templates and scaffolds for tissue engineering.

Sharper or modified definitions may be expected as we move forward

As we learn more and more about biological responses of living tissues to (bio) materials, some ambiguities will resolve, and definitions will become sharper. There is a great need and desire to be able to perform biocompatibility testing in vitro, and then from such data predict biocompatibility in vivo, in the real application. This is, however, not yet the case.

Reference

[1] The Williams dictionary of Biomaterials, D.F. Williams, 1999, ISBN 0-85323-921-5

Contact us at info@biolinscientific.com

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