Life & Science 2023 Vol. 4, No. 4

EDITORIAL

The Past, Present and Future of Biomaterials

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Biomaterials are substances that can be introduced into the body or tissue for a wide array of therapeutic or diagnostic purposes. Biomaterials can be of both natural or synthetic origin. The first examples describing the use of biomaterials includes the Neanderthals use of wood as dental implanting materials, and from 7th BC to the 4th AD, the ancient civilizations of Greece and Rome used various other naturally occurring substances and metals for treatment of wounds and other medical complications. In 16th century in Europe, silver and gold materials were used for dental repair and iron threads were used for bone repairs and various immobilization procedures.[1] Significant advancement has been made in the field of biomaterials in the recent decades, and both natural and synthetic biomaterials have been effectively used to replace various human tissues such as teeth, ligaments, tendons, bones, and load-bearing implants. The biocompatibility, bioactivity, and mechanical properties of biomaterials plays a pivotal role in meeting the need for long-term implants and bone replacement. Biomaterials in use include but are not limited to metal-based biomaterials (titanium alloys, alumina, stainless steel, zirconia, cobalt-chromium alloys) and polymer-based biomaterials (polymethyl methacrylate and ultra-high molecular weight polyethylene). These are usually selected because they meet the required criteria of mechanical strength, biocompatibility, and desired physical and chemical properties. Considerable progress has been made in improving the effectiveness of artificial joints, reducing wear, and extending the life of implants or prostheses inserted into the human body.[2,3] Until recently, the focus had been on biomaterials as replacement materials. However, the main issue is immune rejection of the introduced material. Therefore, the focus has changed to using biomaterials for tissue regeneration. A viable cellular construct in a controlled laboratory environment for the purpose of transplantation can be achieved by using bioactive scaffolds that provide a structured environment to support cell growth and their function. Another strategy has been to trigger tissue regeneration within the body itself by using porous meshes or degradable bioactive materials which can facilitate the process.[2] These techniques pose a risk of infection. Extensive research is currently underway to address these problems. In a recent study, scientists have successfully fabricated a composite scaffold of cellulose and silver nanoparticles.[4] This innovative scaffold showed promising properties in preventing microbial infections and has the potential to prevent infections at wound sites.

However, while it is important to acknowledge the above-mentioned beneficial properties of biomaterials; there is still a long way to go to achieve the desired goals. Immunomodulating biomaterials have been developed with the potential to effectively overcome common chronic diseases such as type 1 diabetes in non-obese diabetic mice. Supramolecular biomaterials, formed by non-covalent interactions between molecular components are being fabricated which can be activated or deactivated in response to physiological signals or which can mimic the signaling mechanisms seen in real biological systems. In addition, injectable biomaterials for delivering therapeutic drugs, proteins and genetic material are being developed, for treating a wide range of diseases via targeted delivery by bypassing immune system recognition. The use of synthetic and naturally produced injectable biomaterials in ongoing research has the potential for future applications in the treatment of bone deformities, detection and treatment of cancer, and heart related diseases.

In Pakistan, researchers have diverted their attention towards biomaterials sciences and its potential role in biomedical devices since last two decade, evident from the increasing number of publications and patents. However, there is still a scarcity of good quality applied research in the field. In addition, the lack of capacity for conducting clinical trials of biomedical devices developed in Pakistan is also a hindrance to the commercialization of these products. For these products to reach the market, high quality clinical trials

according to international best practices have to be conducted. It is imperative for Pakistan to develop centers where phase I and II clinical trials can be conducted that comply with the required international methodological, ethical and regulatory guidelines. This will only be possible where the triple helix model of Government-Academia-Industry collaboration is implemented in its true spirit.

Editor-in-Chief

How to cite this: *Alamgir W, Haider A. The Past, Present and Future of Biomaterials. Life and Science. 2023; 4(4): 363-364. doi: http://doi.org/10.37185/LnS.1.1.500*

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