Volume 8, Issue 4, 2018, 3490 - 3492 ISSN 2069-5837

Biointerface Research in Applied Chemistry

www.BiointerfaceResearch.com

Review Article Open Access Journal

Received: 18.07.2018 / Revised: 08.08.2018 / Accepted: 12.08.2018 / Published on-line: 15.08.2018

Applied biointerface technology for medical diagnosis: a summary

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ABSTRACT

The biointerface is an advanced technology at present. It is widely used for several purposes. Applied biointerface technology for medical diagnosis is an interesting application. The technology is proven for usefulness in medicine. In this chapter, the authors summarized important concepts and reports on applied biointerface technology for diagnostic medicine. In brief, the applied biointerface technology is proven for its advantage in diagnosing of several medical problems including to infections and cancers.

Keywords: *biointerface, medical, diagnosis, technology.*

1. INTRODUCTION

The biointerface is an advanced technology at present. It is widely used for several purposes including the medial application [1 – 2]. It is no doubt that the main result from biointerface application is the effect on thecell, which can further results in the desired biological phenomenon. In medicine, the application of biointerface technology can support the diagnostic and therapeutic activities. Applied biointerface technology for medical diagnosis is an interesting application. The technology is proven for usefulness in medicine. In this chapter, the authors summarized on important concepts and reports on applied biointerface technology for diagnostic medicine. In brief, the applied biointerface technology is proven for its advantage in diagnosing of several medical problems including to infections and cancers.

2. BIOINFERFACE AND APPLICATIONS IN MEDICINE

As earlier mentioned, the application of biointerface technology in medicine is possible and proven as a useful application. First, we should under what a biointerface is. Focusing on the word “biointerfce”, it can imply the “contact” between things via the biological way. This might be between two or more things. The mentioned things might be an organic thing, a biomolecule, cell, biological tissue or organic material or an oeganism. The contact might be between the mentioned thing and others which might be an organic or inorganic thing.

The contact will be non sense if there is no further resulted in consequence. The contact is the trigger point for further reaction. This might be any process that occurs as a result of the contacts between the mentioned two or more things. Based on this concept, the basic requirement of the biointerface reaction is having at least two things at the same time and at the same places. The most important determinant that there is a bioinferace is there must be a contact that causes interaction and result in changing process. The changing process is usually called the resulted biological process in biomedicine. The change due to the process is the starting point of the change of the biological things, in anabolic or catabolic fashions [3 - 4].

To recognize the biointerface, one must understand the basic concept in biology, physics, and chemistry. The contact can result in physical change. The interaction force will occur. This might be seen in the form of bonding energy, either breaking bond or bond formation. The interaction will result in changing of the interfacing things. The physical change and biochemical change of the molecule can be expected. Indeed, biointerface occurs at every second in a living thing. The basic metabolism is a good example of biointerface.

The knowledge biointerface can help explain the biological phenomenon and it can also be the good explanation for the pathogenesis and pathology in medical disorder. As already mentioned, if there is no interaction between things, there will be no biointerface process, no change and no medical alteration of organism. The biointerface process might be good or bad for the organism. In a good view, promotion of cell growth and development can be seen. The effect of the drug on the pathological cellular parts that result in curative outcome is the example of the good result of biointerface in medicine. The intoxication due to exposure to a toxic substance that causes cell death and consequent organ damage and failure is agood example of the bad outcome of biointerface [3 – 4].

To understand the biointerface can help understand the natural history of the medical disorder. Nevertheless, a more complex step for “know what occurs” is “know how to generate the desired biointerface process”. The development of a chemical substance into a drug is a good example. With the advancement of biomedicine technology at present, the practitioner can sucessfully design the molecule aiming at desired bioinferface process. The advanced nanobiomaterial design help faster develop new diagnostic and therapeutic tool in medicine. For the medical diagnostic purpose, a new nanosubstance might be developed to help determination process in vivo or in vitro. For therapeutic purpose, a new nanosubstance might be designed and used as a new therapeutic agent.

Focusing on developing of new substance for triggerring biointerface, the design is the very important step. The necessary thing to know before designing is the desired outcome. Which molecule that we want has to be clarified. For example, in designing a new drug against cancer. The desired molecule should be an extremely small, at nanosize, molecule that can penetrate into the cell. The desired molecule should be easily transported to the target site and the final reaction should occur specifically at the target site. The extracellular reaction should not occur and the intracellular reaction at the pathological site should occur. When one gets the basic requirement, one can further develop and synthesize the specific molecule that has all desired properties. For example, to find a new anticancerous drug with the already mentioned properties, one might developed a new nanopolymer complex that thas biodegradable property for allowing the drug delivery and targeting at the malignant cells [5 – 6].

3. BIOINTERFACE BASED MEDICAL DIAGNOSTIC TOOLS

In biomedicine, the diagnosis is an important step. This is required for a practitioner to know what he/she deals with. Without diagnosis, the next process, the therapy cannot succeed The diagnostic tool becomes an important instrument for yhe medical practitioner. There are many available diagnostic tools that can help diagnosis. Nevertheless, any diagnostic tool has its limitations and it is the main aim of diagnostic medicine that can a better diagnostic property. With the advancement of biotechnology, the applied nanodiagnosis become the new phase of medical diagnosis at present. The use of nanosubstance can help improve the diagnostic property. The use of biointerface technology in medical nanodiagnosis is very interesting.

Basically, the nanosubstance has an extremely small molecular size at nanolevel. /hence, it allows better biointerface and reaction. If we apply the basic medical biochemistry for diagnosis in medicine. The better biointeraction due to the use of nanosubstance in medicine diagnosis should improve the diagnosis efficacy. Classical measurement of biological reaction or biointerface process in clinical biochemistry can be well applied for the case od nanosubstance based medical diagnosis. In fact, there are many improvements of the old classical biochemical diagnostic tool into the new generation as biointerface medical diagnostic tool.

The good examples of newly developed new generation as biointerface medical diagnostic tool are the tools used in clinical hematology, clinical immunology and clinical chemistry laboratory. In laboratory medicine, those new diagnostic tools become the new advancements in diagnosis and can help increase efficacy and reduce the error. The increase in diagnostic sensitivity or threshold can be expected.

Many new nanodiagnostic tools are already developed and used as a point of care testing tools [7 - 10]. The application of nanofluidics in the nanodiagnostic tool helps the practitioner perform diagnosis at the site with a small portable diagnostic analyzer. The example of the new generation of medical diagnostic tool that uses the biointerface nanodiagnosis principle is the new generation glucometer [11 - 14].

Focusing on the technology, the standard biointerface monitoring via clinical chemistry concept is the main core principle for biointerface based nanodiagnostic tool. An additional important technology is the nanofabrication of the medical diagnostic analyzer by nanofluidics technology. In fact, nanofluidics technology is the continuum of microfluidics. Generally, the fluidics principle is the allowance of the analyzed sample flow via the analyzer plate to allow biointerface reaction then measurement of reaction is done and interpreted as the value of determined substance (such as glucose level, cholesterol level, uric acid level, etc. in a blood sample). The classical microfluidics analyzer is usually big and does not allow portable use. The use of nanofabrication engineering helps reduce the size of the analyzer. At present, the nanofluids system has a very small size with the width of the nanofluidic channels about 500 nm, and height of the channel is 400 nm [15 - 18].

Table 1. Some important reports on biointerphase based nanodiagnostic tool.

Authors	Details
Qui et al. [11]	Qiu et al. developed a new invertase-labeling gold-dendrimer for in situ amplified detection mercury(II) with glucometer readout and thymine-Hg(2+)-thymine coordination chemistry [11].
Tang et al. [12]	Tang et al. developed a new glucometer-based immunosensing strategy suitable for complex systems with signal amplification using surfactant-responsive cargo release from glucose-encapsulated liposome nanocarriers [12].
Zhang et al. [13]	Zhang et al. developed a new low-cost and highly efficient DNA biosensor for heavy metal ion using specific DNAzyme-modified microplate and portable glucometer-based detection mode [13].
Tang et al. [14]	Tang et al. developed a new low-cost and highly sensitive immunosensing platform for aflatoxins using one-step competitive displacement reaction mode and portable glucometer-based detection [14].

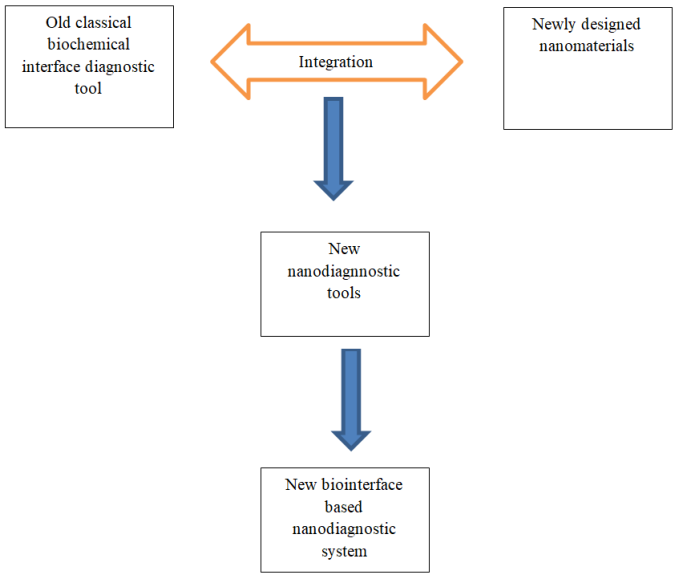

Fig. 1. Concept on developemnt of new biointerface based nanodiagnostic systems

An important consideration of that newly developed nanodiagnostic tool is the lack of standard evaluation according to standard guidelines in clinical pathology and laboratory medicine. Because almost all newly developed nanodiagnostic tools are by the biomedical scientists who lack for the knowledge on the clinical pathology assessment of the tool. Most studies evaluate

the new tool for only diagnostic property (analytical sensitivity, interference, reproductability, etc.) without complete assessment on the clinical diagnostic property (precision, accuracy, clinical sensitivity, clinical specificity, etc..) Hence, there should be a collaboration between clinical pathologists and nanomedical interventors for a complete evaluation of the newly developed nanodiagnostic tool.

Finally, the quality control process of the already available biointerface based nanodiagnostic tool is an important issue that is little mentioned. In clinical laboratory medicine, the quality control and quality assurance is required for all diagnostic tools [19 - 24]. This is because of error is a very common problem in medical diagnosis and can occur elsewhere regardless of accreditation of the laboratory [25 - 30]. At present, there is still a specific guideline for quality management regarding newly available biointerface based nanodiagnostic tool. Hence, the development of the corresponding is needed.

4. CONCLUSIONS

Several applications of biointerface can be seen in medicine. The application in medical diagnostic purpose is very interesting. The applied biointerface technology can help develop an increased effective medical diagnostic tool. The increased diagnostic sensitivity (threshold) can be expected. There are many interesting recent reports that confirm the advanced of applied biointerface technology for medical diagnosis. The important consideration in the next step is on standard clinical validation of the newly developed biointerface medical diagnostic tools. The standard evaluation of the new diagnostic test is needed. The laboratory and clinical evaluation of the new test is necessary and becomes the important step for further studies. One the newly developed biointerface based diagnostic tools is scientifically approved by biomedical and clinical evaluations, the new tests will become the useful things to help care of the suffering patients.

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6. ACKNOWLEDGEMENTS

The authors would like to thank professor Beuy Joob, Medical Academic Center, Bangkok Thailand who helped comment and suggest for the preparation of this scientific article.