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Mini Review

New developments in medicine through artificial intelligence and advances in biotechnology – an overview

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Abstract

Medicine has changed rarely in history as rapidly as it is today. Constantly new methods are being introduced that can improve health outcomes. Six such developments are presented in this article, that is, Artificial Intelligence (AI) in diagnosis and treatment, 3D-printed organs, tele-surgery, nano-medicine, CRISPR technology, and quantum teleportation. Thus, with these developments, several problems in medicine can be solved to the benefit of patients. However, it also increases the responsibility of users to apply the methods in accordance with ethical principles.

Introduction

Our healthcare system is being significantly transformed by advances in Biotechnology and Artificial Intelligence (AI) [1,2]. This new era is characterized by greater precision and improved individualization. One could call it a revolution. The new methods are still unknown to the masses, as most people are still at the level of Newtonian physics. However, to prevent fears arising from the confrontation with the new, innovations should be publicized as widely as possible.

Below, we present six medical innovations in which the new technologies are being used and have the potential to redefine healthcare.

Artificial Intelligence (AI) in diagnosis and treatment

AI could improve the medical landscape at both an administrative and diagnostic level. The ability of AI to quickly sift through millions of scientific papers and patient records increases the ability of hospitals and doctors to improve patient care [3]. The following topics were discussed in June 2015 (15th Conference on Artificial Intelligence in Medicine, AIME 2015, held in Pavia, Italy): process mining and phenotyping; data mining and machine learning; temporal data mining; uncertainty and Bayesian networks; text mining; prediction in clinical practice; and knowledge representation and guidelines [4]. For example, the start-up Oxipit [5] has developed AI solutions that help radiologists analyze medical images (e.g. brain scans for stroke patients), reduce errors, save time, and improve patient outcomes: «AI Solutions for Medical Imaging».

The integration of AI into the healthcare system is progressing and promises not only to improve the quality of care with every advance but also to significantly reduce healthcare costs. New drugs can be developed in less time. Any consistent activity that requires a large memory can be performed better by AI than by humans. What AI lacks is creativity, intuition, conscience, and inspiration. What AI can do perfectly are integrations of existing texts and analysis, interpretations, and imitations of images [6,7]. Of course, AI in medicine can be misused, and ethical considerations are important [8].

3D-printed organs

In the not-too-distant future, 3D bioprinting could put an end to the era of long waiting lists for transplants and offer personalized solutions to patients in urgent need of organ replacement [9]. With this innovative technology, biological tissues and organ structures are produced layer by layer. The process is similar to conventional 3D printing but uses living cells - called "bio-ink" - as the starting material [10].

Because the bio-ink is derived from the recipient's cells, the body is more likely to accept the transplanted tissue as part of itself, minimizing the need for lifelong immunosuppressive therapy. Although 3D-printed organs are still several years away, biotech companies are developing technologies to improve the speed and precision of 3D bioprinting, taking a step towards a future where organ shortages are no longer an issue.

The soonest that could happen is in a decade, thanks to 3D organ bioprinting, said Jennifer Lewis, a professor at Harvard University's Wyss Institute for Biologically Inspired Engineering [11]. Organ bioprinting is the use of 3D-printing technologies to assemble multiple cell types, growth factors, and biomaterials in a layer-by-layer fashion to produce bioartificial organs that ideally imitate their natural counterparts, according to a 2019 study [11]. This type of regenerative medicine is in the development stage, and the driving force behind this innovation is "real human need," Lewis emphasized. If this were to happen, the ethical discussions about organ removal from the dead would become superfluous.

Telesurgery

Telesurgery uses wireless networking and robotic technology to allow surgeons to operate on patients who are distantly located. This technology not only benefits today's shortage of surgeons, but it also eliminates geographical barriers that prevent timely and high-quality surgical intervention, financial burden, complications, and often risky long-distance travel. The system also provides improved surgical accuracy and ensures the safety of surgeons.

Telesurgery is an emerging surgical system that utilizes wireless networking and robotic technology to connect surgeons and patients who are distantly located from one another. The system overcomes today's shortage of surgeons, geographical inaccessibility of immediate and high-quality surgical care, significant financial burden, potential complications, and long-distance travel. This technology not only benefits the patients but also provides technical accuracy and ensures the safety of surgeons.

Telesurgery enables a surgeon to perform a complicated operation from any distance. This is made possible by a combination of advanced robotics and high-speed data connections. With this technology, surgeons can control robotic instruments remotely and provide expert surgical care to patients no matter where they are in the world [12-15]. This technology is already being used for minor procedures such as joint surgery, but its use is also being tested in neurosurgery [16]. As it is not permitted for the tele-function to work without the presence of a doctor on site, ethical discussions are not relevant.

Nanomedicine

The term nanomedicine emerged in 1999, the year when American scientist Robert A. Freitas Jr. published Nanomedicine: Basic Capabilities, the first of two volumes he dedicated to the subject [17]. Nanomedicine is an innovative area of medical research in which nanometer-sized tools are used to control the body and target specific cells for treatment [18].

Nanomedicine is a branch of medicine that seeks to apply nanotechnology—that is, the manipulation and manufacture of materials and devices that are roughly 1 to 100 nanometres (nm; 1 nm = 0.0000001 cm) in size—to the prevention of disease and to imaging, diagnosis, monitoring, treatment, repair, and regeneration of biological systems.

Although nanomedicine remains in its early stages, a number of nanomedical applications have been developed. Research thus far has focused on the development of biosensors to aid in diagnostics and vehicles to administer vaccines, medications, and genetic therapy, including the development of nanocapsules to aid in cancer treatment.

An offshoot of nanotechnology, nanomedicine is an emerging field and has garnered interest as a site for global research and development, which gives the field academic and commercial legitimacy. One area where nanomedicine shines is in the targeted delivery of drugs. While conventional drugs can attack both diseased and healthy cells, nanoparticles can be designed to deliver drugs precisely to the diseased cells, minimizing side effects and increasing the effectiveness of treatment. One example of this is the C60 fullerenes [19,20]. Nanomedicine has the potential to become a cornerstone of minimally invasive treatments [21]. However, ethical considerations are necessary, as problematic contents, such as toxins or genetic components, can also be applied to the tiny «footballs» of nanoparticles.

CRISPR technology: A revolution in genetic medicine

The Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) technology ('gene scissors') allows scientists to selectively replace or modify specific sections of the genetic code with the utmost precision [22]. CRISPR/Cas9 (clustered regularly interspaced short palindromic repeats/CRISPR-associated nuclease 9) system is historically recognized as an adaptive immune system that protects bacteria and archaea from viral (phage) and plasmid infection. But in recent years, CRISPR/Cas9 has become more famous as one outstanding scientific breakthrough in genome editing. It can mediate gene modification at particular locations to help scientists edit the genomes of a variety of organisms rapidly and efficiently, which also provides the potential for cell therapy applications. CRISPR/Cas9 has been explored in research on various diseases, including single-gene disorders such as cystic fibrosis, hemophilia, and sickle cell disease. Furthermore, CRISPR/Cas9 has great promise in the cell therapy of complex diseases, including cancer, heart disease, mental illness, HIV infection, etc.

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This technology is being developed by biotech companies around the world [23], including Caszyme [24], which specializes in providing research services for CRISPR applications and developing new CRISPR-based molecular tools. Caszyme was the first to demonstrate that CRISPR-Cas9 can be used to operate precise double-strand breaks in DNA, thereby enabling a new era of gene editing [24,25].

With the help of these tools, researchers are making significant progress in the treatment of genetic diseases such as sickle cell anemia, congenital blindness, and some heart diseases. Given the ethical debates surrounding advances in research, CRISPR is considered one of the most controversial genetic engineering technologies. The arbitrary intervention in the human genome enables genetic manipulation in the sense of the movie character «Frankenstein». Clear guidelines must be established to prevent misuse.

Quantum teleportation

Quantum teleportation is the transfer of a quantum state using non-classical Einstein-Podolsky-Rosen (EPR) correlations [26]. Among other things, quantum teleportation is suitable for transferring quantum bits in quantum computing. It goes back to a proposal made by Charles H. Bennett, et al. 1993 [27]. The aim is to transfer the unknown state of a quantum system, such as the polarization state of a photon or the spin state of an electron, to a second, spatially distant quantum system. The quantum teleportation of a photon state was first demonstrated in an experiment in 1997 [28]. The transmission protocol of quantum teleportation can be generalized to other quantum states and to several particles.

The application of quantum teleportation in modern medicine is still in its infancy. It involves the postulate of information fields, firstly around the human being, secondly around the planet Earth ("Akashic Records"), and thirdly in the entire universe [29,30]. Accordingly, the cosmos has a holographic and infinite storage capacity for information. In religions, it is described as the Book of God. This can be retrieved using suitable methods, such as the Kozyrev mirror. Conversely, the individual information content can be modified or harmonized by means of the laws of resonance and entanglement.

Quantum teleportation is a process that transfers the quantum mechanical state of a quantum system (source), e.g. a photon or a qubit, to another quantum system (target) [31-35]. The state of the source is changed by the transfer. The method uses a quantum channel for the transmission. A pair of entangled particles is used for this purpose. Quantum teleportation uses properties of quantum entanglement to transfer the state from the source to the destination without measuring it [32,33]. The destination can theoretically be at any distance from the source, and communication is instantaneous, without speed. An equivalent description of quantum teleportation in the context of quantum gravity was found in 2016 by Ping Gao, Daniel Louis Jafferis, and Aron C. Wall when they introduced a new type of wormhole [36,37].

The size of the particles to be transmitted and also the scope of transmitted states and information are constantly increasing in postmodern physics [32,33,34]. In energy and information medicine [38,39], the method is used diagnostically to extract information patterns from the global information field that are characteristic of the patient and his deviations from the norm. Information patterns that are able to harmonize this condition are transferred for therapy.

The Timewaver (TW) Company describes it as follows [39]: «*Information Field technology is based on the theory that the Information Field is the non-material area through which spirit and matter communicate. It reflects what we consider to be the spiritual meaning of life events. The existence of such a field is intensely discussed in scientific literature* [28,29].

The TW system identifies disturbances in the human information field. This information is compared with the large TW databases, which contain complex collections of information patterns (> 1 million). These patterns are also used for therapy by means of quantum teleportation.»

Computerized quantum teleportation with the help of the information field in medicine certainly has a great future as there is ongoing research [40-42]. The author described it in his article "The Digital Clinic" [43]. However, it is necessary for the therapist to ensure four terms and conditions: 1. freedom from stress, 2. positive intention, 3. neutrality without expectations or doubt, and 4. High ethics. This is because the higher the sensitivity of a method, the more susceptible it is to interference.

Conclusion

The new possibilities of integrating the capabilities of modern physics, computers, and biotechnology into medicine are phenomenal. Fields are being opened up that enable unimagined successes in diagnostics and therapy. As is always the case when a new era is ushered in that makes significant interventions possible, the question arises as to the ethics of the users. Such powerful methods can be used for the benefit of patients, but they can also be misused. One can only imagine the potential of the CRISPR gene scissors, which open the door to genetic manipulation. But AI also makes it possible to manipulate information offers of any kind, especially in social media. A globally accepted ethics committee on such new technologies should be established.

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