Letter to Editor

Application of Nanotechnology to Anesthesiology

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Dear Editor

The application of nanotechnology in various fields of biological and medical sciences has been widely expanded, and many materials and devices serving nanotechnology have been introduced at different intracellular scales. The most important and practical goal of nanotechnology in treating diseases is to minimize side effects at tissue and cellular levels (1).

Considering the remarkable progress of nanotechnology in the field of advanced imaging and the technology of nanomedicines, it seems that one of the promising prospects of this science in the future is the control of consciousness and its medicinal manipulation by nanotechnology. With the help of this valuable technology, a new generation of anesthetics with the least side effects is provided, and the depth of the patient's anesthesia can also be managed with advanced tools. Our knowledge is not enough on how to carry out these developments. However, if this hypothesis is realized, it will be possible to understand more patterns of brain activity in different pathological conditions, and the mechanisms involved in consciousness will be clearer (2).

With the help of nanotechnology, the methods of using biosensors are improved, and therefore, it is possible to track glucose levels, the concentration of various tissue ions, and other biomarkers accurately. This technology allows electrochemical, magnetic, and optical biosensors to monitor the glucose level in real time using a controllable sensor. Also, the therapist can evaluate the appropriate insulin dose for each patient and monitor the progress of the treatment. One of the examples of valuable biosensors whose design has recently attracted the attention of anesthesiologists is capnography sensors made based on carbon nanotubes modified by polymer (3).

Among the other applications of modern technology, it is possible to benefit from anesthesia tools, monitors that examine the patient's clinical symptoms, and ventilators that use a battery energy source, which plays a prominent role, especially when moving the patient over long distances. Among the other applications of modern technology, it is possible to benefit from anesthesia tools, monitors that examine the patient's clinical symptoms, and ventilators that use a battery energy source, which plays a prominent role, especially when moving the patient over long distances. This technology also positively affects patients with left ventricular assist devices or artificial hearts. One of the most important challenges of treatment teams is the pain management of patients after surgery (4-5). Although opioids are the gold standard for pain management, their systemic and unplanned use can cause adverse side effects. Studies have shown that using low-dose sedatives combined with local anesthesia is unsuitable for interventional procedures. More advanced treatments with the help of drug-containing nanocarriers can increase tropism while reducing drug toxicity (6-7). Among the pharmaceutical nanocarriers used today, we can mention liposomes, micelles, solid nano lipids, nanoliposomes, nanodevices, and surfactant vesicles (8). Previously, liposomes containing lipid vesicles were used, and recent reports of the successful use of nanoliposomes have also been published. One of the advantages of using nanocarriers is that due to the high surface-to-volume ratio, they increase biodistribution and pharmacokinetics, and with targeted accumulation in the desired location of the therapist, they reduce drug toxicity (9).

Nanoliposomes can be stable in laboratory and in vivo while increasing bioavailability, causing the interaction of bioactive agents with other molecules. The use of these particles is of special interest in medicine and pharmaceutical sciences due to their low toxicity, biodegradability, and biocompatibility. Successful reports of using nanotechnology and nanoliposomes in anesthesia have recently been presented (10). Nanocarriers can cross the blood-brain barrier; for this reason, they are used in medicines prepared for HIV and anti-tumors. After surgery, pain management of patients under anesthesia is done with the help of sodium channel blockers, potassium channel blockers, N-type calcium channel blockers, and vanilloid and cannabinoid-2 receptor antagonists. An example of nanocarriers application in anesthesia is the efficiency of these particles in the halothane molecule, which can increase its effect on the cardiovascular system and remove this molecule from the reach of the liver. In addition, investigating the cancer treatment process and anesthetic agents such as propofol has shown that nanotechnology in this field can increase the effectiveness of the drugs used (11).

Nanocarriers have different functions based on their structure. In the design of nanocapsules, medicinal particles are placed inside a polymer membrane; meanwhile, nanospheres increase the speed of drug transfer by evenly distributing the drug on the surface of the matrix. With the help of these nanoparticles, polymers of D, L-lactide-co-glycolide, or polylactide are produced, which are excreted from the body by hydrolysis and metabolism by the tricarboxylic acid cycle. Therefore, the release of the drug by hydrolysis of PLGA through the matrix is carried out at a constant rate, and by changing the composition of these polymers, it is possible to change the drug release rate (12).

Today, with the help of targeting, which includes the combination of the drug carrier system with tissue-specific antibodies, it is possible to choose the most appropriate dose of the drug. While increasing the bioavailability of the drug in the desired location, the potential side effects of the drug are also minimized. In some cases, therapists use a passive targeting system. This method combines medicinal compounds with a macromolecule, and the reticuloendothelial system is targeted. Entering the drug compound into the cell is done with the help of endocytosis. These endolysosomes can change the surface charge to facilitate entry into the cytoplasm.

Acknowledgment

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Conflicts of Interest

The authors declare that there are no conflicts of interest.

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