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Mini Review

Anesthesia and Pain Management from Tradition to the Future

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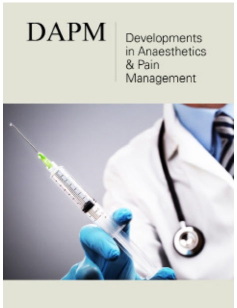

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Abstract

As multiple digital innovations continue to revolutionize healthcare and impact medical technology, anesthesia is not falling behind. Recent changes in anesthesia are also indicative of future change. The main purpose of this review article is to shed light on the future of anesthesia and pain management within the framework of predictions.

Introduction

The adventure of anesthesia, which started with the use of pressure on the carotid artery to make patients unconscious in Mesopotamia, has reached its current position by becoming stronger with the invention of inhalation anesthetics and spinal anesthesia. When we compare the development of anesthesia dating back to 3000BC to the development of the last 200 years, we can predict how much anesthesia will change in the short term. These developments in general anesthesia, regional anesthesia, and pain management will touch the lives of many more people in the future, as they have done so far.

General anesthesia

Advancements in general anesthesia may include 3D modeling systems for the airway, new difficult airway equipment, new monitoring methods, the use of artificial intelligence, neuroelectronic interface, nanorobots, and nanomedicine. 3D modeling of the airway during preoperative evaluation can prevent airway surprises during anesthesia and support the development of personalized airway equipment. In patients who are thought to have a difficult airway, the airway can be scanned using the photogrammetry method [1] in the preoperative period or the airway can be established by scanning with the help of computed tomography or magnetic resonance imaging [2]. This data can be used to manufacture customized airline equipment using 3D printing.

Artificial Intelligence (AI) is defined as the broad concept of machines designed to "intelligently" understand and perform tasks on their own [3]. Preoperative evaluation algorithms with artificial intelligence can make evaluations such as electrocardiogram analysis and radiological imaging analysis, drug interactions, cross-allergic reactions, anticoagulant discontinuation times, determination of intraoperative risks (airway-cardiac-respiratory-hemodynamic risks, etc.), determination of postoperative risks (delirium, nausea, and vomiting, etc.), and provide solutions. In addition, anesthesia machines, infusers, or monitors with artificial intelligence can make recommendations for sedation management, Depth of Anesthesia (DoA), intraoperative hemodynamic management, and intraoperative respiratory management [4]. Clinicians can be warned with early warning systems for possible intraoperative side effects, and success rates can be evaluated by preparing simulations of possible treatments, taking into account the patient's comorbidities. The anesthesia experience of the patient can be recorded with all its data and can be used as a guide for subsequent anesthesia management. Perhaps, even in the future, the brain can be directly monitored with a silicon-based electrical interface created directly between the brain and the computer [5].

On the other hand, while we are waiting for these developments, developing nanotechnology can come to our aid. Due to its optimal size of 0.5-3mm, a nanorobot that can easily pass through capillaries can detect and bind to very specific receptors such as Gamma-Aminobutyric Acid (GABA), opioid, and neuromuscular junction receptors. It may show agonist or antagonistic properties by staying here for the desired period of time [6].

Regional anesthesia

Developing technology will certainly offer innovations in regional anesthesia. The use of artificial intelligence technology in ultrasound can minimize the clinician's errors. In addition, the use of contrast material suitable for ultrasonography with nanotechnology can carry the use of ultrasonography to a completely different dimension. In addition, due to artificial intelligence, real-time 3D modeling that can be created simultaneously from magnetic resonance imaging and ultrasonographic images can facilitate the identification of anatomical structures [6]. Thanks to nanotechnology, it is now possible to produce local anesthetics that are not cardiotoxic, have a fast onset and a long duration of action, and have an antidote. This breakthrough could mean the difference between life and death for a patient at risk of high spinal anesthesia, as a pi-electron-rich nanoparticle could bind to and inactivate bupivacaine, the drug used for spinal anesthesia [7].

Pain management

In addition, advancements in imaging methods that incorporate artificial intelligence, as well as the development of new opioids and local anesthetics through nanotechnology, will greatly benefit pain treatment and anesthesia. While we wait for these developments to come to fruition, we can also look to ongoing clinical studies for potential breakthroughs. For instance, anti-fentanyl antibodies may offer a new treatment protocol for opioid overdose by neutralizing both fentanyl and its potent analogues [8]. Alternatively, organic photosensitizing agents like Protoporphyrin IX can be activated by visible light in a process called Photodynamic therapy, which may provide an alternative to radiofrequency ablation [9,10]. When photosensitive agents are exposed to visible light, their molecules' energy levels increase, forming highly active oxygen species like singlet oxygen or reactive oxygen products. These reactive oxygen species can initiate chemical events that cause the death of cells around them, damaging nerves with oxidative stress instead of heat, which may be more reasonable given the organism's natural damage-repair mechanisms.

Conclusion

Regardless of the field, any kind of advancement has the potential to propel science forward. While it's true that some of these advancements may seem like a threat, such as the potential for computers to replace clinicians, we shouldn't let fear hold us back. Instead, we should view these advancements as stepping stones and learn how to harness their power to improve our work.

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