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Review Article

Acupuncture-Drug Balanced Anesthesia, a Novel Practice of Enhanced Recovery after Surgery

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ABSTRACT

Aim of review: Though new narcotics and anesthetic techniques have been developed, the postoperative mortality rate is still high because of the perioperative complications. The main goal of this article is to introduce how does traditional Chinese medicine improve the quality of perioperative recovery, especially review the attractive influence that acupuncture brought to the perioperative application in surgical patients.

Methods: The article focused on the recent development of perioperative acupuncture and postoperative recovery, went through the most important references in acupuncture history and the key findings from several study groups focused on this area around the world. By listing the evolution of acupuncture over time, the definition and relationship of acupuncture and surgery have changed. The article list systematically a brief conclusion about Potential benefits of perioperative acupuncture.

Recent findings: The advantages of perioperative acupuncture are concluded as relieving the postoperative pain, reducing the doses of analgesic or anesthetic drugs and decreasing the side effects, stabilizing the indexes of the physiological condition, and accelerating the postoperative recovery, etc. There is a lot of documentary evidence to go deep into the mechanisms that acupuncture involved in, such as reducing surgical stress response, maintaining the stability of the homeostasis, and regulating the balance of autonomic nerves, etc. Experimental studies have verified the importance of endocannabinoid system which plays the specific role in acupuncture anesthesia that involved in the protective effects of various organs.

Conclusion: The concept "acupuncture-drug balanced anesthesia (ABA)" is now brought forward to express the optimal role and position of acupuncture practice in the perioperative period. There are reasonable grounds to believe that acupuncture would be commonly used to enhance postoperative recovery and accepted around the world. (Funded by the National Natural Science Foundation of China, the Overseas, Hong Kong & Macao Scholars Collaborated Researching Fund, and the National Key Basic Research and Development Program of China.)

Perioperative period is aimed at the period which professional surgical treatment is needed around disease process, including preoperative, intraoperative and postoperative phase. According to the principle of "making perioperative medicine safe and effective while patients comfortable" during the perioperative period, application of new narcotics and anesthetic techniques has been used. Worldwide, more than 200 million adults undergo major non-cardiac surgery each year and the number of such patients is increasing (1). The number of anesthesia-related deaths has decreased by at least a factor of 10 in recent decades, and these deaths now occur in less than 1 in 100,000 non-cardiac operations. However, the postoperative mortality rate is still high because of the chronic diseases such as cardiovascular disease, chronic lung disease, diabetes (2). 1.5% of adults who undergo inpatient non-cardiac surgery die during the subsequent 30 days. If perioperative death were considered as a separate category, it would rank as the third leading cause of death in the United States (3). Beside the mortality rate, which is the most severe postoperative complications, postoperative nausea and vomiting (PONV), postoperative pain, the time in intensive care unit and the economic expenses the patients undertake are all the important concerns for improving the medical quality for us these days. For example, the appearance of PONV nowadays is over 20% worldwide, and it seems younger age has been associated with a higher risk of PONV (4). Over 50% of the patient went through otorhinolaryngologic surgery suffered from postoperative pain according to the report (5). So how could we take advantages of Chinese anesthesia and make some progress to improve the quality of recovery and decrease the incidence of anesthesia-related side-effects and perioperative death becomes an important issue that needs to be solved (Figure)?

Brief History of Acupuncture Anesthesia

Acupuncture is one of the oldest forms of the natural healing arts. It has been used in China as a therapeutic tool for at least 2000 years and its related techniques are increasingly practiced in anesthesia (5). Acupuncture is a traditional Chinese medical technique that involves the insertion of needles at acupoints to treat diseases by Jingluo (the system of meridians, through which energy is thought to flow through the body in Chinese medicine). It was first reported as "acupuncture anesthesia (AA)" during E.N.T. surgery on Liberation Daily, 1958, and then an "acupuncture boom" began, for out of the 534 papers communicated in the symposium, around 300 papers were related to AA clinical and fundamental research. By 1979, the total number of AA cases had increased to 2 million in China (6, 7). However, because acupuncture plays its analgesic role via activating the endogenous pain modulating system, it fails to produce the complete analgesia on the pain induced by surgical trauma. In 1996, academician Prof. Jisheng Han proposed a new concept of "acupuncture-assisted anesthesia (AAA)" (8), and divided it into three parts: acupuncture-assisted local anesthesia, acupuncture-assisted spinal anesthesia, and acupuncture-assisted general anesthesia. The Neiguan (PC 6), Yintang (EX-HN 3), and Shenmen (HT 7) acupoints are the most studied and effective acupuncture points in reducing preoperative anxiety, postoperative nausea and vomiting, and postoperative pain experiences (9). Using acupuncture and anesthetic drugs together provides complete analgesia, satisfactory muscle relaxation, and slight visceral reaction. What's more, the drug dose of general opioid requirements and epidural space are both reduced, while there is a significant decrease in postoperative nausea and vomiting (10,11). The importance of acupuncture and patients recovery had also been noticed worldwide as well. In 1986, a study group in the United States found out that practice acupuncture on Children with perennial bronchial asthma could significantly decrease the occurrence of exercise-induced asthma (12). There is also some evidence showing acupuncture was in use in the great hospitals of Paris before the second stage of transmission and translation brought it to nineteenth-century Britain (13). The South Korea study group had reported using acupuncture for treating acute ankle sprains in adults and set up quasi-randomized controlled trials for it (14). This evidence makes it more convincing that acupuncture is widely used across the world and has been accepted by

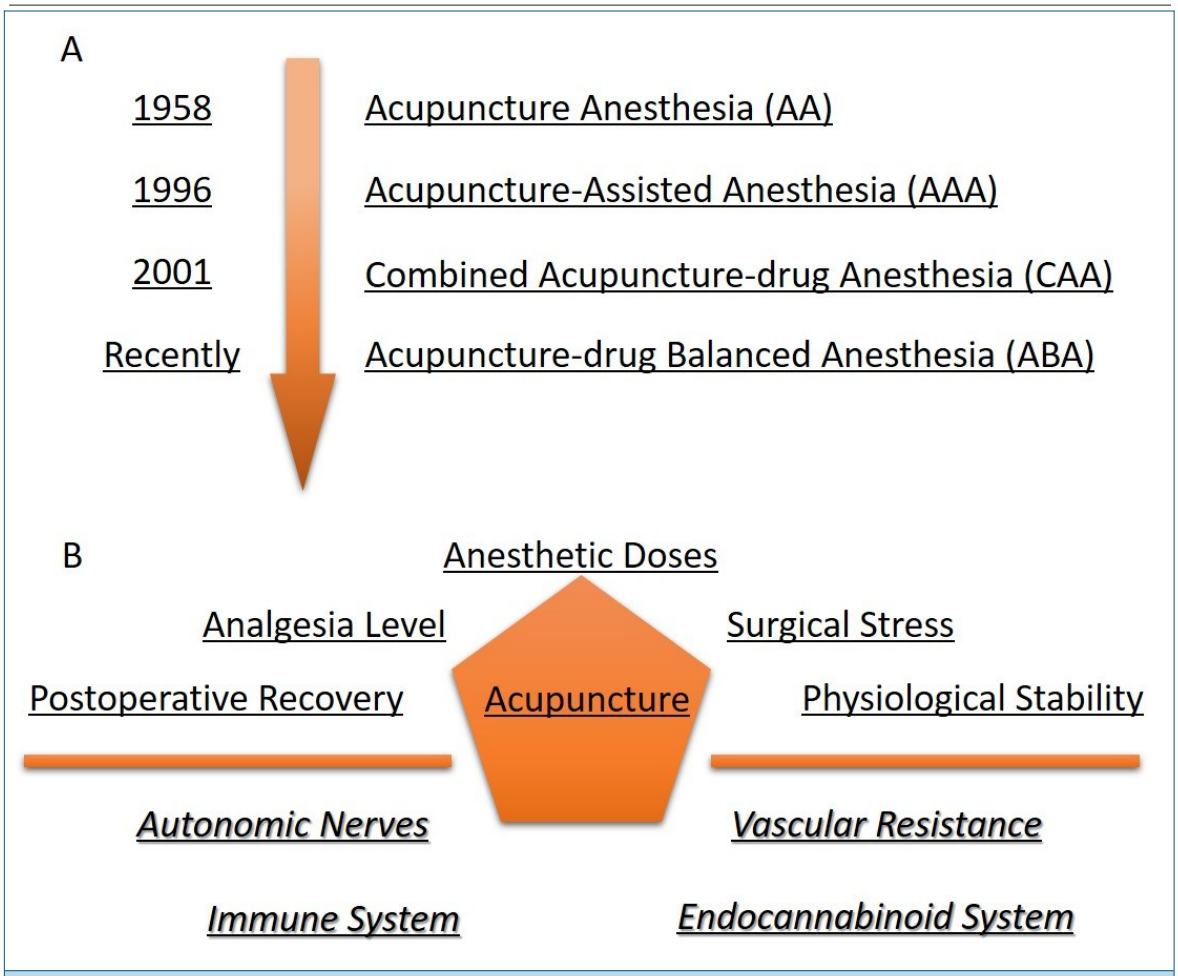

Figure. Acupuncture Anesthesia Development and Its Potential Benefits with the Brief Mechanisms.
A. The brief concept development of acupuncture and its relationship with anesthesia; B. Acupuncture could have several advantages in surgical operations and they are related to multiple systems in the human body potentially.

plenty of hospitals internationally.

Since acupuncture is "efficacy enhancing and toxicity reducing" during anesthesia, a novel concept appeared to stress the importance of acupuncture enhance recovery during surgery. Thus, acupuncture combined with selected drugs to fulfill the requirement of anesthesia is called "combined acupuncture- drug anesthesia (CAA)". In recent years, the CAA has been successfully used in anesthesia for surgical operations such as open-heart surgery with cardiopulmonary bypass, pneumonectomy, craniocerebral operation, thyroidectomy, neolarynx reconstruction, subtotal gastrectomy, cholecystectomy, and renal transplantation, etc. (7,15,16).

Potential Benefits of Perioperative Acupuncture

As been reported in Renji Hospital affiliated with the Shanghai Jiaotong University, compared with the general anesthesia (GA) patients, the combined acupuncture- medicine anesthesia (CAA) patients the doses of anesthetic drugs were reduced by one third to one fourth, the incidence of postoperative pulmonary infection or mechanical ventilation related complications were re-

duced by nearly 50%, the time in intensive care unit (ICU) was reduced by one third, and the overall medical costs were reduced by 20% (15). The similar results came from our clinical trials about whether transcutaneous electrical acupoint stimulation (TEAS) would reduce the narcotics usage during surgery and enhance recovery after surgery. Our results showed that patients in the TEAS group required 39% less remifentanil during surgery than controls, and the time to extubation and recall in the control group was 16.8 (6.8) min and 23.0 (5.0) min, respectively, significantly longer than that in the TEAS group. TEAS also decreased the incidence of dizziness and pruritus within the first 24hrs after surgery (17). What's more, we also verified that 30 min of TEAS at three acupoints located on the hand and forearm before the induction of general anesthesia shorten the mean length of recovery room stay about 10 min compared with the controlled group, TEAS can significantly improve the quality of recovery and decrease the incidence of anesthesia-related side-effects in patients underwent ambulatory surgery as well (18).

As to spread the use of CAA in the clinic, varieties of acupuncture-related techniques are used, including acupressure, electroacupuncture, TEAS, laser acustimulation, and more recently, capsicum plaster acustimulation (6). Since TEAS may provide non-invasive analgesia with minimal side-effects and is the most "user-friendly" technique which can potentially be applied by any anesthesiologists or medical personnel with minimal training, it's the most wildly used technique for CAA in the clinic.

According to previous reports and our trials, the clinical application of CAA has shown its advantages in surgical operations as follows:

· Acupuncture could be combined with all kinds of anesthesia such as local anesthesia, epidural anesthesia and general anesthesia, etc.;

· The effect of analgesia became rather better, in which the patients usually could not feel any pain during the operations, and the postoperative pain was relieved as well;

· The doses of analgesic or anesthetic drugs were reduced obviously during the surgical operations (we found usually about one-third reduction of remifentanil) while the side-effects were decreased;

· The rate of the excellent effect of both operation and anesthesia was increased;

· Many indexes of physiological condition became more stable;

· The postoperative recovery was accelerated, and the period of postoperative hospitalization was shortened (17-20).

Potential Mechanisms of Perioperative Acupuncture

What are the mechanisms CAA involved in? It is well-known that surgery causes a strong stress response, and even results in serious complications. CAA can reduce surgical stress response and maintain the stability of the homeostasis.

Acupuncture effects are mainly dependent on the complete autonomic nervous function through regulating the balance of autonomic nerves. Studies have shown that acupuncture can reduce the excitability of sympathetic nervous center when stress response occurs, evidenced by inhibiting the production of catecholamine, the increase of adrenocorticotropic hormone, cortisol, endothelin, and adenosine to protect the body from damage caused by stress response(16,19). There's also evidence about dopamine-mediated vagal modulation of the immune system by electroacupuncture (21). A large number of our clinical observation and experimental studies confirmed that acupuncture is involved in the protective effects of various organs (brain, heart, lungs, liver, kidneys, gastrointestinal tract, and so on) (22-25). Experimental studies verified that acupuncture enhanced the tolerance to acute cerebral ischemia-reperfusion and reduced brain injury through the regulation of endocannabinoid system (26-28). The pericardium meridian acupuncture can effectively inhibit the calcium overload in myocardial cells and apoptosis in the process of ischemia-reperfusion, and alleviate the degree of myocardial injury. Acupuncture can reduce the tension of liver vascular resistance and significantly improve liver microcirculation to promote the recovery of functions of the liver cell. Acupuncture can protect gastric mucosal injury by regulating gastrointestinal hormones, gastric mucosal blood flow, humoral factors, oxygen-free radicals, stomach

wall barrier, and so on. We are still working on the mechanism of acupuncture protection and its analgesic effect while there is evidence supporting the analgesic effect of acupuncture via activation of endogenous pathways, both by exerting a direct inhibitory effect on opioid-sensitive spinal cord interneurons and by stimulating the release of central endogenous opioid peptides (29,30). Our previous study showed that EA stimulation at the Baihui acupoint (GV20) promotes enkephalin release in rats (31). The immunological functions after surgery are very important to a patient's prognosis, however, anesthesia may cause immunosuppression. Surgical trauma results in immunological dysfunctions, and the increase in the rate of concurrent infections, systemic inflammatory response system (SIRS) and sepsis (32). Studies have shown that acupuncture can regulate the immunological functions after trauma, improve immunity, and decrease infection rates. A group of patients under combined acupuncture-enflurane inhalation general anesthesia showed a rising tendency of T-lymphocyte subpopulations during surgery and on the fifth day after surgery (33). Studies have found that acupuncture-assisted drug anesthesia can increase the γ-interferon content in the serum of patients with lung cancer surgery (34), indicating that acupuncture can increase the immunological functions of patients underwent surgery postoperative nausea and vomiting (PONV) often retarded the postoperative recovery of patients. Currently, possible mechanisms are ascribed to the production of a large amount of serotonin in patients by a surgical stress response, and acupuncture may activate the adrenergic and noradrenergic nerves to change the transfer of serotonin to treat nausea and vomiting. A large number of experimental and clinical studies have confirmed that acupuncture can inhibit gastric acid secretion, regulate gastrointestinal motility, relieve stomach cramps, and effectively prevent nausea and vomiting after surgery via adjustment of the endocrine function(35).

Given the above, the commonly used clinical anesthetic drugs have some side effects, and surgery causes a strong stress response, and even results in serious complications. Many clinical and experimental studies have confirmed the beneficial and protective effect of CAA on patients, in which CAA reduced complications and provided reliable evidence for clinical application. CAA is an anesthetic technique characterized to activate the body's anti-pain system and anti- physiological disorders. The regulation has a "bipolar" feature. When acupuncturing the same acupoints, the deviations in function in the opposite direction can be adjusted oppositely because the acupuncture regulates the body's homeostasis system. It's just in agreement with the law of Yin-Yang regulation when bad things go down, good things go up and there's a balance between "Yin" and "Yang" side. It's the same when the pathogenic factors would be eliminated while acupuncture strengthens the body resistance.

Novel Concept and Prospective

Nowadays, CAA is more optimal than AAA in the aspect of objectively reflecting the role of acupuncture, but still does not express its central role and position in the perioperative period. Anesthesia should not only just ensure safety in the period of surgery but also facilitate the ultimate recovery of patients. Since the concept "perioperative period" is put forward, we pay more attention to CAA not only during surgery, but also the preoperative and postoperative phase, especially facilitate the ultimate recovery of patients. "Balance", which is the essence of Chinese traditional culture and traditional medicine, should be reflected in the two key issues of modern anesthesia: painless and safety, such as the balance of Yin and Yang. In order to highlight the role of acupuncture in modern anesthesia, the name "combined acupuncture-drug anesthesia (CAA)" was proposed to be changed to "acupuncture-drug balanced anesthesia (ABA)". The novel concept of ABA exhibits more practical features and more beneficial to perioperative applications. Just as Prof. Tsung O. Cheng has said, "Acupuncture anesthesia, indeed, has a bright future not only in China but throughout the world."

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