

Application of PC6 Stimulation in the Prevention and Treatment of Postoperative Nausea and Vomiting in Ambulatory Surgery

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Abstract

Postoperative nausea and vomiting (PONV) is a common complication in ambulatory surgery patients, which affects their quality of life and recovery process. In recent years, acupuncture stimulation as a non-pharmacological therapy has shown significant efficacy in the prevention and treatment of PONV. This review mainly discusses the current research on using PC6 stimulation to prevent PONV in ambulatory surgery patients, elucidates the various effects and mechanisms of PC6 stimulation, analyzes the advantages and disadvantages, safety, and feasibility of different stimulation methods, aiming to improve the postoperative recovery quality of ambulatory surgery patients, reduce medical costs, and promote the application of integrative medicine in the prevention and treatment of PONV.

Keywords

Ambulatory Surgery, Postoperative Nausea and Vomiting, Neiguan Acupoint, Traditional Chinese Medicine

1. Introduction

Ambulatory surgery is defined as surgery or operations (excluding outpatient surgery) in which the patient is admitted and discharged within one day (24 h), and special patients whose condition requires extended hospitalization but not more than 48 h. Postoperative nausea and vomiting (PONV) is a common postoperative complication in ambulatory surgery patients and is the second most important factor in prolonging their hospitalization [1]. Compared with inpatients, ambulatory surgery patients are at higher risk for PONV due to shorter inpatient

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monitoring, often incomplete rehabilitation criteria at discharge, early postoperative activity, and lack of scientific management [2]. A study by Maraş *et al.* found that 30.6% of ambulatory surgery patients had PONV and 26.3% had postdischarge nausea and vomiting (PDNV) [3]. With the shift in medical paradigms toward a biopsychosocial model, the management of PONV is no longer the task of a single medical system but requires an interdisciplinary and cross-cultural approach. Traditional antiemetics have limited effect and many adverse effects (*e.g.*, headache, diarrhea, cardiac arrhythmias, drowsiness, and extrapyramidal symptoms), which also increase the cost of treatment [4] [5]. The latest guidelines state that acupoint stimulation, as a non-pharmacological method to prevent nausea and vomiting, has been shown to reduce the incidence of PONV and improve postoperative recovery, and can be used as an alternative or adjunctive treatment to traditional pharmacological prophylaxis [6]. PC6 is an internationally recognized acupoint for the treatment of nausea and vomiting and has been widely used with clinical studies in recent years. The article provides a comprehensive analysis of recent randomized studies synthesizing the effectiveness and feasibility of PC6 stimulation in reducing PONV and improving postoperative recovery outcomes in ambulatory surgery patients. The discussion addresses the limitations and controversies of the current studies and highlights future research directions. Based on the available evidence, practical recommendations for the clinical application of PC6 stimulation are provided to guide the clinical use of evidence-based multimodal antiemetic regimens for the prevention and treatment of PONV.

2. PC6 Stimulation and PONV

PC6 belongs to the hand syncopal meridian and is located on the palm side of the forearm, two inches above the transverse carpal stripe, between the tendon of the palmaris longus and the tendon of the flexor carpi radialis. In Chinese medicine, the PC6 is considered an important point for the treatment of digestive problems such as nausea and vomiting and is widely used in clinical practice for regulating gastrointestinal function and balancing yin and yang gas and blood. PC6 stimulation is similar to antiemetics in preventing PONV and can reduce the risk of PONV by 30% [7].

2.1. Mechanism of PC6 Stimulation

The mechanism of acupoint stimulation in preventing and treating PONV has not been clarified. It is believed that PC6 stimulation may prevent PONV by regulating the functions of the nervous system, endocrine system, immune system, and other aspects of the body. The possible mechanisms include the following four points: 1) Activation of adrenergic and noradrenergic nerve fibers: Excessive 5-HT₃ stimulates specific areas of the brain, producing a feeling of nausea. The stimulation activates adrenergic and noradrenergic nerve fibers, which in turn affects the transmission of 5-HT₃ [8] [9]. 2) Inhibition of vagal reflex: By inhibiting vagal reflex, it reduces the release of gastric actin and gastrin, inhibits the strong

contraction of the gastrointestinal tract, relieves gastric spasms, and normalizes gastric rhythm disorder [10] [11]. 3) Activate endogenous opioid system: Low-frequency and high-frequency electrical stimulation can induce $A\beta$ and $A\delta$ fibers in the vicinity of muscle tendons, causing the release of various endogenous endorphins, which act on different opioid receptors to produce endogenous antiemetic effects [12]. 4) Improvement of hemodynamics: PC6 stimulation can improve hemodynamics, maintain hemodynamic stability, and improve the efficacy of antiemetics.

2.2. PC6 Stimulation Methods

2.2.1. Acupuncture

Acupuncture therapy is the use of different sizes of needles, the use of “twisting, lifting and inserting” technique into the skin so that the patient in the site of the needle feels soreness, numbness, and distension, such as “de qi” feeling is considered to be effective acupuncture. Zhang Y *et al.* [13] showed that acupuncture can reduce the incidence of PONV in children and reduce the use of antiemetics.

2.2.2. Electroacupuncture

Electroacupuncture is a method of inserting needles into specific acupoints followed by connecting an electrical stimulation device, combining needling and electric current to produce stimulation. Park *et al.* [14] performed electroacupuncture on patients undergoing thyroidectomy, and the results showed that the effect of PC6 electroacupuncture was comparable to antiemetics. The feasibility of acupuncture and electroacupuncture in ambulatory surgery is low for several reasons: Firstly, both methods require highly skilled operators and can only be performed by doctors who have specialized training. Secondly, both techniques are invasive procedures, and the needle is not easily protected during surgery, increasing the risk of complications. Lastly, from an economic perspective, it may increase labor costs, time costs, and medical costs. Therefore, the widespread implementation of acupuncture and electroacupuncture techniques in fast-paced ambulatory surgery is extremely challenging.

2.2.3. Transcutaneous Electrical Acupoint Stimulation (TEAS)

Currently, TEAS is the most commonly used method of stimulation. TEAS applies pulsed stimulation through electrodes placed on the surface of acupoints to stimulate the sensory nerve endings of the meridians with low-voltage electrical currents to regulate physiological functions. The most commonly used stimulation method is TEAS. Wang N *et al.* [15] applied TEAS wristbands to hysteroscopic surgery patients, instructing them to wear them continuously for 24 h postoperatively. The results showed that the incidence of PONV in the TEAS group was reduced by 26% in the 24 h postoperative period. Qiu YF *et al.* [16] performed bilateral PC6 TEAS in ambulatory surgery patients undergoing thyroidectomy, starting 30 minutes before surgery and continuing until the end of the operation. The results showed that the incidence of PONV was 20% lower in the TEAS group

than in the control group. TEAS has significant effectiveness in preventing PONV, with simple and safe operations that do not require specialized technical training, and is therefore widely used in clinical practice [17]. It is cheap and does not interfere with daily activities during the treatment process. However, the optimal timing and frequency of stimulation for TEAS have not been clearly defined. Stimulation at different times can affect the effectiveness of PONV prevention, but most current research supports that preoperative intervention is more effective [18]. Regarding the choice of optimal stimulation frequency, alternating sparse and dense waves of 2/100 Hz have been widely used, possibly because pulsed waves can overcome the “tolerance” phenomenon caused by a single frequency. Lu C *et al.* [19] also showed that 2/100 Hz was the most effective for the prevention of PONV and analgesia.

2.2.4. Acupressure

Acupressure is the stimulation of acupoints by physical pressure. Salamah *et al.* [20] showed by Meta-analysis that acupressure can alleviate early postoperative and 24 h PONV in patients undergoing laparoscopic surgery. Debra *et al.* [21] placed acupressure patches on the PC6 unilaterally in high-risk patients with PONV in ambulatory surgery, wearing them continuously until 24 h postoperatively. The results showed that acupressure could reduce the incidence of PONV in three stages of the postoperative recovery period. Considering the side effects of antiemetics and the pain associated with invasive acupuncture, acupressure can be used as an effective and more feasible alternative therapy for ambulatory surgery. However, the effect of acupuncture is controversial, and some studies have not found any effect in the prevention and treatment of PONV. It may be that, compared with other invasive stimulation or electrical stimulation, acupressure stimulation is weaker, and prolonged single-intensity compression tends to make the organism tolerant and reduces the preventive effect. Additionally, the effects of acupressure stimulation may be short-lived, and the effect will disappear with the end of pressure. Lastly, the effects of acupressure may be influenced by various factors, such as the pressure applied by wristbands varying according to the patient’s wrist size, leading to inconsistent pressure and result bias. Therefore, efforts should be made to eliminate factors that may lead to result bias as much as possible in future research.

2.2.5. Acupoint Embedding Needle

Embedding needle is a form of superficial needling in traditional acupuncture. It needs inserting a needle under the skin and leaving it in place for a while. Press needle is an improvement on traditional intradermal needling and is the most commonly used method of embedding needle technique. Jin HR *et al.* [22] showed that combining antiemetics with press needle stimulation at bilateral PC6 and ST36 can be more effective in preventing PONV in patients undergoing gynecological laparoscopic surgery. Similar methods have also been validated in patients undergoing laparoscopic cholecystectomy surgery [23]. Compared with traditional

acupuncture, press needles are shorter and thinner, causing minimal trauma, almost no pain, and no damage to deeper internal tissues, thus not affecting the patient's daily activities. Strict attention should be paid to the principle of asepsis during use to avoid complications such as infection. Press needle patches are inexpensive, and patients can continue to use them after discharge from the hospital. If PDNV occurs, it can be relieved in time by pressing on the end of the needle to achieve the effect of long-lasting effects.

2.2.6. Acupoint Injection

Acupoint injection therapy is the practice of injecting drugs into specific acupoints to achieve effects through the combined effects of needles, acupoints, and drugs [24]. This method has the outstanding advantages of combining Chinese and Western medicine. Commonly used drugs include glucocorticoids, dopamine receptor antagonists, 5-HT₃ receptor antagonists, and saline solutions. Yu Y *et al.* [25] injected saline solution into the PC6 of patients undergoing gynecological laparoscopic surgery, combined with intravenous antiemetic. The results showed that compared to using the two methods alone, incidence of PONV in combined group has decreased by approximately 20%. Li H *et al.* [26] found that compared to intravenous dexamethasone, PC6 injection in elderly patients undergoing thyroid surgery had an 18% lower incidence of PONV at 6 hours postoperatively and a lower severity of PONV. Compared to traditional acupuncture or intravenous injection, acupoint injection therapy has longer-lasting effects and is beneficial in reducing the side effects of drugs. This method still belongs to the invasive stimulation, so the operation should strictly follow the standard. In the process of needle insertion, attention is paid to the constant up and down insertion, with “flat tonic and flat diarrhea” techniques for acupoint stimulation, when the patient has acid, distension, numbness, that is, “de qi”, and after withdrawing no blood, injections can be carried out. In addition, there are still research gaps regarding the selection of the type, dose, and concentration of drugs for acupoint injection and local pharmacokinetics.

2.2.7. Acupoint Application

Acupoint application is the application of processed medicinal patches to specific acupoints. The medicinal ingredients penetrate the skin, travel through the meridians, regulate organ functions, and thereby achieve the purpose of treatment. Liao YJ *et al.* [27] showed that postoperative traditional Chinese medicine patches on bilateral PC6 in ambulatory surgery patients undergoing benign breast lumps excision could effectively reduce the incidence of PONV within 24 h. PC6 application is a safe and simple method with high patient acceptance and good compliance. However, the quality of current research about PC6 applications is low, with significant differences in patch preparation methods and patching protocols, and a lack of uniform standardization. Therefore, there is an urgent need for more standardized, high-quality research to explore the effects and mechanisms of PC6 application to promote its application in clinical practice.

2.3. Other Functions of PC6 Stimulation

1) Alleviating postoperative pain: PC6 stimulation can increase the level of endogenous analgesic substances in the central nervous system, inducing the release of different central nervous opioids and neuropeptides, activating the μ , δ , and κ opioid systems [12], thus alleviating postoperative pain. 2) Promoting gastrointestinal function recovery: PC6 stimulation can promote gastrointestinal motility, accelerate digestion and absorption, shorten the time of postoperative gas and defecation, and alleviate postoperative intestinal paralysis [28]. The mechanism may be related to the influence of the brain-gut axis, thereby reducing the content of substance P [11]. 3) Relieving perioperative anxiety: studies have shown that acupuncture can reduce patients' preoperative tension and anxiety [29]. Many other clinical studies have also demonstrated that PC6 stimulation helps improve patients' perioperative comfort, satisfaction, and quality of postoperative recovery. 4) Immunomodulation: Neiguan acupoint stimulation can effectively protect cellular immune function and alleviate postoperative immune suppression by reversing the decline of NK cells, enhancing phagocytosis of macrophages, and regulating the T lymphocyte subsets population [30] [31]. 5) Reducing the incidence of postoperative cognitive dysfunction: in Chinese medicine, PC6 is considered the preferred acupoint for the treatment of brain injury. Xi LJ *et al.* [32] showed that PC6 stimulation can effectively prevent the incidence of postoperative cognitive dysfunction in elderly patients, reduce the postoperative levels of S100 β , IL-6, and CRP, decrease the inflammatory damage of nerve cells and the brain, and lower the incidence of postoperative cognitive dysfunction. 6) Reducing stress and myocardial protection: PC6 Electrical stimulation can regulate the cholinergic anti-inflammatory pathway and the hypothalamic-pituitary-adrenal axis, reducing the autonomic nervous system and neuroendocrine responses caused by stress in rats and decreasing the release of inflammatory factors [33]. PC6 electrical stimulation can also reduce mitochondrial autophagy-induced damage to the myocardium during ischemia-reperfusion, providing myocardial protection [34].

2.4. Safety of PC6 Stimulation

Acupoint stimulation can lead to local skin sensitization, pain, redness, swelling, and itching. Some invasive procedures may lead to discomfort, bleeding, and infection at the site of the needles, and patients who are sensitive to needles may even faint. However, the incidence of these side effects is low and they are mild, transient, and self-limiting, with no serious complications reported [35]. The anatomical location of the median nerve is close to the PC6, so caution must be exercised during invasive procedures to avoid damaging the median nerve.

2.5. Acupoint Combination

With easy access, stable and independent therapeutic effects, simple operation, and high safety, PC6 is one of the most commonly used acupoints in clinical practice, and it has unique advantages in the prevention and treatment of PONV. The

correct combination of PC6 with other acupoints can further enhance the effect [10]. Commonly used acupoints for this combination include ST36, LI4, and KI1, etc. In traditional Chinese medicine, these acupoints have the functions of regulating gas and blood, relieving asthma, and stopping vomiting, which can be complementary to PC6 to improve the effect. Since each patient's physique and condition are different, individualized adjustment of the pairing method is crucial. Therefore, in clinical practice, doctors need to choose the appropriate combination method based on the specific condition and constitution of the patient to achieve the best therapeutic effect. In addition, although PC6 is effective in preventing PONV, it is not the core acupoint for all diseases, so it is necessary to comprehensively consider the overall situation of the patient and carry out evidence-based diagnosis and treatment to achieve better therapeutic effects in clinical application.

3. Discussion

This review discusses the application of PC6 stimulation in the prevention of PONV in ambulatory surgery patients, but there is less research on ambulatory surgery patients, and most of them are on general inpatients. Given the differences between these two groups of patients and the differences in perioperative management, the research results may also have some differences and cannot be completely equivalent, and it necessitates extensive research to explore the effectiveness of PC6 stimulation in preventing PONV in ambulatory surgery patients. In addition, traditional Chinese medicine emphasizes a holistic view and syndrome differentiation treatment, focusing on the unity of the internal and external aspects of the human body. Although studies have demonstrated that PC6 stimulation can play various roles in the perioperative period, researchers have only observed the effects of PC6 stimulation on a certain aspect individually, without integrating these effects. For example, the effects of PC6 stimulation on postoperative analgesia, gastrointestinal function, emotions, cognitive function, surgical stress and immune response may be related to its effect on the prevention of PONV. The integration of these effects may also contribute to reducing the incidence of PONV. The specific correlations and mechanisms require further in-depth research and evidence support. Considering the above problems and shortcomings, there are some recommendations for future research: 1) Design a large-sample-size, multicenter randomized controlled trial for in-depth research on ambulatory surgery patients. 2) It is recommended to use first-line antiemetics recommended by the guidelines, such as dexamethasone or ondansetron, as the basic preventive measure. Design a sham stimulation group to exclude the interference of psychological factors, and enhance the covertness of stimulation to ensure double-blind effect. 3) The selection of acupoint stimulation methods, optimization of stimulation parameters, and determination of the optimal intervention time are still unclear. Differences between unilateral and bilateral acupoint stimulation, related mechanisms, and how to select appropriate acupoint combinations based on

the surgery and the patient's condition need to be addressed urgently. 4) Increase postoperative follow-up channels, such as telephone follow-up, WeChat contacts, electronic questionnaires, etc. At the same time, extend the postoperative follow-up time and improve the quality of follow-up.

4. Conclusion

As a kind of non-pharmacological therapy with various stimulation methods, PC6 stimulation has a precise effect on preventing PONV. It also has various effects such as postoperative analgesia, promoting postoperative gastrointestinal function recovery, and reducing perioperative anxiety. This is in line with the concept of accelerated rehabilitation surgery and the need for ambulatory surgery, and it has a better prospect of application in ambulatory surgery. In future clinical practice, PC6 stimulation is expected to become an important method for PONV in ambulatory surgery patients and to promote the application of the combination of traditional Chinese medicine and Western medicine in the prevention and treatment of PONV.

Authors' Contributions

Conceptualization: Xu, W.; Writing—Original Draft: Yang, K.Q.; Writing—Review & Editing: Xu, W., Xia, R.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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