Heart Surgery Forum 2024; 27(11): E1351–E1359
doi: 10.59958/hsf.7859

Systematic Review

The Effectiveness and Application of Transcutaneous Electrical Acupoint Stimulation in the Prevention of Postoperative Nausea and Vomiting

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Submitted: 7 July 2024 Revised: 18 August 2024 Accepted: 21 August 2024 Published: 24 November 2024

Abstract

Background: Effective management of postoperative nausea and vomiting (PONV) is crucial for enhancing postoperative recovery and improving the quality of life. Transcutaneous electrical acupoint stimulation (TEAS) is an innovative non-pharmacological intervention that has gained significant attention in PONV management, especially following thoracic surgery. **Methods**: This systematic review aims to evaluate the effectiveness and application potential of TEAS in alleviating PONV and promoting postoperative recovery. The review includes a detailed analysis of recent randomized controlled trials (RCTs) and observational studies that investigate the use of TEAS in various surgical procedures, with a particular focus on video-assisted thoracoscopic lobectomy (VATSL). The principles, procedures, and safety aspects of TEAS are comprehensively discussed. **Results**: The analysis of the included studies demonstrates that TEAS is effective in reducing the incidence of PONV and improving postoperative recovery outcomes across different types of surgeries, including VATSL and other common surgical procedures. The effectiveness of TEAS in PONV management is supported by evidence from multiple RCTs and observational studies, which report a significant reduction in nausea and vomiting rates, as well as improved recovery indicators. **Conclusion**: TEAS shows promising potential as a non-pharmacological intervention for managing PONV and enhancing postoperative recovery. However, the current evidence highlights several limitations and controversies that require further investigation. Future research should focus on addressing these gaps and exploring new directions for the application of TEAS. Practical recommendations are provided for the clinical application of TEAS, emphasizing its role in effective PONV management to promote better postoperative outcomes.

Keywords

postoperative nausea and vomiting (PONV); transcutaneous electrical acupoint stimulation (TEAS); video-assisted thoracoscopic surgery (VATSL); randomized controlled trials (RCTs); non-pharmacological intervention

Introduction

Postoperative nausea and vomiting (PONV) is a common and discomforting complication during the postoperative period, significantly impacting patient recovery and quality of life [1]. PONV management is especially critical after thoracic surgery, as it can lead to adverse outcomes such as fluid imbalance, increased wound tension, and reduced patient comfort. Traditional pharmacological treatments, while effective, may come with risks of adverse reactions and drug interactions [2]. Therefore, finding a safe and effective non-pharmacological intervention is particularly urgent. Previous reviews and meta-analyses have mostly focused on acupuncture or transcutaneous electrical nerve stimulation (TENS) [3]. Transcutaneous electrical acupoint stimulation (TEAS), as an emerging treatment method, has garnered widespread attention from researchers in recent years. TEAS works by stimulating acupoints to regulate the nervous system, thereby preventing and alleviating PONV. Its high safety profile, ease of operation, and lack of drug-related side effects make it a promising option for postoperative recovery [4]. With the shift in medical paradigms toward a biopsychosocial model, the management of postoperative nausea and vomiting (PONV) is no longer the task of a single medical system but requires an interdisciplinary and cross-cultural approach. In this context, the integration of traditional Chinese and Western medicine becomes particularly important, as their complementary roles in PONV management are increasingly evident. For example, in addition to TEAS, traditional Chinese

external therapies such as acupuncture, moxibustion, auricular therapy, massage, and acupoint application are also used for the prevention and management of PONV. These methods work by stimulating specific acupoints and regulating body functions, and they have been proven to reduce the occurrence of PONV and improve postoperative recovery.

This article aims to systematically review the effectiveness and application of TEAS technology in managing PONV after cardiac surgery, thoracic surgery and various other types of surgeries. We will discuss in detail the working principles of TEAS, its clinical operation methods, and its safety, with a particular emphasis on its role in preventing PONV following thoracic surgery. Additionally, we will comprehensively analyze data from randomized controlled trials (RCTs) and observational studies to evaluate the actual effectiveness of TEAS in reducing postoperative nausea and vomiting and promoting postoperative recovery. By discussing the limitations of current research and future research directions, this article aims to provide theoretical and practical support for the further application of TEAS in clinical practice.

Methods

Search Strategy

This article is written in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and the Assessment of Multiple Systematic Reviews (AMSTAR) guidelines. We searched relevant literature on TEAS for the prevention of PONV in databases such as PubMed, EMbase, Ovid, and Web of Science, with the search cutoff date being March 31, 2024. The search terms included TEAS-related terms (such as "transcutaneous electrical acupoint stimulation", "TEAS", "transcutaneous acupoint electrical stimulation", "TAES", or "acustimulation") and terms related to postoperative nausea and vomiting (such as "postoperative nausea and vomiting", "PONV", "postoperative nausea", "PON", "postoperative vomiting", or "POV"). The search was not restricted by date, gender, age, or type of surgery. We searched these terms in the titles and abstracts of potentially relevant articles and reviewed the references of the retrieved articles to identify further related studies. Additionally, we obtained other studies by reviewing the reference lists of relevant systematic reviews and meta-analyses. When developing the search strategy, we fully considered factors that could lead to study heterogeneity, including differences in patient populations, types of surgeries, and TEAS protocols. To address this, we selected academic databases that cover a wide range of disciplines and applied advanced search techniques such as Boolean operators, wildcards, and truncation symbols. We also used keywords that describe the different patient populations, types of surgeries, and TEAS protocols to ensure a comprehensive and accurate retrieval of relevant literature. During the literature screening phase, we conducted stratified analyses to minimize the impact of heterogeneity on the conclusions of the review.

This systematic review was conducted following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The PRISMA checklist is provided as a supplementary file (**Supplementary File 1**).

Data Extraction

Two researchers independently reviewed the identified studies and manually extracted data, including the study type, year, sample size, patient demographics, type of surgery, TEAS protocols, and study outcomes. To ensure objectivity, a third researcher was involved to resolve any discrepancies or differences of opinion between the initial reviewers.

Study Selection

The selection of studies was based on pre-defined eligibility criteria. Only randomized controlled trials (RCTs) and observational studies that evaluated the effectiveness of TEAS for PONV management were included. Studies were excluded if they did not focus on PONV outcomes or were not peer-reviewed. Full-text articles were retrieved for all studies that met the initial screening criteria, and the final selection was made after thorough examination of the full texts.

Introduction to Transcutaneous Electrical Acupoint Stimulation (TEAS) Technology

Transcutaneous Electrical Acupoint Stimulation (TEAS) technology is based on the principles of traditional acupuncture treatment, using electrical currents applied to specific acupoints to regulate the functions of the nervous system. The working mechanism of TEAS involves the complex interaction of multiple physiological and neurobiological mechanisms [5]. Firstly, TEAS delivers electrical stimulation to the acupoints on the skin surface, transmitting the current to deeper tissues and nerve endings [6]. This stimulation can activate Aδ and C fibers around the acupoints, thereby influencing nerve conduction and signal transmission. After stimulation, nerve endings regulate pain signals through the release of neurotransmitters such as endorphins, dopamine, and serotonin, thus alleviating pain perception and modulating inflammatory responses [7]. TEAS can also regulate autonomic nerve balance and reduce resting heart rate in these patients [8]. Secondly, the effects of TEAS are not limited to local effects but

also involve regulation of the central nervous system. Through neural conduction pathways, it may interact with inflammatory factors and neuropeptide regulation related to the gut-brain axis [9]. TEAS can affect central nervous structures such as the cerebral cortex and hypothalamus, modulating pain perception and emotional response inhibition, with the thalamus being one possible mechanism [10]. This neural modulation helps improve the mechanisms underlying postoperative nausea and vomiting (PONV), reducing related neural responses and central excitability.

Additionally, TEAS may exert a systemic regulatory effect by modulating the functions of the autonomic nervous system (sympathetic and parasympathetic nerves), impacting cardiovascular, respiratory, and digestive systems. This systemic effect helps maintain homeostasis, promoting overall regulation and functional recovery during the postoperative recovery process [6].

Principles of TEAS Technology

The operation of TEAS technology is simple yet effective, making it suitable for various clinical settings and patient groups [11]. During the treatment process, healthcare providers select the appropriate acupoints and attach electrode pads, ensuring good current conduction and comfort. Subsequently, based on preset electrical stimulation parameters (such as frequency, waveform, and intensity), the TEAS device is activated to begin the treatment [9]. The current is transmitted through the electrode pads to the deep skin layers and tissues around the acupoints, stimulating nerve endings and the meridian system. Patients may feel a slight tingling or pricking sensation during the treatment, but it usually does not cause significant discomfort or pain. The duration of treatment typically ranges from several minutes to a few hours, depending on the treatment purpose and the patient's tolerance. Selecting the correct acupoints is crucial in the TEAS treatment process. When preventing postoperative nausea and vomiting (PONV), the Neiguan acupoint (P6) is widely considered one of the most effective points. Additionally, depending on the type of surgery and the specific condition of the patient, other auxiliary acupoints can be selected to enhance the therapeutic effect. For example, in patients who have undergone thoracic surgery, the Hegu acupoint (LI4) and the Zusanli acupoint (ST36) can be used as auxiliary points.

Safety of TEAS Technology

TEAS technology is considered a highly safe treatment method [12]. Compared to traditional pharmacological treatments, TEAS has no drug dependence or addiction, and it has fewer side effects. Because TEAS uses small electrical currents, it does not cause significant tissue damage or pose a high risk of infection when stimulating acupoints. However, strict adherence to aseptic procedures is still required during operation to avoid infection.

Common Adverse Reactions of TEAS

Although TEAS technology is generally regarded as a safe and effective non-pharmacological intervention, some adverse reactions may still occur in practical applications. Common local adverse reactions may include skin irritation and allergic reactions. Due to the attachment of electrode pads and current conduction, some patients may experience skin redness, itching, or a slight burning sensation during treatment. These reactions are usually temporary and subside quickly after the treatment ends. Additionally, a small number of patients may have allergic reactions to the adhesive or materials of the electrode pads, resulting in skin itching, rashes, or skin sensitivity.

Application of TEAS in Various Surgeries

Application Effect of TEAS in Video-Assisted Thoracoscopic Lobectomy (VATSL)

Patients undergoing thoracic surgery have a high incidence of postoperative nausea and vomiting (PONV), which is closely related to the complexity of the surgery, the use of anesthetic drugs, and postoperative care [13]. Thoracic surgery typically involves general anesthesia, which increases the risk of PONV. Anesthetic drugs, such as opioids and volatile anesthetics, often cause postoperative nausea and vomiting. Additionally, pain management after thoracic surgery is a challenge, as the analgesics used may further exacerbate PONV. Patients' limited mobility and bed rest during the early postoperative stage may also affect gastrointestinal function, increasing the risk of nausea and vomiting. In thoracic surgery, key acupoints such as Neiguan (P6) are commonly selected for TEAS treatment [14], which is widely recognized as effective in preventing and alleviating nausea and vomiting, especially in postoperative patients [15].

Application of TEAS in Other Types of Surgeries

Abdominal Surgery

Abdominal surgeries, such as laparoscopic cholecystectomy and gastrointestinal surgeries, have a high incidence of PONV due to the direct impact of the surgery on the digestive system. Traditional methods of managing PONV mainly rely on pharmacological treatments, such as 5-HT3 receptor antagonists (e.g., ondansetron) and steroids (e.g., dexamethasone) [16]. These drugs can effectively reduce nausea and vomiting but may also cause side effects like headaches and constipation. TEAS has been shown to reduce the incidence and severity of PONV in high-risk surgical patients and can be used as an adjunct therapy for clinical prevention of PONV [17]. Additionally, there are re-

ports that perioperative TEAS can promote the recovery of postoperative gastrointestinal function and reduce the incidence of PGD and PONV [18]. Conversely, some researchers argue that there is no evidence showing significant advantages of the TEAS group in terms of postoperative pain intensity, nausea, vomiting, sleep quality, and costs [19].

Gynecological Surgery

Gynecological surgeries, such as hysterectomy and oophorectomy, also have a high incidence of PONV, which is related to the physiological and psychological impacts on women. Traditional management methods include preoperative medication, minimizing the use of volatile anesthetics during surgery, and early postoperative resumption of eating. TEAS has shown significant effects on the treatment of PONV in SNVP patients [20]. Additionally, TEAS has been found to influence the perioperative recovery of patients undergoing laparoscopic myomectomy [21].

Orthopedic Surgery

Orthopedic surgeries, such as joint replacement and spinal surgery, pose greater challenges for PONV management, primarily due to the extensive use of opioids for postoperative pain management. Traditional management methods include preoperative medication, the use of local anesthesia during surgery, and multimodal analgesia strategies postoperatively (e.g., combining NSAIDs and local anesthetics). These methods aim to reduce the use of opioids. The use of TEAS as a substitute can further lower the risk of PONV [15].

Other Types of Surgeries

In neurosurgical operations, especially cranial surgeries, the incidence of PONV is also very high due to the interference with the central nervous system. Patients often experience nausea and vomiting postoperatively, which not only affects recovery but can also increase intracranial pressure, impacting surgical outcomes. Traditional PONV management similarly relies on pharmacological treatments, but these are limited in effectiveness and carry significant risks of side effects. TEAS at P6 can reduce the incidence of vomiting and pain scores after craniotomy [22].

Overview of RCT Characteristics for TEAS in Preventing PONV Across Different Types of Surgeries

Table 1 [17–19,21,23–35] summarizes the characteristics of studies included for different types of surgeries. The table includes the authors and year, country of study, patient age range, sample size, type of surgery, target outcomes, and Jadad scores. By comparing different types of surgeries, it demonstrates the application effectiveness of TEAS in preventing postoperative nausea and vomiting (PONV).

The table data show that TEAS exhibits effectiveness across various types of surgeries, especially in video-assisted thoracoscopic lobectomy (VATSL), laparoscopic cholecystectomy (LC), and other common surgeries. TEAS is particularly suitable for patients undergoing video-assisted thoracoscopic lobectomy (VATSL). Studies indicate that using 2/100 Hz TEAS can reduce the intraoperative opioid consumption and slow down the decline in $PaOCO_2$ during one-lung ventilation. Additionally, TEAS effectively lowers pain scores, extubation time, and the time to enter the post-anesthesia care unit (PACU) immediately after surgery, significantly reducing the incidence of PONV [23]. In another study, patients in the TEAS group had significantly lower rates of severe nausea and usage of antiemetics within 24 hours postoperatively, along with significantly reduced pain scores ($p < 0.05$ or $p < 0.01$). The study concluded that using transcutaneous P6 electroacupuncture (TOF) mode can reduce the incidence and severity of nausea and vomiting and provide analgesic effects [14]. Furthermore, in laparoscopic cholecystectomy (LC) and gynecological surgeries (such as laparoscopic hysterectomy), patients in the TEAS group required 39% less remifentanil than the control group, with no significant differences in intraoperative hemodynamics and surgical stress. However, the TEAS group had significantly shorter extubating and recall times ($p < 0.01$), and the incidence of dizziness and itching within 24 hours postoperatively was also significantly lower ($p < 0.01$) [10]. Additionally, TEAS significantly reduced the cumulative incidence of vomiting within 24 hours postoperatively and the cumulative incidence of nausea at 6 and 24 hours postoperatively [24].

Current Research Status and Effectiveness Analysis of TEAS in Different Types of Surgeries

Based on the overview of the study characteristics mentioned above, we further analyze the application effectiveness and current research status of TEAS in various types of surgeries. Through a systematic analysis of the distribution and reported results of high-quality randomized controlled trials (RCTs), we can gain a more comprehensive understanding of the potential and limitations of TEAS in preventing PONV in different surgical contexts. This analysis not only helps assess the focus areas of current research but also provides guidance for future research directions (Fig. 1). High-quality studies (green bubbles) indicate that their results are more reliable and reproducible, whereas low-quality studies (red bubbles) suggest that their results should be interpreted with caution. Laparoscopic Hysterectomy (LH) and Gastric Laparoscopic Surgery (GLS): These types of surgeries have green-colored bubbles, indicating that the studies have high Jadad scores, good research design, and highly credible results. Video-Assisted Thoracoscopic Lobectomy (VATSL): These studies also show high

Table 1. Characteristics of the included studies (sorted by type of surgery).

Authors and year	Country	Age range	Sample size	Type of surgery	Outcomes	Jadad score
Huang *et al*., 2017 [23]	China	Not specified	60/20	VATSL	1	5
Tu *et al*., 2018 [25]	China	Not specified	72/72	VATSL	1	7
Sun *et al*., 2017 [26]	China	18–70	90/271	LS	2, 3, 4	6
Gao *et al*., 2022 [17]	China	18–50	828/827	LS	1, 2, 3, 4, 5	3
Chen *et al*., 2015 [27]	China	18–60	41/42	Thyroidectomy	1, 5	6
Tu *et al*., 2019 [28]	China	Not specified	60/60	URSL	1, 5	6
Zheng *et al*., 2008 [29]	China	39–65	30/30	HNTS	3	3
Xu *et al*., 2012 [24]	China	Not specified	60/59	IC	2, 3, 4	5
Wang *et al*., 2010 [30]	China	20–60	40/40	SC	2, 3, 4	4
Gan *et al*., 2004 [31]	USA	Not specified	26/24	MBS	3, 4	5
Kim *et al*., 2011 [32]	Korea	31–67	210/54	LH	1, 2, 3, 4	3
Yao *et al*., 2015 [33]	China	18–60	35/36	GLS	2, 3, 5	6
Zhang *et al*., 2014 [34]	China	20–50	33/32	ABS	2, 3, 5	7
Wang *et al*., 2014 [10]	China	29–60	30/30	Sinusotomy	1, 4	6
Li *et al*., 2021 [18]	China	18–70	140/140	LAS	2, 3	3
Pan *et al*., 2023 [21]	China	18–60	52/53	GLS	1, 4, 5	4
Xiong *et al*., 2021 [19]	China	<65	31/31	LSG	1, 2, 3, 4	5
Liu *et al*., 2008 [35]	China	18–60	48/48	LC	1, 2, 3, 4	5

VATSL, video-assisted thoracic surgical lobectomy; LC, laparoscopic cholecystectomy; LS, laparoscopic surgery; SC, supratentorial craniotomy; IC, infratentorial craniotomy; MBS, major breast surgery; LH, laparoscopic hysterectomy; LAS, lower abdominal surgery; HNTS, head and neck tumor surgery; GLS, gynecological laparoscopic surgery; LSG, laparoscopic sleeve gastrectomy; ABS, ambulatory breast surgery; URSL, ureteroscopic lithotripsy. Outcome measures: 1 = postoperative nausea and vomiting; 2 = postoperative nausea; 3 = postoperative vomiting; 4 = number of patients requiring antiemetic rescue; 5 = incidence of adverse effects. Jadad score range: 0–7; scores ≥4 reflect high-quality studies.

Jadad scores and significant effects, further supporting the application value of TEAS in these types of surgeries. Head and Neck Tumor Surgery (HNTS): These types of surgeries have red-colored bubbles, indicating that the studies have low Jadad scores, possible deficiencies in research design, and less reliable results.

Other Small Sample Size Studies: Some studies involving fewer patients have bubbles colored red or yellow, indicating lower quality and credibility of these studies, and their results should be treated with caution.

Discussion

This systematic review indicates that transcutaneous electrical acupoint stimulation (TEAS) demonstrates significant effectiveness in the management of postoperative nausea and vomiting (PONV). Multiple randomized controlled trials (RCTs) and observational studies have shown that TEAS can effectively reduce PONV, enhancing postoperative comfort and quality of life for patients. TEAS has shown good application effects in various types of surgeries, especially in video-assisted thoracoscopic lobectomy (VATSL) and laparoscopic cholecystectomy (LC), where it significantly reduces PONV and alleviates postoperative pain. These findings are consistent with previous research results [36], such as Vivien Hewitt's report that P6 acupressure or stimulation effectively reduces nausea and vomiting in patients (both female and male) undergoing laparoscopic cholecystectomy [37]. Additionally, TEAS has shown promising application prospects in gynecological and orthopedic surgeries [38–42]. Particularly in suboccipital craniotomy, TEAS, as an adjunct treatment, significantly reduces the incidence and severity of PONV. These results suggest that TEAS can serve as an effective adjunctive intervention in postoperative management across different types of surgeries.

However, literature on the negative impacts or insignificant effects of TEAS in surgeries is currently lacking, possibly due to small sample sizes in related studies, limitations in study design, and insufficient observation periods, which may prevent the full manifestation of potential adverse effects or inefficacy. The frequency and intensity of TEAS are key factors influencing its efficacy. Different frequencies and intensities of stimulation can activate different neural pathways, leading to varying physiological effects. In this study, we noted that the settings of TEAS devices (such as frequency and intensity) could significantly impact its effectiveness in preventing PONV. Lu *et al*. [43] found that different frequencies of TEAS combined with wristband pressing to stimulate Neiguan (PC 6) had certain therapeutic effects on PONV in patients undergoing laparo-

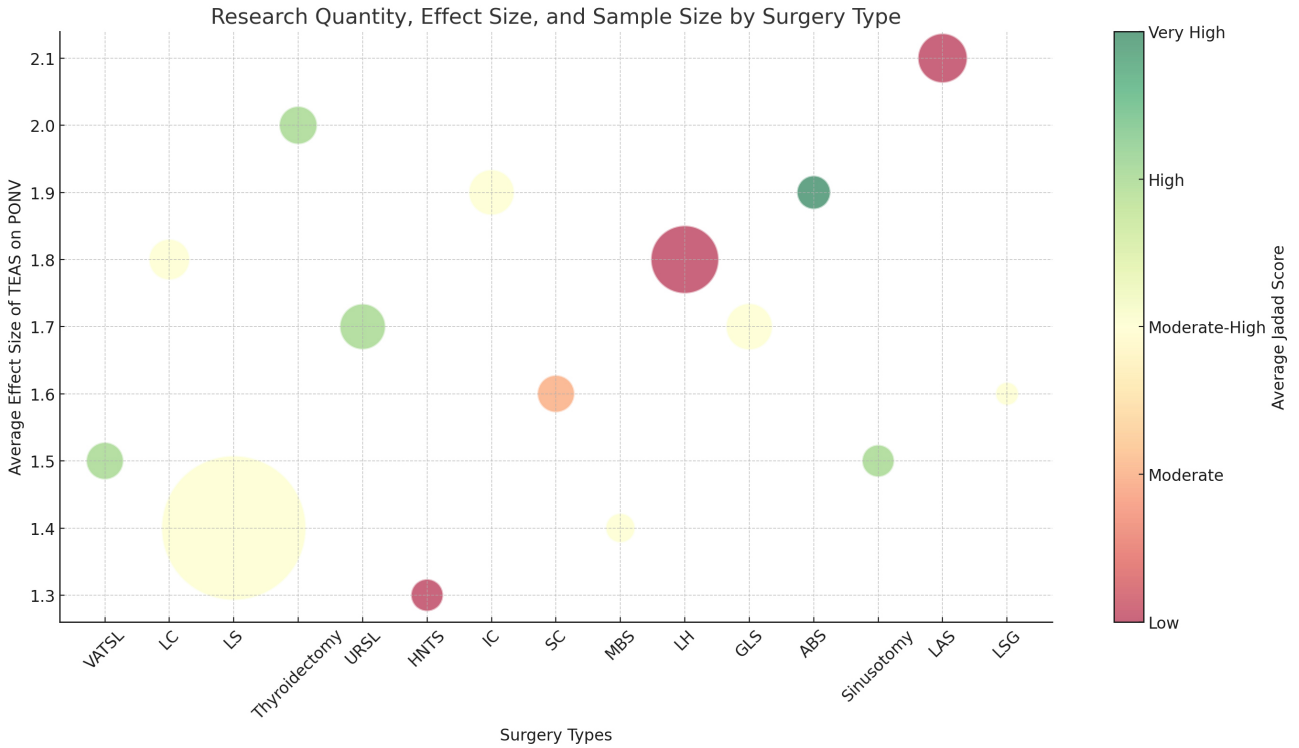

Fig. 1. Analysis of the Application Effectiveness and Research Quality of TEAS in Different Types of Surgeries. Axis Description. X-axis: Represents different types of surgeries (e.g., VATSL, LC, *etc*.). Y-axis: Represents the average effect size of TEAS on postoperative nausea and vomiting (PONV) (e.g., risk ratio or standardized mean difference). The higher the Y-axis value, the greater the effect of TEAS in reducing PONV. Bubble Description. Bubble Size: Indicates the total sample size of studies for each type of surgery. The larger the bubble, the more participants were involved in the studies. Bubble Color: Indicates the average Jadad score of the studies. The greener the color, the higher the quality of the evidence; the redder the color, the lower the quality of the evidence. Green (High Quality): High Jadad score, good research quality. Yellow (Medium Quality): Medium Jadad score. Red (Low Quality): Low Jadad score, poor research quality.

scopic cholecystectomy. Specifically, 2 Hz/100 Hz TEAS combined with wristband pressing on Neiguan (PC 6) was more effective in preventing PONV. Both 2 Hz/100 Hz TEAS and 100 Hz TEAS combined with wristband pressing on Neiguan (PC 6) had postoperative analgesic effects, with the 2 Hz/100 Hz TEAS showing better pain relief [43]. There have also been reports suggesting that frequency and other settings do not significantly affect the treatment outcome. A randomized trial by Li *et al*. [44] found that mixed-frequency TEAS was more effective in controlling acute pain compared to a placebo or 5 Hz or 100 Hz TEAS. However, there are no direct reports on postoperative vomiting and so on.

Although TEAS technology is generally considered safe, there have been reports indicating that it may cause localized skin irritation and allergic reactions. For example, while the common side effects of TEAS are primarily mild local skin irritation and allergic reactions, the incidence and severity of these effects can vary depending on individual differences. To more comprehensively assess these adverse effects, we reviewed existing literature and recommend that clinical management strategies be implemented, such as testing the skin before use, strictly controlling the current intensity and duration of use, to reduce the occurrence of adverse reactions. In practical applications, clinicians need to weigh the risks and benefits of TEAS in the management of PONV. On the one hand, TEAS, as a non-pharmacological intervention, can significantly reduce the incidence of postoperative nausea and vomiting and improve patient recovery. On the other hand, although adverse reactions to TEAS are rare and generally mild, individual differences in treatment effectiveness and side effects must still be considered. Additionally, research is often focused on a single type of surgery, lacking broad validation across various surgical types, which could obscure potential negative effects of TEAS. Moreover, the bubble chart in the results reflects different colors indicating the average Jadad score of the studies, providing a visual indication of the study quality. Our analysis shows that high-quality studies are concentrated in certain types of surgeries. Possible explanations include: First, the complexity and rigor of study design are fully reflected in studies on laparoscopic hysterectomy (LH) and gastric laparoscopic surgery (GLS). These types of surgeries have been researched for

a longer period, accumulating rich experience and standardized research methods, allowing researchers to conduct high-quality RCTs using strict randomization and blinding, ensuring the credibility of the results. Second, the stage of development and widespread use of surgical techniques play an important role. Due to its early development and widespread use, researchers have ample resources and time to conduct high-quality studies on video-assisted thoracoscopic lobectomy (VATSL). Studies on VATSL also use rigorous research methods, such as randomization and blinding, ensuring the rigor and reliability of the results.

Sample size is another key factor. Studies in the fields of LH and GLS are generally able to recruit more patients, ensuring larger sample sizes, which increases the statistical significance and generalizability of the results. Conversely, studies on head and neck tumor surgery (HNTS) and some small sample size studies face difficulties in recruiting sufficient patients due to the relative rarity of the disease or other constraints, leading to inadequate sample sizes. This insufficiency increases the uncertainty of the results and may lead to a lack of statistical significance, affecting the rigor of the study design and the reliability of the results. Due to the current lack of studies and data directly related to cardiac surgery, we selected video-assisted thoracoscopic lobectomy (VATSL) as a comparable study object. VATSL shares certain similarities with cardiac surgery in terms of surgical complexity, anesthesia management, and postoperative recovery, particularly in airway management and the incidence of postoperative nausea and vomiting (PONV). By analyzing the effects of transcutaneous electrical acupoint stimulation (TEAS) in VATSL, we hypothesize that similar effects might also be applicable to cardiac surgery.

Limitations of Existing Research

During the review process, we noticed that some of the original studies had limited sample sizes, which may affect the generalizability and statistical power of their results. Many studies on TEAS have small sample sizes, which limit the statistical significance and generalizability of the results. Small sample size studies are easily affected by individual differences, leading to result instability. Additionally, inadequate sample sizes may underestimate or overestimate the actual effects of TEAS, failing to accurately reflect its efficacy across different populations. Currently, most studies on TEAS focus on short-term effects, lacking long-term follow-up data. This prevents us from understanding the long-term effects and safety of TEAS. Long-term follow-up data are crucial for assessing the sustained effects of TEAS on postoperative recovery and quality of life improvement. We hereby emphasize that future research should incorporate a larger sample size and increase long-term follow-up observations, in order to obtain research results with greater generality and statistical power, thereby gaining a more comprehensive understanding of the sustained effects and safety of TEAS, and further accurately assessing the actual effectiveness of TEAS in the management of PONV.

Prospect

Although existing research indicates the effectiveness of TEAS in PONV management, more large-scale, multicenter randomized controlled trials are needed to further verify its effects and safety. Future research should focus on long-term effect and safety assessments, exploring the application of TEAS in different types of surgeries and various patient populations. We also found that blinding and placebo controls are crucial for ensuring the reliability of the results. Future research should be designed with more rigorous double-blind, placebo-controlled trials to eliminate the potential impact of placebo effects. Additionally, detailed operational guidelines and standardized procedures should be developed in clinical practice to ensure the widespread application and promotion of TEAS.

Conclusion

TEAS shows significant effectiveness and safety in PONV management, supported by multiple studies. Its non-invasive nature and low side effects make it promising. However, we acknowledge study heterogeneity, particularly in patient populations, surgical types, and TEAS protocols. We employed stratified analysis to mitigate heterogeneity impact on our conclusions. Future studies should consider these factors for more reliable results.

Author Contributions

KY and JH designed the research study. LY performed the research and data collection. WX and RX supervised the study and provided guidance and advice. WX and RX also analyzed the data and are the corresponding authors responsible for the overall content. All authors, including the first authors KY and JH, contributed to editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Not applicable.

Acknowledgment

We thank Home for Researchers (https://www.home-for-researchers.com) and Grammarly (https://www.grammarly.com/upgrade) for their help with language.

Funding

This project is supported by the 2023 Medical and Health Science and Technology Planning Project of Jingzhou City, with the project name being 'Application of Situational Simulation Teaching in Perioperative Anesthesia Crisis Management' and the project number being 2023HC13.

Conflict of Interest

The authors declare no conflict of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.59958/hsf.7859.

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