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Effect of acupoint stimulation after caesarean section: a protocol for systematic review with meta-analysis and trial sequential analysis

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ABSTRACT

Introduction Although caesarean sections (CSs) are essential for the management of obstructed labour and other obstetric complications, postoperative pain, delayed recovery and complication risks continue to be significant challenges in perioperative management. Improvements in traditional medications and surgical techniques have helped, yet issues, including medication side effects and extended recovery times, persist. Therefore, it is particularly important to seek non-pharmacological interventions, such as acupoint stimulation, to optimise the perioperative management of CS. The aim of this systematic review protocol is to synthesise the available evidence and assess the effect of acupoint stimulation in the perioperative period of CS.

Methods and analysis We plan to search PubMed, Web of Science, EMBASE, Scopus, the Cochrane Library and China National Knowledge Infrastructure, from their inception to August 2025. Primary outcome indicators will include pain, time to first defecation, time to first bowel movement and time to return of bowel sounds. Secondary outcome indicators will include postoperative complications, such as nausea and vomiting, bloating, anxiety and depression, as well as length of hospital stay and morphine consumption. Subgroup analyses, meta-regression and sensitivity analyses will be used to investigate the potential sources of heterogeneity and to test the stability of the results. Trial sequential analysis will be introduced to enhance the reliability of the evidence.

Ethics and dissemination No ethical approval is required as this study synthesises the existing published data. Results will be disseminated through peer-reviewed publications and conference presentations. Any protocol amendments will be documented in PROSPERO and detailed in the final publication.

PROSPERO registration number CRD42024558572.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Comprehensive literature retrieval across six databases (PubMed, Web of Science, EMBASE, Scopus, Cochrane Library and China National Knowledge Infrastructure) without language restrictions.
⇒ Dual-reviewer process with independent study selection, data extraction and quality assessment.
⇒ Prespecified subgroup analyses exploring heterogeneity sources (eg, maternal age, intervention techniques and surgical procedures).
⇒ Integration of trial sequential analysis to control random errors in meta-analysis findings.
⇒ Restriction to randomised controlled trials may limit applicability to non-randomised clinical settings.

INTRODUCTION

Caesarean section (CS) is a prevalent method of childbirth, particularly in critical scenarios, such as dystocia and fetal distress, playing a pivotal role in safeguarding maternal and neonatal health.[1 2] Epidemiological data reveal a consistent rise in the global CS rate over the past three decades, with 21.1% of births occurring via this method between 2010 and 2018. Projections suggest that, by 2030, this figure may escalate to 28.5%.[3] This trend underscores an overreliance on CS technique in clinical practice and poses significant challenges in managing postoperative pain, delayed gastrointestinal recovery and potential complications.[4 5] Addressing these issues related to CS has become a critical global health priority, as they impact not only the postoperative well-being of mothers but also contribute to increased healthcare costs and dual risks to both mother and child.[2 6]

While traditional pharmacological interventions and advancements in surgical techniques have provided some relief, adverse drug reactions and the inherent limitations of these approaches have constrained their effectiveness. Consequently, the pursuit of a safe and efficacious non-pharmacological treatment modality is imperative for enhancing the perioperative management of CS.

In recent years, acupoint stimulation, including but not limited to acupuncture, acupressure and transcutaneous electrical acupoint stimulation (TEAS), as an important

complementary and alternative therapy, has been widely used in the field of postoperative recovery. Evidence suggests that such stimulation may alleviate postoperative pain, expedite recovery and mitigate the risk of complications.[7–9] Although the precise mechanisms are not fully understood, it is hypothesised that these effects may be attributed to the stimulation of endogenous opioid release, modulation of inflammatory responses and regulation of autonomic nervous system function.[10–12] Owing to these potential benefits, acupoint stimulation is increasingly recognised as an adjunctive strategy in the perioperative management of CS, with studies indicating its potential to reduce postpartum pain, enhance postoperative gastrointestinal function, decrease analgesic consumption and avert perioperative anxiety and depression.[13 14]

However, the heterogeneity across studies, coupled with divergent and occasionally contradictory findings, has impeded the formulation of robust, evidence-based recommendations for the application of acupoint stimulation in the CS perioperative period. A systematic review and meta-analysis of existing research is, therefore, warranted to comprehensively evaluate the therapeutic efficacy and comparative advantages of acupoint stimulation in this context.

While a prior systematic review has examined complementary therapies for postcaesarean pain,[15] none have comprehensively assessed all acupoint stimulation techniques (eg, acupuncture, TEAS and auricular therapy) nor applied trial sequential analysis (TSA) to validate evidence robustness, highlighting the need for this protocol. This systematic review protocol endeavours to delineate the effect and safety profile of acupoint stimulation within the CS perioperative continuum, aiming to furnish clinical practice with evidence-based support and to chart a course for future investigative endeavours.

METHODS

This protocol adheres to the reporting standards of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Protocols guidelines.[16] In addition, the protocol for meta-analysis was registered with PROSPERO (CRD42024558572). Any future amendments will be documented in PROSPERO and detailed in the final publication.

Search strategy

A systematic search across PubMed, Web of Science, EMBASE, Scopus, the Cochrane Library and the China National Knowledge Infrastructure (CNKI), from inception to August 2025, will be conducted. There will be no restrictions on country, publication status or year of publication in the search. The reference lists of all retrieved literature will be manually screened as a supplement. We will additionally search clinical trial registries (ClinicalTrials.gov and WHO ICTRP) and grey literature sources (conference proceedings and dissertations) to mitigate publication bias. The search terms include caesarean section, acupoint stimulation, acupuncture, auricular acupuncture, electroacupuncture, transcutaneous electrical acupoint stimulation and their related topics. The detailed retrieval search strategy in PubMed is shown in table 1. We will tailor the search strategy to accommodate the unique features of each database (eg, Emtree in EMBASE and subject headings in CNKI), and the predefined search strategy for all databases is provided in online supplemental file.

Table 1 Search strategy in PubMed

Number	Search terms
#1	Cesarean Section [Mesh]
#2	Cesarean Section (Title/Abstract) OR Cesarean Sections (Title/Abstract) OR Abdominal Delivery (Title/Abstract) OR C-Section (OB) (Title/Abstract) OR C Section (OB) (Title/Abstract) OR C-Sections (OB) (Title/Abstract) OR Caesarean Section (Title/Abstract) OR Caesarean Sections (Title/Abstract) OR Delivery, Abdominal (Title/Abstract) OR Abdominal Deliveries (Title/Abstract) OR Deliveries, Abdominal (Title/Abstract) OR Postcesarean Section (Title/Abstract)
#3	#1 OR #2
#4	acupoint stimulation (Title/Abstract) OR Acupuncture (Title/Abstract) OR acupoint (Title/Abstract) OR acupoints (Title/Abstract) OR electroacupuncture (Title/Abstract) OR electro-acupuncture (Title/Abstract) OR auricular acupuncture (Title/Abstract) OR manual acupuncture (Title/Abstract) OR auricular acupressure (Title/Abstract) OR body acupressure (Title/Abstract) OR Transcutaneous electrical acupoint stimulation (Title/Abstract) OR TEAS (Title/Abstract) OR Acupressure (Title/Abstract) OR acupressure massage (Title/Abstract) OR Transcutaneous electrical nerve stimulation (Title/Abstract) OR TENS (Title/Abstract)
#5	#3 AND #4

TEAS, transcutaneous electrical acupoint stimulation.

Study selection and inclusion criteria

1. Population: patients undergoing CS will be included in this study. There are no restrictions on the patient's age, race, weight, gestational week, number of pregnancies or method of surgery.
2. Intervention: the intervention is defined as acupoint stimulation, including but not limited to acupuncture, auricular acupuncture, electroacupuncture (EA) and TEAS.
3. Comparison: the control interventions are defined as including, but not limited to, routine postoperative care, sham acupoint stimulation (eg, placebo control), other non-acupoint stimulation interventions and blank controls. Ensure that the control groups are reasonable and comparable to accurately assess the effect of acupoint stimulation.
4. Outcomes.

Primary outcomes

- Postoperative pain: quantified using validated scales (visual analogue scale (VAS), numerical rating scale

or equivalent) at prespecified time points (eg, 6 hour, 24 hours and 48 hours postoperatively).
- Time to first defecation (hours).
- Time to first bowel movement (hours).
- Time to return of bowel sounds (hours).

Secondary outcomes

- Perioperative complications:
  1. Nausea/vomiting: incidence (yes/no) or severity scales (eg, VAS for nausea).
  2. Abdominal distension: clinician assessment or patient-reported scales.
  3. Anxiety/depression: validated instruments (eg, state-trait anxiety inventory, hospital anxiety and depression scale and Hamilton anxiety scale).
  4. Hypotension: defined as systolic blood pressure <90 mm Hg or >20% decrease from baseline.
- Morphine consumption: regarding postoperative morphine consumption, we will convert relevant drugs to morphine equivalents (mg) uniformly to ensure the consistency of extracted data.
- Length of hospital stay: days from surgery to discharge.
  5. Study design: only randomised controlled trials will be included in the study.

EndNote X9 (Thomson Reuters, New York, USA) will be used to manage the literature, perform filtering, categorise the document and remove duplicates. After completing the initial screening, two reviewers will independently review the studies based on their titles and abstracts to exclude irrelevant sections. The full text will then be downloaded for full-text screening to identify studies that are ultimately suitable for meta-analysis. During this process, any excluded studies and the reasons for their elimination will be recorded. In the case of disagreement, a third reviewer will adjudicate. Figure 1 shows the PRISMA flow diagram of the literature selection in this study. Actual screening numbers will be populated during the review process and reported in the final publication.

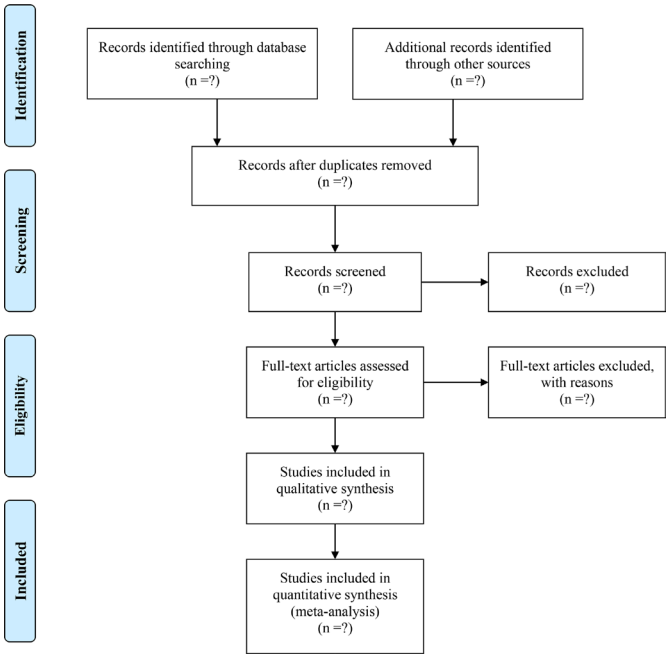

Figure 1 PRISMA flow diagram of study identification and selection. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Data extraction

Preset Microsoft Excel will be used for data extraction and management. Data entry will be carried out by two independent researchers after the final included studies have been identified. The data to be collected will include: title, first author's name, year of publication, country of publication, sample size, gender, mean age, type of procedure, method of intervention, method of control, node of intervention and primary and secondary outcome data related to this study.

For missing data, we will contact the authors first. If there is no response, I will attempt to calculate mean/SDs using the Cochrane formula or another validated method. For example, for studies reporting continuous outcomes as median/IQR instead of mean/SD, we will convert the data using the method proposed by Hozo *et al*.[17] Additionally, we will use WebPlotDigitiser 4.6 (Ankit Rohatgi, Oakland, CA, USA) to collect values from the graphs. If conversion or collection is not available, the study will be excluded from meta-analysis. All data will be cross checked. In addition, any objections will be rechecked by a third reviewer for accuracy and consistency of the data.

Quality assessment

According to the Cochrane Handbook for Systematic Reviews of Interventions, the quality of individual studies will be assessed using The Cochrane Risk of Bias Tool 2.0.[18] The process will be conducted by two independent reviewers, with a third researcher to resolve disagreements if required. Assessments will be divided into six areas, including sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reports and other sources of bias.

Quality of evidence

Quality of evidence for all outcomes will be completed independently by two additional reviewers, based on the Grades of Recommendation, Assessment, Development and Evaluation approach. Each piece of evidence will ultimately be given one of the four levels of evaluation, including high, moderate, low and very low.[19]

Data synthesis and meta-analysis

In this study, continuous outcome variables, including postoperative pain, time to first defecation, time to first bowel movement and time to return of bowel sounds, will use the standard mean difference as the effect measure. Dichotomous variables, such as postoperative complications, will use the risk ratio to evaluate the effect measure. All effect measures will be expressed with 95% CIs.

The statistic I^2 and Cochran's Q test will be used to measure the heterogeneity between studies.[20] In cases

of insignificant heterogeneity (p>0.1 or I^2<50%), a fixed-effects model will be applied for data synthesis. When heterogeneity is large (p≤0.1 or I^2≥50%), the random-effects model will be chosen for the analysis, and further subgroup analysis and/or metaregression analysis will be carried out for the potential sources of heterogeneity. If quantitative analysis is not appropriate, we will provide the necessary qualitative descriptions in the discussion section.

When subgroup analysis is necessary, maternal age, weight, number of pregnancies, surgical procedure, type of intervention and duration of intervention are fully discussed as factors that may affect postoperative recovery. Furthermore, to determine the stability of the study results, sensitivity analysis will be performed for results with I^2>50%.

In cases where the number of studies was less than 5 or studies were substantially heterogeneous, we will use a random-effects model.[16] Additionally, if more than ten studies are ultimately included, we will draw the funnel plot to assess publication bias. The Egger's test will be used to assess the asymmetry of the funnel plot.[21] RevMan 5.3 and STATA 14.0 will be used to perform the meta-analysis.

Trial sequential analysis

To avoid the potential impact of false-positive results due to limited data or repetition of multiple tests, the robustness of the cumulative evidence for the primary outcome indicators will be assessed using TSA (0.9.5.10 β).[22] Preset TSA parameters: setting the Type I error (α) at 5% (two sided), the Type II error (β) at 20% (80% power) and selecting the O'Brien–Fleming spending function for boundary setting. All parameters will be reported in the final publication.

Patient and public involvement

Patients or the public were not involved in the design, conduct or reporting of this research.

DISCUSSION

CS is a prevalent obstetric procedure, with perioperative management playing a pivotal role in the recovery of the parturient and the health of both mother and neonate. The Society for Obstetric Anaesthesia and Perinatology has issued a consensus statement and recommendations on enhanced recovery after caesarean, emphasising the construction of patient-centred care and the improvement of postoperative recovery quality for parturients through optimised standardised protocols.[23] Acupoint stimulation, as a potential non-pharmacological therapy, may offer a more diversified range of treatment options for women, helping them to alleviate pain, accelerate recovery and reduce dependence on medication and associated side effects. Nevertheless, a cohesive evidence assessment of the specific role and efficacy of acupoint stimulation during the CS perioperative period is currently lacking.

Previous research has suggested that acupoint stimulation therapies, including acupuncture, TEAS and auricular massage, may play a positive role in alleviating postoperative pain and improving complications following CS.[24–26] However, other studies have shown no significant advantage of acupoint stimulation. For instance, one study did not observe a significant reduction in nausea and vomiting in caesarean patients after auricular therapy.[13] We note that a previous systematic review on the use of acupoint stimulation therapy after CS has investigated a total of eight different complementary alternative therapies, included only a selection of acupoint stimulation therapies, and had a small sample, and the results showed a significant degree of heterogeneity and low certainty.[15] However, another recent randomised controlled study supports the efficacy and safety of acupuncture for patients after CS.[27] Given the medical community's scepticism regarding the application of acupoint stimulation therapies during the perioperative period of CS, it is essential to systematically synthesise and analyse the existing literature. This will provide reliable evidence-based support for the efficacy of acupoint stimulation as an adjunctive therapy in the perioperative period of CS.

This protocol aims to thoroughly investigate the multidimensional effects of acupoint stimulation on postoperative recovery post-CS through systematic review and meta-analysis methodologies. Compared with traditional studies, it encompasses not only the key indicator of postoperative pain but also extends to indicators, such as the time to first bowel movement, restoration of gastrointestinal motility and return of bowel sounds, which reflect the recovery of gastrointestinal function. Concurrently, this protocol takes into account perioperative complications, including nausea and vomiting, abdominal distension, anxiety, depression and hypotension, as well as indicators like hospital stay and morphine consumption, to comprehensively assess the impact of acupoint stimulation on the postoperative recovery of parturients. On the other hand, this study will employ subgroup analyses, metaregression and sensitivity analyses to investigate the potential sources of heterogeneity and to test the stability of the results. Furthermore, TSA will be introduced to enhance the reliability of the evidence. By employing these multifaceted evaluation strategies, the study aims not only to reveal the comprehensive impact of acupoint stimulation on the perioperative period of CS but also to provide more comprehensive decision support for clinicians.

However, this study inevitably has certain limitations. First, due to language constraints, we may not have included all relevant literature that is not in English or Chinese, which could introduce selection bias. To mitigate this, we opted not to impose language restrictions during the search process and aimed to encompass both Chinese and English databases, thereby reducing the potential for bias. Additionally, the diversity of methods and techniques used in acupoint stimulation may lead to clinical heterogeneity across different studies.

Prespecified subgroup analyses will categorise interventions into manual acupuncture (including body/auricular acupuncture), EA, TEAS and acupressure (including auricular/seeds).

Moreover, there is a strong call for future research to consider larger sample-sized, multicentre trials to explore the specific mechanisms of various acupoint stimulation techniques during the perioperative period of CSs. We anticipate that this study will provide more comprehensive and personalised options for the perioperative care of parturients, thereby enhancing their overall health and well-being.

ETHICS AND DISSEMINATION

No ethical approval is required as this study synthesises existing published data. Results will be disseminated through peer-reviewed publications and conference presentations. Any protocol amendments will be documented in PROSPERO (CRD42024558572) and detailed in the final publication.

Contributors F-jX and WZ conceptualised the study and contributed equally to this work. F-jX and S-jJ obtained funding, and together with WZ designed the study and drafted the initial manuscript. X-hL, KS and L-mC were involved in the review and revision of the protocol. W-nJ and H-mN supervised the study. All authors read and approved the final version of the manuscript. F-jX is the guarantor of this study.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

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