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STUDY PROTOCOL

Acupoint Selection in Postoperative Ophthalmic Pain Management: A Data Mining Protocol

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Background: Postoperative ophthalmic pain not only induces anxiety and depression among patients, but also prolongs the recovery cycle. However, the management of postoperative pain in ophthalmology is still not standardized. The effectiveness of acupuncture in treating postoperative pain has been validated based on numerous clinical trials and meta-analysis. Our study is to conduct the first data mining analysis to identify the most effective acupoints selection and combinations for treating postoperative ophthalmic pain, inform.

Methods: We will search bibliographic databases from inception to November 2023. Clinical trials evaluating the effectiveness of acupuncture therapy in the management of postoperative ophthalmic pain will be selected. Reviews, protocols, animal studies, case reports, systematic evaluations and Meta-analyses will be excluded. Primary outcome indicators will be clinical outcomes related to postoperative ophthalmic pain. Descriptive statistics will be performed in Excel 2019. Association rule analysis will be performed in SPSS Modeler 18.0. Exploratory factor analysis and cluster analysis will be performed in SPSS Statistics 25.0.

Results: This study will investigate the most effective point selection and combination of acupuncture points for the treatment of postoperative ophthalmic pain.

Conclusion: Our findings will provide evidence for the effectiveness and potential therapeutic prescription of acupuncture for postoperative ophthalmologic pain, helping clinicians and patients work together to make more informed decisions.

Keywords: postoperative ophthalmologic pain, management, acupuncture, acupoint, data mining

Introduction

The International Association for the Study of Pain defines pain as a multifaceted sensory and emotional experience linked to tissue damage, whether present or potential.[1,2] Studies indicate that 75% surgical patients experience postoperative pain, with approximately 30% enduring moderate to severe discomfort.[3] Pain can give rise to a range of complications, adversely impacting respiratory, circulatory, endocrine, and other somatic functions, as well as psychological well-being. It is widely acknowledged as the fifth most critical vital sign in human healthcare. While ophthalmic surgery is less invasive, it demands a meticulous level of precision. Ocular tissues exhibit heightened sensitivity to painful stimuli, potentially resulting in severe postoperative pain for patients.[4] Conversely, the majority of anesthetic agents employed in ophthalmic procedures are of short duration, intended to expedite patients' recovery from anesthesia, albeit with the potential to increase the incidence of postoperative pain. Studies have revealed that, within the realm of ophthalmic surgery, the lowest incidence of severe pain is noted in cataract and iridectomy procedures, whereas the highest incidence is associated with cricothyroid and strabismus surgeries.[5,6] Effective pain management not only leads to improved clinical outcomes but also serves as a preventative measure against the development of associated complications. Additionally, it contributes to the reduction of healthcare costs and the enhancement of patients' overall quality of life.

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At present, pharmacotherapy stands as the primary approach to pain management for ophthalmic surgery patients. However, analgesic medications often entail specific adverse effects, including gastrointestinal (eg, nausea, vomiting) and central nervous system (eg, dizziness, headache, somnolence) reactions associated with non-steroidal anti-inflammatory drugs (NSAIDs).[7] Opioid analgesics also present side effects such as nausea, vomiting, and potential addictive properties.[8] Furthermore, local anesthetics exert a potentially toxic impact on corneal endothelial and epithelial cells, potentially leading to cardiac and neurological complications.[9] Various modes of drug administration are employed for postoperative ophthalmic pain relief,[10,11] encompassing oral, intramuscular, intravenous, self-controlled analgesia, transdermal, and transrectal mucosal delivery methods. Nevertheless, all these analgesic approaches are not without limitations. In addition to triggering adverse reactions, they may entail issues such as epidural blood in the dura mater or nerve injury.[12] Consequently, despite the diverse array of available methods for administering postoperative analgesics, their clinical utility remains circumscribed by safety concerns and other considerations. Presently, there persist deficiencies in the management of postoperative pain for ophthalmic patients, highlighting a dearth of standardized non-pharmacological interventions.

Acupuncture therapy exerts its therapeutic effects by targeting specific points on the human body surface, regulating qi and blood flow, and harmonizing bodily functions.[13,14] As an alternative and complementary non-pharmacological intervention, acupuncture-induced paroxysms are widely employed in pain management, offering significant efficacy, high safety, minimal adverse reactions, and cost-effectiveness. Their efficacy in alleviating intraoperative and postoperative paroxysmal pain has gained widespread recognition.[15] The selection and combinations of acupoints constitute a pivotal aspect of acupuncture treatment,[16,17] facilitating its clinical application in postoperative pain management within ophthalmology. The effectiveness of these prescriptions is intricately tied to the pairing of meridian acupoints, displaying complex and nuanced relationships. Consequently, it is imperative to leverage available data to scrutinize the principles governing acupoint selection and combinations, elucidating the effectiveness and potential of acupuncture in addressing postoperative ophthalmic pain. Employing data mining techniques facilitates the discovery of valuable information and insights within extensive literature collections. This study aims to furnish evidence affirming the specificity inherent in distinct acupoints and underscores the significance of acupoint selection in determining the benefits of acupuncture treatment. Thus, delineating the characteristics and patterns governing the allocation of acupuncture for postoperative ophthalmic pain holds paramount importance for both future theoretical investigations and clinical practice. The overarching objective of this study is to delve into the association rules governing acupoints through data mining, ultimately yielding relatively standardized therapeutic guidelines for the application of acupuncture in postoperative ophthalmic pain management.

Methods and Analysis

Search Methods

We will conduct a comprehensive search across both Chinese and English electronic libraries, spanning from their inception to November 2023. This search will encompass renowned database including PubMed, Embase, Cochrane Library, China National Knowledge Infrastructure (CNKI), Wangfang Database, Chinese Biomedical Literature Database (CBM) and Chongqing VIP Database (VIP). The language criterion for inclusion is confined to Chinese and English. Our search terms will consist of a combination of medical subject heading terms and free-text terms. To illustrate, we present the search strategy employed for PubMed. It is important to note that, considering the unique features of each database, we will tailor the search strategy to accommodate specific database constraints. Table 1 exemplifies the deployment of search strategies as evidenced in the context of PubMed.

Review Process

Data Screening

The inclusion criteria comprise the following: (1) Clinical studies employing acupuncture as the primary intervention, with or without randomized and / or controlled methodologies, administered either in isolation or in combination with other Traditional Chinese Medicine treatments, such as tuina or Chinese medicine, among others; (2) Patients diagnosed

Table 1 Search Strategy for PubMed Database

No.	Search Terms
#1	MeSH terms: "postoperative ophthalmic pain"
#2	Title/Abstract: "postoperative ophthalmic pain" OR "postoperative ophthalmological pain" OR "postoperative pain of ophthalmology" OR "post operational pain of ophthalmic"
#3	#1 OR #2
#4	MeSH terms: "acupuncture therapy" OR "acupuncture" OR "acupuncture treatment" OR "moxibustion" OR "cupping therapy" OR "bloodletting" OR "tuina"
#5	Title/Abstract: "acupuncture therapy" OR "acupuncture" OR "acupuncture treatment" OR "cupping therapy" OR "bloodletting" OR "tuina" OR "treated with acupuncture" OR "acupuncture in treating" OR "moxibustion treatment" OR "acupuncture and moxibustion treatment" OR "manipulation" OR "massage"
#6	#4 OR #5
#7	#3 AND #6

with postoperative ophthalmic surgical pain in accordance with established diagnostic criteria for postoperative pain. Patients with postoperative pain caused by ophthalmic surgery can be diagnosed as ophthalmic postoperative pain. Pain assessment is conducted at the end of the surgery when transferring to the nursing unit or when the patient complains of pain. The evaluation methods can use Numeric Rating Scale, Faces Pain Scale Revised, and Patient Controlled Analysis; (3) A minimum of 10 patients in each experimental group; (4) Acupuncture points for acupuncture treatment, either meridian or empirical points; (5) A study comparing different types of acupuncture methods.

In terms of exclusion criteria, the following papers will be excluded: (1) Reviews, protocols, animal trials, case reports, systematic reviews, and meta-analysis; (2) Trails involving micro-acupuncture systems, ear needle, and other non-body needle techniques; (3) Solely presenting laboratory findings; (4) Demonstrating that acupuncture, either alone or in combination with other treatments, did not yield superior outcomes compared to the control group; (5) Lack of complete prescriptions for acupuncture points or absence of any prescriptions altogether.

Data Collection

Xing Wang and Feng Yang conduct an initial review of all titles and abstracts identified through the literature search, excluding those that are evidently irrelevant. Full texts of the remaining references will be gathered, and a secondary evaluation will be performed to eliminate any publications that do not meet the criteria for relevance. Subsequently, Jing Wang and Fang Pang will systematically assess the eligibility of all remaining papers in accordance with the specified inclusion criteria. Any disagreements will be resolved through discussion.

Database Establishment and Data Normalization Processing

The document manager, Endnote 9.3, will receive the imported literature obtained from the search. After eliminating duplicates using the software, two researchers will independently screen the literature in accordance with the predefined inclusion and exclusion criteria, cross-referencing their findings to ensure the accuracy of the included literature. In instances where the two reviewers do not reach a consensus, a third reviewer will be consulted to facilitate a resolution Figure 1.

The extracted data will be entered into Excel 2019 to establish a database specifically focused on acupuncture prescriptions for postoperative ophthalmic pain. Valid prescriptions will be identified using the criterion of "a combination of primary and secondary points constituting an acupoint prescription"[18] By consulting the "Channels-collaterals and Acupoints"[19] we will standardize the nomenclature of the acupoints featured in the literature, and supplement information regarding meridian assignment, point location, and specific acupoint attributes.

Managing Missing Data

To evaluate the data earmarked for processing, we will initiate communication with the original authors. Should they furnish any pertinent missing information, we will proceed with the assessment of the data within the Section. If

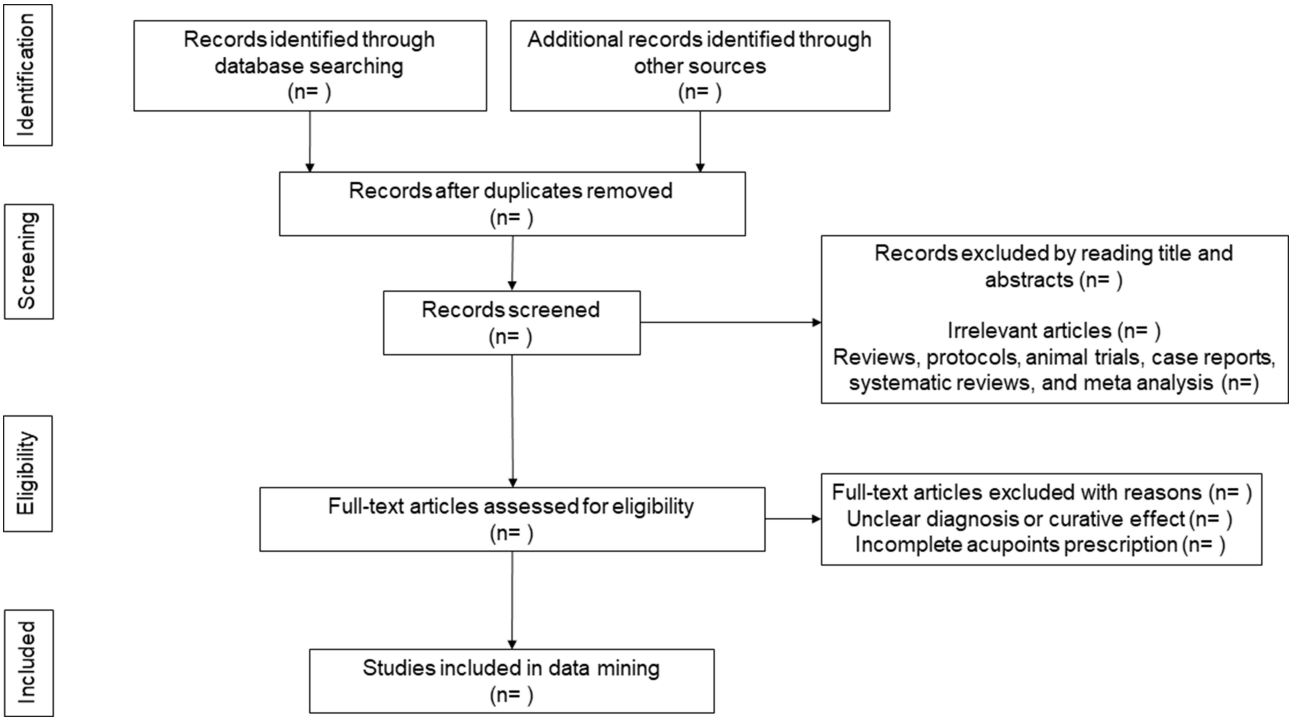

Figure 1 Flow diagram of the study selection process.

comprehensive details remain inaccessible through this avenue, we will regrettably need to exclude the data from our analysis.

Data Analysis

Literature Quality Evaluation

Two reviewers will employ The Cochrane Collaboration's "risk of bias" tool to evaluate potential bias in the included studies.[20] The assessments will cover the following aspects, each independently evaluated by two investigators: generation of randomized sequences, allocation concealment, blinding of participants and personnel, blinding of outcome assessments, handling of incomplete outcome data, selective reporting, and other potential sources of bias. Any discrepancies will be addressed through thorough discussion or, if necessary, consultation with a third investigator.

Descriptive Statistics

All acupoint prescriptions extracted from the selected literature will be inputted into Excel 2019. Subsequently, Excel 2019 will be employed to generate a PivotTable for conducting descriptive statistical analyses on the frequency of acupoint usage, their meridian affiliations, locations, and specific attributions Additionally, high-frequency acupoints will be visually represented using bar charts.

Association Rule Analysis

For the Association rule analysis, we will utilize SPSS Modeler 18.0 software along with the Apriori algorithm to scrutinize the association rules pertaining to high-frequency acupoints. The support metric will denote the likelihood of concurrent occurrence of the former and the latter term, while confidence will signify the probability of the latter term occurring given the presence of the former. Following iterative testing, we will establish optimal thresholds for support and confidence levels, setting the maximum value for the former item. Subsequently, we will generate a comprehensive network diagram to analyze the interrelationships between acupoints.

Exploratory Factor Analysis

The analysis will be conducted using SPSS Statistics 25.0. For the exploratory factor analysis of high-frequency (HF) acupoints, both the Kaiser-Meyer-Olkin (KMO) and Bartlett's tests of sphericity will be applied to the prescription data. Factor analysis will be pursued if KMO > 0.5 and P < 0.05. In such cases, maximum variance rotation will be employed to extract the principal factor components. Conversely, if KMO < 0.5 or P > 0.05, factor analysis will be deemed inappropriate.

Cluster Analysis

In the realm of cluster analysis, SPSS Statistics 25.0 will be utilized to examine the high-frequency acupoints. This analysis will encompass the creation of a cluster analysis tree and the thorough investigation of the clustering relationships among acupoints.

Discussion

Ophthalmic surgery, often viewed as less invasive and predominantly conducted under local anesthesia, has tended to receive less attention in terms of postoperative pain management.[21] Consequently, there has been a dearth of quantitative analyses concerning factors associated with postoperative pain in ophthalmic procedures.[22,23] Nevertheless, as the study of postoperative symptoms among patients has grown more comprehensive, there has been an increasing focus on postoperative pain. Patients undergoing ophthalmic surgery under local anesthesia encounter the limitation of incomplete analgesia, leading to frequent perioperative pain occurrences. Postoperative pain in this context primarily stems from actions like pulling and cutting during surgical procedures, with its onset influenced by a combination of factors. This pain directly impacts the patient's recovery process, resulting in heightened anxiety and diminished sleep quality. Hence, the proposal of effective postoperative pain management methods is crucial for enhancing patient recovery.

Currently, pharmaceutical-based analgesic regimens are commonplace in managing postoperative pain for ophthalmic surgery patients. These encompass the use of opioid analgesics, nonsteroidal anti-inflammatory drugs, local anesthetics, sedatives, and various other medications. Strategies like hyperalgesia and multimodal analgesia are employed to address different pain scenarios.[24] Despite the availability of these analgesic options and the diverse modes of administration, concerns surrounding their safety and other issues have constrained their widespread clinical utilization. Consequently, there remains room for improvement in the management of postoperative pain in ophthalmic surgery, including the implementation of standardized non-pharmacological interventions.

Acupuncture, a pivotal component of traditional Chinese medicine, is widely acknowledged for its analgesic properties.[25–27] Advances in neuroscience and related disciplines have led to rapid progress in understanding the mechanisms underlying acupuncture-induced analgesia. Extensive research has elucidated the neurological underpinnings of acupuncture's therapeutic effects, serving as a valuable resource for investigating its analgesic mechanisms,[28–30] Clinical studies have consistently demonstrated acupuncture's efficacy in alleviating postoperative ophthalmologic pain, attributing its analgesic effects to the modulation of endorphins, 5-hydroxytryptamine, and acetylcholine, as well as its influence on emotional and cognitive processing areas of the brain.[26,31] However, a comprehensive, statistically-based analysis of acupuncture for postoperative ophthalmologic pain is notably lacking, with acupuncturists often relying on their own experiences and theories to select appropriate acupoints.

To address this gap, we propose employing a robust and promising data mining technique to elucidate potential rules governing acupoint selection for postoperative ophthalmologic pain treatment. This method establishes associations between individual data points and calculates their frequencies within the database, enabling us to conduct descriptive statistical analyses to identify commonly utilized acupoints, meridians, specific points, and locations in acupuncture for postoperative ophthalmic pain. Leveraging association rule mining, a powerful tool in data mining and machine learning, we will employ an unsupervised machine learning approach.[32] This technique is instrumental in uncovering meaningful relationships or associations within large datasets. The "Apriori" algorithm, enhanced with specific constraints, will be employed to refine the rules. Support measures the frequency of a specific item or itemset, while confidence assesses the likelihood of choosing B (Y) given the occurrence of A (X). Additionally, lift, defined as P (AB)/P (A) * P (B), gauges

the likelihood of the rule's occurrence compared to random chance. The Apriori algorithm's simplicity and efficiency have made it widely applicable in data mining,[33] enabling the discovery of latent patterns and the prioritization of selections, including acupuncture point pairings and drug combinations. Our proposed methodology aims to identify the most effective combination of acupoints for postoperative pain treatment in ophthalmology, providing evidence-based medical guidance for clinical practice.

Conclusion

Our findings will provide the evidence for the treatment of postoperative ophthalmic pain with acupuncture, and the basis for clinicians to standardize and optimize acupoints therapy.

Patient and Public Involvement

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

Acknowledgement

Jing Wang and Feng Yang have contributed equally to this work and should be considered as co-first authors.

Disclosure

The authors report no conflicts of interest in this work.

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