

Advances in Modern Chinese Medicine Research

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Operating Standard of Alpha Hydroxy Acid Chemical Peel

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Preface

This document is drafted under the provisions of GB/T 1.1-2020 “Directives for Standardization—Part 1: Rules for the structure and drafting of standardizing documents.”

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Introduction

Alpha hydroxy acid chemical peel is one of the most commonly used chemical peels in clinical practice. It is mainly used for skin repair and reconstruction for cosmetic and therapeutic purposes. Currently, as a quick, safe, and effective clinical treatment and cosmetic procedure, alpha hydroxy acid chemical peel is widely used in dermatology and cosmetic clinics.

However, with the continuous development of alpha hydroxy acid chemical peel and the expansion of clinical indications, corresponding issues have also emerged more frequently. Due to the lack of standardized guidelines for

the application of alpha hydroxy acid chemical peels in the field of skin aesthetics, the incidence of complications has been increasing. Therefore, it is necessary to standardize the operational treatment process, leading to the formulation of the “Operating Standard of Alpha Hydroxy Acid Chemical Peel.”

The purpose of this document is to make the operation of alpha hydroxy acid chemical peel more professional, precise, and specific. This initiative aims to facilitate standardized training and guidance to improve its safety and effectiveness. Ultimately, it seeks to elevate the overall quality of the industry, promoting the positive, orderly, and scientific development of chemical peels in the field of skin aesthetics.

1. Scope

This document specifies the basic requirements, efficacy assessment, operational key points, nursing care for complications, and health education for alpha hydroxy acid chemical peel.

It applies to medical and nursing personnel in dermatology departments and skin laser cosmetic institutions at all levels.

2. Normative references documents

There are no normative reference documents in this document.

3. Terms and definitions

The following terms and definitions apply to this document.

3.1. Chemical peels

Using chemical substances on the skin to induce controlled skin damage at various levels, thereby prompting the reconstruction of the epidermis and dermis structures and achieving therapeutic goals.

Note: Common chemical peeling agents include alpha hydroxy acids (AHAs), beta hydroxy acids (BHAs), and compound acids.

3.2. Alpha hydroxy acid chemical peel

One of the commonly used chemical peels. AHAs are a group of organic acids extracted from fruits and dairy

products. They are named for their hydroxyl group (-OH) located at the α position, hence they are also known as α -hydroxy acids (AHAs). AHAs are diverse, including malic acid (apples), tartaric acid (grapes), citric acid (lemons and oranges), mandelic acid (bitter almonds), glycolic acid (sugarcane), and lactic acid (yogurt). The properties of AHAs vary. Among them, glycolic acid is the best. It has the smallest molecular weight and a simple molecular structure. Glycolic acid is non-toxic, odorless, and has strong permeability. It penetrates the stratum corneum easily, allowing for better absorption by the skin while causing minimal damage. Low concentrations of AHAs can reduce the connections between cells in the stratum corneum. High concentrations ($\geq 50\%$) of AHAs can facilitate epidermal exfoliation and improve dermal structure. Currently, as a quick, safe, and effective clinical treatment and cosmetic procedure, alpha hydroxy acid chemical peel is widely used in dermatology and cosmetic clinics. The primary applications include treating acne vulgaris, rosacea, melasma, post-inflammatory hyperpigmentation, photoaging, keratoderma, acne scars, dull complexion, and rough skin.

3.3. Acne vulgaris

A chronic inflammation of hair follicles and sebaceous gland units caused by multiple factors. It typically presents with comedones, papules, pustules, cysts, and nodules. The condition often recurs, and in severe cases, can significantly affect the patients' appearance and has a prolonged course.

3.4. Rosacea

A chronic inflammatory skin condition caused by multiple factors, primarily affecting the facial bloodvessels and perifollicular sebaceous units. It presents with facial flushing, erythema, papules, pustules, and telangiectasia, often accompanied by dryness, burning, stinging, and itching.

Note: Formerly known as acne rosacea or adult acne.

3.5. Melasma

A common acquired pigmentary disorder, clinically presents as patches ranging from light brown to dark brown. It primarily appears on exposed areas of the face, especially on the cheekbones and cheeks, and often shows a symmetrical distribution.

Note: The onset of melasma is influenced by genetics, endocrine disorders, autoimmune conditions, psychological factors, pregnancy, sun exposure, cosmetics, long-term oral contraceptive use, etc.

3.6. Photoaging

Chronic skin damage resulting from external environmental factors, particularly prolonged ultraviolet radiation exposure. It manifests as discoloration, reduced elasticity, and wrinkles, significantly affecting the aesthetic appearance of the face.

Note: Also known as extrinsic aging of the skin.

3.7. Keratoderma

A group of skin diseases characterized by hyperkeratosis (thickening of the stratum corneum beyond its normal thickness), including conditions like keratosis pilaris, porokeratosis, and ichthyosis.

3.8. Post-inflammatory hyperpigmentation

Acquired skin pigmentation that appears after acute or chronic inflammatory reactions, and is one of the common clinical symptoms.

3.9. Acne scars

Caused by inflammation in specific areas of the skin, leading to the proliferation or loss of subcutaneous collagen fibers. They can be classified into atrophic scars, hypertrophic scars, and keloids, and are a common complication of moderate to severe acne.

4. Basic principles

- (1) Personnel operating alpha hydroxy acid chemical peel should be registered nurses or doctors who have received relevant knowledge and operational skills training.
- (2) Alpha hydroxy acid chemical peel should be conducted in legitimate medical institutions or medical aesthetics facilities.
- (3) Patients should receive education on the relevant knowledge of alpha hydroxy acid chemical peel.
- (4) Informed consent for alpha hydroxy acid chemical peel treatment should be signed before the procedure.

- (5) Treatment should strictly adhere to the operational treatment procedure of alpha hydroxy acid chemical peel.

5. Indications and contraindications

5.1. Indications

Common indications include:

- a) Acne vulgaris;
- b) Rosacea;
- c) Melasma, post-inflammatory hyperpigmentation;
- d) Acne scar;
- e) Skin photoaging;
- f) Others: keratosis pilaris, ichthyosis, cutaneous amyloidosis, etc.

5.2. Contraindications

Common contraindications include:

- (1) People with poor general health, such as psychiatric disorders, psychological impairments, or unstable emotions;
- (2) People allergic to chemical peel agents or other components;
- (3) People with sensitive skin conditions, such as those with contact dermatitis, eczema, or other allergic skin diseases at the treatment area; local infectious skin diseases like active herpes simplex or pyoderma; or unhealed wounds.
- (4) People with bleeding disorders or immunodeficiency diseases;
- (5) Pregnant and lactating women;
- (6) People with unrealistic expectations regarding treatment outcomes;

5.3. Relative contraindications

- (1) People with recent ablative laser treatment, cryotherapy, dermabrasion, or other invasive treatments;
- (2) People with recent use of oral retinoid medications should undergo treatment cautiously under the guidance of a medical professional;
- (3) People who cannot strictly avoid sun exposure post-procedure.

6. Operational treatment procedure

6.1. Pre-operational Assessment

- (1) Assess the patients' background knowledge about alpha hydroxy acid chemical peels. Explain the treatment method, operation process, expected effects, precautions, and adverse reactions to the patient patiently, and sign the informed consent form.
- (2) Assess the patients' general information, including current medical history, past medical history, drug allergy history, and any contraindications to treatment.
- (3) Assess the skin condition at the treatment area and take photos.

6.2. The Procedure of the Operational Treatment (See Appendix A)

6.3. Key Points of the Operational Treatment

6.3.1. Preoperative cleansing

Cleanse the treatment area skin using a facial cleanser or makeup remover to remove surface dirt. If acne vulgaris or hyperkeratosis is present, sterile cotton pads dipped in 75% alcohol or other effective cleansers can be used for secondary cleansing of the treatment area to enhance the penetration depth and uniformity of the chemical peel agent.

6.3.2. Skin preparation

Apply erythromycin ointment or petroleum jelly to protect damaged skin areas, delicate areas, mucous membranes (such as lips), and areas prone to acid residue (such as corners of the mouth, sides of the nose, inner and outer corners of the eyes). Cover both eyes with moistened gauze to prevent acid from entering the eyes.

6.3.3. AHAs selection

AHA treatment should start at a low concentration, and increase gradually as the skin tolerates it. For glycolic acid, commonly used concentrations include 20%, 35%, 50%, and 70%. The treatment response of the skin varies with different pH levels of AHAs.

For AHAs with a pH below 3.5, the typical starting concentration for facial treatments is 20%. The duration of AHA application on the skin is recommended to be

between 1.5 to 5 minutes. This can be adjusted based on the endpoint reactions observed during treatment, such as erythema and frosting, and the tolerance level of the subject. Subsequent treatment concentrations and application times can be determined based on the skin's reactions (such as itching, redness, stinging, crusting, peeling, and others) after previous treatments. Increasing the application duration or raising the concentration of glycolic acid further enhances its effectiveness. For example, initial treatment starts with a concentration of 20%. Continue the treatment with the same concentration used in the initial treatment until the skin can tolerate it completely, typically ranging from 5 to 7 minutes. In thicker skin areas or areas with more resistant lesions, the duration time may be extended up to 10 minutes as needed. For subsequent treatments, higher concentrations of glycolic acid can be considered, or the concentration can be increased progressively based on the patient's response after previous treatments. For example, the sequence might start with 20% for the first treatment, followed by 35% for the second treatment, 50% for the third treatment, and 70% for the fourth treatment. For acid solutions with concentrations below 50%, the treatment intervals are typically between 2 to 4 weeks. For acid solutions with concentrations of 50% and above, the treatment intervals are generally 4 weeks. Usually, one course of treatment consists of 5 sessions. If the treatment interval is more than 3 months, it is necessary to restart at the lowest concentration (20%). When treating body areas and keratoderma (such as keratosis pilaris, etc.), an initial concentration of 50% can be used, and the application time can be extended as needed, up to a maximum of 30 minutes. Close observation of the skin's endpoint reactions is recommended, and feedback from the subject should be obtained.

For AHAs with a pH above 3.5: Treatment can start directly with a 30% concentration. The application time on the skin can range from 10 to 30 minutes, with skin reactions and patient tolerance used as criteria for neutralization. The treatment interval is generally two weeks, with a typical course consisting of 4 to 6 sessions. The treatment efficacy primarily depends on the duration of the glycolic acid application and typically does not result in severe adverse skin reactions.

6.3.4. Application of acid solution

Use a special brush to apply the acid solution while starting

a timer. Generally, begin by brushing the “T-zone” and finish with the cheeks. Within 30 to 60 seconds, apply the acid solution evenly, gently, and quickly from the inside to the outside of the treatment area. One application is usually sufficient, but the key treatment areas can be reapplied as needed. Avoid localized pooling or dripping of the acid solution, and prevent excess solution from overflowing into the eyes, neck, ears, or other non-treatment areas. During the procedure, maintain communication with the patient, inquiring about their sensations and carefully observing the skin’s reaction in the treatment area. Determine the acid solution’s duration based on the patient’s feedback and skin reactions, and be ready to neutralize at anytime. When applying the solution, do not forget that the higher the concentration and the longer the duration, the stronger the chemical peeling effect and the more significant the results. However, the risk of adverse reactions also increases correspondingly.

6.3.5. Endpoint reaction

6.3.5.1. For AHAs with a pH below 3.5

- (1) Ideal endpoint reaction: Mild erythema, slight stinging sensation, or scattered frosting observed on the treated skin area.
- (2) Excessive treatment reaction: Severe pain exceeding level 6, or the appearance of blisters and extensive whitening of the skin.
- (3) The treatment typically does not exceed the designated time of 5 minutes. If these conditions occur, immediately spray an alkaline neutralizing solution (such as 10% sodium bicarbonate) to terminate the treatment.

6.3.5.2. For AHAs with a pH above 3.5

- (1) Ideal endpoint reaction: Mild erythema Tingling sensation on the treated skin area
- (2) The treatment typically does not exceed the designated time of 30 minutes. If the condition occurs, immediately spray a neutralizing solution to terminate the treatment.

6.3.6. Neutralization process

Protect the patient’s eyes with cotton pads when spraying the neutralizing solution. Hold the spray bottle of neutralizing solution in one hand, and quickly and

accurately spray the treatment area skin, while using a cotton pad to absorb excess solution on the skin with the other hand. The neutralization process can be repeated multiple times until no more foam is produced on the sprayed skin surface and there is no stinging sensation on the skin.

6.3.7. Post-operational care

Apply a moisturizing and repairing mask to the treated skin area for cold compress (the mask can be refrigerated for use) for 20-30 minutes or wrap an ice pack in gauze for an ice compress, then apply repairing and moisturizing skincare products (avoiding damaged skin areas). For patients with acne vulgaris, after cold compress, perform needle extraction based on the condition of the skin lesions. If there are deep comedones, inform the patient before the treatment that there maybe an increase in comedones after the initial treatment due to the exposure of deep comedones following exfoliation, which is normal. Continue treatment and perform needle extraction, and the symptoms will gradually improve.

6.3.8. Precautions

The operator should select the appropriate chemical peel agent according to the patient’s skin properties, master the type, concentration, dosage, application duration, and treatment intervals, and make appropriate adjustments according to the patient’s skin reaction during the entire course of treatment to achieve the best therapeutic effect. During the treatment of melasma, the concentration of AHAs should not be too high and the duration time should not be too long, so as not to irritate the skin and aggravate the pigmentation symptoms.

7. Nursing care for complications

7.1. Local Irritation Symptoms

Most patients feel mild stinging, itching, or burning during treatment, with observable mild erythema or frosting, all of which are normal reactions to AHA treatment. Symptoms can gradually subside after a cold compress with a repair mask. If the symptoms such as erythema and stinging persist or significantly worsen, follow the doctor’s instructions for timely treatment. Take small doses of glucocorticoids if necessary.

7.2. Desquamation and Scabbing

Mild desquamation and scabbing after the operation are normal reactions following an alpha hydroxy acid chemical peel and will recover without treatment. Instruct patients not to scratch the skin or forcibly remove scabs, but to allow them to fall off naturally. Applying moisturizing and repairing skincare products can promote recovery.

7.3. Pigmentation

The higher the concentration of chemical peel agents and the deeper the penetration, the greater the chance of pigmentation. Individual differences in patient's skin may also cause post-inflammatory hyperpigmentation. Improper care after alpha hydroxy acid chemical peel, especially neglecting sun protection, can easily lead to post-inflammatory hyperpigmentation. Once hyperpigmentation occurs, timely symptomatic treatment is necessary. Instruct patients to strictly avoid sun exposure (use physical sun protection and sunscreen products), and reduce outdoor activities during periods of high UV index (e.g., from 10 AM to 4 PM in summer).

7.4. Scar

Too high a concentration of chemical peel agents, too long duration time, forced scab removal after surgery, and infection caused by improper care can all lead to the formation of scars. Therefore, the acid concentration should be selected carefully, preferably low rather than high, and the duration time should be reasonably controlled. If scabs or desquamation occur after the operation, instruct patients to avoid scratching and allow them to fall off naturally. Patients developing scars can undergo anti-scar treatment (use scar-preventing ointments or patches in the early stage and conduct laser repair treatment in the late stage).

7.5. Reactive Acne

Chemical peel agents can promote the dissolution and exfoliation of keratin plugs at the openings of hair follicles and sebaceous glands, allowing the accumulated sebum to be discharged through the cleared ducts. However, due to the irritant nature of chemical peel agents, some acne vulgaris patients may experience reactive inflammation, resulting in temporary increases in lesions or exacerbation of inflammation after treatment. Patients with reactive acne should receive timely symptomatic treatment and carefully

choose the timing for continued treatment after lesions improve.

7.6. Secondary Bacterial, Fungal, and Viral Infections

A thorough assessment of the patient's skin should be conducted before alpha hydroxy acid chemical peel. The operating treatment procedure should be strictly followed during the operation to prevent secondary infection. If infection occurs, choose sensitive drugs for active anti-infection treatment promptly.

7.7. Other Reactions

Some patients may also experience adverse reactions such as contact dermatitis, milia, or urticaria, which should be treated symptomatically and promptly.

8. Health Education

8.1. Guide patients to develop a healthy lifestyle

Maintain regular routines, have adequate sleep, eat a light diet, avoid smoking and alcohol, consume more fresh vegetables and fruits, focus on self-psychological adjustment, reduce psychological stress, and keep a happy mood.

8.2. Avoid using makeup products within 24 hours after operation

Within 1 to 2 days after operation, local redness or pain may occur, which can be alleviated with cold compresses or cold sprays. Within 3 days after operation, apply collagen or hyaluronic acid masks daily for moisturizing and repair through cold compresses. Within 3 to 7 days after operation, desquamation or scabbing may occur in the treated area, which should be allowed to fall off naturally to prevent hyperpigmentation. Avoid high-temperature environments, such as hot compresses, hot sprays, hot springs, and saunas within 7 days after operation.

8.3. After the operation, pay attention to sun protection and perform moisturizing and repair care, especially for melasma patients

Use functional skincare products after AHA treatment to reduce skin irritation and promote skin regeneration and repair.

8.4. Avoid rubbing the skin after the operation

Be cautious with other exfoliating agents (e.g., retinoids, exfoliating skincare products).

8.5. Closely monitor adverse reactions in the treated area after operation.

If symptoms such as redness, blisters, scabbing, or hyperpigmentation occur, treat them symptomatically and seek medical advice if necessary.

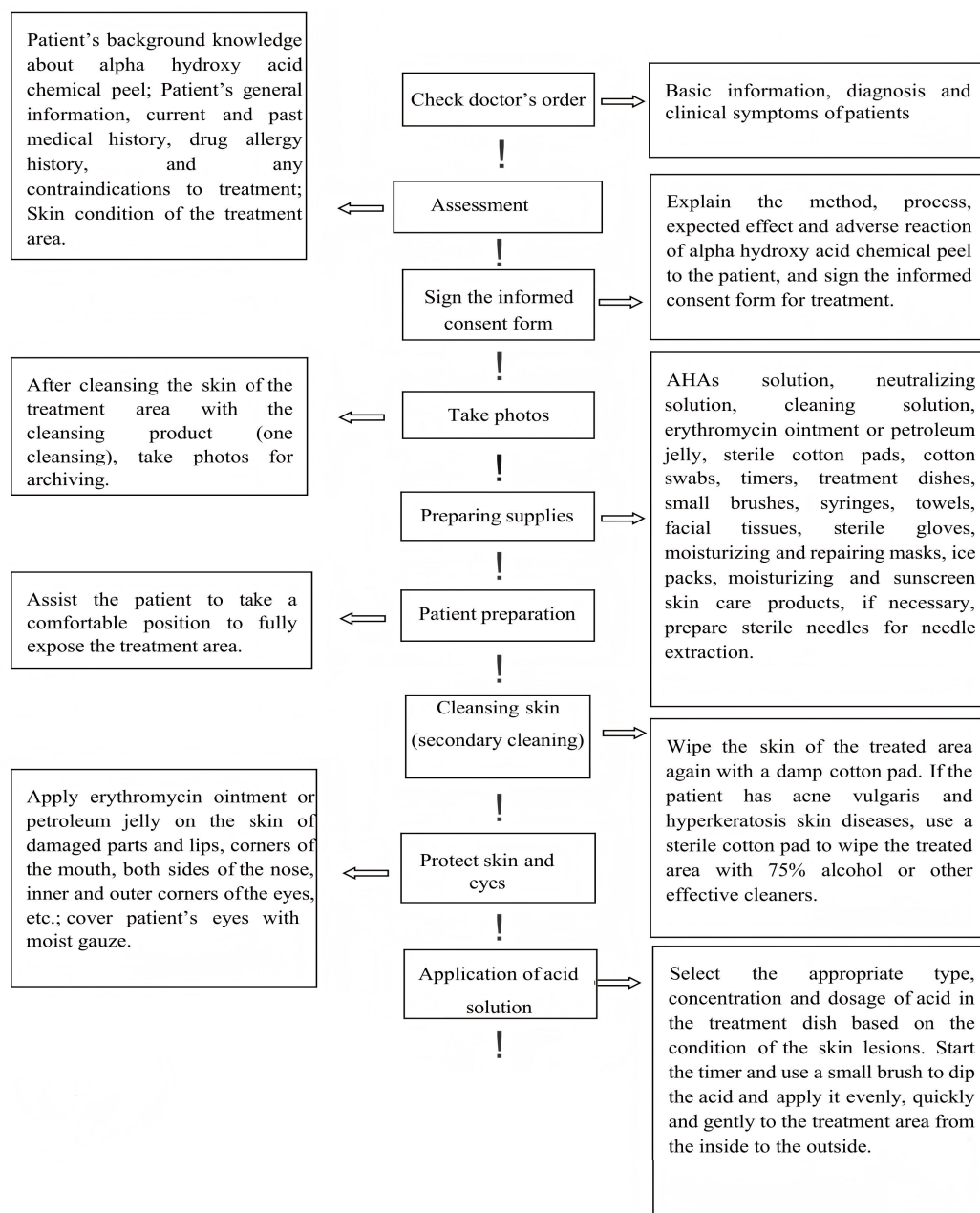
8.6. Acne patients should not squeeze skin lesions with their hands, so as not to aggravate infection and scarring

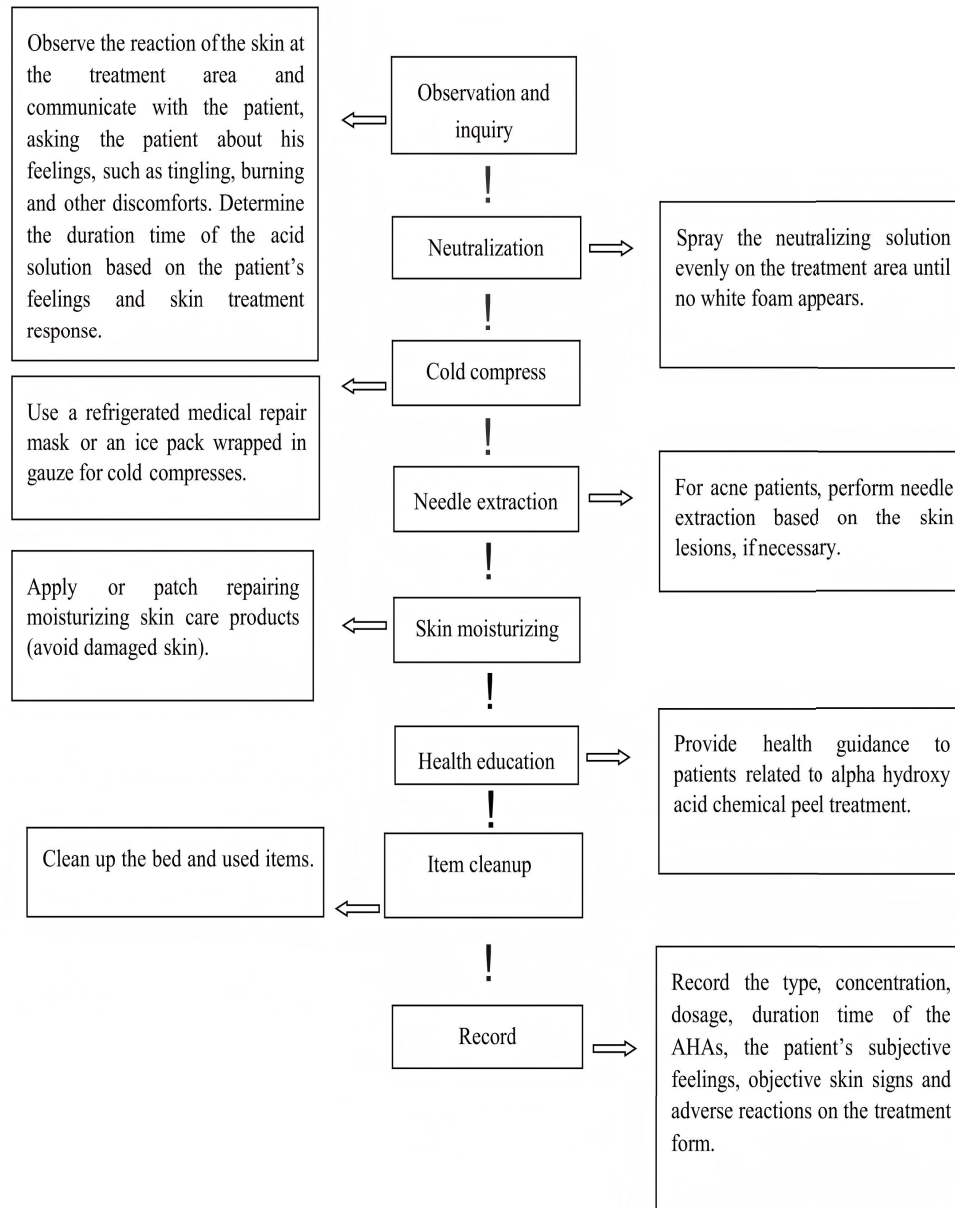
8.7. Postoperative follow-up

Conduct regular follow-ups via phone, SMS, or other means to obtain information about the patient's post-operative condition and provide corresponding health guidance. Instruct patients to follow the treatment course to achieve the best therapeutic effect (the interval of alpha hydroxy acid chemical peel treatments is generally 2 to 4 weeks, with 5 consecutive sessions constituting one course).

Appendix A (Normative)

Operational Flowchart of Alpha Hydroxy Acid Chemical Peel





Appendix B (Informative)

Operational Score Table of Alpha Hydroxy Acid Chemical Peel

Name:		Review Date:		Scores:				
Procedure	Total score	Operating requirements		A	B	C	D	Score
Appearance	4	Be decent and neatly dressed		4	3	2	1	
Assessment	9	1. Assess the patient's general information, including current and past medical history, drug allergy history, any contraindications to treatment, and the skin condition of the treatment area. 2. Assess the patient's background knowledge about alpha hydroxy acid chemical peels.		5	4	3	2	
Pre-operation	15	1. Wash hands and wear a mask.		3	2	1	0	
		2. Explain the treatment method, operation process, expected effects, precautions, and adverse reactions to the patient patiently, and sign the informed consent form.		3	2	1	0	
		3. Make sure the operating environment is clean and tidy, and that all supplies are fully prepared.		3	2	1	0	
		4. Take photos for archiving after cleansing the skin of the treated area with facial cleansing products.		3	2	1	0	
		5. Assist the patient to take a comfortable position to fully expose the treatment area.		3	2	1	0	
While-operation	53	1. Operators are required to wear gloves.		3	2	1	0	
		2. Use 75% ethanol or other effective cleansers to wipe the skin of the treatment area.		4	3	2	1	
		3. Apply erythromycin ointment or petroleum jelly on the skin of damaged parts and lips, corners of the mouth, both sides of the nose, inner and outer corners of the eyes, etc.		4	3	2	1	
		4. Cover the patient's eyes with moist gauze.		3	2	1	0	
		5. Select the appropriate type, concentration, and dosage of acid in the treatment dish based on the condition of the skin lesions.		5	4	3	2	
		6. Start the timer.		3	2	1	0	
		7. Use a brush to dip the acid and apply it to the treatment area. Generally, brush the "T-zone" first and the cheeks last. Apply the acid evenly, quickly, and gently from the inside to the outside (repeat the application appropriately on key areas).		5	4	3	2	
		8. Communicate with the patient during the operation, ask the patient about their feelings, and carefully observe the reaction of the skin on the treatment area.		4	3	2	1	
		9. Understand the endpoint reaction and determine the acid duration time.		9	7	5	3	
		(1) For AHAs with a pH above 3.5: ① The ideal endpoint reaction of AHA is the appearance of slight erythema at the treatment site; ② If no erythema reaction occurs, it usually does not exceed 30 minutes.						
		(2) For AHAs with a pH below 3.5: ① The ideal endpoint reaction is the appearance of mild erythema, slight stinging sensation, or scattered white frost on the skin of the treatment area; ② If the above situation does not occur, it usually does not exceed 5 minutes.						
		10. When the timing is over, take the neutralizing solution for neutralization. When spraying the neutralizing solution, be careful to protect the patient's eyes with cotton pads; The neutralization process can be repeated multiple times until no more foam is produced on the sprayed skin surface.		5	4	3	2	
Post-operation	9	11. Use a medical repair mask (after refrigeration) or an ice pack wrapped in gauze for a cold compress. Acne patients should receive needle extraction treatment when necessary.		4	3	2	1	
		12. Apply moisturizing products (avoid damaged skin).		4	3	2	1	
		1. Provide health guidance to patients.		3	2	1	0	
Evaluation	10	2. Closely observe the adverse reactions of the skin in the operation area, such as redness, swelling, blisters, pigmentation, persistent numbness, etc., and take symptomatic treatment in time.		3	2	1	0	
		3. Arrange the items, wash hands, and record operations		3	2	1	0	
Evaluation	10	1. Correct operation method.		5	4	3	2	
		2. Patients respond well to treatment		5	4	3	2	
Total score	100							

Disclosure statement

The author declares no conflict of interest.

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Exploration and Application of Holographic Traditional Chinese Medicine and Auricular Point Diagnosis and Treatment Techniques

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Abstract

Objective: Through in-depth study of the classic work of traditional Chinese medicine, Huangdi Neijing, we aim to conduct profound exploration and research on holographic traditional Chinese medicine, form a unique theoretical system, and apply it in combination with clinical practice to auricular point diagnosis and treatment techniques. *Conclusion:* Auricular point diagnosis and treatment techniques consist of two parts: auricular point diagnosis and auricular point treatment. The primary concept advocated is “preventive treatment of disease”, which enables rapid disease diagnosis and timely intervention and treatment, guiding people on the path to health without confusion and truly achieving “preventing trouble before it arises”.

Keywords

Holographic traditional Chinese medicine; Auricular point diagnosis and treatment techniques; Auricular point diagnosis; Auricular point treatment; Preventive treatment of disease

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1. Holographic traditional Chinese medicine theory

1.1. Concept of holographic traditional Chinese medicine

Holographic traditional Chinese medicine holds that the human body is an organic whole, with various tissues and organs interconnected and influencing each other. Just as celestial bodies in the universe interact to form a harmonious whole, every part of the human body contains

information about the whole. From a single leaf, one can glimpse the mysteries of the entire forest; from a single ear or palm, one can discern the health status of the entire body. This holistic perspective provides new insights and methods for disease prevention, diagnosis, and treatment.

1.2. Significance of holographic traditional Chinese medicine

By observing holographic reflex zones in the human body,

such as auricular points and foot reflex zones, we can detect potential health risks in advance and make timely adjustments and interventions, thereby achieving the goal of “preventive treatment of disease”. This not only alleviates patient suffering and reduces medical burdens but also effectively improves the overall health level of the population, enabling people to “prevent trouble before it arises” on the path to health ^[1].

2. Theory of holographic element special zones

2.1. Special zones of Yin-Yang holographic elements

In “Plain Questions: On Preserving Life and Maintaining the Complete Form”, it is stated, “Human life, in its tangible form, cannot be separated from Yin and Yang”. “Spiritual Pivot: On Longevity, Short Life, Strength, and Weakness” also says, “Thus, there is Yin and Yang internally, and there is also Yin and Yang externally. Internally, the five viscera represent Yin, while the six bowels represent Yang; externally, the sinews and bones represent Yin, while the skin represents Yang”. Yin and Yang holography exists in every part of the human body. Therefore, traditional Chinese medicine can grasp the changes of Yin and Yang throughout the body through the “three-inch pulse” and “five-inch tongue”

2.2. Special zones of meridian holographic elements

The meridians in the human body exist holographically, and similarly, there is meridian Yin-Yang holography. Each acupoint, to a greater or lesser extent, contains information about the entire meridian system. Each acupoint is like a window to the whole body, through which one can glimpse the holography of the entire system. For example, the philtrum can be used for emergency resuscitation.

2.3. Special zones of Zang-Xiang holographic elements

Zang refers to the internal organs, while Xiang refers to the physiological manifestations on the exterior. Zhang Jingyue, a renowned physician of the Ming Dynasty, said, “Xiang means image. The Zang organs reside internally,

while their images are manifested externally, hence the term Zang-Xiang”. “Whatever exists internally will surely manifest externally”. Therefore, from the perspective of Zang-Xiang theory, every holographic element in the human body contains Zang-Xiang holography. For instance, the pulse condition at the Cun region (a specific pulse-taking point on the wrist) can reveal the holographic state of the body’s visceral Qi.

3. Human life information on the ears

3.1. The life code discovered by humankind

In 1956, artifacts from the Tang Dynasty were unearthed in the Astana region of Turpan, Xinjiang. The “Fu Xi and Nü Wa Diagram” bears a striking resemblance to the DNA double helix model proposed by American scientist Watson and British scientist Crick in 1953. Genes decode the secrets of life, proving that every cell in the human body stores genetic and holistic information about the individual. Genes underpin the fundamental structure and functions of life, storing all information related to the processes of race, blood type, gestation, growth, and apoptosis. The interdependence of environment and heredity orchestrates vital physiological processes such as life propagation, cell division, and protein synthesis. All life phenomena in organisms, including birth, growth, decline, illness, aging, and death, are related to genes, which also serve as the internal factors determining life health.

3.2. Life information on the ears

As an important organ of the human body, the ears also contain vital life information. Ear acupoints are significant information points on the ears that are integral to the whole body. Therefore, one can gain insights into the overall condition of a person by examining local areas, which aligns with the holistic perspective of Traditional Chinese Medicine thinking ^[2].

4. Exploration of auricular points

4.1. The origin of auricular points

The “Zubi Shiyi Mai Jiujiing” (Foot-Arm Eleven Meridian Moxibustion Classic) and “YinYang Shiyi

Mai Jiujiing” (Yin-Yang Eleven Meridian Moxibustion Classic), unearthed from the Han Dynasty Tomb No. 3 at Mawangdui in Changsha, Hunan Province in 1973, are the earliest known monographs on meridian theory and moxibustion therapy. The “YinYang Shiyi Mai Jiujiing” records the “auricular meridian” that connects the ear with the upper limbs, eyes, cheeks, and throat. Upon studying the “Huangdi Neijing” (The Yellow Emperor’s Classic of Internal Medicine), it is found that there are at least more than 30 references to the experiences and theories of treating diseases with ear acupuncture^[3].

4.2. Formation mechanism of auricular points

The formation mechanism of auricular points is a complex and exquisite process. The human body is an organic whole, with the meridian system running throughout the entire body and Qi and blood circulating continuously within the meridians. The ear, as a convergence point of meridian Qi and blood, is interconnected with the meridians throughout the body. When a certain internal organ or tissue experiences pathological changes, the circulation of Qi and blood in the meridians will be affected. This change will be transmitted through the meridians to the corresponding auricular points, resulting in reactions at these points.

4.3. Ancient research on auricular points

In the Tang Dynasty, Sun Simiao recorded in his work “Essential Formulas Worth a Thousand Gold Pieces” that “the auricular point located on the transverse beam above the ear opening can be treated with acupuncture and moxibustion for conditions such as jaundice, epidemic febrile diseases, and other ailments”. Based on his personal experiences and observations, he further noted that “those with firm ears have strong kidneys, and strong kidneys are resistant to diseases, thus preventing lower back pain” and “those with thin ears have fragile kidneys, which are susceptible to heat, leading to tinnitus”. Medical practitioners in the Ming Dynasty provided even clearer and more detailed experiences and records regarding auricular diagnosis. Yang Jizhou of the Ming Dynasty stated in his work “Compendium of Acupuncture and Moxibustion” that “the ear apex auricular point, located at the tip of the ear, can be found by rolling the ear upwards to locate the tip, and is used to treat eye

conditions such as cataracts”. Wang Kentang, also from the Ming Dynasty, further specified in his work “A Guide to Clinical Practice with Medical Records” that “those with rosy ear wheels are alive, while those with yellow, black, or blue and dry ear wheels are dead” and “those with large ears have large kidneys, while those with small ears have small kidneys”. This aligns with the principle that “what is internal will manifest externally”, indicating that internal ailments will inevitably be reflected on the external auricle.

4.4. Modern research on auricular points

Modern medical research has revealed that the ear has an extremely rich nerve distribution and extensive neural connections with various parts of the body. The close relationship between the ear and the body’s internal organs and meridians resemble that of an inverted fetus. In 1956, Dr. Paul Nogier of France published a diagram of auricular acupuncture therapy based on the concept of an inverted fetus^[4]. In December 1958, Mr. Ye Xiaolin published a diagram of an inverted embryo in the Shanghai Journal of Traditional Chinese Medicine. In 1999, a new diagram of auricular points on the back of the ear was presented at the Academic Exchange Conference of the American Association of Chinese Medicine. Huang Lichun systematically organized auricular points related to the five internal organs and six viscera, the endocrine system, the nervous system, specific points, points on the back of the ear, and others. She also proposed concepts such as points, regions, grooves, lines, and meridians, which hold significant importance for the qualitative diagnosis of auricular points^[2,5].

4.5. Several hypotheses regarding the formation of auricular points

Based on repeated study of ancient texts and years of clinical practice, this study proposes several hypotheses regarding the formation of auricular points, as detailed below:

4.5.1. Holographic meridian mesh theory

(1) The mesh-like structure of meridians

Meridians crisscross the human body, forming a three-dimensional network resembling “mesh”. Different levels of meridians (such as channels,

collaterals, and minute collaterals) interweave like threads in a mesh, covering the entire body. This mesh-like structure provides a material basis for the storage, transmission, and exchange of information.

- (2) **Distribution and transmission of holographic Information** Each local area of the human body (such as the hands and face) serves as a holographic unit, containing the overall vital information. The meridian meshwork, functioning as information channels, transmits local holographic information throughout the body while also feeding back overall information to each local area. For instance, stimulating acupoints on the feet can regulate the functions of corresponding internal organs through the meridian meshwork, demonstrating the transmission and regulation of holographic information.
- (3) **Functions and regulatory mechanisms** The holographic meridian meshwork system possesses functions such as regulating the circulation of Qi and blood in the human body, balancing Yin and Yang, and defending against external pathogens. When a pathological change occurs in a certain part of the human body, abnormal local holographic information is transmitted throughout the body via the meridian meshwork, leading to overall functional disorders. Conversely, stimulating specific acupoints or holographic units can also correct abnormal information and restore bodily balance through the meridian meshwork.

4.5.2. The theory of key-lock correspondence points in holographic auricular acupoints

- (1) **Key-lock correspondence points in auricular acupoints**
The “correspondence points” present in auricular acupoints are crucial nodes for precise regulation between local and overall areas. Their structural and functional characteristics resemble those of a “lock cylinder”, while appropriate stimulation methods (such as intensity and frequency) act as “keys”. When the two match, an efficient

regulatory pathway is activated, akin to “one key for one lock”. The three core characteristics of correspondence points are specificity, sensitivity, and dynamism.

- (2) **Implementation pathway of lock-and-key regulation—signal recognition**
The trigger points, through their unique nerve endings and chemoreceptors, identify specific stimulus signals (such as the physical parameters of pressure or electrical stimulation), much like a “lock cylinder” recognizing the serrations of a “key”. Subsequently, pathway activation occurs, with the stimulus signals triggering nerve impulses in the trigger points that travel through conducting pathways directly to the regulatory center of the target organ. After integrating the signals, the center initiates a “lock-opening” effect.

4.5.3. Holographic auricular acupoint neurohumoral gate theory

- (1) **Structure and function of the “gate”**
Peripheral Gate: Located in the dorsal horn of the spinal nerve or the trigeminal nucleus, it inhibits the transmission of pathological signals (such as pain and inflammatory signals) through nerve impulses transmitted from auricular acupoints. Central Gate: Situated in the thalamus and cerebral cortex, it regulates emotions and autonomic nervous function by integrating auricular acupoint signals with somatic/visceral information, indirectly influencing pathological processes. Humoral Gate: It extends and amplifies the “gate” effect through humoral factors released by the neuroendocrine network, maintaining the continuity of regulation.
- (2) **Holographic correspondence and specificity of the gate**
The holographic distribution of auricular acupoints determines the targeting of the “gate”: Stimulating the “stomach area” of the auricular acupoint can activate the regulatory gate of gastrointestinal smooth muscle through the vagus nerve-medulla oblongata pathway, improving dyspepsia. Stimulating the “Shenmen acupoint”

(corresponding to the central nervous system) can close the central gate of pain signals by releasing endorphins, alleviating anxiety-related pain. This specificity stems from the homology of auricular acupoint and corresponding organ in terms of embryonic development and neural innervation, that is, the “bioinformation resonance” between the holographic unit and the whole.

5. The relationship between auricular points and meridians, Zang-Fu organs, nerves, and the eight trigrams

5.1. The relationship between auricular points and meridians

The “Ling Shu · Hai Lun” records that “the twelve regular meridians belong internally to the Zang-Fu organs and externally connect to the limbs and joints”. The meridian system is distributed throughout all parts of the human body. Among the eight extraordinary meridians, the Governor Vessel is the “sea of Yang meridians”, governing all Yang meridians and regulating the Qi of the entire body’s Yang meridians, while the Conception Vessel is the “sea of Yin meridians”. Together, the Governor and Conception Vessels regulate limb movement and the opening and closing of the eyelids. The Yin Link and Yang Link Vessels, respectively, maintain the balance between the six Yin and six Yang meridians, thereby integrating the body’s tissues and organs into an organic whole.

5.2. The relationship between auricular points and Zang-Fu organs

The ears have a close relationship with the five Zang and six Fu organs and serve as an important connection between the body’s surface and internal organs. When there is dysfunction in the Zang-Fu organs and stagnation in the meridians, various positive reaction points appear on the corresponding auricular points, primarily characterized by pain sensitivity, low electrical resistance, and high electrical conductivity. These reactions provide a theoretical basis for disease diagnosis.

5.3. The relationship between auricular points and nerves

The auricle is rich in nerves, including the great auricular nerve and lesser occipital nerve from the cervical plexus of the spinal nerves; branches of the auriculotemporal nerve, facial nerve, glossopharyngeal nerve, and vagus nerve from the cranial nerves; as well as the sympathetic nerve traveling with the external carotid artery. The four pairs of cranial nerves and two pairs of spinal nerves distributed on the auricle are all connected to the central nervous system. For example, the auriculotemporal nerve distributed on the auricle is a branch of the mandibular division of the trigeminal nerve. In addition to controlling mastication and head and face sensations, it also connects to the spinal cord. The facial nerve, apart from controlling facial expression muscle movement, also manages some glands.

5.4. The relationship between auricular points and the eight trigrams

The positioning of auricular Eight Trigrams is based on the “Holographic Auricular Point Medicine-I Ching Homology Theory”, following the Eight Trigrams behind the ear for localization. There is a corresponding relationship between the morphology of the auricle and the images of the Eight Trigrams, which can be divided into eight Eight Trigram regions. Each region not only corresponds to specific internal organs but also embodies the attributes of the Eight Trigrams. As a holographic microcosm of the human body, auricular points exhibit an inherent unity in their distribution patterns and functional characteristics with the theories of Yin and Yang, the Eight Trigrams, and the Five Elements in the I Ching. Together, they form a holistic cognitive framework for understanding human life activities.

6. Auricular point diagnosis

6.1. Principles of auricular point diagnosis

Auricular point diagnosis is primarily based on the principles of holism and holography in the human body. As a microcosm of the human body, auricular points can reflect internal pathological changes. In a healthy individual, auricular points exhibit a rosy color, full shape, and no abnormal reactions such as tenderness. However,

when the body is in a sub-healthy state or a specific area is diseased, corresponding auricular points will exhibit positive reactions, such as tenderness, deformation, discoloration, desquamation, etc. For example, individuals experiencing long-term mental stress and insufficient sleep may exhibit slight tenderness or color changes in auricular point regions corresponding to the heart, liver, and kidneys ^[5].

6.2. Auricular point diagnosis method

Auricular point diagnosis, abbreviated as auricular diagnosis, is a method of auxiliary diagnosis based on abnormal reactions observed at auricular points. Practice has proven that when there is a disease in the body or internal organs, abnormal changes in color and shape, as well as alterations such as tenderness sensitivity and low skin resistance, often occur at corresponding sites on the auricle.

6.3. Methods of auricular point diagnosis

First, inspection; second, palpation; third, audiometry; and fourth, syndrome differentiation. Inspection refers to the visual examination method; palpation refers to the tactile examination method; audiometry involves using an auricular point detector to measure changes in the bioelectricity of auricular points, serving as a reference for the auxiliary diagnosis of somatic and visceral diseases; syndrome differentiation means combining clinical manifestations to determine treatment based on syndrome differentiation.

6.4. Advantages of auricular point diagnosis

Auricular point diagnosis is characterized by its simplicity, rapidity, and accuracy, providing an important reference for clinical diagnosis. It helps in the early

detection of diseases and timely treatment.

7. Auricular point therapy

7.1. Types of diseases treated by auricular point therapy

Auricular point therapy can treat over 200 types of diseases, covering internal medicine, surgery, gynecology, pediatrics, ophthalmology and otorhinolaryngology, orthopedics, and other fields. It can not only treat functional diseases but also organic diseases, as well as diseases caused by viruses, bacteria, parasites, etc. It is also used for disease prevention, beauty care, health maintenance, anti-aging, smoking cessation, alcohol cessation, drug detoxification, and more.

7.2. Methods of auricular point therapy

There are more than 20 auricular point stimulation methods used for disease prevention and treatment, including auricular point plaster therapy, filiform needle therapy, needle-embedding therapy, electroacupuncture therapy on auricular points, bloodletting at the ear apex, plum-blossom needle therapy on auricular points, auricular point massage therapy, auricular point incision therapy, auricular point drug injection therapy, auricular moxibustion therapy, auricular clip therapy, auricular point pressing pellet therapy, etc.

Auricular point therapy is a concrete practice of the Traditional Chinese Medicine (TCM) concept of “holistic regulation and treatment”. By stimulating corresponding acupoints on the auricle, it achieves the effects of “dredging meridians, regulating viscera, and balancing Yin and Yang”. It has significant advantages, especially in the adjuvant treatment of functional diseases and chronic diseases, and is worthy of further research and promotion.

Disclosure statement

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“One Main Thread, Two Carriers”: A Discussion on Curriculum Reform for Systematically Cultivating Classical Thinking in Warm Diseases

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Abstract

Background: This paper addresses the challenges observed in the Warm Diseases (Wen Bing Xue) course at Tianjin University of Traditional Chinese Medicine, where students struggle to effectively master classical texts and their corresponding TCM clinical thinking. **Methods:** A teaching reform model named “One Main Thread, Two Carriers” was proposed and implemented. This approach takes the spirit of “Great Physician’s Sincerity” (Da Yi Jing Cheng) exemplified by renowned Warm Diseases scholars as its central thread (“One Main Thread”). It utilizes both the classical texts of Warm Diseases and the medical cases of famous practitioners as its foundational elements (“Two Carriers”). This framework aims to construct an integrated teaching system combining ideological and political education, knowledge acquisition, and ability cultivation. **Results:** Practice indicates that this model significantly enhances students’ intrinsic motivation for learning the classics of Warm Diseases studies and bolsters their professional confidence. Reforms led to top national rankings in Warm Diseases sections of licensing exams and awards for student research papers. **Conclusion:** The “One Main Thread, Two Carriers” reform represents an effective approach to cultivating classical thinking, integrating moral education with professional competency development in Warm Diseases education. Future work will focus on optimizing the teaching content and structure.

Keywords

Warm diseases; Curriculum ideological and political education; Classical original texts; TCM thinking patterns; Curriculum reform

1. Introduction

President Xi has emphasized the importance of “inheriting the essence, upholding integrity and innovation” for Traditional Chinese Medicine (TCM), a treasure of Chinese civilization. The “Opinions of the Central Committee of the Communist Party of China and the State Council on Promoting the Inheritance and Innovative Development of Traditional Chinese Medicine” further underscore the significance of TCM classics. Warm Diseases (Wen Bing Xue), one of the Four Major Classics of TCM, exemplifies this principle of “Upholding Integrity and Innovation”. Its historical development, building upon and innovating the doctrines of Zhang Zhongjing, demonstrates how ancient methods were adapted without being rigidly bound by ancient formulas, embodying the concept of “medical mastery through adaptation”^[1]. Talent cultivation is central to the inheritance and innovation of TCM. To enable TCM students to “study the classics, emphasize practice, and enhance competence”, mastering the profound patriotism, rich practical experience, and distinctive TCM thinking embedded within the Warm Diseases classics is crucial^[2]. We have continuously explored and attempted reforms in our teaching practice, leading to a preliminary restructuring of the existing Warm Diseases curriculum content and system. This paper aims to discuss the connotative reconstruction of the Warm Diseases course and subsequent challenges, proposing corresponding teaching strategies.

2. Background and necessity for reform

2.1. Challenges in warm diseases teaching

Warm Diseases is a core course within the TCM professional curriculum, serving as a bridge between basic TCM theory and clinical specialties. Classical texts such as Wu Youke’s “Treatise on Pestilence”, Ye Tianshi’s “Guide to Clinical Practice with Case Studies” and “Systematic Identification of Warm-Factor Diseases”, Xue Shengbai’s “Treatise on Damp-Heat Diseases”, and Wu Jutong’s “Systematic Differentiation of Warm Diseases” represent the crystallization of Warm Diseases scholars’ wisdom, containing rich clinical thinking and practical experience. Current national examination standards, including the Licensed Physician and Classic Competency Level 3 exams, focus on these classical

passages. However, the undergraduate textbook for Warm Diseases still places the selected readings from these classics at the end of the book. Due to limited class hours, the syllabus often designates these readings as supplementary self-study material, which hinders students from building a solid foundation in the classics and translating them into clinical thinking.

2.2. Survey on classical warm diseases teaching

To understand the current state and issues regarding the teaching of Warm Diseases classics at the undergraduate and residency training stages, our team conducted an anonymous online survey. Participants included faculty from peer institutions in the Beijing-Tianjin-Hebei and Jiangsu-Zhejiang-Shanghai regions, as well as teaching physicians from relevant departments (e.g., Infectious Diseases) at our university’s affiliated training hospitals. Associate professors comprised 55.6% of respondents, and 63% had over six years of teaching experience. The survey focused on three core dimensions: mastery of classical texts, teaching challenges, and reform suggestions.

2.2.1. Poor mastery of classical texts

Data revealed significant weaknesses among undergraduates, with 70.4% of teachers rating their mastery as “poor” or “partial”. Even among postgraduates who had undergone systematic review for licensing and classic competency exams, 40.7% of teachers believed they had not achieved “proficient” or “basic” mastery.

2.2.2. Teaching challenges focus on the theory-practice gap

Over 70% of teachers cited the complex theoretical system of the classics and students’ lack of systematic learning methods as primary obstacles. This leads to difficulty grasping the connection between classical theory and modern clinical practice. Feedback from chief physicians in tertiary hospitals confirmed this issue: “We can explain the Wei-Qi-Ying-Blood differentiation theory thoroughly in class, but when students encounter fever in clinical practice, they still prefer Western medicine first”. This disconnects results in 37% of teachers rating postgraduates’ clinical application of thinking as “average”.

2.2.3. Reform consensus centers on deep integration of classics

Over half of the teachers rated the current Warm Diseases teaching system as “average”. Experts strongly recommended revising the syllabus to significantly incorporate classical passages (85.2%), increasing their citation and interpretation in teaching. Establishing a “Classical Warm Diseases Case Database” (77.8%) was suggested to bridge the abstract nature of theory through real clinical scenarios, thereby driving deeper understanding and constructing clinical thinking pathways.

3. Reform methodology

Addressing the above issues and following the general requirements of the “Opinions on Strengthening the Work of TCM Talents in the New Era”, we innovatively reconstructed the Warm Diseases curriculum syllabus and teaching design. This reconstruction uses the classical passages outlined in the licensing exam, Classic Competency Level 3, and National Excellent Clinical Talent Training Program as the warp, and the characteristic Warm Diseases diagnostic frameworks of Wei-Qi-Ying-Blood and San Jiao (Triple Burner) differentiation as the weft, all guided by clinical relevance. The goal is to enable students to simultaneously inherit the essence and innovate, value moral cultivation alongside competency enhancement, and combine thinking training with skill development, thereby solidifying their classical knowledge and learning to apply the authentic clinical thinking of Warm Diseases masters.

3.1. “One main thread”: The spirit of “great physician’s sincerity” exemplified by warm diseases masters

Aligning with the State Council’s requirement to “integrate ideological and political education and medical ethics training throughout the entire teaching process”, this thread addresses not only the fundamental task of fostering virtue but also the common issue of insufficient student engagement, thereby enhancing lifelong learning motivation ^[3]. When teaching the classics, we subtly integrate the valuable spirits of these masters: from Ye

Tianshi’s “respect for science” in recognizing distinct treatments from Cold Damage, leading to his writings, and his “life-first” attitude evidenced by effectively treating many; to Wu Jutong’s “innovation within inheritance” through decades of dedicated study before compiling his systematic work, advocating adaptation of ancient methods; to Wang Shixiong’s “self-sacrifice and shared destiny”, who remained dedicated to serving the public during turmoil despite personal tragedy ^[4]. This value-oriented shaping makes the course an effective vehicle for core socialist values education, providing students with a continuous source of professional confidence.

3.2. “Two carriers”: Classical texts and famous case studies

3.2.1. Inheriting the essence: Using classical passages as the warp to substantially strengthen classical learning

To familiarize students with the classics, our team incorporated a “Morning Recitation of Warm Diseases Classics” elective in the semester preceding the main course ^[5]. This course focuses on the essential passages required for licensing exams. Each class holds at least two sessions weekly, involving a 5-minute lecture by a faculty member, 10 minutes of guided group recitation, and 10 minutes of self-directed study. Postgraduate students serve as teaching assistants for online Q&A. The course concludes with an online exam mirroring licensing exam format. To cater to high-achieving students and guided self-study, our team created micro-lectures explaining all exam-relevant passages, uploaded to a blended online-offline learning platform.

Recognizing that the Warm Diseases course, unlike classics courses focused on original texts, is structured more like a clinical course, and that students struggle to connect fragmented classical passages with their textbook knowledge, we restructured the teaching approach ^[6]. We trace the origins of core concepts (e.g., definition of Warm Diseases, diagnostic methods) back to their classical sources, teaching them through original passages. This helps students understand the classical basis before applying the characteristic thinking. Additionally, carefully selected readings beyond the core syllabus are assigned weekly, encouraging habitual engagement with classical literature as advocated by Wang Mengying, to

gradually master the characteristic theories.

3.2.2. Promoting innovation: Using famous case studies as the weft to highlight clinical adaptation

Following TCM classical teaching principles and student cognitive patterns, the teaching of specific disease patterns shifted from pure theoretical lecture to a case-based approach. Classic cases from renowned masters are used to illustrate the etiology, pathogenesis, progression, diagnosis, treatment principles, and pattern identification for common warm-heat and damp-heat diseases.

For warm-heat diseases, the focus is on integrating Wei-Qi-Ying-Blood and San Jiao theory with pattern diagnosis and treatment. Embracing modern educational concepts where the teacher guides and the student learn autonomously, selected cases are presented in stages. This allows students to appreciate the typical progression through Wei, Qi, Ying, and Blood levels, or from Upper to Lower Jiao, as well as critical variations like “reverse transmission” from the Lung to the Pericardium. Through classroom discussions, students learn how Warm Diseases scholars inherited and innovated upon prior classical theories, developing new diagnostic frameworks. This enables students to integrate foundational knowledge with classical thinking, constructing distinctive Warm Diseases clinical reasoning skills, and fostering problem-solving and communication abilities. The aim is to equip students to understand and treat future emerging infectious diseases based on pattern differentiation^[7].

For damp-heat diseases, we first integrate relevant passages from Xue Shengbai, Ye Tianshi, and Wu Jutong to create a systematic framework for San Jiao differentiation of damp-heat. Typical cases are then used for discussion, helping students establish a pattern-based treatment model centered on the patient. This integrates Warm Diseases knowledge with other classical theories, building interdisciplinary clinical reasoning skills, and fostering innovation, critical thinking, and decision-making.

Furthermore, these cases highlight the dedication of masters like Wu Youke, Ye Tianshi, and Wang Shixiong in combating major epidemics, fostering students’ sense of medical compassion (“benevolence of the physician”) and prioritizing people’s life safety and health, thereby enhancing professional and humanistic qualities.

4. Results and summary

The team has developed a syllabus and teaching design integrating ideological education, classical theory, and characteristic TCM thinking. To provide targeted guidance, all members participated in compiling a three-volume Guidebook Series for the Classic Competency Exam. The reform has increased student interest in Warm Diseases. Our university achieved top national rankings in the Warm Diseases sections of the Licensed Physician exam and phase examinations. Undergraduates were inspired to publish theoretical articles based on Warm Diseases theory, winning awards in regional academic competitions. Teaching and research capabilities were also enhanced: the team now holds leadership positions in national Warm Diseases teaching committees and virtual teaching research offices. Members hold positions in professional societies like the Chinese Society of Traditional Chinese Medicine. Through leading multiple provincial/ministerial-level teaching reform projects, publishing related papers, and winning teaching awards (e.g., national micro-lecture competition prizes), the team’s capacity has been significantly strengthened.

Through the “One Main Thread, Two Carriers” reform aimed at cultivating classical thinking, the team has attempted to organically integrate classical passages, case studies, characteristic academic thought, and the spirit of “Great Physician’s Sincerity”. Looking forward, we will continue to optimize the teaching content and structure of Warm Diseases to achieve seamless integration of theory and medical virtue, contributing to the cultivation of virtuous and competent physicians.

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Progress in the Treatment of Chronic Urticaria with Acupuncture and External Auricular Point Therapy

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Abstract

By reviewing relevant literature on the treatment of chronic urticaria (CU) with acupuncture and auricular point therapy in recent years, this paper summarizes the research progress in the treatment of chronic urticaria with acupuncture and auricular point therapy. It demonstrates that acupuncture and auricular point therapy have favorable curative effects in treating chronic urticaria and possess certain advantages over other treatment methods. Additionally, it briefly explores their mechanisms of action. However, further research is needed to comprehensively evaluate their efficacy, mechanisms of action, and safety.

Keywords

Acupuncture; Auricular point; Chronic urticaria; Review

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1. Introduction

Urticaria is a highly prevalent clinical skin condition, with statistics indicating that approximately 15% of the population will experience at least one episode of urticaria in their lifetime ^[1]. Urticaria often presents acutely, with wheals appearing in various forms, leaving no trace after subsiding, and characterized by recurrent episodes and a protracted course that is difficult to resolve ^[2]. Chronic urticaria (CU) refers to the persistent or intermittent occurrence of skin wheals lasting more than six weeks ^[3]. CU can affect individuals of all ages, with an estimated incidence rate of approximately 0.5% to 1%, showing no obvious seasonal patterns ^[4]. This condition is currently

challenging to cure, causing intense skin itching during episodes that significantly disrupts normal work and life ^[5]. Modern medicine suggests that the pathogenesis of CU involves the activation of mast cells through both immune and non-immune mechanisms, triggering localized or systemic edema reactions in the skin ^[6]. At present, conventional Western medical treatments for CU lack effective approaches, primarily focusing on oral medications to reduce recurrence and alleviate itching, often utilizing antihistamines. However, CU is characterized by its persistent nature and high likelihood of recurrence upon discontinuation of medication ^[7]. In recent years, external treatments in traditional Chinese

medicine (TCM) have demonstrated promising results in treating CU, with acupuncture and auricular therapy showing particularly notable efficacy. This article provides an overview of recent advancements in the external treatment of CU using acupuncture and auricular therapy.

2. Understanding of the etiology and pathogenesis of chronic urticaria in traditional Chinese medicine

Urticaria was referred to as “Chizhen” (red rash), “Yinzhen” (hidden rash), “Youfeng” (wandering wind), etc. by ancient people. This disease is mostly caused by external invasion of pathogenic wind, disharmony between nutrient and defense Qi, and abnormal dissemination and distribution of Qi, blood, and body fluids, leading to recurrent itching ^[4]. “Synopsis of Prescriptions of the Golden Chamber” states, “When pathogenic Qi invades the meridians, the body develops rashes and hidden rashes” ^[8]. Although chronic urticaria manifests on the skin and mucous membranes, it is closely related to the dysfunction of various internal organs. The primary characteristic of individuals with a special constitution is congenital insufficiency and acquired malnutrition, along with irregular daily routines, which lead to frequent allergic reactions. Ancient literature defines the meaning of “Bing” (endowment) in the special constitution as “innate endowment”, “fetal endowment” etc., indicating that a person’s growth and development are influenced by what is bestowed by their parents. Individuals with a special constitution have abnormal endowments compared to ordinary people, making them more susceptible to external environmental influences and prone to developing diseases due to environmental stimuli ^[9]. “Essentials of Medicine” points out that dysfunction of the internal organs in the human body, prolonged illness leading to blood deficiency and dryness, are important causes of hidden rashes and itching due to internal organ disharmony. Moreover, the most common syndrome type of hidden rashes is blood deficiency and wind-dryness. Patients with this condition often have a deficient constitution, weakened nutrient and defense Qi, and poorly nourished skin, resulting in persistent skin lesions that are difficult to heal. In the later stages, they

may experience various symptoms such as hot palms and soles, irritability, and easy anger ^[10]. The ability to resist external pathogens decreases, lung defense function becomes impaired, external pathogens invade internally, and nutrient and defense Qi become imbalanced, leading to wind rash and itching ^[11]. When the body’s defensive Qi is weakened, external pathogenic factors can invade, leading to a struggle between the body’s defensive Qi and external pathogens at the skin’s surface, resulting in itching and wheals ^[12]. Given the characteristics of chronic urticaria, external treatment methods in traditional Chinese medicine (TCM) are highly suitable for addressing this condition. By employing corresponding TCM external treatment techniques, such as acupuncture or auricular point stimulation at specific areas on the body’s surface, we can induce local capillary congestion and dilation, trigger nerve reflexes, open sweat glands to induce sweating, and expel external pathogens, thereby harmonizing the body’s defensive and nutritive Qi. External TCM treatments like acupuncture and auricular therapy demonstrate favorable clinical efficacy in treating chronic urticaria by directly targeting the underlying pathogenesis.

3. Clinical application of acupuncture in chronic urticaria

Acupuncture therapy, a classic external treatment method in TCM, involves stimulating specific acupoints on the body to regulate the flow of defensive and nutritive Qi and blood. Acupuncture treatments come in various forms, offering unique advantages by directly addressing the root cause of the disease while simultaneously treating its symptoms. “Urticaria” is considered a condition of deficiency in origin and excess in superficiality, where factors such as overeating and emotional stress can lead to internal invasion by wind pathogens, disrupting the normal flow of Qi, blood, and body fluids, resulting in stagnation and blockage. Acupuncture therapy can swiftly alleviate and improve patients’ discomfort with few adverse reactions and a low recurrence rate, thanks to its diverse, flexible, and convenient treatment methods. Modern research suggests that acupuncture therapy can suppress inflammatory responses, thereby promoting and regulating cellular and humoral immunity.

He Jin et al. randomly divided patients with chronic urticaria (CU) into three groups: the monotherapy group received oral levocetirizine hydrochloride, the dual-therapy group received oral levocetirizine hydrochloride combined with Runzao Zhiyang Capsules, and the triple-therapy group received acupuncture treatment in addition to the dual-therapy regimen^[13]. For CU patients, combining Runzao Zhiyang Capsules and/or acupuncture with a double conventional dose of levocetirizine hydrochloride was administered. The results indicated that the combined therapy supplemented with acupuncture could further enhance the overall response rate. Hu Changhe treated the study group with Yangxue Xiaofeng Decoction combined with acupuncture, while the control group received mizolastine^[14]. The overall response rate was 90.91% in the study group and 65.91% in the control group, demonstrating the favorable efficacy of acupuncture in treating chronic urticaria. Wang Hui et al. randomly divided patients into a control group (oral desloratadine citrate disodium tablets) and an observation group (vitamin B12 injection at bilateral Quchi acupoint in addition to the control group's treatment) according to a random number table^[15]. Both groups were treated for 30 days and followed up for 2 months. Clinical efficacy, recurrence rate during follow-up, Urticaria Activity Score (UAS) before treatment and at 10, 20, and 30 days of treatment, as well as serological and other test indicators before and 30 days after treatment, were compared between the two groups. The results showed that this acupuncture treatment could reduce the recurrence rate and alleviate inflammatory responses. Wang Mengli et al. adopted the treatment of chronic urticaria of Qi-blood deficiency type by combining governor vessel moxibustion with acupuncture at Dong's extraordinary points^[16]. The needles were retained for about 15 minutes, once every two weeks, with three sessions constituting a course of treatment, and a total of three courses were administered continuously. The overall effective rate was 94.29%. This demonstrated that the treatment of chronic urticaria with governor vessel moxibustion combined with acupuncture at Dong's extraordinary points was simple in method and unique in efficacy. Jia Jingli et al. administered oral ebastine to the control group; the treatment group received acupuncture treatment (at points such as Quchi and Hegu) in addition to the treatment

given to the control group, using the filiform needle acupuncture technique^[17]. The results showed that the treatment group had better efficacy than the control group, and the recurrence rate after one month of follow-up was lower than that of the control group. The conclusion was that the acupuncture therapy combined with ebastine had a lower recurrence rate and better efficacy in the treatment of chronic urticaria.

4. Clinical application of auricular point therapy in chronic urticaria

Auricular point therapy has a long history in the treatment of skin diseases such as chronic urticaria. Its therapeutic mechanism lies in the stimulation of corresponding acupoints through auricular acupressure with beans, which helps to dredge the meridians and regulate Qi and blood^[18]. By stimulating specific skin sensory areas on the ear, auricular points can regulate various functions of the human body, including the nervous, humoral, and endocrine systems^[19]. Auricular points are the reaction points of diseases on the ear^[20]. Traditional Chinese medicine holds that the ears are closely related to the twelve meridians and five internal organs of the human body. The auricle and the nervous system originate from the same ectoderm. Auricular therapy induces a series of reactions by stimulating the sensory points on the ear's skin and transmitting nerve messages. Through auricular therapy, stimulating the auricular points corresponding to the affected internal organs and meridians in the human body can have the effects of calming the nerves, lowering and normalizing blood pressure, relieving pain, and improving and promoting various immune functions of the human body. Auricular plaster therapy has a definite curative effect on urticaria^[21]. Auricular therapy has numerous advantages, including convenience, ease of operation, high cost-effectiveness, affordability, minimal side effects, minimal patient discomfort, and no damage to the ear's skin, making it easily acceptable to patients. Moreover, it does not interfere with the patient's normal work and life during treatment^[22]. Modern anatomy suggests that the auricle is innervated by multiple nerves, and thus auricular therapy has various effects such as relieving spasms, alleviating pain, relieving itching, and reducing allergies^[23].

Wei Ruixian et al. utilized acupoint catgut embedding combined with auricular point pressing with beans for the treatment of chronic urticaria (CU), achieving an effectiveness rate of 82.14%^[20]. This demonstrates that the combined therapy of acupoint catgut embedding and auricular point pressing with beans is clinically effective for treating CU, with a low recurrence rate, excellent long-term efficacy, and good treatment safety. Zou Tian administered acupuncture treatment to the treatment group and acupuncture combined with auricular point pressing with beans to the control group^[24]. The results indicated that acupuncture combined with auricular point pressing with beans significantly improved the clinical symptoms of CU and exhibited high safety. Wang Hongjian et al. treated the control group solely with autohemotherapy at acupoint injection, while the treatment group received additional auricular therapy based on the control group's treatment^[21]. The results after treatment showed that auricular point pressing combined with autohemotherapy at acupoint injection had a better clinical effect on treating chronic urticaria. Liu Binbin provided the treatment group with auricular point pressing combined with external application of purslane, while the control group received oral Western medication^[25]. The results demonstrated that auricular point pressing combined with external application of purslane had a good therapeutic effect on CU. Li Gang et al. administered a comprehensive treatment to the treatment group, consisting of modified Duopi Decoction combined with auricular seed embedding and cetirizine hydrochloride drops, while the control group received only cetirizine hydrochloride drops^[23]. The results showed that the clinical efficacy of the treatment group was superior to that of the control group, indicating that the combined therapy of modified Duopi Decoction, auricular seed embedding, and cetirizine hydrochloride drops was significantly effective in treating

chronic urticaria and had a low recurrence rate.

5. Summary and prospects

In summary, chronic urticaria is a common skin disease that is clinically difficult to treat, and Western antihistamine medications have limitations^[26]. The recurrent episodes of chronic urticaria are closely related to psychological factors such as anxiety and irritability in patients, as well as social environmental factors. These factors can interfere with normal nervous, humoral immune, endocrine, and other systems, serving as significant contributors to the recurrent and protracted nature of the disease, thereby making chronic urticaria a psychosomatic disorder. Traditional Chinese medicine (TCM) external treatment methods such as acupuncture and auricular therapy have demonstrated favorable clinical outcomes in treating chronic urticaria. With a wide range of treatment options available, whether through acupuncture alone, auricular therapy alone, or comprehensive treatment approaches, satisfactory clinical efficacy can be achieved with a relatively low recurrence rate, highlighting the unique advantages of TCM external treatment methods. However, based on clinical literature analysis, given the complex and diverse range of treatments such as acupuncture and auricular therapy, there is currently a limited number of studies that can be included for analysis, with a lack of long-term efficacy follow-up and other observations. There is also a dearth of rigorous randomized controlled research methods, and systematic and comprehensive evaluations of adverse reactions and safety have not been conducted. Further relevant analyses and studies are needed in the future to screen for safe, effective, highly operable, and easily acceptable acupuncture and auricular therapy programs for the treatment of chronic urticaria.

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Clinical Observation of the Therapeutic Effect of Chrysanthemum Indicum Injection Combined with Budesonide Suspension Nebulization in the Treatment of Acute Suppurative Tonsillitis

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Abstract

Objective: To investigate the clinical efficacy of Chrysanthemum Indicum injection combined with Budesonide suspension nebulization in the treatment of acute suppurative tonsillitis. **Methods:** A total of 60 patients with acute suppurative tonsillitis admitted to our hospital from January 2021 to December 2022 were selected as the research subjects. Both groups received anti-inflammatory treatment with cefathiamidine. The control group (30 cases) also received dexamethasone nebulization therapy, while the treatment group (30 cases) received nebulization therapy with a combination of wild chrysanthemum injection and budesonide suspension. Before treatment, the age, gender, and clinical symptoms such as sore throat, tonsillar congestion, suppuration, fever, and cough of the patients were observed and recorded. The changes in clinical symptoms during the treatment period were continuously observed and recorded. On the day of treatment completion, the clinical symptoms of sore throat, tonsillar congestion, suppuration, fever, and cough were observed and recorded, and the number of patients who recovered was recorded. **Results:** Before treatment, there were no significant differences between the two groups of patients in terms of gender and age ($p > 0.05$). Additionally, there were no significant differences in the severity of symptoms such as sore throat, tonsillar congestion, purulence, fever, and cough ($p > 0.05$). After 3 days of treatment, symptoms like sore throat, tonsillar congestion, purulence, and cough were significantly alleviated, while fever showed no significant improvement. The total symptom scores between the groups were significantly different ($p < 0.05$). After 5 days of treatment, the clinical symptoms were further significantly improved, the total symptom scores remained significantly different ($p < 0.05$), and the number of patients who recovered increased significantly ($p < 0.05$). **Conclusion:** Nebulization therapy with a combination of wild chrysanthemum injection and budesonide suspension for acute suppurative tonsillitis is more effective than traditional dexamethasone nebulization therapy,

Keywords

Chrysanthemum indicum injection; Budesonide suspension; Dexamethasone; Acute suppurative tonsillitis

1. Introduction

Acute suppurative tonsillitis (AST) is a common pharyngeal disease primarily caused by bacterial infections, with *Streptococcus pyogenes*, *Prevotella* spp., and *Streptococcus dysgalactiae* being frequently implicated ^[1,2]. Patients often present with symptoms such as sore throat, fever, cough, tonsillar congestion and swelling, and suppuration. Inadequate or delayed treatment may lead to complications including acute otitis media and acute sinusitis ^[3]. In recent years, increasing bacterial resistance has diminished the efficacy of antibiotic therapy. In comparison, glucocorticoids demonstrate superior therapeutic effects, although traditional dexamethasone treatment yields suboptimal outcomes ^[4]. Budesonide suspension is a novel glucocorticoid with high affinity for glucocorticoid receptors and potent anti-inflammatory action. Nebulization delivers high drug concentrations to the pharynx, effectively clearing inflammation, alleviating local pain, and promoting recovery ^[5]. Chrysanthemum indicum possesses heat-clearing, detoxifying, anti-inflammatory, and anti-edema properties, and has been shown to significantly inhibit pathogens such as *Staphylococcus aureus* and *Salmonella typhi* ^[6]. Therefore, this study analyzes the clinical efficacy of Chrysanthemum indicum injection combined with budesonide suspension nebulization for AST.

2. Materials and methods

2.1. Clinical data

Sixty AST patients admitted between January 2022 and January 2024 were enrolled and randomly assigned in a 1:1 ratio to either the treatment or control group using a random number table generated by SPSS 20.0. The treatment group comprised 17 males and 13 females with a mean age of 38.37 ± 14.68 years. The control group comprised 13 males and 17 females with a mean age of 40.20 ± 16.06 years. All patients provided informed consent, and the study was approved by the hospital's ethics committee.

2.2. Selection criteria

2.2.1. Diagnostic criteria

- (1) TCM diagnostic criteria referred to the Chinese

Society of Traditional Chinese Medicine Standards-Guidelines for Diagnosis and Treatment of Common Diseases in TCM Otolaryngology (China Press of Traditional Chinese Medicine, 2012).

- (2) Western diagnostic criteria referred to the textbook Otolaryngology-Head and Neck Surgery (People's Medical Publishing House, 2nd Edition) edited by Kong Weijia.

2.2.2. Inclusion criteria

- (1) Met the above diagnostic criteria;
- (2) Aged 14–65 years;
- (3) Acute onset with illness duration, within 1 week;
- (4) No use of glucocorticoids, antibiotics, or other drugs affecting study outcomes within 1 week prior;
- (5) Agreed not to use other interfering therapies during the study.

2.2.3. Exclusion criteria

- (1) Complicated by severe laryngitis or lower respiratory tract infections;
- (2) History of severe adverse reactions to the study drugs;
- (3) Participation in other clinical trials;
- (4) Conditions hindering participation (e.g., intellectual disability, communication barriers);
- (5) Re-enrollment of the same patient.

2.2.4. Dropout and termination criteria

- (1) Poor compliance;
- (2) Occurrence of severe adverse events, complications, or physiological changes precluding continued participation;
- (3) Voluntary withdrawal or loss to follow-up;
- (4) Use of non-protocol treatments significantly affecting efficacy assessment

2.2.5. Elimination criteria

- (1) Inadvertent enrollment despite not meeting inclusion or meeting exclusion criteria;
- (2) No receipt of intervention or lack of usable data

2.3. Treatment and observation methods

All 60 patients received anti-infective treatment with cefthiamidine (Manufacturer: Guangzhou Baiyunshan Pharmaceutical Co., Ltd., National Medicine Permit No.: H44024253). The treatment group (n = 30) additionally received nebulization with Chrysanthemum indicum injection (Manufacturer: Jiangxi Zhongshan Pharmaceutical Co., Ltd., National Medicine Permit No.: Z20026529) combined with budesonide suspension (Manufacturer: AstraZeneca (Wuxi) Trading Co., Ltd., Import Drug Approval No.: H20140475). The control group (n = 30) received nebulization with traditional dexamethasone (Manufacturer: Tianjin Jinyao Group Hubei Tianyao Pharmaceutical Co., Ltd., National Medicine Permit No.: H42020019). Treatment was administered twice daily for 20 minutes per session, for 3–5 days. Patients were instructed to inhale the aerosol through the mouth and exhale through the nose to facilitate drug deposition in the pharynx. Eating and drinking were prohibited for 30 minutes post-nebulization to maintain efficacy. Any adverse events were recorded.

2.4. Efficacy observation indicators

(1) Primary outcomes

Sore throat, tonsillar congestion/swelling, tonsillar suppuration.

(2) Secondary outcomes

Fever, cough.

(3) Assessment timeline

Pre-treatment (admission day): Clinical signs and symptoms, including body temperature, sore throat, cough, as well as pharyngeal and tonsillar congestion, redness and swelling, and secretions, were observed and recorded. During treatment: The aforementioned clinical signs and symptoms were observed and recorded daily for patients in the treatment group. The time to resolution of fever, alleviation of sore throat, disappearance of exudates, reduction in tonsil size, and relief of tonsillar congestion were calculated. Post-treatment (final day) assessments of symptoms and signs were recorded. Time to fever resolution, sore throat relief, exudate disappearance, tonsil reduction, and congestion relief were calculated.

(4) Comprehensive efficacy criteria

Based on the reduction rate of total symptom score.

(5) Symptom quantification scores

Sore Throat: None (0 points); Mild, unaffected swallowing (2 points); Moderate, significantly affected swallowing (4 points); Severe, persistent pain, severely affected swallowing (6 points). Tonsillar Congestion/Swelling: Normal (0 points); Mild congestion, swelling not exceeding the palatopharyngeal arch (I degree) (2 points); Moderate congestion, swelling exceeding the palatopharyngeal arch but not reaching the midline (II degree) (4 points); Severe congestion with exudate, swelling beyond the midline (III degree) (6 points). Tonsillar Suppuration: None (0 points); Unilateral suppuration (2 points); Bilateral suppuration, scattered pus points (4 points); Bilateral suppuration, confluent pus patches (6 points). Fever (Axillary Temperature): ≤ 37.4 °C (0 points); 37.5–38.5 °C (1 point); > 38.6 °C (2 points). Cough: None (0 points); Occasional, single coughs (1 point); Paroxysmal, multiple coughs (2 points). Tonsillar congestion/swelling and suppuration were the primary outcomes for evaluation.

(6) Disease severity grading

Mild: total score 6–11; Moderate: 12–17; Severe: 18–22.

(7) Efficacy judgment standards (based on score reduction rate)

Cure: $\geq 90\%$; Marked effect: 70% to $< 90\%$; Effective: 30% to $< 70\%$; Ineffective: $< 30\%$. Reduction rate = $[(\text{Pre-treatment score} - \text{Post-treatment score}) / \text{Pre-treatment score}] \times 100\%$. The disease efficacy criteria were established according to the guidelines outlined in “Diagnostic and Efficacy Criteria for Acute Suppurative Tonsillitis” (Hangzhou Conference, 1991) formulated by the Otolaryngology Committee of the Chinese Society of Traditional Chinese Medicine, and the “Guiding Principles for Clinical Research of New Chinese Medicines” (2002 Edition).

2.5. Statistical methods

SPSS 20.0 was used. Categorical data were analyzed by chi-square test. Measurement data are presented as mean \pm standard deviation ($\bar{x} \pm s$). Inter-group comparisons used *t*-tests. $p < 0.05$ indicated statistical significance.

3. Results

3.1. Gender comparison

No significant difference was found between groups ($\chi^2 = 1.062$, $p = 0.302 > 0.05$), indicating comparability (Table 1).

3.2. Age comparison

No significant difference was found ($F = 0.713$, $t = -0.461$, $p = 0.402 > 0.05$), indicating comparability (Table 2).

3.3. Pre-treatment clinical symptoms

No significant differences in pre-treatment symptom scores were observed between groups ($p > 0.05$), indicating comparability (Table 3).

3.4. Pre-treatment disease severity

No significant difference in severity distribution was found ($\chi^2 = 1.130$, $p = 0.568 > 0.05$), indicating comparability (Table 4).

3.5. Clinical symptoms after 3 days of treatment

After 3 days, symptoms like sore throat, congestion, suppuration, and cough improved significantly in both groups, but fever improvement was insignificant. The total score difference between groups was significant ($p < 0.05$) (Table 5).

Table 1. Patient gender comparison

Group	n	Male	Female
Control	30	17	13
Treatment	30	13	17

Table 2. Patient age comparison ($\bar{x} \pm s$)

Group	n	Mean age (years)
Control	30	40.20 \pm 16.06
Treatment	30	38.37 \pm 14.68
<i>t</i> -value	/	-0.461
<i>p</i> -value	/	0.402

Table 3. Pre-treatment symptom scores ($\bar{x} \pm s$)

Group	Primary			Secondary		Total score
	Total score	Congestion	Suppuration	Fever	Cough	
Control	4.47 \pm 1.39	4.00 \pm 1.29	4.33 \pm 1.40	1.23 \pm 0.63	1.07 \pm 0.79	15.10 \pm 3.00
Treatment	4.20 \pm 1.42	3.93 \pm 1.53	4.67 \pm 1.21	1.07 \pm 0.79	1.10 \pm 0.8	14.97 \pm 3.32

Table 4. Pre-treatment disease severity (n)

Group	n	Mild	Moderate	Severe
Control	30	6	16	8
Treatment	30	4	20	6

3.6. Clinical symptoms after 5 days of treatment

After 5 days, all symptoms were significantly improved. The total score in the treatment group (3.31 ± 2.73) was significantly lower than in the control group (5.33 ± 4.16) ($p < 0.05$) (Table 6).

3.7. Recovery rates

After 5 days of treatment, the symptoms of the patients were significantly improved. In the control group, 4 cases were cured, 12 showed marked improvement, 11 had slight improvement, and 3 were essentially ineffective. Compared with traditional dexamethasone nebulization therapy, the combination of Chrysanthemum indicum injection and budesonide resulted in significantly greater symptom improvement ($\chi^2 = 4.80$, $p = 0.03 < 0.05$). Specifically, 7 patients were cured, 17 showed marked effect, 6 were effective, and 0 were ineffective (see Table 7). These results indicate that the combination therapy of Chrysanthemum indicum injection and budesonide is more effective for patients with acute suppurative tonsillitis.

4. Discussion

The tonsils are important immune organs. When inflamed, they can become a focus of infection, potentially leading to complications such as myocarditis, pneumonia, or cellulitis^[7,8]. AST is common in spring and autumn, particularly among children, adolescents, and immunocompromised individuals, often accompanied by systemic symptoms like fever and chills^[9]. Currently, antibiotic agents remain the primary therapeutic choice in clinical practice, such as azithromycin and penicillin. However, antibiotic therapy has certain limitations, including a tendency to promote bacterial resistance and the potential for adverse effects such as rashes and allergic reactions^[8,10]. Furthermore, surgical intervention can achieve radical eradication of the disease. Nevertheless, considering the financial burden on patients and acceptability issues, it is not an optimal choice. Consequently, identifying therapeutic strategies that are economical, convenient, and highly efficacious represents the future direction for managing this condition.

In TCM, AST falls under “rǔ é” (tonsillitis) and “làn rǔ é” (suppurative tonsillitis). “Yi Zōng Jīn Jiàn” states its etiology involves internal heat and external wind-

Table 5. Symptom scores after 3 days of treatment ($\bar{x} \pm s$)

Group	Primary			Secondary		Total score
	Sore throat	Congestion	Suppuration	Fever	Cough	
Control	2.69 ± 1.26	3.27 ± 1.02	3.25 ± 1.57	0.18 ± 0.39	0.68 ± 0.61	8.98 ± 4.27
Treatment	2.56 ± 0.99	2.47 ± 0.92	1.8 ± 1.20	0.18 ± 0.39	0.61 ± 0.49	$8.96 \pm 2.98^*$

Note: $p < 0.05$ compared to control group total score.

Table 6. Symptom scores after 5 days of treatment ($\bar{x} \pm s$)

Group	Primary			Secondary		Total score
	Sore throat	Congestion	Suppuration	Fever	Cough	
Control	1.40 ± 1.19	2.20 ± 1.34	1.07 ± 1.72	0.03 ± 0.18	0.77 ± 0.68	5.33 ± 4.16
Treatment	0.87 ± 1.14	1.27 ± 0.98	0.47 ± 1.25	0.00 ± 0.00	0.50 ± 0.57	3.31 ± 2.73

Note: $p < 0.05$ compared to control group total score.

Table 7. Clinical efficacy after 5 days (n)

Group	Cure	Marked Effect	Effective	Ineffective
Control	4	12	11	3
Treatment	7	17	6	0

heat, making “heat” the key pathogen. Treatment should clear heat, detoxify, reduce swelling, and relieve pain ^[11]. Chrysanthemum indicum injection, with its primary component being Chrysanthemum indicum, fulfills this principle and is cost-effective ^[12]. It may also modulate immunity and has broad clinical applications ^[13].

Dexamethasone nebulization, previously common for AST, has drawbacks including higher systemic absorption and inferior anti-inflammatory potency compared to budesonide. Budesonide’s advantages include as follows ^[14,15].

- (1) High potency at low doses;
- (2) Prolonged action due to esterification in the tissue
- (3) Rapid onset and targeted delivery via nebulization, with minimal systemic exposure due to high first-pass metabolism ^[16,17]. One study reported 97.22% efficacy for budesonide in chronic nasopharyngitis versus 75% for dexamethasone ^[18]. Our study combined

Chrysanthemum indicum injection with budesonide. Results showed significant improvement in most symptoms by day 3 and in all symptoms, including complete fever resolution, by day 5 in the treatment group, which also had significantly higher recovery rates. This demonstrates the superior efficacy of the combination therapy over dexamethasone for AST.

5. Conclusion

Nebulization with Chrysanthemum indicum injection combined with budesonide suspension can rapidly alleviate clinical symptoms in AST patients by delivering drugs directly to the site of infection, effectively reducing disease severity within a short period. This regimen demonstrates significant clinical efficacy and can be considered for clinical application.

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Disclosure statement

The authors declare no conflict of interest.

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Efficacy of Auricular Point Pressing Beans Combined with Modified Suanzaoren Decoction in Treating Post-Stroke Insomnia

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Abstract

Objective: To analyze the effect of auricular point pressing with beans combined with modified Suanzaoren Decoction in treating post-stroke insomnia. **Methods:** A total of 80 patients with post-stroke insomnia admitted to our hospital from December 2019 to December 2021 were included in this study by convenience sampling and randomly divided into two groups with equal numbers of cases using a digital random table. Both groups of patients received modified Suanzaoren Decoction treatment, while patients in the observation group also received auricular point pressing with beans treatment on this basis. Both groups of patients underwent biochemical tests before medication and at the end of the treatment course. The serum tumor necrosis factor- α levels of the two groups of patients before medication and at the end of the treatment course were compared. The Pittsburgh Sleep Quality Index was used to assess the sleep quality of patients before medication and at the end of the treatment course, and the scores of the two groups were compared. The efficacy of the two groups of patients was evaluated according to the “Guiding Principles for Clinical Research on New Traditional Chinese Medicines” and the total effective rates of the two groups were compared. **Results:** Before medication, there was a minor difference in serum tumor necrosis factor- α (TNF- α) levels between the two groups of patients ($p > 0.05$). At the end of the treatment course, the serum TNF- α level in the observation group had increased compared to the pre-medication level, significantly higher than that in the control group ($p < 0.05$). Before medication, the Pittsburgh Sleep Quality Index (PSQI) showed a minor difference between the two groups ($p > 0.05$). At the end of the treatment course, the PSQI in the observation group had decreased compared to the pre-medication level, significantly lower than the assessment results in the control group ($p < 0.05$). The total effective rate of treatment in the observation group was higher than that in the control group, showing a statistically significant difference ($p < 0.05$). **Conclusion:** The combination of auricular point pressing therapy with modified Suanzaoren Decoction demonstrates a definite therapeutic effect in treating post-stroke insomnia, more effectively improving patients’ serum TNF- α levels and sleep quality, and is worthy of application.

Keywords

Post-stroke insomnia; Suanzaoren decoction; Auricular point pressing therapy; Tumor necrosis factor; Sleep quality; Therapeutic effect

1. Introduction

Cerebral stroke is a cerebrovascular disease caused by various factors that lead to a disturbance in the brain's blood supply, resulting in ischemic and hypoxic necrosis of brain tissue. Cerebral stroke has a high incidence rate in China, particularly among the elderly population. With the development of intravenous thrombolysis therapy and other emergency treatment techniques, the mortality rate from cerebral stroke has significantly decreased ^[1]. However, stroke patients are prone to sequelae, with insomnia being a common one. This complication not only affects the recovery of neurological function and daily life in stroke patients but may even increase their risk of recurrence. In recent years, traditional Chinese medicine has played a significant role in the treatment of stroke and its complications. Suanzaoren Decoction has the effect of nourishing blood and tranquilizing the mind, while auricular point pressing with bean is a common external treatment method in traditional Chinese medicine ^[2,3]. To analyze the efficacy of auricular point pressing with bean combined with modified Suanzaoren Decoction in treating post-stroke insomnia, a comparative analysis was conducted on 80 patients with post-stroke insomnia admitted to our hospital. The research process and results are reported as follows.

2. Materials and methods

2.1. Baseline data

A total of 80 patients with insomnia after stroke admitted to our hospital from December 2019 to December 2021 were included in this study using convenience sampling. They were randomly divided into two groups with an equal number of cases in each group using a digital randomization table. In the observation group, there were 25 male and 15 female patients; the youngest patient was 51 years old and the oldest was 75 years old, with an average age of (68.30 ± 4.11) years; the disease duration ranged from 1 to 3 months, with an average of (1.20 ± 0.43) months. In the control group, there were 23 male and 17 female patients; the youngest patient was 50 years old and the oldest was 78 years old, with an average age of (67.62 ± 4.08) years; the disease duration ranged from 1 to 3 months, with an average of (1.40 ± 0.45) months. The baseline data of the two groups showed minimal

differences ($p > 0.05$), allowing for a comparative study.

2.1.1. Inclusion criteria

- (1) Diagnosed with stroke through imaging examination;
- (2) Meeting the relevant diagnostic criteria in the "Guidelines for the Diagnosis and Treatment of Insomnia in Chinese Adults";
- (3) Absence of other diseases affecting treatment prognosis;
- (4) Ability to communicate normally and good compliance;
- (5) Signed informed consent form.

2.1.2. Exclusion criteria

- (1) Mental disorders or cognitive impairment;
- (2) Allergy to the medications used in this study;
- (3) Patients who have recently taken antidepressants or other medications that may affect the efficacy;
- (4) Presence of other serious organic lesions;
- (5) Incomplete clinical data.

2.2. Methods

Both groups of patients received modified Suanzaoren Decoction treatment, with the following formula: *Caulis Polygoni Multiflori* 25 grams, *Rhizoma Anemarrhenae* 20 grams, *Ziziphi Spinosae Semen* 25 grams, *Rhizoma Chuanxiong* 20 grams, *Poria* 20 grams, *Radix Glycyrrhizae Preparata* 15 grams, *Os Draconis* (calcined) 25 grams, and *Concha Ostreae* (calcined) 25 grams. For patients with night sweats, an additional 20 grams of *Concha Ostreae* (calcined), 12 grams of *Fructus Tritici* Levis, and 8 grams of *Fructus Schisandrae* were added; for those who woke up easily, 20 grams of *Dens Draconis* and 10 grams of *Radix Ginseng* were added; for those whose anxiety affected their sleep, 8 grams of *Fructus Gardeniae* and 6 grams of *Rhizoma Coptidis* were added; and for those with excessive phlegm, 20 grams each of *Pericarpium Citri Reticulatae*, *Rhizoma Pinelliae*, and *Bambusae Concretio Silicea* (Note: "Gallbladder Heart" may be a misinterpretation or a specific term in TCM; please verify its accuracy) were added. One dose per day was decocted in water to obtain 300 milliliters of juice, which was taken twice daily for two consecutive months ^[4,5].

On this basis, patients in the observation group

received auricular point pressing therapy with beans. Auricular points corresponding to Shenmen, Sympathetic, Heart and Spleen, etc., were selected. After confirming the sensitive areas of the auricular points with a probe, routine disinfection was performed using alcohol. Vascular forceps were used to attach Vaccaria seeds patches to the sensitive auricular points, and patients were instructed to appropriately massage these sensitive auricular areas for about 1–2 minutes each time, at least three times a day ^[6,7].

2.3. Evaluation methods

Both groups of patients underwent biochemical tests before medication and at the end of the treatment course. The serum tumor necrosis factor- α (TNF- α) levels of the two groups were compared before medication and at the end of the treatment course. The biochemical tests for both groups were performed by the same laboratory physician, using an automatic biochemical analyzer and enzyme-linked immunosorbent assay kits to complete the corresponding tests.

The Pittsburgh Sleep Quality Index (PSQI) was employed to evaluate the sleep quality of patients before medication and at the end of the treatment course. Patients were asked to truthfully complete the questionnaire based on their sleep conditions over the past month, which included 19 self-assessment items and 5 negatively-worded items. Each item was scored on a scale of 0 to 3, and the cumulative scores of all factors constituted the total score for this assessment, with a maximum possible score of 21. The score was negatively correlated with sleep quality, and the scores of the two groups were compared.

The efficacy in the two groups of patients was determined according to the “Guidelines for Clinical Research on New Traditional Chinese Medicines”. Patients whose insomnia symptoms completely disappeared after treatment were considered cured, those whose insomnia symptoms significantly improved after treatment were considered effective, and those who did not meet the above criteria after treatment were considered ineffective. The total effective rate of treatment was the sum of the cure rate and the effective rate, and the total effective rates of the two groups were compared.

2.4. Statistical methods

The data of the two groups of patients were organized using Excel spreadsheets and statistically analyzed using the SPSS 16.0 software package. Measurement data were expressed as (mean \pm standard deviation) and analyzed using the t-test. Count data were expressed as the number of cases and analyzed using the chi-square (χ^2) test. A *p*-value less than 0.05 indicated a significant difference between the results of the two groups, with statistical significance.

3. Results

3.1. Comparison of serum tumor necrosis factor alpha level between the two groups

Before medication, there was a minimal difference in serum tumor necrosis factor alpha levels between the two groups of patients (*p* > 0.05). At the end of the treatment course, the serum tumor necrosis factor alpha level in the observation group increased compared to before medication and was significantly higher than that in the control group (*p* < 0.05), as shown in **Table 1**.

3.2. Comparison of Pittsburgh sleep quality index assessment results between the two groups

Before medication, there was a minimal difference in the Pittsburgh Sleep Quality Index between the two groups of patients (*p* > 0.05). At the end of the treatment course, the Pittsburgh Sleep Quality Index in the observation group decreased compared to before medication and was significantly lower than that in the control group (*p* < 0.05), as shown in **Table 2**.

3.3. Comparison of clinical efficacy between the two groups

The total effective rate of treatment in the observation group was higher than that in the control group, with a statistically significant difference (*p* < 0.05), as shown in **Table 3**.

4. Discussion

Insomnia is a common complication of stroke. Data indicates that the incidence of insomnia during the acute

Table 1. Serum tumor necrosis factor alpha level before and after treatment in both groups (ng/L)

Group	Before treatment	After treatment	<i>t</i> -value (Within-group)	<i>p</i> -value (Within-group)
Observation group	98.32 ± 9.26	229.61 ± 10.12	60.534	< 0.05
Control group	99.27 ± 9.23	196.20 ± 12.05	40.388	< 0.05
<i>t</i> -value (Between-group)	0.460	13.428		
<i>p</i> -value (Between-group)	> 0.05	< 0.05		

Table 2. Pittsburgh sleep quality index assessment results before and after treatment in both groups

Group	Before treatment	After treatment	<i>t</i> -value (Within-group)	<i>p</i> -value (Within-group)
Observation group	16.72 ± 2.19	10.06 ± 2.07	13.978	< 0.05
Control group	16.95 ± 2.15	13.11 ± 2.03	8.213	< 0.05
<i>t</i> -value (Between-group)	0.474	6.653		
<i>p</i> -value (Between-group)	> 0.05	< 0.05		

Table 3. Total effective rate of treatment in both groups

Group	Before treatment	After treatment	<i>t</i> -value (Within-group)	<i>p</i> -value (Within-group)
Observation group	16.72 ± 2.19	10.06 ± 2.07	13.978	< 0.05
Control group	16.95 ± 2.15	13.11 ± 2.03	8.213	< 0.05
χ^2 value (Between-group)	0.474	6.653		
<i>p</i> -value (Between-group)	> 0.05	< 0.05		

phase of stroke approaches 70%, with the rate remaining close to 50% after 18 months. The causes of insomnia following a stroke are complex and may be related to the location of the injury and the severity of the condition in stroke patients^[8]. The nuclei that regulate sleep, including the locus coeruleus and hypothalamus, can be damaged in stroke patients, leading to the interruption of relevant conduction pathways. This disruption can prevent the initiation of sleep or disrupt the sleep-wake rhythm. Additionally, stroke patients often face a prolonged recovery period, during which many experience prolonged limb weakness and other sequelae. The financial strain caused by long-term treatment can impose significant psychological burdens on patients, leading to anxiety and other emotions that severely affect their sleep^[9]. Insomnia after stroke not only affects the neurological recovery and daily life of stroke patients but may also increase their risk of recurrence. Therefore, it is particularly important to strengthen the treatment of this

complication.

Stroke falls under the category of “apoplexy” in traditional Chinese medicine (TCM), while insomnia is classified as “insomnia disorder”. There are numerous records regarding both conditions in TCM literature. TCM views apoplexy primarily through the lenses of external wind theory and internal wind theory, attributing the onset of apoplexy to liver Yang hyperactivity and internal wind agitation. External wind, heart fire, Qi counterflow, and blood stasis are considered closely related to the occurrence of apoplexy^[10]. There is no explicit record of “insomnia after stroke” in traditional Chinese medical literature. However, stroke patients often suffer from insomnia due to disrupted Qi and blood circulation, phlegm and blood stasis, blocked meridians, and hyperactivity of liver Yang, which disturb the mind. Insomnia, in turn, does not deplete Yin essence, leading to a decline in Qi and blood in patients, thus creating a vicious cycle with stroke. Therefore, the treatment

of insomnia after stroke should primarily focus on regulating the Yin and Yang of the viscera, calming the mind, and replenishing Qi ^[11]. In the Suanzaoren Decoction, Poria helps to stabilize essence and calm the mind, Anemarrhena nourishes Yin, moistens dryness, clears heat, and purges fire, Suanzaoren (*Ziziphi Spinosae Semen*) replenishes Qi, nourishes blood, and calms the heart and mind, *Ligusticum chuanxiong* dispels wind, relieves pain, promotes blood circulation, and regulates Qi, *Polygonum multiflorum* calms the mind, nourishes the spirit, dispels wind, and unblocks the meridians, calcined oyster shell heavily sedates and calms the mind, calcined dragon bone subdues liver Yang and tranquilizes the mind, and licorice harmonizes all the ingredients ^[12]. Modern research has confirmed that *Ziziphi Spinosae Semen*, a key herb in the Suanzaoren Decoction, exhibits various pharmacological effects. The hydrolyzed substance of jujuboside A can penetrate the blood-brain barrier and form hydrogen bonds with γ -aminobutyric acid receptors, thereby prolonging total sleep time ^[13]. The flavonoid components in *Ziziphi Spinosae Semen* can synergize with the central inhibitory effects of sodium pentobarbital. Animal experiments have demonstrated that these components can counteract the excitation induced by amphetamine in mice, exhibiting good anti-anxiety and sleep-inducing effects. Furthermore, animal experiments have confirmed that the volatile oils contained in *Ziziphi Spinosae Semen* can inhibit cerebral activity in animals, demonstrating a significant central sedative effect ^[14]. Thus, applying the Suanzaoren Decoction to the treatment of patients with insomnia after stroke yields favorable sleep-promoting effects.

Traditional Chinese medicine holds that each of the five internal organs and six viscera in the human body has its corresponding representative area on the auricle. By precisely attaching medicinal beans to auricular points with adhesive tape, stimulating sensations such as sourness and fullness are induced at these points, which can regulate the corresponding visceral functions, balance Yin and Yang, and regulate Qi and blood. Therefore, this study applied auricular point sticking therapy to the treatment of patients with insomnia after stroke. Selecting corresponding acupoint points such as Shenmen, Jiaogan, and Xinpi for treatment can have a calming and soothing effect on the mind and regulate Qi and blood. Combined

with Suanzaoren Decoction, it can enhance therapeutic efficacy ^[15]. The Pittsburgh Sleep Quality Index (PSQI) was used to evaluate the sleep quality of the two groups of patients before and after treatment. This scale has been proven to have good reliability and validity. The results showed that there was little difference in the PSQI scores between the two groups before medication ($p > 0.05$). At the end of the treatment course, the PSQI score of the observation group decreased compared to that before medication and was significantly lower than that of the control group ($p < 0.05$). In terms of overall therapeutic efficacy, the total effective rate in the observation group was 95.00%, higher than the 75.00% in the control group. Based on the above results, the combined application of Suanzaoren Decoction and auricular point sticking therapy in the treatment of patients with insomnia after stroke has better therapeutic efficacy and can significantly improve patients' sleep quality. It is noteworthy that the use of auricular point pressing therapy with beans is contraindicated in patients with heart disease or auricular skin lesions. This external traditional Chinese medicine therapy can be employed once the patient's lesions have healed. During the treatment period, it is also essential to enhance health education for patients, improving their understanding of auricular point pressing therapy with beans and their compliance with the treatment to ensure its efficacy.

Tumor necrosis factor (TNF) is a pro-inflammatory cytokine produced by macrophages and also a cytokine that can damage neurons. The expression of TNF- α in normal brain tissue is almost rhythmic, with the highest levels occurring during deep sleep. A study on Parkinson's disease patients with sleep disorders found that plasma TNF- α concentrations were associated with sleep disturbances and other non-motor symptoms in Parkinson's disease patients. TNF- α and other inflammatory mediators can activate a series of downstream signaling pathways in the brain, thereby prolonging the duration of non-rapid eye movement sleep. These inflammatory mediators can also alter neuroendocrine activity, prompting the release of neurotransmitters that cause brain excitation, leading to symptoms such as sleep disturbances and memory decline in patients. The increase in TNF- α is due to its release from activated glial cells in the substantia nigra of

the central nervous system. The high expression of this inflammatory mediator at night can promote sleep to a certain extent; otherwise, it can cause sleep disturbances^[16]. Based on this, both the observation group and the control group patients in this study underwent biochemical tests before and after medication administration. The serum tumor necrosis factor- α (TNF- α) levels of the two groups of patients before and after treatment were statistically analyzed and compared. There was a minor difference in the serum TNF- α levels between the two groups of patients before medication ($P > 0.05$). At the end of the treatment course, the serum TNF- α level in the observation group patients had increased compared to that

before medication and was significantly higher than the test results of the control group patients ($p < 0.05$). This result indicates that the treatment of post-stroke insomnia patients with auricular point pressing combined with Suanzaoren Decoction can improve patients' sleep quality by regulating their TNF- α levels.

In conclusion, the combined treatment of auricular point pressing and modified Suanzaoren Decoction has a definite therapeutic effect on post-stroke insomnia, effectively elevating patients' serum TNF- α levels and improving their sleep quality, and is thus worthy of application.

Disclosure statement

The author declares no conflict of interest.

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Clinical Application and Effect Observation of Acupoint Pressure Antithrombotic Pump in Patients Undergoing Colorectal Cancer Surgery

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Abstract

Objective: To investigate the application effect of an acupoint pressure antithrombotic pump based on acupoint stimulation in preventing deep vein thrombosis (DVT) in patients undergoing colorectal cancer surgery and to evaluate its impact on postoperative quality of life. **Methods:** A total of 78 patients who underwent colorectal cancer surgery in the gastrointestinal surgery department of a tertiary-level grade A hospital from January 2024 to May 2025 were selected and randomly divided into a control group (n = 39) and an observation group (n = 39). Both groups implemented the Enhanced Recovery After Surgery (ERAS) nursing protocol for colorectal procedures. The control group received conventional manual acupoint massage (at Zusanli (ST36) and fenglong (ST40) acupoint) combined with intermittent pneumatic compression device therapy; the observation group received “acupoint pressure antithrombotic pump therapy” (acupoint-assisted stimulation device stimulating Zusanli (ST36) and fenglong (ST40) acupoint combined with intermittent pneumatic compression device). The incidence of postoperative deep vein thrombosis (DVT) and quality of life were compared between the two groups. **Results:** No DVT occurred in either group after surgery. The SF-36 quality of life assessment showed that on the 3rd postoperative day and at discharge, the observation group scored significantly higher than the control group in four dimensions: role-physical (RP), general health (GH), role-emotional (RE), and mental component summary (MCS) ($p < 0.05$). Additionally, on the 3rd postoperative day, the observation group also scored significantly higher than the control group in the bodily pain (BP) dimension ($p < 0.05$). **Conclusion:** Based on the ERAS protocol, the application of acupoint pressure antithrombotic pumps can effectively prevent the occurrence of DVT in patients after colorectal cancer surgery and significantly improve their short-term postoperative quality of life, demonstrating good clinical application value.

Keywords

Colorectal cancer; Deep vein thrombosis; Pressure antithrombotic pump; Acupoint stimulation; Quality of life; Enhanced recovery after surgery

1. Introduction

Deep vein thrombosis (DVT) is a venous return disorder caused by abnormal blood coagulation in deep veins, commonly occurring in the lower extremities. Thrombus detachment can lead to pulmonary embolism (PE), with DVT and PE being manifestations of the same disease at different stages. Collectively, they are referred to as venous thromboembolism (VTE). Patients with malignant tumors are at high risk for VTE, with an incidence rate of 4% to 20% ^[1]. Gastrointestinal malignancies have a high incidence in China, and once VTE occurs, it not only affects patients' quality of life and prognosis but can also be life-threatening in severe cases. Currently, the reported Western medical prevention methods for DVT mainly include pharmacological prevention and mechanical prevention. In traditional Chinese medicine (TCM), many external treatment methods have also demonstrated definite efficacy in preventing DVT. This study innovatively integrates the theory of TCM meridians and acupoint with modern mechanical antithrombotic technology. It utilizes an acupoint-pressure antithrombotic pump (a combination of an antithrombotic pump and an acupoint massage device (utility model patent CN222444789U), which stimulates bilateral Zusanli (ST36) and fenglong (ST40) acupoint while applying pressure with the antithrombotic pump) to explore the clinical efficacy of this combined device in reducing the incidence of postoperative DVT and improving the quality of life in patients with colorectal cancer.

2. Materials and methods

2.1. Study subjects

This study employed a randomized controlled clinical trial design, selecting 78 patients with colorectal cancer who underwent surgical treatment in the Gastrointestinal Surgery Department of Tianjin Nankai Hospital from January 2024 to May 2025. These patients were randomly divided into an intervention group and an observation group, with 39 patients in each group. This study was approved by the Medical Ethics Committee, and informed consent forms were signed by both the patients and their families.

2.1.1. Inclusion criteria

- (1) Inpatients undergoing surgical treatment for colorectal tumors (patients admitted for treatment 1–2 weeks prior to surgery);
- (2) Aged between 18 and 80 years old;
- (3) No history of abdominal or thoracic surgery, with normal blood, urine, and stool tests, as well as normal heart, liver, and kidney function;
- (4) Patients voluntarily participating in the experiment and signing informed consent forms;
- (5) Exclusion of deep vein thrombosis in both lower extremities via color Doppler ultrasound examination after admission and postoperatively

2.1.2. Exclusion criteria

- (1) Patients with severe cardiocerebrovascular diseases, pulmonary edema, metabolic diseases, and severe lower extremity edema;
- (2) Patients with deep vein thrombosis of both lower extremities, thrombophlebitis, and pulmonary embolism;
- (3) Patients who are unable to care for themselves or are uncooperative;
- (4) Patients currently participating in other clinical drug trials;
- (5) Patients who voluntarily withdraw from the study after enrollment and fail to complete the entire treatment plan;
- (6) Patients or their legal representatives who refuse to participate in this study

2.2. Intervention measures

2.2.1. Both groups received the same intervention protocol

Both the control group and the observation group will adopt an accelerated rehabilitation nursing plan for colorectal surgery, which includes:

- (1) Pre-rehabilitation measures
Paying attention to patients' psychological changes and providing psychological care; guiding patients to enhance their dietary nutrition; strengthening physical training and pulmonary function training; implementing standardized thrombosis prevention and management measures.

(2) Accelerated rehabilitation surgical measures

Early postoperative mobilization, early drinking and eating as prescribed by the doctor, effective management of pain, nausea, and vomiting, and postoperative antithrombotic management measures.

2.2.2. Control group

(1) Manual acupoint massage

Performed by two trained professional nurses from the research team. The operators accurately locate the bilateral Zusanli (ST36) and fenglong (ST40) acupoints, and perform acupoint massage using the surface of the thumb or flexed finger joints, alternating between pressing, pushing, and kneading techniques. The massage should be continued until the patient feels a mild soreness and distension, while avoiding skin damage. Each acupoint is massaged for 5 minutes, totaling 20 minutes, twice daily, from admission until postoperative recovery and discharge.

(2) Intermittent Pneumatic Compression Antithrombotic Pump (Model: Flowtron Excel). Patients use the pressure antithrombotic pump to prevent deep vein thrombosis; the duration is 1 hour, twice daily, until postoperative recovery and discharge.

2.2.3. Observation group

Patients in this group received acupoint pressure antithrombotic pump therapy, as follows.

Using a self-developed utility model patent product, an acupoint massage device based on an antithrombotic pump (CN222444789U): The spherical center of the device's silicone hemisphere (with a base diameter of 3 cm and a height of 1.5 cm) is precisely aligned with the bilateral Zusanli (ST36) and bilateral fenglong (ST40) acupoints (the acupoint selection method is the same as that used in the control group). The device is secured in place using an accompanying fixation patch, with the tightness adjusted to ensure stable and continuous vertical pressure on the acupoint by the silicone hemisphere. Subsequently, the intermittent pneumatic compression antithrombotic pump is activated, and patients can clearly feel a mild soreness and distension at the acupoint sites

under the pressurized state of the antithrombotic pump. The duration is synchronized with the usage time of the pressure antithrombotic pump, twice daily for 1 hour each session, until postoperative recovery and discharge.

2.3. Observation indicators**2.3.1. General information**

This includes patient ID, gender, age, disease diagnosis, height, weight, history of abdominal surgery, preoperative comorbidities, surgical approach, duration of surgery, and intraoperative blood loss.

2.3.2. Efficacy indicators for DVT

The incidence of lower extremity DVT. Patients underwent routine color Doppler ultrasound examinations upon admission and after surgery to exclude DVT, and the results of thrombotic risk assessments were recorded.

2.3.3. Quality of life assessment

The perioperative quality of life of patients was evaluated using surgery-related dimensions from the Short Form Health Survey (SF-36): role-physical (RP), body pain (BP), general health (GH), vitality (VT), social functioning (SF), role emotional (RE), and mental health (MH). This scale has high universality, with higher scores indicating a better quality of life. Recording times: Records were taken once before surgery, on the third day after surgery, and at discharge to compare improvements in the patients' quality of life.

2.4. Statistical methods

Clinical data in this study were analyzed using SPSS 21.0 statistical software. Continuous data were expressed as mean \pm standard deviation ($\bar{x} \pm s$) and analyzed using the *t*-test, while categorical data were expressed as percentages (%) and analyzed using the χ^2 test. A *p*-value of less than 0.05 was considered statistically significant.

3. Results**3.1. General information**

There were no statistically significant differences in baseline data such as gender, age, BMI, diagnosis, and intraoperative blood loss between the two groups of patients (*p* > 0.05). The grouping randomization was well-

executed, ensuring reliable comparability of subsequent results (see **Table 1**).

3.2. DVT efficacy indicators

The incidence rate of DVT in both groups was 0.

3.3. Quality of life assessment (SF-36) related to surgical dimensions

The observation group scored better than the control group in the following aspects: physiological function at 3 days post-surgery and at discharge, bodily pain at 3 days post-surgery, overall health at 3 days post-surgery and at discharge, social function at 3 days post-surgery, emotional function at 3 days post-surgery and at discharge, physical health dimension at 3 days post-surgery and at discharge, and mental health at 3 days post-surgery and at discharge. The differences were statistically significant ($p < 0.05$) (see **Table 2**).

4. Discussion

This study innovatively applied the meridian-acupoint pressure antithrombotic pump, which combines traditional Chinese medicine meridian-acupoint theory with mechanical thrombotic devices, to patients in the perioperative period of colorectal cancer. The aim was to explore its positive effects in reducing the risk of deep vein thrombosis (DVT) in postoperative patients and improving their quality of life. The results showed that, compared to traditional acupoint massage combined with intermittent pneumatic compression antithrombotic pumps, the meridian-acupoint pressure antithrombotic pump demonstrated significant advantages in preventing postoperative DVT and comprehensively improving patients' quality of life. This provides new insights and practical evidence for the collaborative measures of integrated traditional Chinese and Western medicine in preventing postoperative complications, accelerating recovery, and saving labor costs.

4.1. Analysis of DVT prevention effects

No symptomatic lower extremity DVT events occurred in either group of patients after surgery in this study, which is closely related to the widespread adoption of comprehensive preventive measures under the

current concept of enhanced recovery after surgery (ERAS) and the standardized diagnosis, treatment, and nursing care for thrombus prevention^[2]. Standardized ERAS protocols, including standardized and accurate preoperative assessments and adequate prehabilitation, perioperative basic screening and prevention, early postoperative ambulation, and standardized use of anticoagulant medications, form the cornerstone of DVT prevention^[3]. Additionally, all patients included in this study were elective surgery patients, and relevant high-risk factors such as active bleeding risk and severe coagulation dysfunction had been effectively managed before surgery, further reducing the incidence of DVT. Furthermore, from the perspective of traditional Chinese medicine theory, the possible mechanism lies in the following: The acupoint pressure antithrombotic pump combines the positive effects of mechanically increasing venous blood flow velocity and reducing stagnant hemodynamics with effective stimulation of specific acupoints. Zusanli (ST36) is the He-sea point of the "Stomach Meridian of Foot-Yangming", which has the functions of invigorating the spleen and replenishing Qi, tonifying deficiency and strengthening the body, and dredging meridians and activating collaterals. Fenglong (ST40) is the Luo-connecting point of the Stomach Meridian, which can resolve phlegm, eliminate dampness, promote blood circulation, and unblock collaterals. Compared with simply using an antithrombotic pump or manual massage, this device precisely and continuously acts on acupoints by setting pressure parameters, potentially generating a synergistic effect of "1 + 1 > 2".

4.2. Discussion on the mechanism of improving quality of life

The comparison results of the surgery-related dimensions of the SF-36 scale between the two groups of cases in this study show that the observation group scored significantly higher than the control group in multiple dimensions, including role-physical, bodily pain, general health perception, role-emotional, social functioning, physical health, and mental health. This indicates that the acupoint pressure antithrombotic pump comprehensively improves the postoperative quality of life of colorectal cancer patients. This improvement can be attributed to multi-level mechanisms:

Table 1. Comparison of general treatment between the two groups of patients

Characteristic	Category	Control group (n = 39)	Observation group (n = 39)	Statistical value (<i>t</i> / χ^2)	<i>p</i> -value
Gender [n (%)]	Male	18 (46.2%)	22 (56.4%)	a0.82	0.37
	Female	21 (53.8%)	17 (43.6%)		
Age (years)		62.74 \pm 10.12	63.69 \pm 9.13	b-0.44	0.67
BMI (kg/m ²)		23.33 \pm 2.97	23.32 \pm 3.45	b0.01	0.99
Diagnosis [n (%)]	Colon cancer	21 (53.8%)	25 (64.1%)	a0.80	0.37
	Rectal cancer	18 (46.2%)	14 (35.9%)	b1.64	0.10
Intraoperative blood loss (mL)		62.18 \pm 38.64	48.46 \pm 34.98		

Note: a indicates the χ^2 value, and b indicates the *t* value.

Table 2. Comparison of SF-36 scale scores related to surgical dimensions between the two groups of patients

		Control group (n = 39)	Observation group (n = 39)	<i>t</i> -value	<i>p</i> -value
Role-physical	Preoperative	69.87 \pm 36.80	80.77 \pm 34.15	-1.36	0.18
	Postop Day 3	4.49 \pm 17.08	19.87 \pm 25.76	-3.11	< 0.001
	Discharge	44.87 \pm 33.53	78.85 \pm 30.64	-4.67	< 0.001
Bodily pain	Preoperative	73.51 \pm 22.90	81.56 \pm 16.66	-1.78	0.08
	Postop Day 3	35.90 \pm 13.51	49.79 \pm 16.09	-4.13	< 0.001
	Discharge	75.33 \pm 13.00	79.74 \pm 15.82	-1.35	0.18
General health	Preoperative	55.64 \pm 15.10	51.79 \pm 17.97	1.02	0.31
	Postop Day 3	40.26 \pm 6.28	43.59 \pm 4.86	-2.62	0.01
	Discharge	66.15 \pm 6.93	70.38 \pm 3.51	-3.40	< 0.001
Vitality	Preoperative	72.18 \pm 19.46	75.00 \pm 12.93	-0.75	0.45
	Postop Day 3	39.23 \pm 14.12	42.69 \pm 13.12	-1.12	0.27
	Discharge	69.36 \pm 9.40	68.21 \pm 8.77	0.56	0.58
Social function	Preoperative	73.08 \pm 24.26	74.04 \pm 20.36	-0.19	0.85
	Postop Day 3	26.60 \pm 13.81	34.94 \pm 13.20	-2.73	0.01
	Discharge	67.31 \pm 12.37	71.15 \pm 9.58	-1.54	0.13
Role-emotional	Preoperative	83.76 \pm 32.33	83.76 \pm 34.94	0.00	1.00
	Postop Day 3	2.56 \pm 9.00	11.97 \pm 23.56	-2.33	0.02
	Discharge	50.43 \pm 30.47	81.20 \pm 27.35	-4.69	< 0.001
Physical health summary	Preoperative	289.92 \pm 62.70	306.56 \pm 53.98	-1.26	0.21
	Postop Day 3	98.08 \pm 32.54	123.77 \pm 40.57	-3.09	< 0.001
	Discharge	248.67 \pm 52.68	293.85 \pm 50.38	-3.87	< 0.001
Mental health summary	Preoperative	297.32 \pm 75.24	308.39 \pm 62.05	-0.71	0.48
	Postop Day 3	123.88 \pm 36.76	149.18 \pm 36.39	-3.06	< 0.001
	Discharge	262.99 \pm 44.51	298.40 \pm 36.99	-3.82	< 0.001

4.2.1. Effective postoperative analgesia (Improvement in dimensions such as bodily pain and physical health)

Surgical trauma is the primary source of postoperative pain. Zusanli (ST36) acupoint is a crucial point for analgesia. Many modern studies have demonstrated that stimulating this acupoint can inhibit the transmission of nociceptive signals, activate the endogenous analgesic system, and promote the release of analgesic substances such as β -endorphin, enkephalin, and dynorphin from the central nervous system, thereby effectively reducing pain sensitivity^[4,5]. The stimulation of the Zusanli (ST36) acupoint by the acupoint pressure anti-embolism pump combined with auxiliary devices provides a non-invasive, non-pharmacological analgesic method for postoperative patients, significantly enhancing their comfort. Additionally, delayed recovery of gastrointestinal function after colorectal cancer surgery is a significant factor that severely affects patients' disease recovery and quality of life. Zusanli (ST36) acupoint is a classic acupoint for regulating gastrointestinal function. Although this study does not mention research results regarding gastrointestinal function recovery, stimulating the Zusanli (ST36) acupoint also promotes the recovery of gastrointestinal function and improves appetite in postoperative patients^[5,6], thereby enhancing nutritional status, promoting physiological health, laying the foundation for overall patient recovery, and indirectly improving vitality and overall health perception.

4.2.2. Improvement of negative emotions (Improvement in emotional function and mental health dimensions)

Malignant tumors and surgery itself can serve as significant psychological stressors for patients, easily triggering negative emotions such as anxiety, depression, and fear. In traditional Chinese medicine (TCM), it is believed that "stagnation of emotions and spirits leads to Qi stagnation", which affects the function of the Zang-Fu organs. Stimulating the Zusanli (ST36) and fenglong (ST40) acupoints has the effects of regulating Qi circulation, soothing the liver and resolving depression, and calming the mind and spirit^[7]. Modern mechanistic studies have revealed that this stimulation may exert anti-anxiety and anti-depressant effects by regulating the function of the hypothalamic-pituitary-adrenal

axis, increasing the concentrations of neurotransmitters such as serotonin and gamma-aminobutyric acid, and reducing stress hormone levels^[8,9]. The regular acupoint stimulation provided by the equipment in this study offers patients a passive and comfortable relaxation experience, helping to alleviate psychological stress and improve emotional states.

4.3. Value and unique advantages of the integrated traditional Chinese and Western medicine model

The acupressure antithrombotic pump in this study successfully demonstrates the effective integration of Western medical equipment treatment with traditional Chinese medicine external therapies. Its core advantages lie in the following:

4.3.1. Synergistic enhancement

Western antithrombotic pump treatment improves hemodynamics through physical external force, directly reducing venous stasis and serving as a classic mechanical means for preventing deep vein thrombosis (DVT). Traditional Chinese medicine acupoint stimulation, based on a holistic perspective, activates meridians and harmonizes Qi, blood, Yin, and Yang, thereby regulating the neuro-endocrine-immune network and vascular endothelial function, and improving the internal environment of "hypercoagulability" at a deeper level^[10]. The effective combination of these two approaches achieves simultaneous treatment of both the "symptoms" and the "root cause", with physical external force and biological effects working synergistically to achieve superior results in improving coagulation indicators compared to single approaches or simple additive effects.

4.3.2 Safety and generalizability

Compared to pharmacological anticoagulation therapy, acupoint pressure antithrombotic pump therapy is a non-invasive physical therapy with minimal side effects. Moreover, its standardized operation and controllable parameters avoid issues such as uneven pressure and time- and labor-consuming processes that may arise with manual massage. No adverse events related to the device were observed during the study's observation period, indicating good safety. In addition to being suitable for

colorectal cancer surgery patients requiring multimodal thrombosis prevention, this device should also hold high utility value for other tumor and surgical patient populations, making it easy to promote in clinical settings.

4.3.3. Comprehensive multi-target intervention to promote accelerated overall recovery of patients

This device primarily focuses on DVT prevention, while its acupoint stimulation also plays a significant positive role in pain management, gastrointestinal function recovery, and psychological adjustment, meeting the comprehensive physiological-psychological-social needs of patients under the current ERAS concept^[11]. This characteristic of “one method with multiple effects” is difficult to match by purely Western medical devices or medications, highlighting the value of integrated traditional Chinese and Western medicine nursing in enhancing overall care efficacy.

4.4. Study limitations and future directions

This study is single-center research with a relatively limited sample size, which may introduce certain selection bias and affect the generalizability of the results. Secondly, the observation period was primarily focused on the postoperative hospitalization period, lacking long-

term follow-up assessment of deep vein thrombosis (DVT). Furthermore, this study did not delve into the effects of different pressure parameters, stimulation durations, and varying intensities of acupoint effects, leaving room for optimizing treatment protocols. Future research can further validate these findings by expanding the sample size, conducting multi-center randomized controlled trials (RCTs), assessing long-term effects through follow-up, and optimizing acupoint stimulation protocols.

This study confirms that the acupoint pressure antithrombotic pump, which integrates traditional Chinese medicine meridian acupoint theory with modern mechanical antithrombotic technology, can effectively prevent the occurrence of DVT in patients undergoing colorectal cancer surgery and significantly improve their quality of life across multiple dimensions. The technology, which combines this device with auxiliary devices, is easy to operate, safe, and synergistic in multiple effects, providing a promising innovative strategy for preventing postoperative DVT and promoting comprehensive and accelerated rehabilitation in patients, thus holding significant value for clinical application and dissemination.

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Disclosure statement

The authors declare no conflict of interest.

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Research on the Correlation between Human Infrared Thermal Structure and Disease Risk Based on Traditional Chinese Medicine Constitution

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Abstract

Objective: To explore the correlation between human infrared thermal patterns and disease risk using infrared thermography (IRT) technology, and to investigate auxiliary methods for objective diagnosis in traditional Chinese medicine, providing new insights for clinical diagnosis and therapeutic evaluation. **Methods:** A cross-sectional study was conducted on 451 patients who met the inclusion criteria, focusing on the distribution patterns of constitution types and diseases, as well as the correlation between infrared thermal patterns and disease risk. **Results:** Among the included cases, the most prevalent constitution types were deficiency of both Yin and Yang with phlegm-dampness, and deficiency of Yang and blood; the top three diseases were chronic fatigue syndrome (CFS) with 98 cases (21.7%), chronic gastritis with 94 cases (20.8%), and gastrointestinal polyps with 31 cases (3.6%). In the study of the correlation between infrared thermal state structure and the risk of chronic fatigue syndrome (CFS), univariate analysis indicated that there were differences between the outcome event cohort and the non-outcome event cohort in terms of gender, age, T_{facial} , $T_{\text{upper energizer}}$, $T_{\text{middle energizer}}$, $T_{\text{lower energizer}}$, $T_{\text{left dorsal foot}}$ and $T_{\text{right hypochondriac region}}$ ($p < 0.05$). Multivariate logistic regression analysis revealed that gender, age, $T_{\text{middle energizer}}$ and $T_{\text{left dorsal foot}}$ were independent risk factors for CFS (with odds ratios [ORs] of 2.706, 0.956, 0.686, and 1.310, respectively, $p < 0.05$). The establishment of a receiver operating characteristic (ROC) curve assessment model found that $T_{\text{left dorsal foot}}$ had certain diagnostic value (area under the curve [AUC]: 0.564, 95% confidence interval [CI]: 0.498–0.630). **Conclusion:** There is a potential correlation between the human infrared thermal state structure and disease risk prediction. Promoting the clinical use and research popularization of infrared thermography (IRT) can provide a visual basis for disease state prediction and assessment, and is of great significance for in-depth research on constitutional types and the biophysical properties of meridians and acupoints.

Keywords

Traditional Chinese medicine constitutional types; Infrared thermography; Cross-sectional study; Risk prediction; Fatigue syndrome

1. Introduction

Traditional Chinese Medicine (TCM) constitution refers to the comprehensive and relatively stable inherent characteristics that the human body develops in terms of morphological structure, physiological function, and psychological state during the life process, based on innate essence and acquired factors, in order to adapt to the humanistic, natural, and social environments. In TCM, the human body serves as a carrier for the continuous circulation and operation of Yin and Yang, Qi and blood, and body fluids. Constitution, as a reactive tendency reflecting the fluctuations in the abundance or deficiency of Yin and Yang, Qi and blood, and body fluids, not only represents a potential cause of diseases but also serves as a crucial diagnostic basis for predicting the progression, changes, and prognosis of diseases ^[1]. Different constitutions exhibit varying susceptibilities and predispositions to different diseases or even the same disease ^[2]. Therefore, objectively, authentically, and accurately identifying TCM constitutions, as well as intuitively, comprehensively, and systematically reflecting the connotations of TCM constitutions, are pivotal for TCM constitutions to play a role in disease diagnosis and treatment efficacy evaluation.

As a TCM diagnostic tool that achieves objectivity, visualization, and intelligence in TCM constitution identification, IRT embodies TCM diagnostic principles such as “inferring internal conditions from external manifestations”, “judging abnormalities based on norms” and “detecting significant changes from subtle signs”. IRT (Infrared Thermography) utilizes the “thermoelectric simulation method” to capture specific infrared wavelength signals of thermal radiation emitted by human internal organs via computers. It converts these radiation signals into distinguishable graphics and images, calculates temperature values, and thereby reflects the cold-heat bias of the body’s internal organs and meridians ^[3]. Currently, it has been widely applied in the early diagnosis of diseases such as vascular-related diseases, rheumatic diseases, painful conditions, and tumors, as well as in the study of infrared characteristics and therapeutic effects in Traditional Chinese Medicine (TCM) ^[4–7]. However, there has been relatively little research on the correlation between the infrared thermal state structure of the human body based on TCM

constitutional types and disease prediction. Based on this, to explore a visual basis for predicting and assessing disease states and to provide certain clinical references for promoting the establishment of mathematical diagnostic and prognostic models for related diseases based on TCM constitutional theory, this study conducted a cross-sectional study involving 451 patients who sought medical treatment at Liuzhou Traditional Chinese Medicine Hospital (Liuzhou Zhuang Medicine Hospital) from January 1, 2023, to August 14, 2023.

2. Materials and methods

2.1. Study subjects

The study subjects were patients who visited Liuzhou Traditional Chinese Medicine Hospital (Liuzhou Zhuang Medicine Hospital) from January 1, 2023, to August 14, 2023, regardless of gender or age. A total of 451 patients with complete data available for analysis were included, comprising 168 males (37.25%) and 283 females (62.75%), with an average age of (44.75 ± 16.65) years.

3. Research methodology

3.1. Research design

This study employs a cross-sectional design to investigate the Traditional Chinese Medicine (TCM) constitutional types and infrared thermal characteristics of a patient population, exploring the risk correlation between infrared thermal patterns and prevalent diseases. Information on constitutional diagnosis, clinical diagnosis, and general conditions of all patients in the group was collected, and infrared thermal detection values were recorded. After conducting a preliminary exploration of the distribution of TCM constitutional types and thermal characteristics in the population, patients diagnosed with the prevalent disease—chronic fatigue syndrome (CFS)—were marked as having an outcome event, with males uniformly assigned a value of “1”. Patients not diagnosed with CFS were marked as non-outcome events, with females uniformly assigned a value of “0”. The 451 observed cases were divided into two cohorts: outcome events and non-outcome events. A multivariate logistic regression model was used to screen for risk factors, and a Receiver Operating Characteristic (ROC) curve was established to

validate its predictive performance.

3.2. Infrared thermal imaging collection

The MDK-M01L cabin-type medical infrared thermal imager manufactured by Wuhan Medk Infrared Technology Co., Ltd. was used^[8]. The inspection method is as follows: Conduct the examination in an environment where the room temperature is controlled at 25–27°C, the indoor humidity is $\leq 70\%$ RH, there is no direct sunlight or intense light interference, and indoor and outdoor ventilation is isolated. Instruct the examinee to stand 1.5 meters away from the infrared camera lens in an anterior upright position. Use the infrared acquisition system to locate and measure the average body temperature of the examinee's front side, as well as the temperatures of body surface projection areas such as the face, upper energizer, middle energizer, lower energizer, palms of both hands, and dorsum of both feet. Then, instruct the examinee to adopt a posterior upright position and use the infrared acquisition system to locate and measure the temperature of the body surface projection area of the Governor Vessel on the examinee's back. Next, instruct the examinee to adopt left and right lateral positions and use the infrared acquisition system to locate and measure the temperatures of the body surface projection areas of the two hypochondriac regions on the examinee's sides (see **Figure 1**).

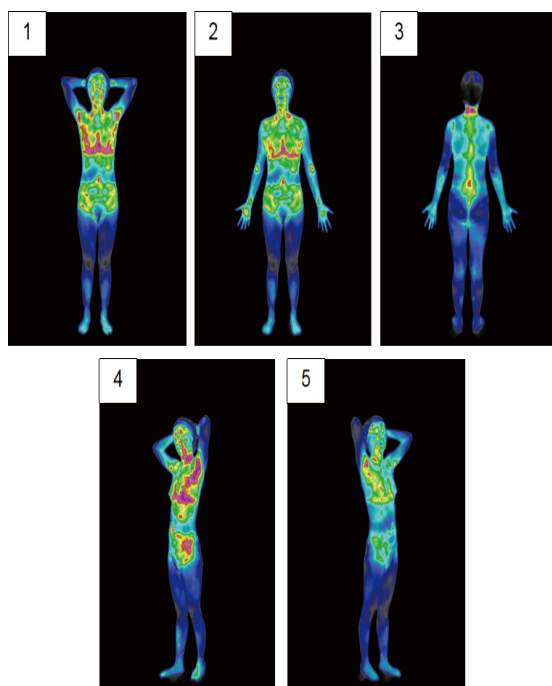


Figure 1. Standard infrared acquisition diagram.

3.3. Statistical methods

After all data are entered into an EXCEL spreadsheet, statistical processing is performed using SPSS 22.0 statistical software. Measurement data with a normal distribution are expressed as mean \pm standard deviation ($\bar{x} \pm s$), while measurement data with a skewed distribution are expressed as median (interquartile range) [M(IQR)]. Comparisons between groups are made using the *t*-test or Mann-Whitney U test. Count data are expressed as percentages, and comparisons between groups are made using the χ^2 test or Fisher's exact test. Multivariate Logistic regression models are used to screen for risk factors, and ROC curves are plotted. A *p*-value of 0.05 is set as the threshold for statistical significance.

4. Research findings

4.1. Distribution of TCM constitution types among the population

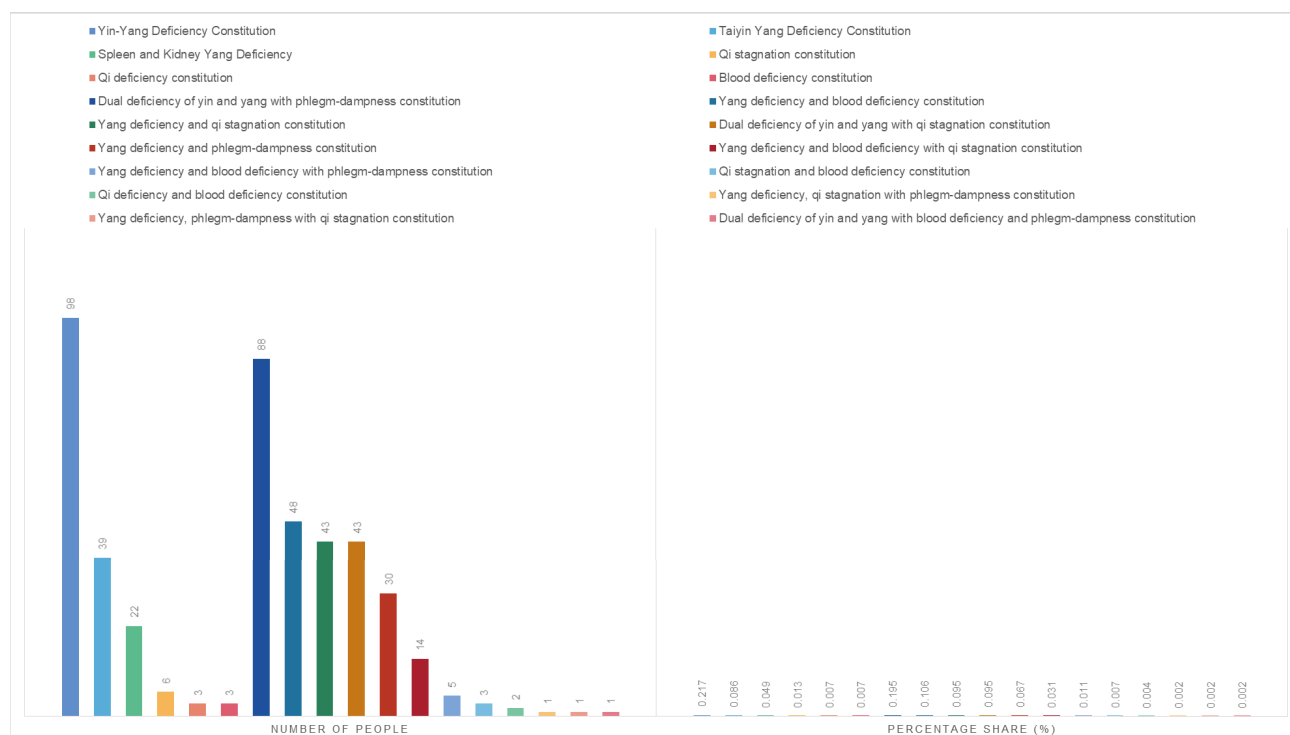
This study included a total of 451 subjects, encompassing 19 types of constitutional diagnoses. Among these, six single-biased constitutional types, namely Yin-Yang deficiency, Taiyin Yang deficiency, spleen and kidney Yang deficiency, Qi stagnation, Qi deficiency, and blood deficiency, accounted for 37.9%. Meanwhile, mixed constitutions, which involve two or more of the aforementioned types, constituted 62.1%. Among the single constitutions, the one with the highest clinical diagnosis rate was Yin-Yang deficiency (98 cases, 21.7%), followed by Taiyin Yang deficiency (39 cases, 8.6%). Among the mixed constitutions, the highest clinical diagnosis rate was for Yin-Yang deficiency combined with phlegm-dampness (88 cases, 19.5%), followed by Yang deficiency and blood deficiency (48 cases, 10.6%) (refer **Table 1** and **Figure 2**).

4.2. Disease distribution among individuals with biased constitutions

This study examined the primary Western medical diagnoses of the 451 subjects, identifying over 100 diagnostic types. Among these, 15 disease types had a clinical diagnosis rate exceeding 1%. The top three were CFS with 98 cases (21.7%), chronic gastritis with 94 cases (20.8%), and gastrointestinal polyps with 31 cases (3.6%) (see **Figure 3**).

Table 1. Composition of biased constitution types

No.	Constitution category	Constitution type	No. of cases	Percentage (%)
1	Single constitution	Yin-Yang Deficiency	98	21.7%
2		Taiyin-Yang Deficiency	39	8.6%
3		Spleen-Kidney Yang Deficiency	22	4.9%
4		Qi Stagnation	6	1.3%
5		Qi Deficiency	3	0.7%
6		Blood Deficiency	3	0.7%
7	Combined constitution	Yin-Yang Deficiency with Phlegm-Dampness	88	19.5%
8		Yang Deficiency with Blood Deficiency	48	10.6%
9		Yang Deficiency with Qi Stagnation	43	9.5%
10		Yin-Yang Deficiency with Qi Stagnation	43	9.5%
11		Yang Deficiency with Phlegm-Dampness	30	6.7%
12		Yang and Blood Deficiency with Qi Stagnation	14	3.1%
13		Yang and Blood Deficiency with Phlegm-Dampness	5	1.1%
14		Qi Stagnation with Blood Deficiency	3	0.7%
15		Qi Deficiency with Blood Deficiency	2	0.4%
16		Yang Deficiency, Qi Stagnation, and Phlegm-Dampness	1	0.2%
17		Yang Deficiency, Phlegm-Dampness, and Qi Stagnation	1	0.2%
18		Yin-Yang Deficiency with Blood Deficiency and Phlegm-Dampness	1	0.2%
Total			451	100%

**Figure 2.** Distribution of biased constitution types.

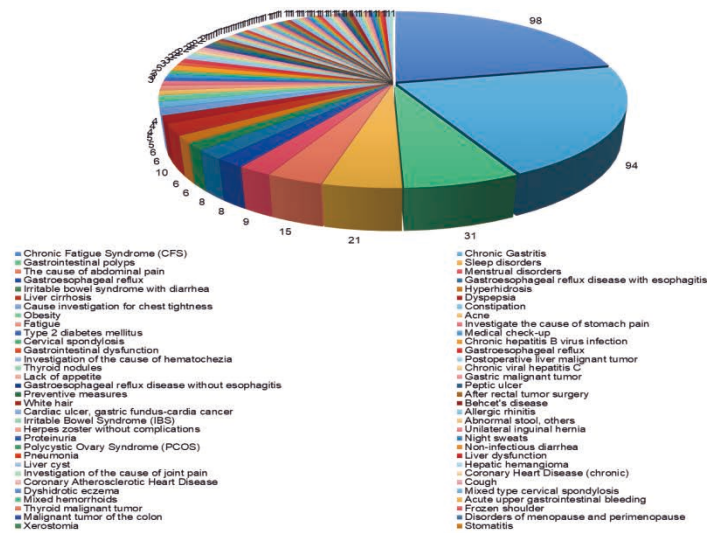


Figure 3. Disease distribution map of individuals with biased constitutions.

4.3. Correlation study between human infrared thermal patterns and disease prediction

(1) One-way analysis of variance

Variables such as gender, age, and the average temperatures of the face, left armpit, right armpit, upper energizer, middle energizer, lower energizer, left palm, right palm, left dorsum of the foot, right dorsum of the foot, Governor Vessel, left hypochondrium, and right hypochondrium were included in the research model. Compared with cases where no outcome event occurred, statistically significant differences ($p < 0.05$) were observed in variables such as gender ($p = 0.013$, CI%: 0.33–0.42), age ($p = 0.000$, CI%: 43.27–46.22), T_{face} ($p = 0.028$, CI%: 31.18–31.38), $T_{\text{upper energizer}}$ ($p = 0.049$, CI%: 31.38–31.63), $T_{\text{middle energizer}}$ ($p = 0.002$, CI%: 31.23–31.46), $T_{\text{lower energizer}}$ ($p = 0.007$, CI%: 31.30–31.53), $T_{\text{left dorsum of the foot}}$ ($p = 0.021$, CI%: 30.23–30.45), and $T_{\text{right hypochondrium}}$ ($p = 0.018$, CI%: 29.28–29.67) in cases where an outcome event did occur (see Table 2).

(2) Multivariate logistic regression analysis

The variables with statistical differences mentioned above were included as independent variables, and the occurrence of the outcome event was used as the dependent variable in a multivariate logistic regression model. The study

found that among the 98 cases with outcome events, 72 were female (73.47%); among the 353 cases without outcome events, 211 were female (59.77%). This suggests that the risk of developing CFS in females is approximately 2.7 times that of males, and the risk of developing CFS increases with age (Table 3).

(3) ROC curve

An ROC curve graph was constructed based on four independent risk factors: gender, age, $T_{\text{middle jiao}}$, and $T_{\text{left dorsum of foot}}$. The ROC curve analysis indicated that the areas under the curve for gender, age, $T_{\text{middle jiao}}$, and $T_{\text{left dorsum of foot}}$ were 0.432 (95% CI: 0.369–0.494), 0.292 (95% CI: 0.241–0.344), 0.402 (95% CI: 0.339–0.465), and 0.564 (95% CI: 0.498–0.630), respectively.

5. Discussion

5.1. The disease prediction value and modern clinical application of IRT

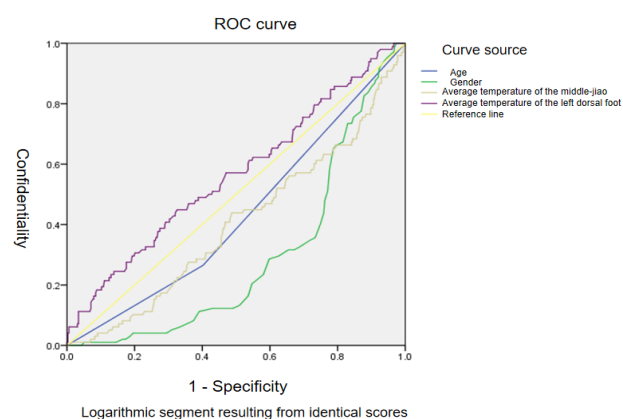
As a new technology in modern functional imaging examination, Infrared Thermography (IRT) enables non-invasive, radiation-free, intervention-free, pollution-free, and side-effect-free monitoring under natural human conditions. Without the need for external emission sources or the ingestion of contrast agents or other marker drugs, it can sensitively detect abnormal changes in the temperature field caused by metabolic disorders before

Table 2. One-way analysis of clinical characteristics in patients

Clinical feature	Total (N = 451)	Outcome event (N = 98)	Non-outcome event (N = 353)	p-value
Gender				0.013
Female	283 (62.8%)	72 (73.5%)	211 (59.8%)	
Male	168 (37.2%)	26 (26.5%)	142 (40.2%)	
Age (years)				0.000
< 18	13.50 ± 3.80 (32)	15.00 ± 1.41 (6)	13.00 ± 4.09 (25)	
18–65	43.64 ± 11.89 (367)	37.33 ± 10.50 (91)	45.65 ± 11.62 (277)	
≥ 65	70.88 ± 5.09 (52)	73.00 ± 0.00 (1)	71.76 ± 4.91 (51)	
Temperature (°C)				
T _{Face}	31.29 ± 1.09	31.07 ± 1.09	31.34 ± 1.08	0.028
T _{Left Axilla}	29.01 ± 2.15	29.03 ± 2.26	29.01 ± 2.13	0.948
T _{Right Axilla}	29.19 ± 2.18	29.15 ± 2.23	29.07 ± 2.17	0.820
T _{Upper Jiao}	31.51 ± 1.30	31.28 ± 1.31	31.57 ± 1.28	0.049
T _{Middle Jiao}	31.34 ± 1.27	31.99 ± 1.31	31.44 ± 1.24	0.002
T _{Lower Jiao}	31.41 ± 1.23	31.12 ± 1.20	31.50 ± 1.23	0.007
T _{Left Palm}	28.04 ± 2.55	28.01 ± 2.60	28.04 ± 2.53	0.904
T _{Right Palm}	27.98 ± 2.37	27.97 ± 2.52	27.98 ± 2.32	0.965
T _{Left Dorsal Foot}	30.34 ± 1.28	30.60 ± 1.26	30.26 ± 1.27	0.021
T _{Right Dorsal Foot}	30.27 ± 1.27	31.38 ± 1.40	30.24 ± 1.24	0.351
T _{Governor Vessel}	30.83 ± 1.67	31.57 ± 1.58	30.90 ± 1.62	0.078
T _{Left Hypochondrium}	29.48 ± 2.10	29.13 ± 2.21	29.57 ± 2.09	0.065
T _{Right Hypochondrium}	31.28 ± 1.35	31.00 ± 1.23	31.36 ± 1.37	0.018

Table 3. Multivariate logistic regression analysis

Variable	OR	95% CI	p-value
Gender	2.706	1.563–4.685	0.000
Age	0.956	0.940–0.971	0.000
T _{Middle Jiao}	0.686	0.566–0.831	0.000
T _{Left Dorsal Foot}	1.310	1.069–1.605	0.009

**Figure 4.** ROC Curve Graph for Gender, Age, T_{middle jiao}, and T_{left dorsum of foot}

obvious symptoms or signs appear in the body. Thus, it can be used for health assessment, early disease auxiliary detection, and functional evaluation of therapeutic effects, and has become a research hotspot in recent years for early disease monitoring and prevention ^[4]. Wang Jiali et al. discovered that after cold stimulation, patients with phlegm-dampness constitution metabolic syndrome (MS) exhibited a lower average surface temperature in the supraclavicular region (SCR) compared to healthy individuals ^[9]. The thermal deviation in the SCR of phlegm-dampness MS patients was not significant, and the elevated temperature difference was lower than that of healthy individuals and non-phlegm-dampness MS patients. Utilizing IRT to study the infrared manifestations in the SCR of phlegm-dampness MS patients can provide objective evidence and new targets for the early detection and precise treatment of phlegm-dampness MS. Yang Qian et al. found that female patients with Hashimoto's thyroiditis (HT) exhibited higher thermal values in the left and right lobes of the thyroid gland and lower thermal values in the uterus, Governor Vessel, and Shenque area. This characteristic also provides new clinical theoretical evidence for HT-induced infertility. Meanwhile, the thermal values in the left and right lobes of the thyroid gland can serve as one of the indicators for early diagnosis and screening of HT, affirming the clinical significance of IRT as an auxiliary diagnostic tool to improve the diagnostic efficacy of HT. Meanwhile, when assessing the risk of foot lesions, Infrared Thermography (IRT) can provide useful clinical information by detecting characteristic changes in the temperature of the lower extremities and plantar regions. It can sensitively identify metabolic differences caused by early peripheral nerve and vascular lesions associated with diabetic foot (DF), offering additional reference information for early warning and diagnosis of DF ulcers ^[10]. It is worth mentioning that in the fields of basic traditional Chinese medicine (TCM) theory and TCM diagnostic research, the advent of IRT has provided objective, visual, and intelligent diagnostic evidence for TCM clinical differentiation of common and frequently occurring diseases such as stomachache, coronary heart disease, and ischemic encephalopathy ^[11–13].

5.2. Unique advantages of IRT in the field of traditional Chinese medicine research

As stated in “Su Wen: Great Treatise on Correspondence Between Yin and Yang and the Images of the Natural World”, “Water and fire are the manifestations of Yin and Yang”. It also says, “Excess of Yang leads to heat, excess of Yin leads to cold, deficiency of Yin leads to heat, and deficiency of Yang leads to cold”. Changes in cold and heat reflect the balance of Yin and Yang Qi in the body's organs and meridians. Based on the principle of infrared radiation, IRT can capture the instantaneous infrared thermal radiation temperature of the human body and convert it into a visualized image of the body's surface temperature distribution, intuitively reflecting the body's cold-heat Yin-Yang status. It also aids in syndrome differentiation by combining the infrared thermal image characteristics of different locations, such as disease sites, organ regions, and meridian pathways ^[14]. Currently, the application of Infrared Thermography (IRT) in Traditional Chinese Medicine (TCM) has centered around three major research hotspots: meridian acupoint studies combined with acupuncture and Tuina therapy, auxiliary diagnosis of diseases and syndromes, and TCM constitution research ^[9]. Particularly in the field of TCM constitution identification, IRT offers unique advantages in terms of objectivity, visualization, dynamism, and intelligence. Li Hongjuan first utilized IRT to analyze the thermal characteristics of nine different constitutional groups, discovering that the relative temperature variations in specific areas such as the Du meridian, Ren meridian, Shenque (CV8), upper energizer, middle energizer, lower energizer, lungs, heart, and liver among different constitutional groups aligned with the typical characteristics outlined in TCM constitution theory, visually demonstrating the characteristic changes in population constitutions ^[15]. Xie Jiding et al. employed IRT to investigate the effects of Baduanjin exercise on Body Mass Index (BMI) and abdominal temperature, revealing that Baduanjin could elevate abdominal temperature, activate specific acupoints, and promote metabolism and blood circulation ^[16]. Liu Feng et al. also proposed that the adequacy of Zang-fu Qi could be preliminarily inferred from the infrared characteristics of the projected skin areas of the Zang-fu organs and their corresponding front-mu acupoint ^[17]. This underscores

the objective reference value of IRT in clinical constitution research and application. With the continuous advancement of modern technology, infrared thermal imaging technology has become closely integrated with the development of “Internet Plus” and artificial intelligence. Li Xin designed an algorithm based on a Convolutional Neural Network (CNN) to automatically extract and classify temperature features from segmented infrared images of cervical spine regions ^[18]. By introducing an attention mechanism, the algorithm’s performance was further enhanced, enabling effective differentiation of cervical spine conditions and promoting the intelligent application of Infrared Thermography (IRT) in clinical diagnosis and treatment. Research on the spectral and quality detection of traditional Chinese medicine (TCM) samples, based on IRT and an Internet sharing model, has demonstrated that intelligent IRT applications represent a crucial avenue for rapid TCM quality detection ^[19]. Although the current scope and depth of IRT research in the field of TCM remain insufficient, its ability to reflect differences in body surface temperature under various conditions and interventions highlights its advantages for studying TCM concepts with clear body surface localization. Furthermore, its convenience, speed, and lack of side effects in clinical applications have led to widespread use in objective TCM clinical diagnosis and efficacy evaluation.

5.3. Evaluation of CFS risk based on IRT

Among the 451 observed cases in this study, 98 experienced outcome events, with incidence rates of 5.8% in males and 15.9% in females, consistent with previous literature reports on chronic fatigue syndrome (CFS) incidence ^[20,21]. The 98 CFS patients were predominantly female, with a peak age range of 18–65 years. In terms of constitutional diagnosis, 30.6% (30 cases) were classified as having a deficiency of both Yin and Yang, while 21.4% (21 cases) exhibited a deficiency of both Yin and Yang combined with phlegm-dampness. Multifactor logistic regression analysis suggests that gender and $T_{\text{left dorsum of foot}}$ in infrared thermal state structure are positively correlated with the onset of fatigue syndrome, while age and $T_{\text{middle jiao}}$ region of infrared thermal state structure are negatively correlated. Chronic Fatigue Syndrome (CFS) falls into the categories of “consumptive disease” and “depression

syndrome” in traditional Chinese medicine, caused by pathogenic factors impairing the body’s vital energy, improper balance between work and rest, and emotional disturbances, leading to deficiencies in Qi, blood, Yin, and Yang of the internal organs, as well as disharmony in the Qi mechanisms of the five organs, primarily involving the heart, liver, and spleen, along with imbalances in Qi and blood ^[22]. Women are prone to worry, and their hormonal levels are more susceptible to fluctuations than men, leading to emotions such as anxiety and depression ^[23]. Moreover, as women age, their likelihood of developing the condition increases significantly compared to before. Studies have shown that the incidence of depression in perimenopausal women reaches as high as 47.02%, which aligns with the patterns of onset observed in this study ^[24]. To further explore the best predictive factors for CFS, this study utilized ROC curve analysis. The results indicate that the AUC of the ROC curve for $T_{\text{left dorsum of foot}}$ is 0.564 (95% CI: 0.498–0.630), with an optimal predictive value of 30.82, a sensitivity of 0.449, and a specificity of 0.674. The foot, as a holographic organ of the human body, has corresponding reflex zones for all internal organs and tissues ^[25]. The meridians that pass through the dorsal foot include the Stomach Meridian of Foot-Yangming, Gallbladder Meridian of Foot-Shaoyang, and Liver Meridian of Foot-Jueyin, and this area encompasses five shu points and source points such as Qiuxu, Jiexi, Chongyang, Zulinqi, Xianggu, Taichong, Neiting, and Xingjian. Among them, Taichong (LR3) is the Shu-Stream and Source point of the Liver meridian, corresponding to the characteristics of the “Kan Trigram”. The Liver stores blood and belongs to Yin, while its function of regulating the flow of Qi is Yang. The Source point of the Liver meridian also embodies the principle of Yin in substance and Yang in function, demonstrating the effect of Yin in essence and Yang in action ^[26]. In animal experimental studies, the use of Hegu (LI4) and Taichong (LR3) as the Four Gate points for treating chronic fatigue syndrome (CFS) has been shown to be effective by downregulating serum TNF- α and lipopolysaccharide levels in rats, thereby inhibiting inflammatory responses ^[27]. The combined use of acupoints on the Stomach and Spleen meridians can significantly alleviate psychological and physical fatigue in CFS rats and enhance their antioxidant capacity ^[28]. Therefore, for CFS, which is

primarily characterized by deficiency with intermingled excess and deficiency as its basic pathogenesis, the clinical selection and combination of acupoints on the Liver and Stomach meridians on the dorsal foot hold greater significance in terms of nourishing the acquired constitution, promoting the generation of Qi and blood, and regulating the flow of Qi.

In summary, the infrared thermal patterns on the dorsal foot and middle-jiao regions in CFS patients are correlated with the onset of CFS. In this study, the infrared skin temperature of the left dorsal foot ($T_{\text{left dorsum of foot}}$) emerged as the best predictor for the occurrence of CFS, with relevant experimental results further confirming the association between the human infrared thermal patterns and disease risk prediction.

However, as this study is a single-center retrospective cross-sectional study, it cannot avoid selection bias and temporal bias in the study subjects. Moreover, the number of detection sites is still insufficient, and the sensitivity of individual sites is not high. Therefore, a large number of multi-center, large-sample, and long-time-zone randomized controlled trials are still needed to construct a comprehensive evaluation model of composite sites, promote the clinical use and research popularization of IRT, reveal the potential physiological regulatory functions of Zang-fu organs and meridians in traditional Chinese medicine constitution, and provide important experimental evidence for in-depth research on constitution and the biophysical properties of meridians and acupoints.

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Advances in Traditional Chinese Medicine for Acute Pancreatitis: A Comprehensive Review

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Abstract

Acute pancreatitis (AP) is an acute inflammatory disorder of the pancreas with a significant disease burden and high mortality in its severe form. While modern medicine provides supportive care, it lacks specific pharmacological agents to halt disease progression, highlighting the need for complementary strategies. The integration of Traditional Chinese Medicine (TCM) with conventional Western medicine has emerged as a promising approach for AP management. This review comprehensively summarizes recent advances in the TCM-based understanding and treatment of AP. We elucidate the TCM etiology and pathogenesis, which attribute AP to systemic imbalances such as dampness-heat accumulation and fu-organ obstruction. The review details various TCM treatment modalities, including oral formulations (e.g., *Dachengqi* Decoction, *Qingyi* Decoction), external therapies, acupuncture, and moxibustion, all guided by syndrome differentiation. Furthermore, we analyze the clinical efficacy and multi-target mechanisms of TCM interventions, including anti-inflammatory effects, gut barrier protection, microcirculation improvement, and oxidative stress alleviation, supported by both clinical evidence and pharmacological studies. By consolidating this body of evidence, this review aims to provide a robust theoretical and clinical foundation for the integrated treatment of AP, demonstrating its potential to improve patient outcomes and offering a more comprehensive therapeutic strategy.

Keywords

Acute pancreatitis; Traditional Chinese medicine; Integrated medicine; Herbal formulations; Acupuncture; Anti-inflammatory mechanisms

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1. Introduction

Acute pancreatitis (AP) is an acute inflammatory disorder of the pancreas, characterized by the premature activation of digestive enzymes within pancreatic acinar

cells, leading to autodigestion of the gland and potential systemic complications ^[1]. The clinical presentation of AP typically ranges from mild, self-limiting abdominal pain to a severe, life-threatening condition characterized

by severe epigastric pain radiating to the back, nausea, vomiting, and abdominal distension. In its most severe form, AP can progress to systemic inflammatory response syndrome (SIRS), leading to organ failure in distant organs such as the lungs and kidneys ^[2]. The global incidence of AP has been rising, posing a significant disease burden characterized by high hospitalization rates, substantial healthcare costs, and a mortality rate of up to 30–40% in the necrotizing form ^[3].

Modern medicine has made considerable strides in understanding the etiology of AP, with gallstone migration and chronic alcohol abuse accounting for the majority of cases ^[4]. The current standard of care is primarily supportive, focusing on aggressive fluid resuscitation, pain management, and nutritional support ^[5]. For severe cases, interventions such as enteral nutrition to maintain gut barrier function and targeted antibiotic therapy for infected pancreatic necrosis are critical ^[6]. Despite these advances, modern treatment faces significant limitations. There is a notable absence of specific pharmacological therapies that directly halt the pathological inflammatory cascade or effectively promote pancreatic regeneration. Furthermore, the management of local complications like pancreatic necrosis often requires invasive procedures, which carry their own risks ^[7]. This therapeutic gap underscores the urgent need for novel treatment strategies that can modify the disease course and improve outcomes.

In contrast, Traditional Chinese Medicine (TCM) conceptualizes AP not as an isolated organ disease but as a systemic disorder resulting from internal imbalances. It is often classified under disorders like ‘hollow organ disease’ or ‘spleen-heart pain’, with its pathogenesis primarily attributed to accumulation of dampness-heat, Qi stagnation and blood stasis, and failure of the fu-organs to drain properly ^[8]. The therapeutic principles of TCM for AP, therefore, focus on purging the interior to remove pathogenic factors, clearing heat and resolving toxin, and promoting blood circulation and removing stasis. A key advantage of the TCM approach is its emphasis on holistic regulation and multi-target intervention. Classical formulas like *Dachengqi* Decoction and *Qingyi* Decoction are composed of multiple herbs that are believed to work synergistically to alleviate inflammation, improve microcirculation, modulate immune function, and protect intestinal mucosa ^[9]. A growing body of clinical

and experimental research is now providing scientific evidence for these traditional uses, suggesting that integrating TCM with conventional Western medicine may offer a superior therapeutic effect by addressing multiple pathological pathways simultaneously.

2. Etiology and pathogenesis in traditional Chinese medicine

TCM offers a distinct perspective on the etiology and pathogenesis of AP, viewing it not merely as a localized pancreatic inflammation but as a systemic disorder arising from imbalances in the body’s functional systems. This holistic framework attributes AP primarily to the interplay of external pathogens, dietary irregularities, emotional disturbances, and visceral deficiencies, leading to core pathological patterns such as dampness-heat accumulation, Qi stagnation and blood stasis, and fu-organ obstruction ^[10].

2.1. External pathogenic factors

External pathogens, particularly dampness-heat, are considered significant triggers for AP. These pathogens invade the body through the mouth or skin, impairing the spleen and stomach’s transportation functions. This leads to internal accumulation of dampness and heat, which obstruct the middle jiao and disrupt the flow of Qi and blood in the pancreas and surrounding fu-organs. Classical texts like the *Huangdi Neijing* state: “Irregular diet and lifestyle disrupt the six fu-organs” ^[11]. Modern studies confirm that infections (e.g., biliary tract infections) and environmental toxins can exacerbate pancreatic inflammation by activating inflammatory cascades, aligning with TCM’s “heat-toxin” concept ^[12].

2.2. Dietary irregularities

Excessive consumption of greasy, sweet, spicy, or alcohol directly damages the spleen and stomach, generating internal heat and dampness. The *Treatise on Spleen and Stomach* by Li Gao notes: “Overeating injures the stomach and intestines” ^[13]. Alcohol, in particular, is regarded as a “damp-heat toxin” that induces liver-gallbladder dampness-heat, which then obstructs pancreatic ducts and triggers enzyme activation ^[14,15]. Epidemiological studies corroborate alcohol and

hyperlipidemia as leading causes of AP^[16,17].

2.3. Emotional imbalance

Chronic stress, anger, or anxiety cause liver Qi stagnation, which may transform into fire or impair spleen function, leading to dampness accumulation. The Huangdi Neijing describes: “Anger drives Qi upward... overthinking knots Qi”^[11]. Psychogenic stress is clinically linked to sphincter of Oddi dysfunction and biliary stasis, increasing AP risk^[18]. TCM correlates this with liver-spleen disharmony, where stagnant liver Qi attacks the spleen, exacerbating pancreatic inflammation^[8].

2.4. Visceral deficiency

Chronic illness, aging, or overexertion weakens the spleen, liver, or kidneys, creating a foundation for AP. Spleen deficiency fails to transform fluids, accumulating dampness; kidney Yang deficiency causes cold-dampness obstruction; liver Yin deficiency generates deficient fire. The Jingyue Quanshu states: “When healthy Qi is sufficient, pathogens cannot invade”^[19]. Modern research shows that comorbidities like diabetes (linked to spleen-kidney deficiency) increase AP severity and mortality^[1]. Immune dysfunction in severe AP aligns with TCM’s “deficiency of genuine Qi”^[8].

3. Treatment methods of traditional Chinese medicine and pharmacy

Traditional Chinese Medicine (TCM) employs a multi-modal strategy for Acute Pancreatitis (AP), integrating herbal formulations (oral and external), acupuncture, and manual therapies. Treatment is guided by syndrome differentiation, targeting core pathological patterns like dampness-heat accumulation, Qi-blood stagnation, and Fu-organ obstruction.

3.1. Oral herbal formulations

3.1.1. Excess heat patterns

- (1) Dampness-heat in liver/gallbladder

Formula: *Dachaihu* Decoction

Composition: *Bupleurum chinense* DC., *Scutellaria baicalensis* Georgi, *Paeonia lactiflora* Pall., *Pinellia ternate* (Thunb.) Breit., *Citrus aurantium* L., *Rheum*

palmatum L., *Zingiber officinale* Roscoe.

Action: Clears liver-gallbladder dampness-heat, promotes bile flow, purges heat. Evidence: Reduces serum amylase, inhibits NF-κB inflammation pathway, and improves pancreatic microcirculation in AP patients^[20].

- (2) Heat toxin accumulation

Formula: *Qingyi* Decoction

Composition: *Rheum palmatum* L., Sodium sulfate, *Curcuma aromatica* Salisb., *Corydalis yanhusuo* W.T.Wang, *Aucklandia lappa* Decne.. Action: Clears heat-toxin, unblocks Fu-organs, resolves stasis. Evidence: Significantly lowers IL-6, TNF-α, and endotoxin levels in severe AP (SAP), reducing mortality^[21].

3.1.2. Deficiency patterns

- (1) Spleen deficiency with dampness

Formula: *Shenling Baizhu* San

Composition: *Panax ginseng* C.A.Mey., *Atractylodes macrocephala* Koidz., *Poria cocos* (Schw.) Wolf, *Coix lacrym-jobi* L., *Dioscorea opposita* Thunb. Action: Strengthens spleen, resolves dampness, restores gastrointestinal function. Evidence: Improves intestinal barrier integrity and reduces bacterial translocation in SAP models^[22].

- (2) Qi-Yin Deficiency

Formula: *Shengmai* San

Composition: *Panax ginseng* C.A.Mey., *Ophiopogon japonicus* (L.f.) Ker-Gawl., *Schisandra chinensis* (Turcz.) Baill. Action: Tonifies Qi and Yin, stabilizes microcirculation. Evidence: Attenuates pancreatic ischemia-reperfusion injury and oxidative stress in AP^[23].

3.2. External therapies

3.2.1. Herbal enemas

Formula: *Dachengqi* Decoction.

Composition: *Rheum palmatum* L., Sodium sulfate, *Citrus aurantium* L., *Magnolia officinalis* Rehder & E.H.Wilson. Mechanism: Direct colonic delivery reduces intestinal permeability, inhibits pro-inflammatory cytokines (e.g., IL-1β), and accelerates bowel function

recovery^[24]. Application: 200 mL decoction retained for 30 min, 1–2 times/day during acute phase.

3.2.2. Topical compresses

Formula: *Phellodendron chinense* Schneid. + *Rheum palmatum* L. paste. Action: Clears heat-toxin, reduces local edema and pain. Evidence: Abdominal application decreases serum CRP and pancreatic necrosis volume in SAP^[8].

3.3. Acupuncture and moxibustion

3.3.1. Acupuncture

Key Points:

- (1) Zusanli (ST-36)
Regulates gastrointestinal motility, reduces inflammation via vagal activation^[25].
- (2) Neiguan (PC-6)
Alleviates nausea/vomiting, modulates autonomic nervous system.
- (3) Tianshu (ST-25)
Resolves Fu-organ obstruction, relieves abdominal distension. Protocol: Electroacupuncture (2 Hz, 15–30 min) for 5–7 days.

3.3.2. Moxibustion

Point: Shenque (CV-8) Action: Warms spleen Yang, resolves cold-dampness stagnation. Evidence: Indirect moxibustion reduces TNF- α and improves intestinal barrier in SAP rats^[26].

4. Clinical efficacy and mechanisms of action

Extensive clinical and experimental research demonstrates that TCM offers significant therapeutic benefits for AP, particularly when integrated with conventional Western medicine. TCM not only alleviates core symptoms (abdominal pain, nausea, vomiting) but also addresses systemic dysregulation, reduces complications (e.g., pancreatic necrosis, organ failure), and lowers recurrence rates. Its multi-target mechanisms bridge traditional theories with modern pathophysiology.

4.1. Anti-inflammatory effects

TCM formulas inhibit key inflammatory cascades implicated in AP pathogenesis:

- (1) Cytokine suppression
Qingyi Decoction reduces serum TNF- α , IL-6, and IL-1 β by blocking NF- κ B and MAPK signaling pathways, mitigating systemic inflammation and SIRS progression^[21].
- (2) Neutrophil infiltration control
Dachengqi Decoction downregulates ICAM-1 and E-selectin expression, limiting neutrophil adhesion and pancreatic tissue damage^[27].
- (3) Inflammasome modulation
Baicalin (from *Scutellaria baicalensis*) inhibits NLRP3 inflammasome activation, reducing caspase-1-dependent IL-18 release^[28].

4.2. Gut barrier protection

TCM interventions preserve intestinal mucosal integrity and microbiome balance:

- (1) Mucosal repair
Shenling Baizhu San upregulates tight junction proteins (occludin, ZO-1) and enhances mucin-2 secretion, preventing bacterial translocation^[29,30].
- (2) Microbiota regulation
Dachengqi Decoction increase *Lactobacillus* and *Bifidobacterium* abundance while suppressing pathogenic *Enterobacteriaceae*, reducing endotoxemia risk^[31].

4.3. Improvement of microcirculation

TCM resolves “blood stasis” by enhancing pancreatic perfusion:

- (1) Vasodilation
Ligusticum chuanxiong and *Salvia miltiorrhiza* activate eNOS/NO pathways, alleviating microvascular thrombosis and ischemia^[32,33].
- (2) Capillary permeability reduction
Astragalus membranaceus inhibits VEGF overexpression and stabilizes endothelial junctions^[34].

4.4. Oxidative stress alleviation

TCM herbs scavenge reactive oxygen species (ROS) and boost endogenous antioxidants:

(1) Direct ROS neutralization

Rheum palmatum contains emodin, which activates Nrf2/HO-1 pathways, enhancing SOD and GSH-Px activity^[35].

(2) Mitochondrial protection

Ginsenosides from *Panax ginseng* C.A.Mey. restore ATP synthesis and inhibit cytochrome c release, reducing acinar cell apoptosis^[36].

4.5. Clinical outcomes

4.5.1. Meta-analyses confirm TCM's efficacy:

Integrated TCM-WM therapy can reduce SAP mortality (RR 0.36, 95% CI 0.16–0.79)^[37]. *Qingyi* Decoction combined with conventional Western therapy reduced the risk of pancreatic infection by 64% (RR = 0.36, 95% CI [0.24, 0.53], $p < 0.00001$) and shortened hospital stays by 5.99 days in severe acute pancreatitis (SAP) patients, significantly outperforming effects in mild cases (MD_{SAP} = −5.99 vs. MD_{MAP} = −5.05)^[38]. *Dahuang Mudan* Decoction demonstrated superior clinical outcomes compared to conventional therapy alone, with the treatment group showing significantly higher overall efficacy, reduced hospitalization duration, and lower post-treatment inflammatory factor levels^[39].

5. Conclusion and future perspectives

The accumulated clinical and experimental evidence robustly demonstrates that Traditional Chinese Medicine (TCM), particularly when integrated with conventional Western medicine, offers a valuable and multifaceted approach to managing Acute Pancreatitis (AP). The holistic principles of TCM, centered on syndrome differentiation, provide a unique advantage by targeting the core pathological patterns of AP, such as Fu-organ obstruction, dampness-heat accumulation, and Qi-blood stagnation. The integrative “Huaxi Model” pioneered by Sichuan University exemplifies this success, demonstrating that TCM-based protocols can significantly reduce mortality rates in severe AP to approximately 10%, a figure notably lower than international benchmarks. This is achieved through multi-modal interventions, including classic formulas like Dachengqi Tang and Chaiqin Chengqi Tang for purging the interior

and clearing heat, acupuncture for pain management and organ function modulation, and topical applications, which together contribute to alleviating systemic inflammation, protecting organ function, and shortening hospital stays.

However, the field of TCM for AP faces several challenges that need to be addressed to solidify its evidence base and promote global acceptance. A significant limitation is the relative scarcity of large-scale, multicenter randomized controlled trials (RCTs) with rigorous methodology. Many existing studies have limited sample sizes, and the lack of standardization in TCM syndrome differentiation and outcome measures complicates the comparison and pooling of data. Furthermore, while network pharmacology and modern molecular techniques have begun to elucidate the multi-target mechanisms of herbal formulas (e.g., the effects of active components like emodin and baicalin on inflammatory pathways such as NLRP3 and TLR4), a comprehensive understanding of the pharmacodynamic material basis and precise mechanisms of action remains incomplete.

Future research should prioritize several key directions to overcome these limitations. First, conducting high-quality, large-sample RCTs following CONSORT guidelines is paramount to providing robust clinical evidence and “telling the world about the efficacy” of TCM interventions. Second, advanced technologies like multi-omics, artificial intelligence, and sophisticated pharmacological models should be employed to further “clarify the mechanisms” at a systems level, identifying quality markers (Q-Markers) for herbal formulas and validating their targets. Third, efforts must be made to standardize TCM diagnostic criteria and core outcome sets for AP to enhance the consistency and reliability of clinical research. Finally, the integrative treatment model should be optimized, focusing on the precise timing and sequence of TCM interventions throughout the entire disease course, from the critical early phase to prevent organ failure to the recovery phase to prevent recurrence, ensuring seamless collaboration between TCM and Western medicine in a patient-centered framework.

In summary, the integration of TCM with Western medicine represents a promising and sophisticated strategy for AP management. By building on existing

clinical successes and addressing current research challenges through rigorous scientific inquiry, TCM is poised to make even greater contributions to improving

patient outcomes and offering a more comprehensive solution to this complex disease.

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Effects of drill noise on the Auditory Threshold of the guinea pigs under occluding the round window and Its Correlation with the Pathological Mechanisms of Noise-Induced Hearing Loss

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Abstract

Objective: To investigate the synergistic damaging effects of electric drill noise on auditory thresholds under round window occlusion conditions, and to systematically analyze the pathological mechanisms of noise-induced hearing loss (NIHL) with advances in integrated Traditional Chinese and Western medicine prevention and treatment strategies. **Methods:** Thirty-six healthy male guinea pigs were randomly divided into control, round window occlusion-only, noise exposure-only, and occlusion + noise combined groups. A round window occlusion model was established, and animals were exposed to 92.5 dB SPL electric drill noise with a dominant frequency of 10 kHz for 30 minutes. Auditory brainstem response (ABR) testing was used to evaluate changes in auditory thresholds. **Results:** The occlusion + noise combined group exhibited a significant and persistent increase in ABR thresholds at 16 kHz. **Conclusion:** Round window occlusion enhances inner ear susceptibility to electric drill noise, leading to frequency-specific auditory threshold elevation. Combined with NIHL mechanisms such as oxidative stress and neuroinflammation, integrated Traditional Chinese and Western medicine interventions may offer novel clinical strategies for prevention and treatment.

Keywords

Round window occlusion; Electric drill noise; Noise-induced hearing loss; Auditory threshold; Oxidative stress; Integrated Chinese and Western medicine prevention and treatment

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1. Introduction

The round window membrane, a critical structure between the middle and inner ear, plays an indispensable role in maintaining normal auditory physiology, particularly by

ensuring cochlear fluid pressure balance and lymphatic vibration stability. Clinically, round window occlusion may occur due to congenital anomalies, otosclerosis, chronic otitis media, or post-middle ear surgery^[1-3]. Early

studies, such as those by Tonndorf et al., suggested that isolated round window occlusion has limited impact on auditory thresholds ^[4]. However, further research indicates that alterations in round window status may profoundly influence the inner ear's response to various insults.

Perez et al. demonstrated that while round window occlusion alone does not alter thresholds, it significantly increases susceptibility to subsequent noise exposure, exacerbating hearing loss ^[5]. This finding highlights the round window's functional integrity as a key defense against external stressors. Concurrently, electric drills are essential tools in otological microsurgery, but their high-intensity noise poses a risk of iatrogenic hearing damage. Domenech et al. reported high-frequency sensorineural hearing loss following tympanoplasty, attributing it to drill-generated acoustic trauma ^[6]. Bao Shiping's studies further confirmed the direct impact of drill noise on guinea pig auditory function ^[7].

A critical clinical question arises: Does pre-existing round window occlusion synergize with inevitable intraoperative drill noise exposure to produce a "1 + 1 > 2" effect? Although prior research has explored round window physiology and noise damage separately, systematic evidence on synergistic injury, particularly regarding frequency specificity, remains scarce. This study establishes a guinea pig model of round window occlusion combined with electric drill noise exposure to systematically investigate this synergistic effect and provide theoretical insights for clinical practice.

2. Literature review: Pathological mechanisms and prevention strategies for NIHL

2.1. Definition and epidemiology of NIHL

NIHL typically presents as threshold shifts characterized by high-frequency hearing loss. Based on reversibility, it is classified as temporary threshold shift (TTS), permanent threshold shifts (PTS), or hidden hearing loss. Globally, noise exposure is a leading preventable cause of hearing disability, with prevalence rates of 30–50% among high-risk occupational groups. Notably, recreational noise exposure from personal audio devices has led to increasing NIHL incidence among adolescents, posing a significant public health burden ^[8,9].

2.2. Multilevel pathogenesis

2.2.1. Mechanical and metabolic damage

High-intensity sound waves first cause direct mechanical trauma to cochlear structures, disrupting CDH23 protein links between stereocilia of inner and outer hair cells (OHCs), leading to disarray, bending, or rupturing. Severe mechanical damage may perforate Vestibular membrane, mix perilymph and endolymph, and induce potassium influx that exacerbates hair cell dysfunction ^[8,10]. Metabolic damage, secondary to mechanical injury, is central to hair cell apoptosis, with oxidative stress as a core mechanism.

2.2.2. Neuroinflammation and excitotoxicity

Following noise exposure, inflammatory cells such as macrophages in the bloodstream infiltrate the cochlea and become locally activated, releasing potent pro-inflammatory factors like tumor necrosis factor- α (TNF- α) and interleukin-1 β (IL-1 β). While this neuroinflammatory response helps clear cellular debris, it can also inadvertently damage nearby surviving hair cells and supporting cells, thereby expanding the initial area of injury ^[11]. On the other hand, excessive acoustic stimulation can lead to the over-release of the neurotransmitter glutamate from inner hair cells to the auditory nerve terminals, resulting in excitotoxicity.

2.3. Advances in Western medicine interventions

2.3.1. Pharmacological strategies

Targeting the core mechanism of oxidative stress, antioxidants are currently the most extensively studied pharmacological agents. For instance, N-acetylcysteine, a precursor of glutathione, effectively elevates cochlear glutathione levels by approximately 30%, thereby significantly enhancing cellular antioxidant capacity and shortening the recovery time of temporary threshold shifts by 40%. Neurotrophic drugs such as methionine combined with vitamin B12 can cross the blood-labyrinth barrier; animal studies have demonstrated their ability to reduce permanent threshold shifts by up to 50% ^[10]. To improve drug delivery efficiency, novel delivery systems, such as liposome-encapsulated superoxide dismutase, have been developed. These systems can increase local drug concentrations in the cochlea by tenfold,

substantially enhancing therapeutic efficacy.

2.3.2. Emerging therapies

With the advancement of molecular biology, gene therapy and cell therapy have brought new hope for the repair of noise-induced hearing loss (NIHL). Studies utilizing adenoviral vectors to deliver the *Math1* gene into the cochlea, leading to its overexpression in supporting cells, have successfully induced the transdifferentiation of supporting cells into functional new hair cells. Animal models have demonstrated approximately 30 dB of hearing improvement. Additionally, mesenchymal stem cell transplantation has been shown to promote the repair of damaged synapses and enhance cell survival through its paracrine effects, which include the release of various neurotrophic factors such as brain-derived neurotrophic factor (BDNF)^[9].

2.4. Traditional Chinese medicine (TCM) approach

2.4.1. Etiology and treatment principles

NIHL falls under “chronic deafness” or “sudden deafness” in TCM. The core pathogenesis is primarily attributed to deficiency of the liver-kidney, resulting in insufficient essence and blood failing to nourish the ears, leading to malnourishment of the auditory orifices; or due to invasion of external wind pathogens that ascend along the meridians, obstructing the clear orifices; or phlegm-fire stagnation that blocks the ear collaterals, causing disharmony of Qi and blood and occlusion of the auditory orifices^[12]. The fundamental treatment principle is based on “dredging the meridians’ Qi and harmonizing Qi and blood”, emphasizing a holistic therapeutic approach that combines local acupoint selection with distal points based on pattern differentiation.

2.4.2. TCM therapies and mechanisms

Acupuncture therapy is a characteristic modality in Traditional Chinese Medicine for the treatment of hearing loss. Local acupoints around the ear, such as Yifeng (TE17), Tinggong (SI19), Ermen (TE21), Tinghui (GB2), and Jiaosun (TE20), are frequently selected to dredge the Qi of the Shaoyang Meridian and directly stimulate Qi and blood circulation in the auditory region. Distal acupoints like Taixi (KI3) and Sanyinjiao (SP6) are

combined to nourish the kidney and replenish essence, thereby reinforcing the congenital foundation, while Fenglong (ST40) and Hegu (LI4) are used to resolve phlegm, clear fire, and diffuse lung Qi. Clinical studies have shown that acupuncture treatment can improve the pure-tone hearing thresholds of patients with sensorineural hearing loss by an average of 15–25 dB, with a total efficacy rate reaching 82.3%^[12]. Integrated therapies demonstrate greater advantages; for example, the combined application of Tongqiao Huoxue Tang (Orifice-Unblocking and Blood-Invigorating Decoction) and acupuncture has been shown to significantly increase cochlear blood flow by up to 30%, thereby improving the microcirculation of the inner ear.

3. Materials and methods

3.1. Animals and grouping

Thirty-six specific-pathogen-free (SPF) healthy male guinea pigs (250–300 g) were acclimatized for one week and randomly divided into four groups ($n = 12/\text{group}$): control, occlusion-only, noise-only, and occlusion + noise combined.

3.2. Model establishment

3.2.1. Round window occlusion

The animals were anesthetized via intraperitoneal injection of sodium pentobarbital. After the anesthesia took effect, the surgical site was disinfected with povidone-iodine. An incision was made layer by layer through the skin and subcutaneous tissues along the medial side of the mandible. Under microscopic guidance, blunt dissection was performed to separate the submandibular gland, digastric muscle, and surrounding connective tissues to fully expose the tympanic bulla. The bulla was opened approximately 0.5 cm anterior to the styloid process, adequately exposing the cochlea, stapes, round window niche, and membranous structures. Autologous periosteal tissue harvested from the animal’s own tympanic bulla was trimmed to an appropriate size and tightly packed into the round window niche. Medical fibrin glue was applied to secure the graft, ensuring complete occlusion of the round window. Postoperatively, the incision was closed layer by layer, and intramuscular injections of cefradine were administered for three

consecutive days to prevent infection.

3.2.2. Noise exposure

The noise source utilized a NOUVAG high-speed electric drill, commonly employed in clinical otological surgery, operating at a speed of 26,000 bpm and equipped with a 2 mm diameter diamond polishing burr. Within a soundproof chamber, calibrated using a precision sound level meter, the noise intensity generated by the drill was measured at the animal's head position as 92.5 dB SPL, with the primary energy peak of the noise located at 10,000 Hz. A steel ring was positioned behind the left ear of the guinea pig, snug against the temporal bone. The polishing burr was then used to deliver drill noise stimulation for a total duration of 30 minutes, administered in cycles of 5 minutes of noise exposure followed by 1-minute intervals, amounting to a total procedure time of 35 minutes.

3.3. Auditory assessment

ABR thresholds were measured at 8, 16, and 24 kHz preoperatively, immediately post-exposure, and at 3 months. Wave III was used as the response threshold.

Auditory brainstem response (ABR) testing was employed to evaluate auditory thresholds in guinea pigs. Measurements were conducted at three time points: preoperatively, immediately post-exposure, and 3 months postoperatively. After anesthesia, the external auditory canal was cleared of cerumen, and otoscopic examination confirmed intact tympanic membranes without perforation or discharge. Animals were placed in a prone position on a testing platform within a soundproofed electrically shielded chamber.

A needle recording electrode was positioned at the midline of the cranial vertex, with a reference electrode placed on the ipsilateral earlobe and a ground electrode attached to the nasal tip. Tone burst stimuli at frequencies of 8 kHz, 16 kHz, and 24 kHz were delivered. The auditory threshold was defined as the lowest intensity level that elicited a clear and reproducible Wave III response.

3.4. Statistical analysis

All data are expressed as mean \pm standard deviation. Statistical analyses were performed using SPSS

20.0 software. To verify baseline equivalence across experimental groups prior to interventions, a one-way analysis of variance (ANOVA) was conducted to compare preoperative ABR thresholds among the four groups. For longitudinal comparisons, independent samples *t*-tests were employed to analyze: Intergroup differences in ABR thresholds immediately post-operation, Intergroup differences in ABR thresholds at the 3-month postoperative timepoint changes from preoperative baseline values at both postoperative intervals. The threshold for statistical significance was set at $p < 0.05$ for all analyses.

4. Results

4.1. ABR threshold changes

Preoperatively, no significant differences were observed in the baseline ABR thresholds at the three test frequencies (8 kHz, 16 kHz, and 24 kHz) among the four experimental groups, indicating comparable baseline hearing levels across all groups (**Figure 1**).

Postoperative testing immediately following the intervention revealed that neither the round window occlusion-only group nor the noise exposure-only group showed statistically significant differences in ABR thresholds compared to the control group. In stark contrast, the occlusion + noise combined group demonstrated significant and frequency-specific alterations in auditory thresholds. Specifically, at the 16 kHz frequency, this group exhibited an abrupt elevation in ABR threshold from a preoperative value of 4.58 dB to 43.3 dB immediately after the procedure, representing a substantial threshold shift of 38.72 dB. This change was determined to be highly statistically significant ($p < 0.01$). Long-term follow-up assessments conducted at 3 months postoperatively demonstrated that the occlusion + noise combined group maintained persistently elevated thresholds at 16 kHz, with an average value of 42.9 dB. This sustained threshold elevation provides compelling evidence that the synergistic damage (**Figure 2 to 6**).

5. Discussion

This study, by establishing a guinea pig model combining round window occlusion with electric drill noise exposure,

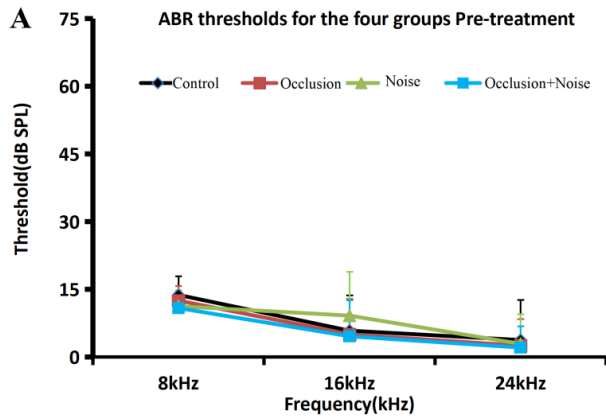


Figure 1. ABR thresholds for the four groups Pretreatment.

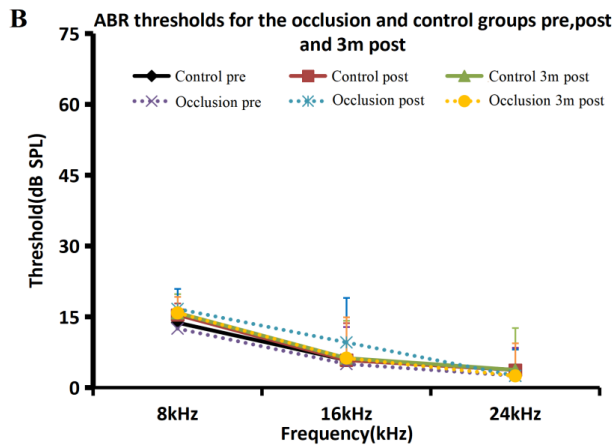


Figure 2. ABR thresholds for the occlusion and control groups pre, post and 3m post.

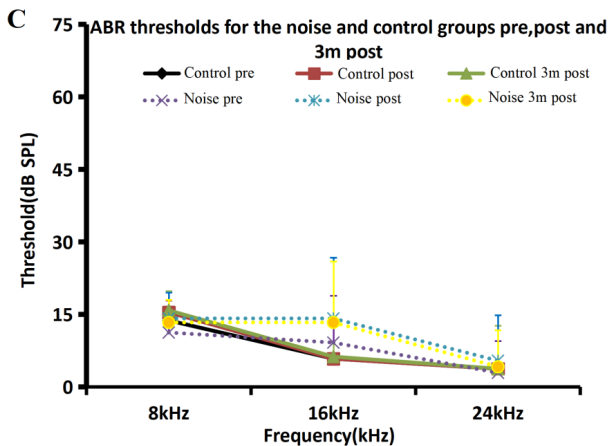


Figure 3. ABR thresholds for the noise and control groups pre, post and 3m post.

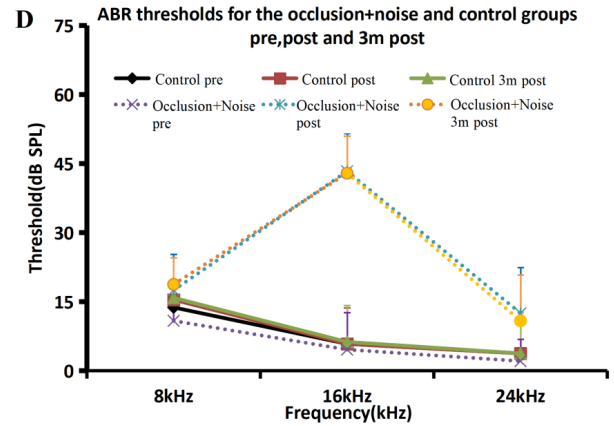


Figure 4. ABR thresholds for the occlusion + noise and control groups pre, post and 3 m post.

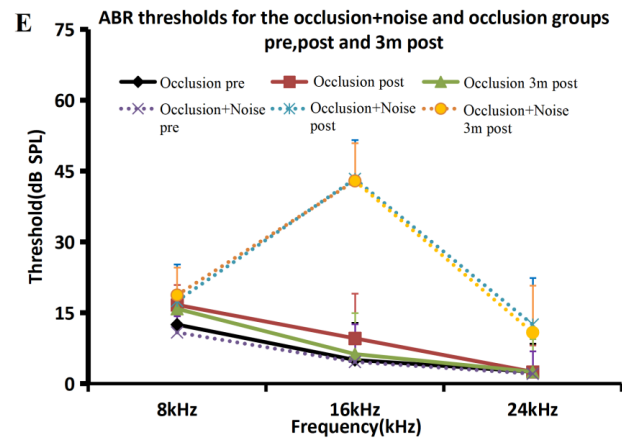


Figure 5. ABR thresholds for the occlusion + noise and occlusion groups pre, post and 3m post.

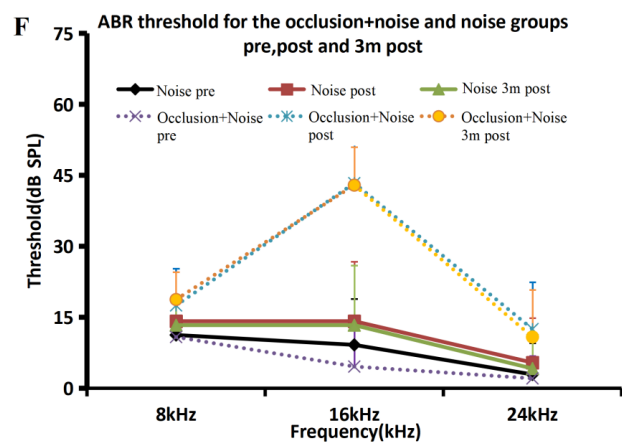


Figure 6. ABR threshold for the occlusion + noise and noise groups pre, post and 3m post.

confirmed the existence of a synergistic damaging effect between the two factors. The results demonstrated that neither round window occlusion alone nor exposure to 92.5 dB electric drill noise alone was sufficient to induce significant permanent threshold shifts. However, when combined, they resulted in severe hearing loss centered at 16 kHz. This finding not only corroborates the academic viewpoint proposed by Perez et al. that round window occlusion enhances inner ear susceptibility to noise, but also deepens the understanding of its harm from the perspectives of frequency specificity and persistence^[13].

From a mechanistic standpoint, the round window serves as a critical “pressure release valve” for the cochlea, and its normal function is essential for maintaining the hydrodynamic balance of inner ear fluids. Given that the mobility of the round window is five times greater than that of the oval window, and the volume ratio of the scala vestibuli to the scala tympani is 5:3, during the condensation phase of the sound wave, the compressed bony wall causes perilymph in the semicircular canals to be forced into the larger-volume scala vestibuli, which then flows into the smaller-volume scala tympani. Furthermore, the mobility of the round window membrane exceeds that of the stapes footplate, leading to basilar membrane displacement towards the scala tympani (downward) and outward bulging of the round window membrane. During the rarefaction phase, the bony labyrinth wall rebounds, the lymph fluids return to their original positions, the basilar membrane displaces upward to its original state, and the oval window bulges outward^[14-16]. Therefore, both air and bone conduction stimulation require movement between the cochlear wall and the oval window, the presence of two mobile windows, and a pressure difference across the basilar membrane^[14]. This highlights the critical importance of the oval and round windows. Conventionally, it is believed that during this process, when the stapes footplate moves, the round window membrane acts to cushion pressure changes within the cochlea and is a necessary condition for vibration of the intracochlear structures. Because inner ear fluids are incompressible, complete occlusion of the round window should reduce the mobility of the stapes footplate, consequently leading to conductive hearing loss^[17]. When the round window is occluded by packing material, the compliance of cochlear fluid vibration

decreases significantly, potentially altering the normal traveling wave pattern of the basilar membrane and the pathway of pressure transmission, thereby weakening the cochlea’s natural protective mechanisms against intense sound stimuli.

Combined with the pathological mechanisms of noise-induced hearing loss, this initial mechanical damage rapidly triggers a cascade of secondary pathological events. Hair cells, hypermetabolic in response to overstimulation, undergo a sharp increase in oxidative stress levels. Excessive ROS production attacks stereocilia structures and cell membrane systems, which likely directly contributed to the observed widespread stereocilia disarray, breakage, and even fusion in the experiment. Concurrently, metabolic disturbances lead to calcium influx and activation of apoptotic pathways, ultimately resulting in programmed cell death of hair cells, manifesting as extensive cell loss. Additionally, damaged hair cells and activated supporting cells release chemokines, attracting macrophage infiltration and triggering local neuroinflammation. The release of inflammatory cytokines further expands the scope of damage.

The findings of this study carry clear clinical implications. For patients with pre-existing conditions such as otosclerosis or chronic otitis media, who may inherently have round window occlusion or similar structural abnormalities, the risk of synergistic noise damage during otologic surgeries requiring drill use is significantly elevated. Based on this, we recommend preoperative assessment of round window status for such high-risk patients using methods like high-resolution temporal bone CT. If definite round window occlusion is identified intraoperatively, and ensuring the primary surgical goal is achievable, careful removal of the obstructive material to restore the mobility of the round window membrane could be considered prior to subsequent drilling procedures.

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