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Research Progress on the Intervention of Prediabetes with Non-pharmaceutical Therapies featuring Traditional Chinese Medicine

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Abstract: *Prediabetes, also known as impaired glucose regulation (IGR), refers to a pathological state in which blood glucose levels are higher than the normal range but do not meet the diagnostic criteria for diabetes. No organic lesions develop in the prediabetic stage, which corresponds to the "Pi Dan" pattern in traditional Chinese medicine (TCM). This stage represents a golden intervention window to reverse glucose metabolic disorders and block the occurrence of type 2 diabetes and its complications.Western intervention mainly consists of lifestyle guidance and pharmacotherapy, yet such approaches come with inevitable adverse drug reactions, low patient compliance, and challenges in long-term sustained management.Guided the TCM concept that "superior physicians treat diseases before they occur", characteristic TCM non-pharmacological interventions — including acupuncture, moxibustion, acupoint catgut embedding, acupoint application, auricular point pressing, tuina, and traditional Daoyin exercises — can comprehensively regulate visceral functions and improve insulin resistance. These therapies feature the merits of non-invasiveness, high safety, and minimal adverse effects.*

Keywords: *Prediabetes; Pi Dan; Characteristic non-pharmacological therapies of traditional Chinese medicine*

1. Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder. Prediabetes serves as a pivotal transitional phase in the progression of diabetes. The prevalence of prediabetes among the Chinese population rises year by year. Studies[1] indicate that without any intervention, approximately 93% of patients with impaired glucose regulation (IGR) will develop DM within 20 years, whereas patients receiving long-term lifestyle interventions face a 43% lower risk of progression to DM. Accordingly, timely and effective intervention for prediabetes can stall or even reverse disease progression.TCM characteristic non-pharmacological therapies center on physical constitution conditioning. Based on individualized syndrome differentiation and treatment, such therapies target patients' underlying pathogenesis to regulate visceral functions and unblock meridian qi transformation, thereby halting disease progression at its incipient stage and realizing the core TCM principle of "preventing disease before its onset".

Characteristic non-pharmacological therapies of TCM are safe and non-invasive. They bypass gastrointestinal metabolism and avoid drug-induced liver and kidney injuries, thereby compensating for the drawbacks of adverse reactions caused by pharmacotherapy. Such therapies feature simple operations, and some manipulations can be performed by patients at home, which addresses the difficulty of long-term adherence to oral hypoglycemic agents.Western interventions merely aim to regulate blood glucose values and fail to relieve discomforts including dry mouth and thirst, obesity, heavy limbs, abdominal distension and sticky stool, as well as general lassitude. In contrast, TCM characteristic non-pharmacological therapies are not restricted to lowering glucose indicators, with a richer array of intervention modalities. Stratified combined regimens can be flexibly formulated based on individualized syndrome differentiation. Clinicians may selectively apply acupuncture, moxibustion, acupoint application, acupoint catgut embedding, auricular point therapy and tuina alongside traditional Daoyin exercises, adopting tonifying, purgative or even tonifying-purgative manipulations to deliver personalized treatment.Multiple clinical trials and experimental researches have verified that TCM non-pharmacological therapies can alleviate clinical symptoms and stabilize blood glucose fluctuations, and they exert prominent superiority in lowering the risk of progression from IGR to DM[2]. These therapies

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facilitate holistic physical conditioning and rectify internal disharmony of Yin-Yang, qi, blood and body fluids, ameliorating sub-health status induced by disordered glucose metabolism and halting disease progression at its incipient stage, so as to fully realize the TCM concept of "preventing disease before its onset".

2. Etiology and Pathogenesis of Prediabetes

From the perspective of TCM, prediabetes falls into the disease categories of Pi Dan (spleen stagnation wasting), Xiao Dan (consumptive thirst) and food stagnation. Suwen·Strange Treatise records: "This stems from the overflow of five qi, named Pi Dan. Greasy food generates internal heat, and sweet food leads to middle jiao fullness; the qi surges upward and transforms into xiaoke (thirst wasting)." This proves that Pi Dan is the pre-stage of xiaoke.Lingshu· Five Transformations states that congenital insufficiency and dysfunction of the five zang-organs and six fu-organs are closely related to the occurrence of xiao dan: "All people with frail five zang-organs are susceptible to consumptive thirst." Congenital deficiency serves as the core internal pathogenic foundation of prediabetes. Visceral fragility originates from inborn constitution. If congenital kidney qi and essence are insufficient, visceral functions will be inherently weak. The transportation and transformation of the spleen-stomach, liver's qi dispersion, and lung's fluid distribution easily become disordered, leading to abnormal circulation of food nutrients and endogenous generation of greasy turbidity, phlegm and blood stasis, which ultimately develops into Pi Dan.Ye Tianshi, a distinguished physician of the Qing Dynasty, wrote in Treatise on Warmth and Heat: "The tongue may be covered with sticky white coating — this is Pi Dan, formed by accumulated damp-heat contending with food qi, resulting in excessive earth qi that surges upward when congested." He held that the disease arises from improper dietary habits. Long-term overconsumption of sweet, rich and greasy food impairs the spleen and stomach, disrupts their transporting functions, and causes internal retention of damp turbidity that transforms into heat, which further consumes body fluids.Lingshu·Five Transformations also notes: "Anger drives qi upward and accumulates it in the chest, reversing the circulation of blood and qi... Heat scorches the body surface and fluids, leading to consumptive thirst." This indicates emotional disturbance and hyperactive five-mind fire are major inducing factors of Pi Dan.Plain Questions advocates that moderate diet, regular daily schedules and restrained physical exertion can harmonize the physique and spirit to sustain long-term health. Nowadays, improved living standards coupled with mounting work pressure have reduced people's physical activity. Sedentary lifestyles and irregular work-rest cycles lower systemic metabolism, thereby causing a sharp rise in the population with IGR.

3. Characteristic Non-pharmacological Therapies of Traditional Chinese Medicine

3.1. Acupuncture Therapy

Acupuncture therapy is guided primarily by the meridian and acupoint theories of TCM. Based on syndrome differentiation and treatment, practitioners insert fine filiform needles into corresponding acupoints and manipulate them with proper techniques to unblock meridians, harmonize qi and blood, and balance visceral yin-yang for disease prevention and treatment.Yuan Jiahui et al.[3] pointed out that acupuncture acts on multiple targets. It ameliorates insulin resistance and stabilizes blood glucose via multiple mechanisms: regulating appetite, suppressing abnormal autophagy of hypothalamic cells, exerting anti-inflammatory effects, alleviating oxidative stress injury, restoring the activity of pancreatic β-cells, and modulating insulin signaling pathways.Ji Pinchuan et al.[4] divided 66 patients with impaired glucose regulation (IGR) into two groups. The control group received routine dietary and exercise interventions, while the experimental group was additionally treated with acupuncture at acupoints including Zusanli, Weishu, Yushu, Pishu and Ganshu. Trial results demonstrated that the combined acupuncture regimen yielded superior improvements in patients' waist circumference, BMI, blood glucose and insulin resistance-related indicators compared with basic intervention alone.

3.2. Chinese Tui Na Therapy

Tui Na, also known as Chinese therapeutic massage, is guided by the TCM theories of zang-fu organs, meridians, qi and blood. Practitioners apply standardized manipulations including pushing, grasping, pressing, rubbing, kneading, rolling, tapping and digital pressing to specific body regions, meridians and acupoints. External mechanical stimulation unblocks meridians, activates qi and blood circulation, improves visceral functions and balances yin-yang. Sun Hao[5] conducted clinical research and verified

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that abdominal Tui Na manipulations—abdominal rubbing, abdominal kneading, vibrating abdomen, abdominal transporting, abdominal grasping and digital abdominal pressing—combined with lifestyle intervention can regulate visceral activity and fortify the spleen-stomach transport and transformation function. When applied to patients with IGR, abdominal Tui Na paired with lifestyle management effectively lowers fasting plasma glucose (FPG) and 2-hour postprandial glucose (2hPG), alleviates insulin resistance, relieves clinical manifestations and blocks progression to DM.

3.3. Acupoint Application

Acupoint application is an external therapy where herbal slices are ground into ointment and pasted on acupoints or lesion areas of the patient's body surface. Herbal ingredients penetrate the skin, and medicinal efficacy travels along meridians to regulate zang-fu organs, unblock collaterals, and harmonize qi and blood, thus exerting therapeutic effects.Fang Ping[6] carried out an intervention trial combining acupoint application with lifestyle management for patients with IGR, and verified that this therapy can stabilize blood glucose and blood lipid levels.Zhao Jia et al.[7] conducted a controlled trial enrolling 90 IGR patients of spleen deficiency and phlegm-dampness pattern. The control group received routine Western medical interventions, whereas the experimental group was additionally treated with acupoint application based on Modified Liujunzi Decoction. After 3 months of intervention, the experimental group presented lower levels of FPG, 2hPG, HbA1C, TC and TG than the control group. This demonstrates that acupoint application can relieve TCM clinical manifestations and correct glycolipid metabolic disorders in such patients, and its underlying mechanism is associated with alleviating inflammatory reactions and balancing intestinal flora.

3.4. Moxibustion Therapy

Moxibustion adopts moxa wool and moxa sticks processed from dried folium artemisiae argyi as raw materials. Once ignited, the thermal energy and medicinal efficacy of moxa penetrate the skin to stimulate meridian qi when fumigating human meridians and acupoints. This therapy warms meridians to dispel cold, activates qi-blood circulation, tonifies yang to consolidate the root, unblocks collaterals, and maintains physical wellness. Its common modalities include suspended moxibustion, indirect moxibustion and apparatus moxibustion.Wang Lijun[8] demonstrated that early moxibustion combined with dietary control and exercise intervention can restore blood glucose to the normal range in some patients with IGR.He Jing et al.[9] divided 70 IGR patients with spleen deficiency and excessive dampness into two groups. The control group received simple TCM syndrome differentiation-based treatment, while the treatment group was additionally administered heat-sensitive moxibustion. After one treatment course, the treatment group achieved more prominent reductions in TCM syndrome scores and blood glucose values, with overall efficacy far superior to the control group. Heat-sensitive moxibustion combined with syndrome differentiation therapy can effectively lower blood glucose, improve pancreatic insulin secretion function and reverse the state of IGR.

3.5. Auricular Point Pressing Therapy

Also called auricular seed pressing, auricular point pressing is established on the holographic reflex theory. Vaccaria seeds, magnetic beads and other materials are affixed to acupoints on the auricle. Continuous stimulation activates meridian qi, harmonizes qi and blood, and modulates visceral functions.Hong Luqi et al.[10] carried out a controlled trial and confirmed that compared with lifestyle intervention alone, auricular seed therapy dredges systemic meridians, boosts qi-blood circulation, regulates visceral functions and improves systemic glycolipid metabolism, thereby achieving better control over FPG, 2hPG, HbA1C, TC and TG levels.Yang Qi et al.[11] adopted meta-analysis to investigate the therapeutic efficacy of auricular point pressing combined with herbal therapy in the intervention of IGR. The results indicated that auricular point pressing, whether applied monotherapeutically or combined with Chinese herbal medicine, yielded superior efficacy in ameliorating prediabetic conditions relative to control interventions.

3.6. Acupoint Catgut Embedding

Acupoint catgut embedding is an external therapy whereby absorbable medical protein threads are implanted subcutaneously at acupoints. The threads provide persistent stimulation to exert long-term therapeutic effects: unblocking meridians, harmonizing qi and blood, reinforcing healthy qi and eliminating pathogenic factors.Yang Lixia et al.[12] randomly divided 66 patients with impaired glucose

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regulation (IGR) into two groups. The control group received lifestyle intervention only, whereas the observation group was additionally treated with acupoint catgut embedding. Acupoints were selected in accordance with Professor Lai Xinsheng's Tongyuan Acupuncture Therapy, including Baihui (GV20), Yintang (GV24.5), Yushu (Pancreatic Shu), Pishu (BL20), Shenshu (BL23), Zhongwan (CV12), Guanyuan (CV4), Qihai (CV6), Zusanli (ST36) and Sanyinjiao (SP6). After one course of treatment, comparative results demonstrated that acupoint catgut embedding possesses definite curative effects for IGR treatment. It can decrease multiple blood glucose indicators and insulin levels, and its mechanism is associated with modulating ghrelin and ameliorating insulin resistance.

3.7. Traditional Daoyin Exercises

Traditional Daoyin exercises integrate physical flexion and extension, breath regulation and mental concentration to dredge meridians, harmonize qi and blood, relax tendons and bones, and nourish visceral organs. Classic styles consist of Baduanjin, Tai Chi and Wuqinxi. Fu Xiaochen et al.[13] classified 47 patients diagnosed with diabetes mellitus (DM) or impaired glucose regulation (IGR) into a control group (23 patients) and an observation group (24 patients). In the control group, patients with IGR received lifestyle intervention alone, while patients with DM were provided with health education combined with hypoglycemic agents or insulin therapy. On the basis of the above interventions, the observation group practiced the Six-Step Meridian Daoyin Technique, which comprises six movements: squeezing Gaohuangshu posture, stretching Gaohuangshu posture, stretching the belt vessel, willow swaying left and right, golden rooster standing on one leg, and bending backward to stretch tendons. After 14 days of intervention, outcomes indicated that this Daoyin technique lowers blood glucose and stabilizes glucose fluctuations by unblocking meridians and regulating qi-blood circulation, meanwhile avoiding the risk of hypoglycemia.

4. Treatment Based on Syndrome Differentiation

4.1. Spleen-Tonifying, Phlegm-Dissipating and Dampness-Eliminating Therapy

Treatise on the Spleen and Stomach records: "Spleen-stomach deficiency leads to dysfunction in transportation and transformation, whereby dampness generates endogenously." Li Dongyuan proposed that the spleen and stomach serve as the pivot for qi ascent and descent. Spleen deficiency with impaired transportation generates internal damp turbidity; qi stagnation further facilitates the accumulation of phlegm-damp turbidity.Zhao Botao et al.[14] conducted a controlled trial enrolling 80 patients with spleen deficiency and phlegm-dampness type impaired glucose regulation (IGR) from Tiantai Hospital of Traditional Chinese Medicine. The control group received lifestyle intervention alone, whereas the treatment group additionally accepted acupoint catgut embedding based on the Taiji Liuhe Acupoint Selection Method. Targeting phlegm-damp manifestations including obesity, lassitude, epigastric stuffiness and thick greasy tongue coating, the acupoint prescription was designed as follows: the Kun, Dui, Qian and Kan positions of inner Bagua and middle Bagua; for external Bagua acupoints, Shenshu, Weishu (penetrate to Pishu), Yushu, Yinlingquan, Fenglong, Taixi, Zusanli and Sanyinjiao were adopted. After two courses of treatment, the treatment group achieved more favorable reductions in fasting plasma glucose (FPG) and 2-hour postprandial plasma glucose (2hPG) compared with the control group. The results demonstrated that acupoint catgut embedding with syndrome differentiation based on Taiji Liuhe theory remarkably ameliorates glucose metabolic disorders in IGR patients with spleen deficiency and phlegm-dampness, thereby effectively halting and reversing the progression of prediabetes.Yang Yaoran[15] performed research on 90 IGR patients of phlegm-dampness pattern. The control group received basic combined therapy plus metformin hydrochloride enteric-coated tablets, while the treatment group was supplemented with spleen-tonifying and dampness-resolving acupoint application herbal paste (Astragalus 140 g, Ginseng 90 g, Atractylodes macrocephala 90 g, Poria cocos 100 g, Pericarpium Citri Reticulatae 100 g, Pinellia tuber 50 g, Pogostemon cablin 130 g, Radix Glycyrrhizae 100 g). The selected acupoints contained Pishu, Shenshu, Tianshu, Zusanli, Sanyinjiao and Fenglong. Following three treatment courses, outcomes revealed that spleen-tonifying dampness-resolving acupoint application exerted obvious therapeutic effects on phlegm-dampness IGR patients, improving glucose metabolism as well as partial clinical symptoms of early nerve injury.

4.2. Heat-Clearing and Dampness-Eliminating Therapy

Professor Wang Juan[16] studied classical TCM literatures and summarized years of clinical

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experience, proposing that a delicate, vulnerable spleen predisposes the body to endogenous damp-heat. Modern populations frequently consume fatty, sweet and greasy diets and are susceptible to obesity. Obese individuals easily develop phlegm-damp retention, which obstructs qi movement and stagnates the middle jiao; prolonged stagnation eventually leads to internal heat accumulation. Damp-heat stagnating the middle jiao and disrupting spleen-stomach transportation serves as a critical driver for the progression from Pi Dan (spleen stagnation wasting) to Xiao Ke (consumptive thirst). For obese Pi Dan patients presenting with damp-heat obstructing the middle jiao, the therapeutic principle is clearing and resolving damp-heat, eliminating turbidity and lowering glucose levels to treat both root causes and clinical manifestations. The regimen combines oral herbal medicine with acupoint catgut embedding, a distinctive TCM external therapy, for integrated internal-external treatment. Patients take modified Lianpu Yin decoction orally, accompanied by acupoint catgut embedding at Shangwan, Zhongwan, bilateral Tianshu, Guanyuan, Qihai, bilateral Zusanli and bilateral Fenglong. This therapy reduces body weight and adiposity, removes the pathological environment where glucose turbidity accumulates, and lowers patients' risk of progressing to DM.

4.3. Liver-Regulating and Qi-Moving Therapy

Emotional depression causing visceral dysfunction acts as a crucial inducing factor for Pi Dan (spleen stagnation wasting). Liver dysfunction in qi dispersion results in hyperactive liver wood invading spleen earth. Liver-regulating therapies protect spleen-stomach function and block the transmission of pathogenic pathogens; hence, soothing the liver and regulating qi constitutes one of the core therapeutic principles for Pi Dan.TCM treatment centers on soothing the liver and regulating qi as the fundamental guideline, prioritizing qi movement regulation to restore the transportation and transformation function of the spleen and stomach.For TCM non-pharmacological treatments, clinicians may adopt acupuncture, acupoint catgut embedding, meridian tuina, and traditional Daoyin exercises. Acupoint selection focuses mainly on Liver Meridian points, with Ganshu, Qimen, Tanzhong, Neiguan and Taichong as core acupoints. Additional acupoints are flexibly modified according to accompanying syndromes. Such interventions unblock the Liver Meridian, smooth qi movement, relieve emotional depression, epigastric and hypochondriac distension, polyphagia and easy hunger, and assist in modulating glucose metabolism.

4.4. Qi-Tonifying and Yin-Nourishing Therapy

Xiaoke (consumptive thirst) is characterized by root deficiency and superficial excess, with yin deficiency as the root cause and dry-heat as the superficial manifestation. During the progression from Pidan (spleen stagnation wasting) to Xiaoke, pathogenic heat gradually intensifies while healthy qi becomes deficient. Qi-yin consumption serves as the core pathogenesis driving disease progression.TCM external therapies including acupuncture, acupoint application and meridian Daoyin mainly follow the therapeutic principle of tonifying qi and nourishing yin, aiming to tonify visceral qi and replenish yin fluid. Acupoints are chiefly selected from the Spleen Meridian of Foot-Taiyin, Kidney Meridian of Foot-Shaoyin and Back-Shu points, namely Sanyinjiao, Taixi, Zusanli, Pishu, Shenshu and so on. These external therapies harmonize visceral qi and blood and replenish consumed qi and yin.Yang Weijun[17] randomly divided 99 IGR patients with qi-yin deficiency pattern into three groups: control group, experimental group A and experimental group B. All groups received routine dietary guidance. Experimental group A was treated with herbal tea (lotus leaf 3 g, Euonymus alatus 3 g, Salvia miltiorrhiza 3 g, Astragalus membranaceus 2 g, Dendrobium 2 g, Ligustrum lucidum 2 g). On the basis of group A's intervention, experimental group B additionally received the Six-Step Hypoglycemic & Lipid-Lowering Daoyin Exercises, consisting of six movements: squeezing Gaohuang posture, stretching Gaohuang posture, stretching the Belt Vessel, swaying left and right like willow branches, golden rooster standing on one leg, bending backward to stretch tendons.After 12 weeks of intervention, outcomes indicated that the combined regimen dredges meridians, regulates qi and blood and balances visceral functions, accelerates metabolism and improves bodily homeostasis. Accordingly, it assists blood glucose regulation, corrects glycolipid metabolic disorders, relieves clinical symptoms and elevates overall therapeutic efficacy, producing superior effects compared with the control group and the herbal tea group alone.

4.5. Phlegm-Dissipating and Stasis-Resolving Therapy

Treatise on Blood Disorders states: "Internal blood stasis obstructs qi movement and hinders the ascent and transportation of body fluids, thereby giving rise to thirst. Once blood stasis is eliminated, thirst disappears." This excerpt demonstrates that blood stasis disrupts the transportation and

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transformation of body fluids, serving as the core pathogenesis of thirst.Zhao Liang et al.[18] held that phlegm-stasis obstruction constitutes a pivotal pathogenic stage in overweight or obese patients with impaired glucose tolerance. Following the therapeutic principle of simultaneous treatment of phlegm and blood stasis, the researchers administered modified Taohong Siwu Decoction combined with Liujunzi Decoction and achieved satisfactory clinical efficacy.Wu Tingchao et al.[19] adopted data mining and statistical analysis to analyze literature concerning herbal compound prescriptions for IGR. The results showed that spleen-tonifying, qi-reinforcing and phlegm-eliminating herbs ranked highest among commonly used medicines for IGR therapy, while blood-activating and stasis-dissipating herbs also occupied a considerable share.For TCM external therapies, practitioners follow the concept of simultaneous resolution of phlegm and stasis, flexibly adopting acupoint catgut embedding, auricular point pressing, acupuncture and other interventions to invigorate the spleen for resolving phlegm, activate blood circulation and unblock collaterals. These therapies dredge the systemic circulation pathways of qi, blood and body fluids, and relieve symptoms caused by binding phlegm and stasis, including heavy limbs and body lassitude, limb numbness and sticky stool.

5. Summary and Prospect

TCM characteristic non-pharmacological therapies apply treatment based on syndrome differentiation for the intervention of "Pi Dan" (prediabetes, spleen stagnation wasting). Such therapies possess distinctive merits: holistic physical constitution regulation, favorable safety profile without adverse reactions, and diversified therapeutic protocols. They compensate for the drawbacks of lifestyle intervention alone (poor patient compliance) and drug-related side effects, thereby occupying an irreplaceable practical value in the early prevention and management of chronic diseases.

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