

# Expert Consensus on Clinical Management of T2DM Combined with Obesity Reversal Treatment in China (2023 Edition)

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**Abstract:** With lifestyle changes, the incidence of type 2 diabetes (T2DM) and obesity has significantly increased, becoming major chronic diseases that seriously threaten the health of China's residents. Both domestic and international guidelines and consensus exist regarding the diagnosis and management of this disease. In recent years, T2DM treatment has focused more on new tactics that lean towards a patient-centered comprehensive management approach, replacing the traditional glucose-centered approach. Additionally, an increasing amount of evidence in medicine suggests that the reversal of diabetes is possible. However, there is currently no expert consensus on the clinical management of T2DM combined with obesity reversal treatment. Therefore, experts and scholars in China with extensive experience in T2DM combined with obesity reversal treatment have been invited to develop this consensus. The content includes early identification and diagnosis of T2DM combined with obesity, definition and mechanisms of diabetes reversal, disease assessment and grading, staging of diabetes and goals of reversal, the 2+N reversal strategy, inpatient system treatment combined with comprehensive outpatient management (including weight control, precise nutrition, scientific exercise, glucose-lowering medication, psychological intervention, rehabilitation therapy, and remote follow-up through online platforms), and evaluation of post-reversal efficacy. The aim is to further improve the level of T2DM combined with obesity reversal diagnosis, treatment, and management in China, and to implement the Healthy China strategy.

**Keywords:** Type 2 diabetes mellitus (T2DM); Obesity; Reversal treatment; Clinical management; Expert consensus

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## 1. Introduction

As people's lifestyles evolve and population aging accelerates, the prevalence of type 2 diabetes mellitus (T2DM)

and obesity is on a rapid incline. The initial *Diabetes Map of China*, released by the Chinese Center for Disease Control and Prevention in 2022, indicates that the overall prevalence of T2DM in China surged to 14.92% between 2015 and 2019, ranking it first globally. This is in stark contrast to the 1.29% recorded from 1980 to 1984 <sup>[1]</sup>. Obesity is intricately linked with T2DM. The 2023 *Obesity Map of China* reveals a 36.8% prevalence of diabetes among obese/overweight individuals in China <sup>[2]</sup>, with 58% of diabetes patients being overweight or obese <sup>[3]</sup>. Therefore, obesity emerges as the primary cause of T2DM.

Traditionally considered an incurable chronic progressive disease, T2DM's best-expected outcome through conventional hypoglycemic therapy has been to manage hyperglycemia and delay inevitable complications. Unfortunately, the compliance rate for diabetes control has been historically low, leading to a worsening public health situation related to diabetes. Recent years have witnessed a shift in the traditional "hypoglycemic-centered" approach to T2DM treatment, with a growing recognition of the "patient-centered" integrated management concept. Simultaneously, the previously considered irreversible cognitive pattern of T2DM is transforming <sup>[4]</sup>.

Mounting evidence suggests that diabetes can be reversed. Numerous studies confirm that managing body weight through lifestyle intervention, certain drug treatments, and metabolic weight loss surgery can enhance insulin sensitivity, improve insulin secretion, foster B cell redifferentiation, and repair and reverse pancreatic function, thereby delaying or even reversing diabetes progression. In 2016, the World Health Organization (WHO) acknowledged that diabetes could be reversed through weight loss and calorie restriction. Most experts posit that, in the absence of hypoglycemic drugs, maintaining blood glucose levels lower than diabetes diagnostic criteria for an extended period and glycosylated hemoglobin (HbA1c) below 6.5% fulfill the requirements for diabetes remission <sup>[5,6]</sup>. The concept of "reversal of diabetes" aims to prevent the progression of diabetes into a destructive cycle, repair or even reverse islet  $\beta$  cell function, delay or prevent disease progression, reduce or cease the use of diabetes drugs, enhance patient's quality of life, alleviate the medical burden on patients and society, and reverse the severe health crisis of diabetes.

Over the past decade, more than one hundred experts from the Specialized Committee of Obesity Reversal of the Guangdong Provincial Geriatric Health Association and the Specialized Committee of Diabetes Management of the Guangdong Provincial Hospital Association have affirmed that T2DM patients with obesity can undergo reversal through extensive clinical practices. This draft refined through multiple revisions after extensive discussions and then consensus-seeking while acknowledging differences, serves as a clinical pathway guide for reversal therapy. It integrates the latest theories and clinical practices related to diabetes globally, offering valuable insights to domestic counterparts.

## **2. Significance and purpose of reversing T2DM combined with obesity**

Diabetes can lead to chronic complications such as vasculopathy and neuropathy, as well as acute complications such as infection and ketoacidosis, necessitating lifelong medication treatment for patients. According to the 2017 National Medical Insurance Sampling Database, Chinese diabetic patients incur an average annual personal expenditure of 18,785 CNY (including inpatients), while the corresponding annual personal expenditure covered by medical insurance is 41,682 CNY <sup>[1]</sup>. This imposes a substantial economic burden on patients, their families, and society.

Increased body weight or waist circumference can exacerbate insulin resistance, complicating blood glucose control <sup>[7,8]</sup>. Weight loss proves effective in improving insulin resistance, managing blood glucose, reducing cardiovascular and cerebrovascular disease risk factors, and enhancing overall quality of life. Within a certain range, greater weight loss correlates with more significant health benefits <sup>[9]</sup>. Obesity heightens the risk of

chronic complications in T2DM patients independently. It serves as a key risk factor for diabetic kidney disease, contributing to the progression of chronic kidney disease. Moreover, weight loss proves advantageous in reducing proteinuria in chronic kidney disease patients and slowing down the decline in renal function <sup>[10,11]</sup>. Obesity also substantially elevates the risk of cardiovascular and cerebrovascular diseases <sup>[12]</sup>. Therefore, reinforcing weight management in T2DM patients with obesity while concurrently addressing blood glucose is of paramount importance.

In 2016, the Endocrinology Branch of the Chinese Medical Association established *An Expert Consensus on the Comprehensive Management of T2DM Complicated with Obesity in China* <sup>[13]</sup>. In 2021, Professor Zou Dajin and Professor Ji Linong collaboratively formulated China's inaugural *Chinese Expert Consensus on Alleviating T2DM*. In 2022, Professor Wu Yiming and a team of 13 experts nationwide issued the *Expert Consensus on Weight Management of Patients with T2DM in China* <sup>[14]</sup>, guiding the systematic management of T2DM patients complicated with obesity. The economic and social value of reversing diabetes and obesity is substantial as it reduces medication dependency, alleviates complications, and diminishes personal, family, and socio-economic burdens.

The purpose of formulating a reversal therapy clinical expert consensus on T2DM complicated with obesity is to further standardize clinical management processes, improve blood glucose compliance rates and diabetes-related weight control, reduce the risk of complications, enhance patients' overall quality of life, and alleviate personal and social economic burdens.

### 3. Diagnostic criteria for T2DM complicated with obesity

The diagnostic criteria and classification of T2DM adhere to the standards set by the WHO in 1999 <sup>[15]</sup>. The diagnostic criteria for obesity are derived from *the Expert Consensus on Chinese Adult Obesity Prevention (2011 Edition)* <sup>[16]</sup>, and the criteria for abdominal obesity outlined in the *Chinese Type 2 Diabetes Prevention Guide (2020 Edition)* <sup>[17]</sup>. Patients meeting the diagnostic criteria for both conditions are managed in accordance with T2DM complicated with obesity. **Tables 1** and **2** present the diagnostic criteria for diabetes and obesity, respectively.

**Table 1.** Diagnostic criteria for diabetes

Diagnostic criteria	Venous plasma glucose level (mmol/L)
Typical symptoms of diabetes (polydipsia, polyuria, polyphagia, weight loss) and random blood glucose testing	≥ 11.1
Fasting blood glucose detection	≥ 7.0
Blood glucose testing 2 h after glucose loading (for those without diabetes symptoms, the testing should be repeated on some other day)	≥ 11.1

**Table 2.** Diagnostic criteria for obesity

Score index	Score
Body mass index (kg/m <sup>2</sup> )	
Overweight	≥ 24
Obesity	≥ 28
Abdominal obesity - waistline (cm)	
Male	≥ 90
Female	≥ 85

## 4. Definition of diabetes reversal

Presently, there exists no uniform standard for the definition of T2DM reversal. In 2017, the DiRECT study delineated diabetes remission as the withdrawal of anti-diabetic drugs for a minimum of 2 months and an HbA1c level below 6.5% at the one-year mark <sup>[18]</sup>. In 2009, the definition of T2DM remission within the pertinent consensus of the American Diabetes Association (ADA) categorized it into partial remission, complete remission, and long-term remission (**Table 3**). The 2021 Consensus Report titled “Definitions and Explanations for T2DM Remission,” drafted by the International Expert Group of the ADA, proposed the use of an HbA1c level below 6.5% after at least 3 months of discontinuation of hypoglycemic drugs as a diagnostic criterion for T2DM remission.

In China, the domestic standard for T2DM remission has incorporated the postprandial blood glucose level index, and the requirement for HbA1c levels is relatively lenient. Professor Li Guangwei and Professor Weng Jianping applied the same criteria to assess the remission of T2DM patients undergoing intensive insulin therapy <sup>[19]</sup>: in the absence of medication after intensive treatment, fasting blood glucose should be below 7.0mmol/L, and blood glucose two hours post-meal should be below 10 mmol/L, with this state maintained for over a year.

**Table 3.** T2DM remission criteria in 2009 ADA expert consensus

Category	Definition	Criterion
Partial remission	The blood glucose level is below the diagnostic threshold of diabetes for at least 1 year without active drug intervention or some other interventions.	Without active drug intervention or ongoing intervention, HbA1c < 6.5%, and fasting blood glucose is 5.6–6.9 mmol/L for at least 1 year.
Complete remission	Normal blood glucose level lasts for at least 1 year, with no active drug intervention or other ongoing interventions	Without active drug intervention or ongoing intervention, HbA1c is within the normal range, and fasting blood glucose is less than 5.6 mmol/L for at least 1 year.
Long-term remission	Complete remission lasts at least 5 years	

## 5. Mechanisms of diabetes reversal

Insulin resistance and islet  $\beta$ -cell dysfunction represent the primary pathophysiological characteristics of T2DM complicated with obesity. In skeletal muscle, lipid accumulation diminishes blood glucose utilization, concurrently escalating insulin secretion. The heightened insulin concentration in the portal vein triggers liver fat deposition, further exacerbating liver insulin resistance. Additionally, synthesized fat infiltrates pancreatic tissue, resulting in impaired pancreatic  $\beta$ -cell function,  $\beta$ -cell dedifferentiation, and a subsequent decline in insulin response to ingested glucose, thereby elevating postprandial blood glucose levels. Notably, insulin resistance impacting blood glucose control predominantly originates from the liver rather than skeletal muscle <sup>[20]</sup>.

Recent studies challenge the notion that  $\beta$  cells in T2DM patients undergo apoptosis; instead, they lose key  $\beta$ -cell characteristics due to dedifferentiation. Consequently, these cells lose their normal secretory regulation function, rendering them incapable of metabolic regulation in glucose homeostasis <sup>[21]</sup>.

Research indicates that lifestyle intervention and comprehensive treatments, such as hypoglycemic drug application and nutritional adjustment, stand out as primary effective measures for diabetes reversal. Lifestyle intervention not only delays the onset of T2DM but also diminishes the risk of cardiovascular and cerebrovascular adverse events, microvascular complications, and cardiovascular and all-cause mortality, thereby prolonging life expectancy <sup>[22-24]</sup>. Short-term intensive insulin therapy in the early stages of diabetes

alleviates the condition and contributes to the recovery of  $\beta$ -cell functions <sup>[25]</sup>. GLP-1 receptor agonists (GLP-1RAs), through multiple mechanisms, reduce insulin resistance and play a role in diabetes reversal <sup>[26]</sup>. Precise nutritional therapy, meanwhile, contributes to weight reduction and the partial restoration of insulin function <sup>[27]</sup>.

## **6. Reversal methods and processes**

### **6.1. Reversal mode**

- (1) 2+N reversal mode: “2” signifies the integration of traditional Chinese medicine and Western medicine, as well as the fusion of drug and non-drug approaches. “N” encompasses a range of comprehensive measures, including precise nutritional therapy, scientific exercise, correction of detrimental lifestyle habits, and mental conditioning.
- (2) In-hospital treatment: Recommended for new-onset diabetes, patients experiencing unstable blood glucose fluctuations (fasting blood glucose > 10mmol/L, random blood glucose > 15 mmol/L), and those with severe complications.
- (3) Out-of-hospital comprehensive management: Appropriate for patients with stable conditions post short-term hospitalization, individuals whose severe complications are under control, and those whose blood glucose levels meet the standard.

### **6.2. Reversal process – main operational steps of clinical management standard**

#### **6.2.1. Establishment and personnel allocation of multidisciplinary diagnosis and treatment team**

The comprehensive management of T2DM patients with obesity/overweight necessitates a multidisciplinary diagnosis and treatment team. The team’s formation involves professionals and the acquisition of necessary hardware equipment. Led by diabetes specialists, the multidisciplinary team includes nutritionists, health managers, psychologists, weight loss surgeons, sports medicine doctors, rehabilitation physiotherapists, diabetes specialist nurses, and network managers. Hardware equipment comprises common medical tools such as a glucometer, instantaneous continuous blood glucose monitoring system, sphygmomanometer, computer, height and weight instrument, tape, nylon wire, tuning fork, human body fat composition analyzer, non-mydriatic ophthalmoscope, Doppler stethoscope, and peripheral nerve sensory threshold detector.

The medical staff at primary medical institutions, outpatient departments of hospitals at all levels, physical examination centers, weight loss centers, nutrition departments, and health care institutions should be trained to conduct diabetes screening, focusing on families with a history of diabetes.

Endocrine doctors with specialized reversal training formulate a reversal plan, oversee the entire reversal process, and guide health management institutions, nutritionists, rehabilitation physiotherapists, health managers, psychologists, and sports fitness coaches, all of whom have received professional reversal training, to jointly supervise patients in completing the reversal work.

#### **6.2.2. Screening of high-risk population**

Screening for adults (> 18 years old) with high-risk diabetes complicated with obesity includes measuring body mass index and waist circumference, blood glucose screening, glucose tolerance testing, differential diagnosis of etiology, understanding of diabetes and obesity-related complications, and testing and inquiring about related medical history.

#### **6.2.3. Confirmation of patients**

Diagnosis of T2DM patients complicated with obesity/overweight adheres to the diagnostic criteria of both

T2DM and obesity/overweight. The diagnosis of abdominal obesity primarily utilizes waist circumference, with diagnostic criteria of male  $\geq 90$  cm and female  $\geq 85$  cm.

#### 6.2.4. Improvement of auxiliary examination and establishment of files for reversed patients

The perfect auxiliary examination involves filing and measuring height, weight, waist circumference, hip circumference, body fat content, and body mass index, as well as taking photos. Biochemical tests include blood lipids, blood glucose, HbA1c, insulin and C-peptide levels, urinary microalbumin, thyroid function, adrenocortical hormone, and sex hormones. Peripheral nerve electrophysiological examination, fundus examination, electrocardiogram, abdominal ultrasound, chest X-ray, and body fat composition analysis should be performed.

Filing involves the collection of patients' basic information, evaluation of islet  $\beta$ -cell function and complications, and establishment of personal medical records through hospitals, community health service centers, or health management institutions.

#### 6.2.5. Evaluation and grading of patients

Assessment and grading include disease assessment, lifestyle assessment, and psychological assessment. Disease assessment can be summarized as ABCD, where A represents Age and HbA1c; B represents BMI and blood pressure; C represents Cholesterol and Cigarettes; D represents Diet and Duration. Patient condition is divided into 4 grades based on weight and blood glucose control level (see **Table 4**), where a higher grade indicates a more severe disease.

**Table 4.** Diabetic and obesity/overweight classification

Patient classification		Classification of diabetes (HbA1c)		
Classification of obesity (BMI: kg/m <sup>2</sup> )	Early stage of diabetes	Diabetes level 1 ( $\leq 7.5\%$ )	Diabetes level 2 (7.5%–9.0%)	Diabetes level 3 ( $> 9.0\%$ )
Overweight (24.0–27.9)	Level 1	Level 2	Level 2	Level 3
Obesity level 1 (28.0–32.9)	Level 2	Level 2	Level 3	Level 3
Obesity level 2 (33.0–37.9)	Level 2	Level 3	Level 3	Level 4
Obesity level 3 ( $\geq 38$ )	Level 3	Level 3	Level 4	Level 4

Note: The obesity grading standard refers to the grading standard on obesity of the WHO, and it is adjusted according to the weight of the Chinese people.

Lifestyle assessment encompasses various aspects such as diet, exercise habits, exercise willingness, exercise feasibility, and smoking and drinking habits. Sports feasibility includes physical function feasibility and environmental feasibility. Psychologists should also evaluate patients based on quality of life, sleep status, and anxiety status.

#### 6.2.6. Formulation of intervention schemes

An individualized reversal intervention plan should be formulated based on the evaluation of the patient's condition. The plan sets control objectives such as ideal weight, blood glucose, and complications. Lifestyle, drug intervention, and bariatric surgery schemes are then developed. Diabetes reversal treatment sets goals according to different stages of the disease (see **Table 5**).



**Table 5.** Staging and reversal targets of diabetes

High-risk stage	Earlier stage	Early stage	Middle stage	Late stage
Carry out interventions during the obesity and insulin resistance stages to restore normal body weight and eliminate insulin resistance.	In IGT and IFG stages, reverse to normal glucose tolerance and normal fasting blood glucose.	Within 3 years of the new onset of diabetes, islet function is better. After reversal, 90% can reach normal blood glucose, and no need for medication.	The course of the disease is more than 3 years, the islet function is good, no obvious complications, the antidiabetic drug cannot well control blood glucose, 50% of patients can stop the drug, and their blood glucose is normal.	The course of the disease is more than 10 years, the islet function is poor, there are obvious complications, a variety of drugs cannot control blood glucose, and can make the blood glucose stable. When reducing drugs, complications are alleviated.

The ideal control targets for blood glucose, blood pressure, and blood lipid should be determined according to different stages. In the middle and late stages of diabetes, blood glucose control is relatively loose (refer to **Tables 6** and **7** for specific control targets).

**Table 6.** Comprehensive control objectives after reversal

<b>Reversal targets</b>	1	Early stage: HbA1c (%) < 6.5–7.0 Middle and late stage: HbA1c (%) 7.0–7.5
	2	Early stage: fasting blood glucose and postprandial blood glucose are completely normal Middle and late stage: fasting blood glucose (mmol/L): 4.4–7.0, non-fasting: < 10.0
	3	Blood pressure (mmHg): < 140/90 BMI (kg/m <sup>2</sup> ): < 24 Waist circumference (cm): < 85 (male), < 80 (female)
	4	TG (mmol/L): < 1.7 LDL without coronary heart disease (mmol/L): < 2.6 LDL with coronary heart disease (mmol/L) < 1.8 CH (mmol/L): < 4.5; HDL-C (mmol/L): > 1.0 (male), > 1.3 (female)

**Table 7.** Blood glucose control targets

Blood glucose control targets	HbA1c level	Description
Strict	< 6.5%	Newly diagnosed, less than 65 years old, no complications and severe concomitant diseases, and no adverse reactions such as hypoglycemia or weight gain in hypoglycemic therapy; Planning pregnancy or combined pregnancy; No need for hypoglycemic drug intervention
Standard	6.5%–7.0%	Under 65 years old, oral hypoglycemic drugs can not meet the standard, combined with insulin therapy or switching to insulin therapy; More than 65 years old, no risk of hypoglycemia, good organ function, expected survival for more than 15 years; Planning pregnancy based on insulin treatment for diabetes
Loose	7.0%–9.0%	Have cardiovascular disease (CVD) or CVD with very high risk; Equal to or more than 65 years old, expected survival for more than 15 years; high-risk groups of hypoglycemia; Patients with difficulties in implementing treatment programs such as mental or intellectual or visual impairment; Too poor medical conditions.

### 6.2.7. Implementation of intervention measures

When implementing intervention treatment schemes for diabetic patients, individualized choices are made according to different conditions. Drug intervention scheme choices consider improving insulin resistance and protecting  $\beta$ -cell function, prioritizing drugs with comprehensive metabolic benefits. Hypoglycemic drugs with significant weight loss effects are preferred, followed by those with minimal impact on body weight. Drugs that

increase body weight should be used sparingly, with weight loss drugs and surgery considered if necessary.

Several key intervention treatment issues:

- (1) Lifestyle intervention: Lifestyle intervention, a pivotal part of the reversal process, includes dietary adjustments, exercise routines, habit corrections, and psychological therapy. Successful intervention requires collaborative efforts from Western medicine practitioners, Chinese medicine practitioners, and healthcare managers. The integration of Internet+ is instrumental in achieving optimal results. The 5+2 reversal treatment model, combining the traditional “five carriages” with co-management and Internet+, proves effective where traditional methods fall short.
- (2) Weight management: Effective weight management is crucial for diabetic patients with obesity. Early weight loss goals range from 5% to 10%, with the ultimate target being a BMI < 24 kg/m<sup>2</sup>.
- (3) Precise nutrition: A scientifically sound diet forms the foundation of diabetes reversal therapies. Patients with T2DM and obesity require precise, personalized, and systematic nutrition therapy. The selection of nutritional interventions should align with metabolic indicators such as obesity degree, blood glucose, blood pressure, blood lipid, and uric acid. Recommended dietary modes include the ketogenic diet, low-carbohydrate diet, Mediterranean diet, and Paleo diet, flexibly adapted to the patient’s condition. Diet therapy principles include:
  - (a) Determine total calorie intake based on body mass index and weight loss goals;
  - (b) Adjust the proportion of carbohydrate intake according to blood glucose control, choose foods with a low glycemic index (GI) and/or low glycemic load (GL) such as coarse grains and vegetables, and avoid the intake of refined rice and flour foods and refined sugars;
  - (c) Appropriately adjust the total amount of protein intake and avoid a long-term high-protein diet;
  - (d) Avoid the intake of trans-fatty acids, and appropriately intake high-quality fat;
  - (e) Increase dietary fiber intake;
  - (f) Appropriately select types and quantities of fruits according to the control of blood glucose;
  - (g) Ensure the intake of rich vitamins, minerals, and antioxidants;
  - (h) Reasonably allocate dieting time to reduce the stimulation of the pancreas;
  - (i) Chewing slowly is conducive to digesting food;
  - (j) Pay attention to intestinal health and appropriately supplement probiotics and/or prebiotics.
- (4) Scientific exercise therapy: Exercise enhances insulin sensitivity, improves skeletal muscle function, and positively impacts metabolic disorders. Principles of exercise therapy for T2DM with obesity include:
  - (a) Medical evaluation before exercise therapy and strict control of indications and contraindications;
  - (b) Individualized exercise prescriptions according to the patient’s course of disease, degree of illness, severity of complications, etc., by considering a variety of factors such as age, family status, exercise habits, and cultural background; the exercise prescription should include five elements: exercise frequency, exercise intensity, exercise duration, exercise type, and amount of exercise;
  - (c) Focusing on moderate intensity and aerobic exercises, at least 3 times a week, not less than 20 minutes each time. Aerobic exercise and resistance exercise should be carried out alternately, integrating outdoor and indoor activities. They should exercise at any time and anywhere according to their specific living and working environment. Meanwhile, they should integrate the concept of exercise into life and work, persist in a personalized, continuous, and systematic exercise mode, and walk at least 5,000–10,000 steps every day (depending on the patient’s



physical condition);

- (d) They should follow the principles of from light to heavy, from less to more, from slow to fast, and from sparse to dense to adjust their own sports scheme;
  - (e) They should adjust the exercise scheme in time according to blood glucose monitoring and weight loss.
- (5) Mental intervention: Obesity and diabetes increase the psychological burden on patients. Strengthening psychological intervention, guided by professional psychologists or diabetes specialists, helps patients adjust their mentality, improve their life attitude, and boost their confidence. Weight loss not only overcomes psychological barriers but also fosters self-confidence, contributing to enhanced life satisfaction.
- (6) Developing good living habits: A poor lifestyle is a significant factor leading to diabetes and obesity. A good lifestyle is essential for reversing diabetes complicated with obesity. Doctors play a crucial role in helping patients identify existing problems, providing corrective training, and ensuring patients form and maintain good living habits.
- (7) Chinese medicine acupuncture and rehabilitation therapy: Traditional Chinese medicine offers advantages in regulating metabolic disorders caused by diabetes and treating diabetic complications. “Obesity or overweight - spleen-warm syndrome - Xiaoke - Xiaoke complications” is the natural development process of obese diabetes. The effect of the “Kaiyu Qingre method” is significant in the treatment of early and middle diabetes<sup>[28]</sup>. Compound preparations such as Dahuang Huanglian Xiexin Decoction, Gegen Qinlian Decoction, and Dachaihu Decoction can appropriately reduce blood glucose and reduce risk factors for complications<sup>[29]</sup>. Therefore, Chinese medicine conditioning, tailored to blood glucose, constitution, and Chinese medicine dialectical methods, significantly improves physical condition, stabilizes blood glucose, and enhances the reversal effect of diabetes.

By stimulating the corresponding acupoints, acupuncture plays a role in dredging the channel, balancing yin and yang, regulating Zang and Fu, and running qi and blood, and ultimately achieves the purpose of weight loss and blood glucose regulation<sup>[30]</sup>. Acupuncture can also inhibit the occurrence of hunger and reduce food intake by adjusting the activity of neurotransmitters. Meanwhile, it can promote the adrenal medulla to secrete adrenaline, enhance fat mobilization and decomposition, and reduce the content of growth hormone and insulin, thereby reducing weight, lowering blood glucose, and reversing diabetes.

Major acupoints of acupuncture therapy included Yishu, Pishu, and Sanyinjiao. Matching acupoints for patients with damp-heat retention in the spleen may include Quchi and Neiting. Functional acupuncture, moxibustion, and ultrasonic energy meter can dredge the channel, relieve diabetic complications, and activate stem cells to repair islet function<sup>[31-33]</sup>. Therefore, it has a very important adjuvant therapeutic effect on the reversal of T2DM patients complicated with obesity.

- (8) Rational use of drug therapy: In the early stage of diabetes reversal, drugs should be applied rationally based on blood glucose and complications. **Tables 10 to 12** show the characteristics and types of related drugs. However, in the late reversal, medication should be minimized to prevent hypoglycemia.
- (9) Surgical treatment: Metabolic surgery can be considered for T2DM patients with obesity/overweight if blood glucose control or weight loss is unsatisfactory after comprehensive reversal therapy. Surgical methods and types are individually selected based on the patient’s condition and willingness, following corresponding guidelines.

**Table 10.** Types of hypoglycemic drugs for weight loss

	<b>Metformin</b>	<b>SGLT-2 inhibitor</b>	<b>GLP-1 receptor agonist</b>
Mechanism of action	Reduce liver glucose output, improve insulin resistance	Inhibit renal glucose reabsorption, increase urinary glucose excretion, negatively balance energy metabolism	Promote insulin secretion, inhibit glucagon secretion, and delay gastric emptying
Representative drugs	Metformin	Dapagliflozin, Ertugliflozin	Exenatide, Liraglutide
Advantages	Reduce HbA1c, low risk of hypoglycemia, mild weight loss, cardiovascular protection.	Reduce HbA1c, lose weight, lower systolic blood pressure, possible cardiovascular and renal benefits	Reduce HbA1c, lose weight, low risk of hypoglycemia, lower blood pressure, decrease fasting and postprandial blood glucose fluctuations

**Table 11.** Types of hypoglycemic drugs that have little effect on body weight

	<b>DPP-4 inhibitor 1</b>	<b><math>\alpha</math>-Glucosidase inhibitor</b>
Mechanism of action	Increase glucose-dependent insulin secretion by delaying GLP-1 degradation	Inhibit the absorption of carbohydrates in the upper small intestine
Representative drugs	Sitagliptin, Saxagliptin, Linagliptin, Alogliptin, Vildagliptin	Acarbose, Voglibose
Advantages	Moderate reduction of HbA1c, low risk of hypoglycemia	Moderate reduction of HbA1c, low risk of hypoglycemia, protective effect of cardiovascular on patients with impaired glucose tolerance and diabetes

**Table 12.** Types of weight loss drugs

	<b>Orlistat</b>	<b>Lorcaserin hydrochloride</b>	<b>Phentermine / Topiramate extended-release agent</b>	<b>Naltrexone extended-release agent / Bupropion extended-release agent</b>
Mechanism of action	Gastrointestinal lipase inhibitor	5-hydroxytryptamine 2c receptor agonist	Promote the release of norepinephrine (Phentermine) and regulation of GAB receptor (Topiramate)	Opioid receptor agonist (Naltrexone); Dopamine and norepinephrine reuptake inhibitors (Bupropion)

- (10) Control of multiple risk factors: Assessment of risk factors for cardio-cerebro-renal vascular disease (such as carotid ultrasound, peripheral nerve sensory threshold, fundus, urinary microprotein, liver and kidney function) should be conducted annually. Treatment plans should be adjusted based on examination results.
- (11) Monitoring and follow-up:
- Monitoring: FPG and PG 2 hours after the meal should be detected at each follow-up, and HbA1C, blood lipids, body weight, and other risk factors of cardiovascular, cerebrovascular, and renal vascular diseases should be monitored regularly. OGTT and islet function tests should be performed at least once a year.
  - Follow-up: Face-to-face or telephone follow-up should be carried out at least once a week to understand the patient's diet and exercise situation, complications, blood glucose control, symptom improvement, etc. The physical examination should be recorded to conduct a dynamic comparison and formulate a diagnosis and treatment plan.
  - Efficacy evaluation after reversal: 3–6 months after reversal, the blood glucose stability of patients should be evaluated. All indicators before reversal should be re-examined to compare the differences before and after treatment and evaluate the therapeutic effect. Meanwhile, patient satisfaction, medical expenses, and medical insurance payments should be evaluated.

## Disclosure statement

The authors declare no conflict of interest.

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