

RELEVANCE OF YOGA THROUGH PASCHIMOTTANASANA ON TYPE 2 DIABETES MELLITUS - A LITERATURE REVIEW

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ABSTRACT^[1,2,3,4]

Diabetes mellitus is a metabolic disorder of endocrine system and one of the most dreadful lifestyle disease conditions which is spreading as an epidemic across the globe as large number of individuals remain asymptomatic and unaware of having this disorder. Once regarded as a single disease entity, diabetes is now seen as a heterogeneous group of diseases, characterized by a state of chronic hyperglycemia resulting from environmental and genetic factors acting jointly. Unavailability of satisfactory treatment in modern medicine has led to alternative approach to this refractory and iceberg disease. Various alternative approaches such as lifestyle modification, Yoga, use of medicinal plants having multiple beneficial effects. Alternative methods not only

take care of most of the metabolic abnormalities associated with diabetes but can also reduce the risk of developing or delay the onset of diabetes mellitus among susceptible persons. Yoga has always been an essential part of life in traditional system of treatment as it include physical activities like several postures in the form of Asana, breathing exercises in the form of Pranayama which can play a vital role to prevent such lifestyle related diseases. The system of yoga advocated by Acharya Patanjali consists of eight limbs. The third limb of

yoga is asana. Asana brings steadiness, health and lightness to body. Nowadays large number of population is suffering from lifestyle disorder like diabetes mellitus, so for this the most excellent of all Asanas is the Paschimottanasana.

KEYWORDS: Diabetes mellitus, yoga, Paschimottanasana.

INTRODUCTION^[5,6,7]

Diabetes mellitus comprises a group of common metabolic disorders that shares the phenotype of hyperglycemia. Several distinct types of diabetes mellitus exist and are caused by a complex interaction of genetics, environmental factors and lifestyle choices. Depending on the etiology of the diabetes mellitus factors contributing to hyperglycemia may include reduced insulin secretion, decreased glucose utilization and increased glucose production. The metabolic dysregulation associated with diabetes mellitus causes secondary pathophysiologic changes in multiple organ systems that impose a tremendous burden on the individual with diabetes and on the healthcare system. In United States, diabetes mellitus is the leading cause of end stage renal disease, non-traumatic lower extremity amputation and adult blindness. With an increasing incidence worldwide, diabetes mellitus will be a leading cause of morbidity and mortality for the foreseeable future. Globally an estimated 422 million adults are living with diabetes mellitus according to the latest 2016 data from the world health organization. Diabetes currently affects more than 62 million Indians, which is more than 7.1% of the adult population. The average age on onset is 42.5year. in 2008 an estimated 347 million people in the world had diabetes and the prevalence is growing, particularly in low and middle income countries. India has 69.2million people living with diabetes (8.7%) as per the 2015 data of these it remained undiagnosed in more than 36 million peoples.

MATERIALS AND METHODS

All available authentic books in the yogic literature have been referred for the specific material. Related modern books, internet websites, magazines, articles etc. have been used as literature materials. Using different research database with the key words “diabetes mellitus”, “muscle contraction” and “Paschimottanasana” a comprehensive search of the research literature from core scientific and nursing journals yielded studies that met inclusion criteria. These studies were included in this review.

Anatomy of the Pancreas^[8]

Location: The pancreas lies more or less transversely across the posterior abdominal wall, at the level of first and second Lumbar vertebrae.

Size and Shape: It is J shaped or retort shaped set obliquely. It is about 15-20 cms long, 2.5-3.5 cms broad and 1.2 -1.8 cms thick and weigh about 90gms.

Nerve supply: The vagus/parasympathetic and the splanchnic or sympathetic nerves supply the pancreas through the coeliac plexus (solar plexus) around its arteries.

Blood supply: Mainly by the pancreatic branches of the splenic artery, the superior pancreaticoduodenal artery and the inferior pancreaticoduodenal artery.

Venous drainage-veins drain into splenic, superior mesenteric and portal veins.

Physiology of pancreas^[9,10]

The pancreas is composed of 2 major types of tissues (1)the acini which secrete digestive juices into the duodenum and (2)The islet of pancreas which secretes insulin and glucagon directly into the blood. The islets contain three major types of cells, alpha, beta and delta cells

- (1) Alpha cell-secretes insulin.
- (2) Beta cell- secretes glucagon.
- (3) Delta cell-secretes somatostatin.
- (4) PP cell-secretes pancreatic polypeptide.

Insulin is the important hormone that is concerned with regulation of carbohydrate metabolism and blood sugar level. It is also concerned with metabolism of proteins and fats.

Pathophysiology of diabetes mellitus^[6]

Insulin is the principal hormone that regulates the uptake of glucose from the blood into most cells of the body, especially liver, adipose tissue and muscle, except smooth muscle, in which insulin acts via the IGF-1. Therefore, deficiency of insulin or the insensitivity of its receptors play a central role in all forms of Diabetes mellitus.

The body obtains glucose from three main sources: the intestinal absorption of food; the breakdown of glycogen, the storage form of glucose found in the liver; and gluconeogenesis, the generation of glucose from noncarbohydrate substrate in the body. Insulin plays a critical role in balancing glucose level in the body. Insulin can inhibit the breakdown of glycogen or

the process of gluconeogenesis, it can stimulate the transport of glucose in to day and muscle cells, and it can stimulate the storage of glucose in the form of glycogen.

Insulin is released in to the blood by beta cells, found in the islets of Langerhans in the pancreas, in response to rising levels of blood glucose, typically after eating. Insulin is used by about two thirds of the body’s cell to absorb glucose from the blood for use as fuel. For conversion to other needed molecules, or for storage. Lower glucose level results in decreased insulin release from the beta cells and in the breakdown of glycogen to glucose. This process is mainly controlled by hormone glycogen, which acts in the opposite manner to insulin.

If the amount of insulin available is insufficient, if cells respond poorly to the effects of insulin or if the insulin itself is defective, then glucose will not be absorbed properly by the body cells that require it, and it will not be stored appropriately in the liver and muscle. The net effect is persistently high levels of blood glucose, poor protein synthesis and other metabolic derangement such as acidosis.

When the glucose concentration in the blood remains high over time, the kidney will reach a threshold of reabsorption, and glucose will be excreted in the urine (glycosuria).This increases the osmotic pressure of the urine and inhibits reabsorption of water by the kidney, resulting in increased urine production (polyuria) and increases fluid loss. Lost blood volume will be replaced in osmotically from water held in body cells and other body compartment, causing dehydration and increased thirst (polydipsia).

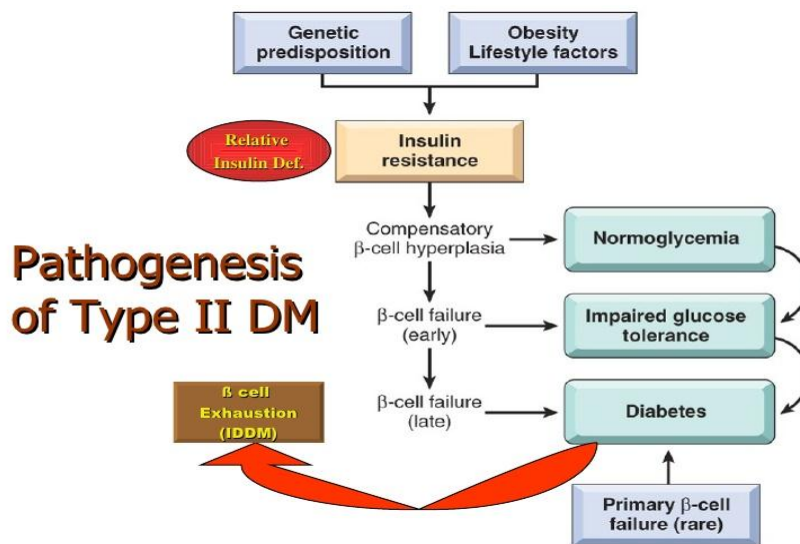


Fig.1.

Pàschimottanasana (Ugrasana/Brahmacharyasana)^[11,4]

Paschim means the West. It implies the back of the whole body from head to the heels. In this asana the back of the whole body is intensely stretched, hence the name.

Technique to perform the above asana

1. Sit on the floor with the legs stretched straight in front. Place the palms on the floor by the side of the hips. Take a few deep breaths.
2. Exhale, extend the hands and catch the toes. Hold the right big toe between the right thumb and the index and the middle fingers and likewise the left big toe.
3. Extend the spine and try to keep the back concave.
4. Now exhale, bend and widen the elbows, using them as levers, pull the trunk forward and touch the forehead to the knees. Gradually rest the elbows on the floor, stretch the neck and the trunk, touch the knees with the nose and then with the lips.
5. When this becomes easy, make a further efforts to grip the soles and rest the chin on the knees.
6. When this also becomes easy, clasp the hands by interlocking the fingers and rest the chin on the shins beyond the knees.
7. Try and stay in whichever of the above positions you can achieve from 1 to 5 minutes, breathing evenly.
8. Return to first step reversing the steps and the breathing.

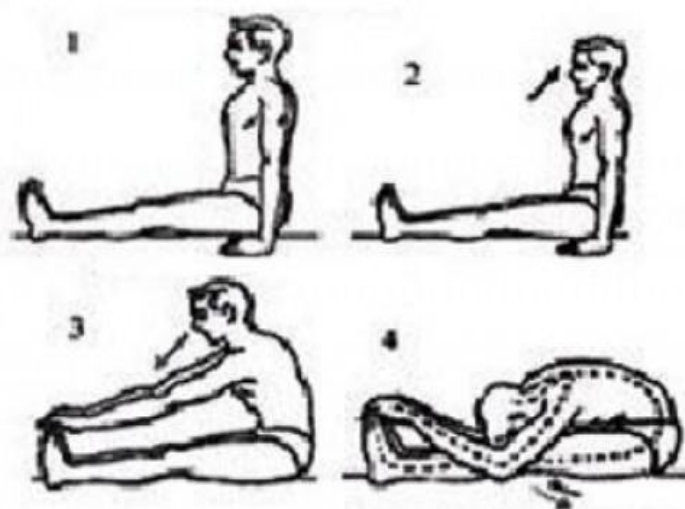


Fig.2.

Limitations

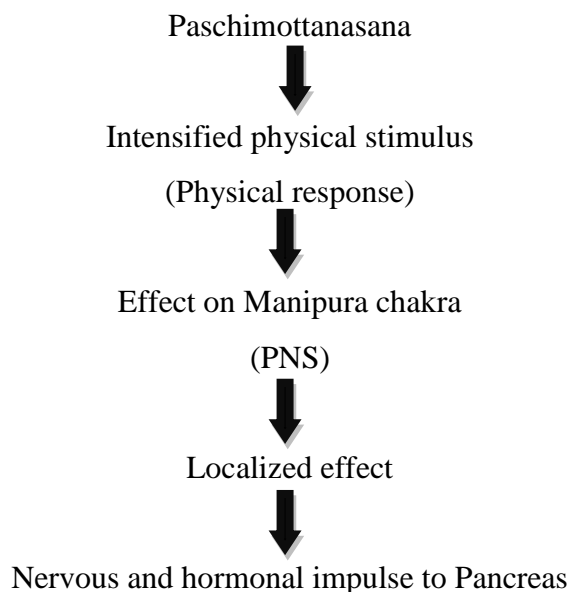
People with acute abdominal pain, lumbago, hernia, hydrocele, heart ailments, back problems like back pain and spondylosis should avoid this posture. Avoid practicing this asana if patient suffer from asthma or any respiratory problems or if patient have recently had any type of abdominal surgery. Practitioner would also have to skip this if they are pregnant or if they have diarrhea. Also people who suffer from slipped disc should not practice this asana.

DISCUSSION

Probable mechanism of action of paschimottanasana on diabetes mellitus-

(1) Action of paschimottanasana on type 2 diabetes mellitus through manipura chakra^[12,13,14]

Chakra verbally means “wheels of light”. Anatomically these chakras are wheels of neurovascular circulatory channels attached to the connective tissue of human body in various shape and size, where from different branches spring up and are communicated with or distributed to various organs and structure of body. In shatchakra nirupana manipura chakra is third chakra which can be correlated with vessels and nervous arrangement in the abdominal region as coeliac plexus and lumbar plexus and lumbar plexus lies in center surrounded by emerging superior mesenteric, inferior mesenteric and celiac vessels and in periphery on outer margin venous arcade can be seen. This anatomical concept is the base for understanding functions of manipura chakra. In hatha yoga pradipika many Asanas, Pranayama, Bandha and Mudra are mentioned with chakra as a point of action. There are many Asanas one of which is paschimottanasana which acts on manipura chakra. Regular practice of this asana stimulates Manipura chakra. As the adhisthana of this chakra is nabhi and peripheral Anatomical structure related to it, are the main pressing point by this Asana. The Manipura chakra is anatomically related to coeliac plexus, the celiac branches (rami celiac) are derived mainly from the Right vagus nerve and they join the coeliac plexus and supplies the pancreas. Vagus nerve supplies motor parasympathetic fibers to all organs except suprarenal glands. The parasympathetic fibers are secreto-motors, hence this asana by activating the parasympathetic fiber, stimulates the Beta cell of pancreas to secrete Insulin.



(2) Action of paschimottanasana on type 2 diabetes mellitus through Psycho-neuro-endocrine mechanism^[15,16]

Stressful experiences have been implicated in the onset of Diabetes in individuals already predisposed to developing the diseases. Stress suppress body's immune system and Neuro humoral actions thereby affecting normal psychological state. Pathophysiology of type 2 diabetes mellitus and co-morbidities in type 2 diabetes mellitus has been correlated with stress mechanism. With regard to the effect of stress on the neuroendocrine system, the HPA axis is of considerable importance. HPA axis act as a stress system of the body.

Any stress results in increased level of cortisol. The release of cortisol is controlled by the paraventricular nucleus (PVN) of the hypothalamus, where corticotrophin-releasing hormone (CRS) is released in response to stress. CRS then acts on the pituitary gland causing it to release adrenocorticotrophic hormone (ACTH), which in turn causes the adrenal cortex to release cortisol. The ultimate result of HPA axis is activation is to increase the level of cortisol in the blood during times of stress. Cortisol's main role is in releasing glucose into the bloodstream in order to facilitate the flight or fight response. Yoga acts via down regulating the HPA axis which get hyper activated as a response of stress. The postulated mechanism of action of paschimottanasana is through parasympathetic activation and the associated anti stress mechanism. It reduces perceived stress and HPA axis activation thereby improving overall metabolic and psychological profiles, increasing insulin sensitivity and improving glucose tolerance and lipid metabolism.

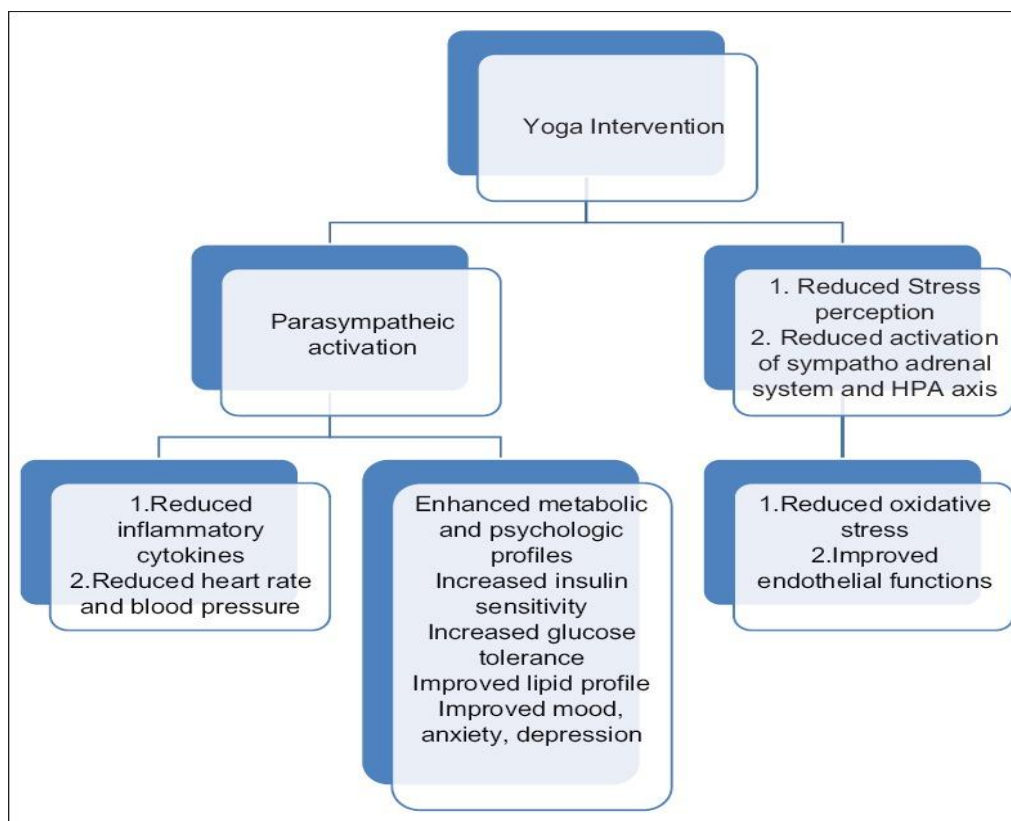


Fig.3.

(3) Action of paschimottanasana on type 2 Diabetes mellitus via muscle contraction^[17,18]

Paschimottanasana is a forward bending pose, while performing this asana, the forward bending action causes the contraction of the anterior abdominal muscle, muscle contraction results in an increase in membrane permeability to glucose. The actual mechanism by which contractile activity increases membrane permeability is unknown. However kinetic studies suggest that this increase is due to an increase in the number of glucose transporters associated with the plasma membrane. Unlike insulin stimulated glucose transport, in which permeability is reversed rapidly upon removal of the insulin, the increase in membrane permeability following contractile activity can persist for many hours. It has also been reported that the stimulatory effects of insulin and contraction are additive and that prostaglandin E₂ augments the effect of insulin on glucose transport but has no effect on contraction facilitated glucose transport. Collectively these findings suggest that insulin and contractile activity increase membrane permeability to glucose by independent mechanisms. With an increase in muscle activity, there is an increase in delivery of glucose and insulin to the muscle as a result of an increase in muscle blood flow. Glucose uptake may also be facilitated by an increase in the insulin sensitivity of the muscle. The increases in muscle blood flow and insulin sensitivity may be associated with activation of the Kinin-

prostaglandin system of the muscle. The increase in muscle insulin sensitivity may also involve an increase in insulin binding to its receptors on the sarcolemma. Muscle glycogen may also affect the rate of glucose uptake while performing this asana.

CONCLUSION^[19,4,15]

Studies indicate that the high incidence of diabetes in the country is mainly because of sedentary lifestyle, limited physical activity, obesity, stress and consumption of unhealthy diets. Diabetes is posing a serious lifestyle challenge and needs immediate attention. Yoga is a traditional exercise regimen that has yielded a statistically significant role in controlling the progression of diabetes mellitus. Asanas are a part of yoga. The science behind the asana is not hypothetical, since time immemorial there had been numerous yogis who achieved perfection through its practice. Paschimottanasana is one such asana which is said to be an excellent asana to control diabetes. Diabetes mellitus are multifactorial. Similarly it is difficult to postulate any single unidirectional pathway of paschimottanasana action on type 2 diabetes mellitus. Studies indicate that it acts through activation of parasympathetic pathway. It reduces stress and HPA axis activation thereby improving overall metabolic and psychological profiles. It also increases the cell permeability to glucose via muscle contraction as well as increases insulin sensitivity and improving glucose tolerance and lipid metabolism.

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