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Efficacy of Transcutaneous Tibial Nerve Stimulation on Constipation in Middle Aged Women: Literature Review

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Abstract

Background: Constipation is a common and costly condition which ultimately results in social and economic burden as it affects work performance and activities of daily living and prevalence of constipation is consistently higher in women than in men especially in the middle age.

Aim of Study: This review aims to investigate the effect of transcutaneous tibial nerve stimulation on constipation in middle aged women and to provide a framework for future research in order to formulate more comprehensive life style centered guidelines for treating middle aged women with constipation.

Material and Methods: A literature search was conducted in Pubmed, Cochrane library and Google Scholar databases with the keywords "Constipation", 'Middle age', "Tibial nerve stimulation", `Women'. Reviewed literature was descriptively analyzed and summarized.

Results: In the majority of the studies, transcutaneous tibial nerve stimulation is effective method for treating constipation in sufferer women.

Conclusion: Transcutaneous tibial nerve stimulation should be considered as an effective method for relieving constipation related symptoms and should be added in the treatment protocol of constipation in the affected women.

Key Words: *Constipation — Middle age — Tibial nerve stimulation — Women.*

Introduction

CONSTIPATION is one of the most common gastrointestinal complaints; it seems like a ubiquitous condition, something people of all ages experience and many complain about. It is often associated with infrequent bowel movements; however, in reality, constipation has a wide array of symptoms including hard stools, feeling of incomplete evacuation, abdominal discomfort, bloating, distension, excessive straining, sensation of anorectal blockage, or need for manual maneuvers during defecation [1].

Constipation can be divided into two main categories: Primary and secondary. Primary constipation is further divided into three main types: Functional, outlet dysfunction, and slow transit constipation. Secondary constipation may be caused by dietary and exercise patterns, disease processes and adverse effects of medication **[2,3].**

Constipation affecting many patients worldwide, estimated prevalence range of 1% to 80% **[4].** Women are more than twice as likely to suffer from constipation than men ***[5].*** It is frequently reported in the middle age which is classified as early middle age (ages 35-44), late middle age (ages 45-64), and late adulthood (ages 65 and older) ***[6,7].***

Constipation is higher in female due to female specific physiological characteristics. It is known that men have a greater skeletal muscle mass and a longer anal sphincter compared to women. Men also have a higher sphincter resting pressure and squeeze pressure than women [8].

In addition, it may also be attributed to unique hormonal fluctuations in females. Receptors of female sex hormones such as estrogen and progesterone are expressed throughout the gastrointestinal tract. These hormones can influence visceral sensitivity and slow gastric emptying and intestinal transit time **[9,10].**

Under the effect of progesterone during the luteal phase of the menstrual cycle or gestation period,

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the contraction of intestinal smooth muscle is inhibited and the transit time of the small intestine and colon is increased, which cause difficulty in defecation and the prevalence of constipation increased with longer menstruation timing [11-13].

The risk of constipation during pregnancy increased due to the significant rise in sex hormones, reduced movement and bowel emptying due to mechanical compression caused by the gravid uterus **[14].**

Also, it is high in multiparous women as damage to pelvic floor muscles and nerves which may occur during delivery cause pelvic floor dysfunction, which is also a risk factor of increased incidence of constipation in older women **[8,13,15,16].** Furthermore, women during menopause are frequently complained of constipation due to decline of sex hormones which affects muscle strength, tissue elasticity and resilience to load bearing in the pelvis **[8,16,17],** or may be due to Dyssynergic defecation which is associated with pelvic floor dysfunction and particularly with paradoxical contraction or insufficient relaxation of the levator ani, anal sphincter and abdominal wall muscles **[18,19].**

All the previous factors may explain the higher prevalence of constipation in females and why female sex is a risk factor for constipation.

Constipation is a common and costly condition which ultimately results in social and economic burden as it affects work performance and activities of daily living **[20].** Left untreated, constipation can worsen and potentially cause lifelong complications like hemorrhoids, anal fissures, and rectal prolapse **[21].** Straining can also damage the pudendal nerve and weaken the muscles of the pelvic floor **[22].**

Management of constipation has been prescribed, including topical drugs such as laxatives, probiotics, traditional therapies, and non-pharmacological treatments **[23].** Physicians and patients have increasingly considered non-pharmacological therapies. The main reason for this issue is that these therapies are mainly cheap, safe and have no side effects, and could also contribute to improving other illnesses **[24].** Diet modification and increased physical activity are the most crucial element of non-pharmacological therapies especially diet containing fiber and fluid **[25].**

A newer, cheaper and less invasive variant of sacral nerve stimulation (SNM) is tibial nerve stimulation (TNS). The tibial nerve is a branch of the sciatic nerve. It is a mixed nerve containing both motor and sensory fibers originating from the IA-S3 roots of the sacral plexus. These roots provide stimulation to the genitourinary tract as well as the pelvic floor muscles and the lower gastrointestinal tract **[26].**

Transcutaneous tibial nerve stimulation (TTNS) activates parasympathetic and inhibit sympathetic nervous systems so, it enhances the gastrointestinal peristalsis and colonic propagating sequences to speed up transit time and relieve symptoms of constipation **[27].**

There is a lack of standardized "TTNS treatment protocols and knowledge about the optimal "TTNS parameters, especially for constipation. Only few studies about the effect of "TTNS on constipation have been published **[28-31].** These studies all feature a heterogeneous study population, use different stimulation parameters and different outcome measures. So, this study reviewed the available literature studied the effect of "TTNS on constipation specially in middle aged women to illustrate its benefits in improving patients' outcomes.

Material and Methods

This literature review was based on a literature search in Pubmed, Cochrane library and Google Scholar databases with the keywords "Constipation", "Middle age", "Tibial nerve stimulation", "Women". The search depended on articles published from 2016-2022. The search was exclusive to articles written in the English language. Studies on children were excluded.

Results

Results of this review are based on reviewing the available literature about the effect of transcutaneous tibial nerve stimulation on constipation in women, taking into consideration that some articles included both sexes in their sample. A summary of the six reviewed studies is provided in (Table 1).

Table 1: The characteristics of the studies investigated the effect of tibial nerve stimulation on constipation

Author year	Study design	Patients	.Ige mean	Outcomes	Comparator	Parameters	('onclusion
lqbal et al. [301	Not clear	15 patients (12 females) with constipation diagnosed according to the Rome III criteria	median age was 46 years	-Patient Assessment of Constipation Symptoms (PAC-SYM) -Patient Assessment of Constipation Quality of Life (PAC-QOL) -Visual Analogue Scale (VAS)	TINS group	- TINS, 30 min, daily for 6 weeks, pulse width of 210 ps and frequency of 14 Hz -with a rest time of 99 s and 2 s at an amplitude of tolerable sensory threshold (maximum 33 mA) but below motor threshold.	Bilateral transcutaneous tibial nerve stimulation appears to be effective in a quarter of patients with chronic constipation. Carefully selected patients with less severe disease may benefit more.
Gokce et al.[311	Not clear	105 patients 64 females. 41 males with functional constipation diagnosed	The mean age was 43.1	The Constipation Severity Instrument (CSI)	TINS group	Bilateral TTNS, 30 min. 3 times per week for 6 weeks and for another 6 weeks after the	Bilateral TINS is a noninvasive. easily applicable, and effective treatment for functional constipation, without
		with Rome I% criteria				treatment pulse width of 200 ss and frequency of 10 Hz	major adverse effects
Madbouly et al.1291	prospective case series	36 patients (25 women) with rectal evacuation disorder without anatomic obstruction who were failing maximal conservative treatments	The *mean* age of patients was 57.2 years	Modified Obstructed Defecation Score Rectal Sensitivity Volumes (urge to defecate volume and maximal tolerable volume) - Patient Assessment of Constipation Quality of Life (PAC-QOL)	TINS group	Bilateral TINS, 30 min, 3 times per week for 6 consecutive weeks. pulse width of 200 its and frequency of 10 Hz. the amplitude was maintained at a level that induced a response but was comfortable for the patient.	-Bilateral TINS can improve symptoms in a considerable percentage of patients with obstructed defecation without anatomic obstruction --The procedure is more effective in patients with less modified obstructed defecation syndrome'
Saba and Elsawy.1361	Randomized ,:linical trial	41 patient(25 females, 16 males)	The mean age was 37.95 ± 15.45 years	Modified Obstructed Defecation Score (MODS) -Patient Assessment of Constipation-	Percutaneous tibial nerve stimulation (PTNS)group (20 patients) Biofeedback	PTNS group: patients received 18 sessions of PINS at a frequency of	-Both biofeedback pelvic floor muscle training and posterior tibial nerve electrostimulation are considered effective

				Quality of Life questionnaire(PAC-QoL) -Time of toileting -Maximum anal pressure during straining to evacuate.	(BF) group (21 patients)	three sessions per week over a period of 6 weeks, pulse width of 200 tts and frequency of 10 Hz The amplitude was maintained at a level that induced a response but was comfortable for the patient	methods in the treatment of functional obstructed defecation. However, biofeedback pelvic floor muscle training seems to be more effective and superior in comparison to posterior tibial nerve electrostimulation. -Posterior tibial nerve electrostimulation could be consid ered as a second line therapy after failure of biofeedback pelvic floor muscle training.
Zhang et al. [271	A placebo-controlled cross over study	12 patients (SFemales, 4Malcs) with chronic function constipation diagnosed with Rome III criteria	The median age was 60 years	-Bowel habit diary -PAC -SYM **PAC_QOL** .Anorectal motilit❙	Transcutaneo us neuromodulati on (TN) (group 1) -Sham TN (group 2)	Two electrodes were placed for posterior tibial nerve and acupoint S36 stimulation, it was applied with pulse width of 0.5ms, pulse frequency of 25 Hz, amplitude of 2 to 10 mA (depending on the tolerance of the patients fort hour twice daily for 2 weeks	-Needleless TN at posterior tibial nerve and ST 36 is able to improve the major symptoms of constipation and anorectal motility. especially rectoanal inhibitory reflex' and rectal sensation. -Home-based noninvasive TN therapy may be a potential treatment for functional constipation.
Wu **at** al. [371	Randomized, single-blinded cross-over pilot study.	**18 Patients (Male/Female:** 9/9) With functional constipation diagnosed with Rome Ill criteria	**The median** age was 54 years	**Bowel habit** diary **PAC _SYM** PAC-QOL **Anorectal manometery**	-TN at ST36 group 1 -TN at PIN group2	The TN treatments were applied on both legs simultaneously via 2 stimulators on each leg with pulse width of 0.5 ms. pulse frequency of 25 Hz. amplitude of 2 to 10 mA (depending on the tolerance of the patients Twice daily for 1 hour for 2 *weeks*	TN at ST36 is more potent than TN at PTN in treating constipation and improving constipation-related symptoms and rectal sensation.

Discussion

How TTNS may work to treat constipation in middle aged women:

The effects of the 'TTNS on constipation are secondary to changes in autonomic functions. It enhanced the activation of the parasympathetic nervous system and suppressed the activation of sympathetic nervous system. Reductions in the activities of sympathetic nerves improve the gastrointestinal peristalsis that result in an increase in colonic propagating sequences to speed up transit time. Increasing parasympathetic nerve activities with 'TTNS possibly relieve symptoms of constipation through improvement in anorectal physiology or colonic peristalsis **[27].**

Posterior tibial nerve stimulation influences both motor and sensory pathways, as well as the central nervous system. Stimulation of posterior tibial nerve roots (IA to S3) could improve stool evacuation through S3 and/or S2 stimulation **[29].** It might also increase the frequency of both antegrade and retrograde colonic propagating sequences

(through S3 and S2 stimulation), hence improving the mechanism of defecation **[32].**

Application of TNS:

Tibial nerve stimulation can be applied in the form of transcutaneous or percutaneous stimulation. Transcutaneous is applied via two adhesive surface stimulation electrodes attached to the skin. The positive electrode is placed 10cm cranially to the medial malleolus. A second, negative, electrode is placed behind the medial malleolus on the same leg [29,30].

Percutaneous stimulation is applied by the application of a 34-Gauge needle electrode 5cm cephaled to the medial malleolus and 2cm posterior to the tibia. The needle is inserted approximately 2cm into the leg and the electrode is connected to the lead wire. The superficial electrode is attached near the medial aspect of the calcaneus. The right strength of current can be determined by slowly increasing the current until a response is provoked. This response can be either motor (flexion of the toe) or sensory (tingling in the heel or toes). Once the response is obtained, the current level is reduced slightly to sub-threshold **[33,34].**

Stimulation parameters vary with a frequency ranging from 10-14 Hz and a pulse width ranging from 200-220p s **[28].** Most stimulators use a fixed pulse frequency of 20 Hz and pulse width of 200ps. Previous studies have suggested that changing these parameters may affect success rate in treating constipation **[34].**

There is no consensus regarding the fact that stimulation should be performed unilaterally or bilaterally. However, a pilot study on bilateral 'TTNS predicts a better efficacy in comparison with unilateral stimulation, as is the case with other types of neurostimulation [35].

TTNS Parameters:

Type of current: TENS was used in all studies.

Pulse width: The pulse width ranging from 200-220p s. The most common used pulse width was 200ps **[29,31,36].** However, some studies used higher pulse width of 220p s **[30].**

Frequency: The most common used frequency was 10 HZ **[29,31,36].** Some studies used high frequency 14 Hz **[30],** and other studies used pulse frequency of 25 Hz **[27,37].**

Intensity: The amplitude was maintained at a level that induced a response but was comfortable for the patient **[29,31,36].** There weretwo studies usedamplitude of 2 to 10mA (depending on the tolerance of the patients) **[27,37],** and one study used amplitude of tolerable sensory threshold (maximum 33mA) but below motor threshold **[30].**

Duration of the session: It was mainly applied for 30 minutes **[29,30,31,36].** In some studies the session duration was 1 hour **[27,37].**

Repetition of the treatment: The session was applies 3 times per week **[29,31,36].** In one study the session was applied daily **[30],** and in two other studied the session was applied twice daily **[27,37].**

Total duration of the treatment program: It was commonly applied for 6 weeks **[29,30,31,36].** It was rarely used for less than 6 weeks, some studied used it for only two weeks **[27,37].**

Concluion:

TTNS is a low-cost, non-invasive, easy-to-apply method with no complications. So, it can be used as a complementary therapy to improve symptoms of constipation in the middle aged females without side effects. Therefore, it should be recommended as an alternative treatment for constipation in women with resistant to standard care and laxative agents.

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فعالية تحفيز العصب الظنبوبى عبر الجلد على الإمساك لدى النساء فى منتصف العمر: مراجعة الادبيات

الإمساك هو أحد أكثر مشاكل الجهاز الهضمى انتشاراً ويحدث فى جميع الأعمار ويشكو منه الكثير وله مجموعة من الأعراض كالبراز الصلب، والشعور بالإخلاء الغير كامل وعدم الراحة فى البطن، والإنتفاخ والإجهاد المفرط والاحساس بانسداد الشرج أو الحاجة لاستخدام اليد أثناء التغوط. فالنساء أكثر عرضة للإصابة بالإمساك مرتين من الرجال كما أنه يحدث بصورة كبيرة فى منتصف العمر لدى السيدات. والإمساك حالة شائعة ومكلفة تؤدى إلى عبء اجتماعى واقتصادى لأنه يؤثر على أداء العمل وأنشطة الحياة اليومية. وإذا تُرك دون علاج يؤدى إلى مضاعفات مدى الحياة مثل البواسير والشرح الشرجى وسقوط المستقيم. كما أنه قد يؤدى إلى تلف العصب الفرجى وإضعاف عضلات الحوض. فمن الممكن استخدام تنبيه العصب الظنبوبى عبر الجلد كعلاج بديل لتحسين أعراض الإمساك فى الإناث فى منتصف العمر حيث أنه منخفض التكلفه، سهل التطبيق وليس له أى مضاعفات أو أعراض جانبيه لذلك يوصى به كعلاج بديل للإمساك.

فالعصب الظنبوبى هو فرع من العصب الوركى وهو عبارة عن عصب مختلط يحتوى على ألياف حركية وحسية وحسية تنشأ من جذورمن الضفيرة العجزية L4–S3.

وتعمل هذه الجذور على تحفيز الجهاز الهضمى السفلى وعضلات قاع الحوض. تعتبر تأثيرات تحفيزه على الإمساك ثانوية للتغيرات فى الوظائف اللاإرادية. فيعمل على تعزيز تنشيط الجهاز العصبى الباراسمبثاوى وقمع تنشيط الجهاز العصبى السمبثاوى فتؤدى التخفيضات فى أنشطة الأعصاب السمبثاوى إلى تحسين التمعج المعدى المعوى الذى ينتج عنه زيادة فى تسلسل انتشار القولون لتسريع وقت العبور. وزيادة أنشطة العصب الباراسمبتاوى قد يخفف من أعراض الإمساك من خلال تحسين وظائف الأعضاء الشرجية أو التمعج القولونى.