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

WALAA S. MOHAMED, M.Sc.*; AFAF M. BOTLA, PhD.*; SAGED M. EI MAZALY, M.D.** and MANAL A. EL-SHAFEI, PhD.*

The Department of Physical Therapy for Women's Health*, Faculty of Physical Therapy, Cairo University and Department of Obstetrics & Gynecology**, Faculty of Medicine, Al-Azhar University

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,
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 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 L4-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

<table>
<thead>
<tr>
<th>Author year</th>
<th>Study design</th>
<th>Patients</th>
<th>ge mean</th>
<th>Outcomes</th>
<th>Comparator</th>
<th>Parameters</th>
<th>Conclusion</th>
</tr>
</thead>
</table>
| Iqbal 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 treatment | Bilateral TINS is a noninvasive, easily applicable, and effective treatment for functional constipation, without 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 ns 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 clinical trial | 41 patients(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 of 20 patients | PTNS group | -Both biofeedback pelvic floor muscle training and posterior tibial nerve electrostimulation are considered effective |
1312 Efficacy of Transcutaneous Tibial Nerve Stimulation on Constipation in Middle Aged Women

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 µs 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 considered as a second line therapy after failure of biofeedback pelvic floor muscle training.

Zhang et al. [27]
A placebo-controlled cross-over study
12 patients (6 Females, 3 Males) with chronic function constipation diagnosed with Rome III criteria

-Bowel habit diary
-PAC-SYM
-PAC-QOL
-Anorectal motility
Transcutaneous neuromodulation (TN)
- Sham TN (group 2)

Two electrodes were placed for posterior tibial nerve and acupoint ST36 stimulation, it was applied 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 for 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

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 10 cm 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 5 cm cephalad to the medial malleolus and 2 cm posterior to the tibia. The needle is inserted approximately 2 cm 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 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 200-220 ps [28]. Most stimulators use a fixed pulse frequency of 20 Hz and pulse width of 200 ps. 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 200-220 ps. The most common used pulse width was 200 ps [29,31,36]. However, some studies used higher pulse width of 220 ps [30].

Frequency: The most common used frequency was 10 Hz [29,31,36]. Some studies used higher 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 used amplitude of 2 to 10 mA (depending on the tolerance of the patients) [27,37], and one study used amplitude of tolerable sensory threshold (maximum 33 mA) 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 applied 3 times per week [29,31,36]. In one study the session was applied daily [30], and in two other studies 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 studies used it for only two weeks [27,37].

Conclusion:

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.

References

10- LENHART A., NALIBOFF B., SHIH W., GUPTA A., TILLISCH K., LIU C., et al.: Postmenopausal women with irritable bowel syndrome (IBS) have more severe symp-
Efficacy of Transcutaneous Tibial Nerve Stimulation on Constipation in Middle Aged Women


فعالية تحفيز العصب الضوغي عبر الجلد على الإمساك
لدى النساء في منتصف العمر:
مراجعة الأدبيات

الإمساك هو أحد أكثر مشاكل الجهاز الهضمي انتشاراً ويحدث في جميع الأعمار ويشكو منه الكثير ولها مجموعة من الأمراض كالبراز الصلب، والشعور بالإزهار، الغير كاملاً وعدم الراحة في البطن، والالتهاب والإجهاد المزمن والإحساس بالشعور بأعدم الراحة أو الحاجة لاستخدام اليد أثناء التغذية. فالنساء أكثر عرضة للإصابة بالإمساك مرتين من الرجال كما أنه يحدث بصورة كبيرة في منتصف العمر لدى السيدات. والإمساك حالة شائعة وكتلة تؤدى إلى عبء اجتماعي واقتصادي لأنه يؤثر على أداء العمل وأنشطة الحياة اليومية، وإذا نجح دون علاج يؤدي إلى مضاعفات مدى الحياة مثل البواسير والشرج الشرجي وضعف المستقبل. كما أنه قد يؤدي إلى تليف العصب الفرغي وإضعاف عضلات الحوض. فمن الممكن استخدام تنبيه العصب التوسيع عبر الجلد كعلاج بديل لتحسين أعراض الإمساك في الإناث في منتصف العمر حيث أنه منخفض التكلفة، سهل التطبيق وليس له أي مضاعفات أو أعراض جانبية لذلك يوصى به كعلاج بديل للإمساك.

العصب التوسيع هو إجرا من العصب الوركي وهو عبارة عن عصب مخلط يحتوي على ألياف حركية وحساسية تنشأ من جذور من السفيرة العجزية S3-4.

وترتكز هذه الجذور على تهيج الجهاز الهضمي السفلي ومضادات قاع الحوض. تعتبر تأثيرات تهيج هذه الجهاز ثانوية للعصب، فإنها تساعد في التظاهر الإراديات. فعلم على تهيج تهيج الجهاز التوسيع الباراسيمباوتي وقمب تتشابه الجهاز العصبي السمباوتي فتدأ التحسينات في منشأة الجهاز السفلي إلى تحسين التشنج المعرفي المزمن والذي ينتج عنه زيادة في تسلسل انتشار القولون وتسريع وقت البدور، وزيادة منشأة الجهاز الباراسيمباوتي قد يخفف من أعراض الإمساك من خلال تحسين وظائف الأعضاء الشرجية أو التمتع الفوقلي.