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Effect of Pulsed Electro Magnetic Field versus Transcutaneous Electrical Nerve Stimulation on Menstrual Distress of Primary Dysmenorrhea

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Abstract

Background: Dysmenorrhea known as painful periods or menstrual cramps, the pain is commonly felt in the lower abdomen or pelvic, Backache, diarrhea, and nausea are some of the other symptoms . Symptoms usually last three days or less.

Aim of Study: This study was conducted to determine effect of pulsed electro magnetic field versus Transcutaneous electrical nerve stimulation on menstrual distress of primary dysmenorrhea.

Patients and Methods: Forty female diagnosed as primary dysmenorrhea with normal menstrual cycle (certified gynecologist) their ages 18-24 years, their body mass index (BMI) less than 29kg/m^2 with no medical or psychological problems, were selected randomly from Alexandria General Hospital (Obstetrics and Gynaecology Department), from 5 April to 30 September 2021. The females were divided equally and randomly allocated within two groups of 20 per each; study (G1) group received PEMF of 50HZ and 60gauss at lumbosacral region (L4-S3) for 3 sessions per cycle for 3 consecutive cycles, each was 30 minute, while female in a comfortable modified side lying with small paddings across curves, While control (G2) group received TENS using 100Hz with pulse width 95 microseconds, with intensity produced a comfortable perceptible paraesthesia without muscular contraction along 30minutes while female in supine and electrodes were bilaterally placed ~5cm laterally to midline at umbilical level, study protocol applied twice per day for first two days of menses, along two successive menses. Primary dysmenorrhea was evaluated by Walidd score, Menstrual symptom questionnaire (MSQ) and measurement concentration of prostaglandins level pre and post treatment of both groups.

Results: Obtained result has revealed a statistically significant decrease in prostaglandins values, Walidd score and menstrual symptom questionnaire in both groups, but study (G1) group revealed a statistically significant improvement at all measures than control (G2) group (p<0,001).

Conclusion: Based on the obtained study results, it's concluded that both PEMF and TENS were effective modalities, but PEMF was more effective than TENS in treating primary dysmenorrhea.

Key Words: *Primary dysmenorrhea – Pulsed electromagnetic field- TENS – Prostaglandin level.*

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Introduction

DYSMENORRHEA can be defined as painful menses in females that represent a common gynecologic problem worldwide affecting about 60% of womenamong adolescent andyoung adult females. It categorized into two types: Primary and secondary dysmenorrheal **[1,2]**. Primary dysmenorrhea is a painful menstrual cramp that felt in lower abdomen and pain can transfer downwards into the inner thighs. Common symptoms displayed by females suffering from the condition include nausea, diarrhoea, vomiting, lethargy, and headaches, many of which can have an adverse impact on daily life **[3]**. Primary dysmenorrhea usually happen in earlier age but may be remained until 50 years old. It begins around the time that a female's initial menstruation begins. Specifically, it appears one to two years following the start of menarche (first menstruation), and this notably corresponds to the incidence of consistent ovulatory cycles. Typically, the discomfort associated with the condition starts several hours prior to or following the beginning of menstruation, and its duration is two to three days **[4]**.

The etiology of primary dysmenorrhea is not exactly understood, but can be explained by excessive or imbalanced secretion of uterine prostaglandins form endometrium during menstruation with falling progesterone level during the luteal phase

brings about these elevations, particularly PGF2 a [5]. These levels reach their peak during the initial two days of menstruation and, as such, facilitate myometrial contractions characterised by ischemia and dysrhythmic behaviour, with increased basal tone and increased active pressure. Uterine hypercontractility, reduced uterine blood flow, and increased peripheral nerve hypersensitivity are effective in inducing pain [4]. Prostaglandin (PG) increases the level of tension and contraction strength of uterus and blood vessels, and this process may induce pain, thus, the measure of PG level can be an indicator of intensity of dysmenorrhea. PG level can show the therapeutic effect on dysmenorrhea objectively [6]. Drugs therapy centring on PG inhibitors, which include non-steroid anti-inflammatory drugs (NSAIDs), result in hepatic, renal, hematologic, and gastrointestinal pain, along with central nervous system (CNS) toxicity, which includes indigestion, nausea, constipation, diarrhoea, headache, abdominal pain, dizziness, rashes, impaired renal blood flow, renal papillary necrosis, and vertigo [7,8].

A range of treatment options have been examined in the literature, including heat application, pelvic floor and aerobic exercises, and acupuncture, acupressure, Herbs, Low level laser therapy (LLLT) [9,10,11], and Transcutaneous electrical nerve stimulation with several producing effective outcomes, It induce blood flow and analgesic effect, and inhibition of nociceptive fibers throughout evoking responses along dorsal horn. Based on gate control theory concerning pain control, such inhibition was initiated by large diameters excitation of those afferents through applied Tens modality [12].

Pulse Electromagnetic field (PEMF) has been used in the physical therapy field as a useful modality for treatment of many diseases, it shows vasodilatation, analgesic effect, anti-inflammatory action and anti-edematous activity [13]. PEMF offers a non-invasive, harmless, and simple method to directly treat the site of lesion, the source of pain and inflammation in a wide range of diseases and pathologies [14]. The beneficial effects of PEMF on body tissues include: Pain reduction, decrease of inflammation, improving the number and action of white blood cells and fibroblast in the wound, increase rate of edema reduction, absorption of hematoma, stimulates osteogensis, anti-infective activity, and increases the healing of peripheral and central nervous system [15]. Study to investigate the effect of PEMF versus TENS in treatment of primary dysmenorrhea concluded that both of them have effect in dysmenorrhea, providing an effective, safe, low-cost and successful alternative rather thanpharmacological treatment [16]. But, PEMF appears to be more effective than TENS in treatment of primary dysmenorrhea.

Subjects and Methods

Subjects:

Forty females were suffering from primary dysmenorrhea with normal menstrual cycle (diagnosed by gynecologist). They were assigned randomly into two groups (A,B) equal in numbers. Group (A) received PEMF of 50 Hz and 60 gauss at lumbosacral region (L4-S3) for 3 sessions per cycle for 3 conservative cycle, while female in a comfortable modified side lying with small paddings across curves, While (GB) received TENS using 100Hz with pulse width 95 microseconds, with intensity produced a comfortable perceptible paraesthesia without muscular contraction along 30 minutes while female in supine and electrodes were bilaterally placed 5cm laterally to midline at umbilical level, study protocol applied twice per day for first two days of menses, along two successive menses. The Inclusion Criteria were as follow: Their age ranged between 18-24 years, Their BMI less than 29Kg/m^2 with no medical or psychological problems. The exclusion criteria were as follow: Having pacemaker or metal implantations, Irregular or infrequent menstrual cycle, cardiovascular problems, chest infection, pulmonary problem, any pelvic disorders including endometriosis, adenomyosis or any other problems in the pelvis. The females participated in the study after signing an informed consent form before data collection. After ethical approval, females were selected from Alexandria General Hospital (Obstetrics and Gynaecology Department), from 5 April to 30 September 2021.

Materials (Equipments):

Current study equipment's were allocated into two categories; measurement equipment and treatment equipment:

1- *Measurement equipment:*

The following measurement instruments were used in this study:

- Informed consent form which is a voluntary free written consent that assigned by each female before participating in the research study.
- Recording data sheet where tabulate personal and demographic data of each female.
- Weight and height scale which is a health scale was used to evaluate height and weight to calculate BMI before starting the study for both groups.

- Walidd score which was used to diagnose dysmenorrhea before and after treatment (3 month) for both groups.
- Menstrual symptom questionnaire which was used to assess psychological and physical manifestations of dysmenorrhea in both groups before and after the study (3 month).

2- *Treatment equipment:*

- Pulsed electromagnetic field (PEMF).
- Transcutanuos electrical nerve stimulation (TENS).

Methods (Procedures):

All females received a full in detailed information concerning current study and a written approval consent form was signed at the beginning of the current study.

Evaluation procedures:

All study examining procedures were performed at the beginning and by the end of study protocol, as well after 3 month "follow-up". History taking In details Obstetric, medical and menstrual present history were taken from each female in both groups to be sure for their inclusion criteria or other issue might exclude any of them or even influence current trial and recorded in such case.

Weight and height measurement: Weight, height and BMI were measured During measurement, females wore thin layer of clothes and no shoes.

Walidd score: It was verified to examine dysmenorrhea before and after treatment (3 month) for females. It is a survey tool containing; working ability, location, intensity, days of pain.

Females of both groups were asked questions before and after treatment sessions included in this scale such as:

Anatomical pain sites number (none, lower abdomen, lumbar area, lower extremities, inguinal area).

Wong-Baker range of pain (not hurting, a little, a little more, even more, a lot, a lot more) **[16]**.

Extent of days during menstruation felt pain (0, 1-2, 3-4, ›_5). 4) Frequencies of disabling pain to perform own activities (never, almost never, almost always, always).

Each scale item supply for a specific value from 0, 1, 2 and 3, and sum overall score was 0-12 points.

Score: 0 no dysmenorrhea, 1-4 mild, 5-7 moderate, 8-12 severe dysmenorrhea.

Menstrual symptom questionnaire (MSQ): Was used for evaluating both psychological and physical manifestations associated with dysmenorrhea before and after the study (3 month).

Females were asked questions in a table contain physical and psychological variables each of them had a score ranged from 1 to 5, these variables measured at beginning and by the end of trial protocol to estimate the treatment gains.

Blood samples: The measurement of concentration of serum PGF2a was conducted by collect (5ml) of blood sample from each female before and after three months of treatment application **[17]**.

Treatment procedures:

Pulsed electromagnetic field (PEMF):

Concerning females in study group (G1), where females were instructed in brief to gain their familiarization to machine. Each female received the session in the following manner.

Preparation of the females:

Each female must not wear any metal objects during the magnetic field application or anything sensitive to magnetic field, such as chains, belts, watches. Mobile phones were apart from the equipment. The treatment was applied while the female lying in a comfortable modified side lying position with small paddings under her body curves. Explanation of magnetic therapy apparatus and the protocol of treatment to females before treatment.

Magnetic therapy parameters were adjusted as the following **[17]**:

- Current: Series of magnetic pulses.
- Frequency of magnetic field: Low frequency magnetic field (50Hz).
- Intensity of magnetic field: 60 gauss.
- Length of application: 30 minute for every female in the study group (G1). Recommended accessories: Solenoid 70cm was adjusted to be over abdomen and back.
- Frequency of treatment: 3 sessions per cycle, for 3 consecutive ones.
- Location: At lumbosacral region (L4-S3) level.
- Application of equipment: When the subject complain of unbearable pain a day before beginning of menstrual flow, and the treatment was repeated on the first and second days of the menstrual flow, each session last for 30 minutes.

After completing the treatment session time, the device was switched off and the solenoid was removed.

Transcutaneous electrical nerve stimulation (TENS): The main procedure done for control (G2), general instructions in brief concerning TENS were given to gain participants familiarization. Each female received the session in the following manner.

Preparation of the females:

Females were covered with a white she et except for the treated part.

The treated part was inspected for cuts, abrasions, swellings, and infection.

Females were asked to be stable and to avoid moving during the session.

Females were placed in a relaxed comfortable position (supine lying position).

Position of electrodes: Were bilateral placed nearby a 5cm lateral to midline at umbilical level.

The TENS parameters were adjusted as the following **[18]**:

- Frequency: High frequency 100Hz.
- Pulse width: 95 microseconds.
- Intensity: Just to gain a comfort perceptible paraesthesia without muscular initiation.
- Duration: 30 minute.
- Frequency of treatment: It was applied twice per day for first two days of the current menstrual cycle and repeated for two successive menstrual cycles.

Statistical analysis:

Unpaired *t*-test were conducted for comparison of subject characteristics between groups. Normal distribution of data was checked using the Shapiro-Wilk test for all variables. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. Unpaired *t*-test was conducted to compare the mean values of prostaglandin level, WaLIDD score and MSQ between groups. Paired *t*-test was conducted for comparison between pre and post treatment in each group. The level of significance for all statistical tests was set at $p<0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

Results

- Subject characteristics:

Table (1) showed the subject characteristics of the group A and B. There was no significant difference between groups in age, weight, height and BMI ($p>0.05$).

Table (1): Basic characteristics of participants.

	Group A Mean ± SD	Group B Mean ± SD	MD	*t*-value	*p*-value
Age (years)	22.15±1.49	21.9±1.29	0.25	0.56	0.57
Weight (kg)	67.25±4.71	66.7±4.32	0.55	0.38	0.7
Height (cm)	170.2±3.5	170.1±3.24	0.1	0.09	0.92
BMI (kg/m^2)	23.29±1.97	23.2±1.48	0.09	0.17	0.86

SD: Standard deviation. *p*-value, level of significance.

Effect of treatment on prostaglandin level, WaLIDD score and MSQ:

- Within group comparison:

There was a significant decreasein prostaglandin level post treatment in thegroup A and B compared with that pre treatment ($p>0.01$). The percent of change of prostaglandin level in group A was 35.8% respectively and that of group B was 19.88% respectively (Table 2).

There was a significant decrease in WaLIDD and MSQ scorespost treatment in the group A and B compared with that pre treatment ($p>0.001$). The percent of change of WaLIDD and MSQ scores in group A was 64 and 61.44% respectively and that of group B was 48.03 and 46.55% respectively. (Table 3).

- Between groups comparison:

There was no significant difference betweengroups pre-treatment ($p>0.05$). Comparison between groups post treatment revealed a significant decrease in prostaglandin level, WaLIDD score and MSQ score of the group A compared with that of the group B ($p<0.001$). (Tables 2,3).

Table (2): Mean prostaglandin levelspre and post-treatment of the group A and B.

Prostaglandin level (ng/100 mg tissue)	Group A Mean ± SD	Group B Mean ± SD	MD	*t*-value	*p*-value
Pre treatment	28.83±5.31	30.18±4.22	–1.35	–0.89	0.37
Post treatment	18.51±3.28	24.18±3.96	–5.67	–4.93	0.001
MD	10.32	6			
% of change	35.8	19.88			
t-value	10.17	11.58			
	$p=0.001$	$p=0.001$			

SD : Standard deviation.
MD: Mean difference.
p-value: Probability value.

Table (3): WaLIDD score and MSQ score pre and post-treatment of the group A and B.

	Group A Mean ± SD	Group B Mean ± SD	MD	*t*-value	*p*-value
WaLIDD score:					
- Pre treatment	6.25±1.94	6.35±1.84	–0.1	–0.16	0.86
- Post treatment	2.25±0.96	3.3±0.86	–1.05	–3.62	0.001
- MD	4	3.05			
- % of change	64	48.03			
- *t*-value	14.23	10.35			
	p=0.001	*p*=0.001			
MSQ score:					
- Pre treatment	20.1±1.65	20.3±1.94	–0.2	–0.35	0.72
- Post treatment	7.75±1.11	10.85±1.04	–3.1	–9.07	0.001
- MD	12.35	9.45			
- % of change	61.44	46.55			
- *t*-value	50.69	19.1			
	p=0.001	*p*=0.001			

SD : Standard deviation.
MD: Mean difference.
p-value: Probability value.

Discussion

Obtained result of current clinical trial revealed a statistically significant decrease in prostaglandins values, Walidd score as well menstrual symptom questionnaire in both groups, unless when comparing study two groups, it was found that the study (G 1), which treated with pulsed electromagnetic field, showed a statistically significant decrease in prostaglandins level, Walidd score, and Menstrual symptom questionnaire more than the control (G2) tat received TENS (p<0,001).

Our obtained results came in agreement with Sweeney et al., **[19]**, who studied the PEMF benefits in pain-relieving, found that it had myorelaxation and Spasmolytic effects (blood flow improvement, blood vessel relaxing, and the washing out of acidic metabolites that cause painful irritation).

The result of the study came in same context with Rohde et al., **[20]**, had reported that PEMF could raise cytokine interleukin (IL)-1 that considered an anti-inflammatory, and in turn lowering proinflammatory cytokine IL-1b that is a potent hyperalgesic modulator, as well considered a nociceptors initiator. Furthermore, IL-1b has been shown to affect neuronal excitability by influencing release of nociceptive known molecules involving; IL-6, also prostaglandins through neuronal detectors including receptors of gamma-amino butyric acid, as well receptors of glutamate, also neuronal ions across channel protein.

The result of the study were agreed with Strauch et al., **[21]**, who demonstrated that PEMF had analgesic effect and reduce pain by nitric oxide (NO) synthesis and/or release, as well as the inverse relationship between pain intensity and NO levels, demonstrated that it has a powerful analgesic effect. PEMF may also boost endogenous opioid precursor proteins.

The result of the study were supported with Awad et al., **[22]**, who reported that PEMF held higher gains than aerobic exercise trainings for pain modulations, also improving primary dysmenorrhea patients' quality of life, plus statistically significant difference regarding both outcomes.

The result of current study came in the same context with Sweeney et al., **[19]**, who demonstrated that the vasodilatory impact of PEMF that the efflux of muscular Ca2+ talks place in presence of PEMF, causing relaxation of muscle blood vessels and precapillary sphincters, resulting in a vasodilating action.

Earlier, both Markov and Colbert **[23]**, supports our results when reported that PEMF had numerous benefits including vasodilatory and inflammatory lowering, as well therapeutic gains for edema, also a rise in pain sensitivity limits.

The result of current study was agreed with Ali et al., **[17]**, when ensured that PEMF considered effective for managing of primary dysmenorrhea.

The result of current study were in the same line with Vadala et al., **[24]**, for considering the PEMF have numerous gains involving; reducing pain by selective attenuate of neuronal depolarizing through altering membrane potential levels, improving circulatory supply that in turn accelerate healing process, also alter ion kinetics, taking away any noxious mediators, thus modulating various cytokines release.

The result of current study were supported by Mohamed et al., **[25]**, through their reported the PEMF' substantial effect for pain intensity modulation for primary dysmenorrhea patients.

The result of current study were in the same context with Refaye et al., **[26]**, as they discussed benefits of PEMF for primary dysmenorrhea management and ensured an obvious improvements concerning 'menstruation pain and serum prostaglandin values', also clear benefits in both psychological as well physical manifestations of dysmenorrhea. As a result, PEMF is useful in alleviating dysmenorrhea discomfort by raising progesterone and lowering prostaglandin and uterine menstrual pain.

The result of current study were supported by the work of Moffett et al., [27], concerning therapeutic gains of PEMF that stimulates cytokines release, also reducing any inflammatory activities across metabolic pathways, in addition endogenous initiates opioid generating precursors at both peptide, also messenger (m) RNA levels.

The result of current study were agreed with work of Lee et al., [28], when they had stated that PEMF's effects on pain perception through modifying nerve impulses, enhancing endorphins, lowering edoema or reducing fluid retention are responsible for the PEMF group's superior results.

In addition, Marko and Marko [29], had stated that Magnetic therapy may improve circulation by dilation of blood vessels, increased blood oxygen, alkalinization of physiological fluids, and removal of harmful chemicals from blood vessel walls, or by affecting cellular calcium channels.

The result of current study were supported by the work of Tabasam [30], who reported that TENS also interferential therapeutic electro modality proved to as a successful therapy for primary dysmenorrhea patients, without any analgesics' possibly harmful side effects. Also, Proctor [31], had recorded in the same line symptomatic resolve for primary dysmenorrhea depending on high frequency TENS as an electrotherapy modality.

The result of current study was supported by Lewers et al., [32], who hadclinical trial on primary dysmenorrhea using TENS and they ensured its safety and effectiveness as a therapeutic adjunct modality.

As well, Howard [33], stated that TENS considered a modulator for pain of women suffering from menstrual painful cramps.

The result of current study were supported by Kaplan et al., [34], who stated that TENS could considered a safe, efficient modality, plus no need for any medicines while managing primary dysmenorrhea patients, It could be a major therapy option for women with primary dysmenorrhea who did not want or were unable to use conservative pharmaceutical medications. In addition, in severe cases of primary dysmenorrhea, TENS could be used as an adjunct to standard pharmaceutical treatment.

The result of current study were disagreed with Beaulieu [35], due to neglecting of any direct PEMF efficiency on perception of pain among healthy populations. Mentioned study was conducted to investigate PEMF analgesic gains among patients, plus attributing PEMF effects if direct on pain or indirect ones for PEMF, as well facing the same issue for healing process and inflammatory process. Where Beaulieu did not recorded any alteration for pain or unpleasantness outcome in neither real nor sham PEMF populations included by his work. Such findings may be explained based on application and the clinical heterogeneity that considered an obstacle for comparing modalities. Numerous clinical trials were differed in PEMF devices used, even their therapeutic parameters, as well designed protocol extend in addition to evaluating outcome measures.

Conclusion:

According to our results revealed, the obvious conclusions were:

Pulsed electro magnetic field (PEMF) and transcutaneous electrical nerve stimulation (TENS) were effective benefits on primary dysmenorrhea, but, PEMF more efficient for primary dysmenorrhea management.

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تأثير المجال الكهرومغناطيسى المتقطع مقابل جهاز التنبيه الكهربى فى تخفيف الالام المصاحبه لحالات عسر الطمث الاولى

أجريت هذه الدراسة لمعرفة تأثير المجال الكهرومغناطيسى المتقطع مقابل جهاز التنبيه الكهربى فى تخفيف الالام المصاحبة لحالات عسر الطمث الأولى. شارك فى هذه الدراسة أربعون من الإناث يعانون من آلام عسر الطمث الأولى (تم تشخيصهن بواسطة طبيب أمراض النساء) وقد تراوحت أعمارهم بين ١٨ إلى ٢٤ عام، وكان مؤشر كتلة الجسم لديهم أقل من ٢٩ كجم/م٢. تم اختيارهن عشوائياً من مستشفى اسكندرية العام قسم أمراض النساء والتوليد أجريت هذه الدرسة فى الفترة من ٥ أبريل ٢٠٢١ إلى ٣٠ سبتمبر ٢٠٢١.

تم تقسيمهم عشوائياً إلى مجموعتين متساويتين فى العدد، ٢٠ لكلا منهما، تلقت مجموعة الدراسة (م ا) العلاج بالمجال الكهرومغناطيسى المتقطع ذات التردد المنخفض ٥٠ هرتز، لمدة ٣٠ دقيقة، ٣مرات كل دورة شهرية، لمدة ثلاثة اشهر متتالية (إجمالى ٩ جلسات)، بينما تلقت المجموعة الضابطة (م٢) لجهاز التنبيه الكهربى ذات التردد ١٠٠ هرتز، لمدة ٣٠ دقيقة، تلت مرات، كل دورة شهرية، لمدة تلت شهور متتالية (إجمالى ٩ مرات).

تم تقييم نسبة البروستاجلاندين فى الدم، وتقييم الالم والاعراض المصاحبة عن طريق استبيان أعراض الطمث قبل وبعد إجراء العلاج لكلا المجموعتين. أظهرت النتائج المتحصل عليها من هذه الدراسة انخفاضا ذات دلالة إحصائية فى نسبة البروستاجلاندين، واستبيان أعراض الطمث فى كلا المجموعتين، و لكن عند مقارنة نتائج المجموعتين، وجد ان مجموعة الدراسة (م١) التى تلقت المجال الكهرومغناطيسى المتقطع أظهرت انخفاضاً أكبر من المجموعة الضابطة (م٢) التى تلقت التنبيه الكهربى.

\النتائج: أوضحت النتائج أن الجهاز الكهرومغناطيسى المتقطع له فاعلية أكبر من جهاز التنبيه الكهربى فى قليل الام الدورة الشهرية وما يصاحبها من أعراض.

ويمكن أن نستخلص أن لمجال الكهرومغناطيسى المتقطع أثبت فاعلية أكبر من جهاز التنبيه الكهربى فى تحسين الالام عسر الطمث.