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ORIGINAL RESEARCH

Electrostimulation in pain control in primary dysmenorrhea

Eletroestimulação no controle da dor na dismenorreia primária

Electroestimulación en el control del dolor en la dismenorrea primaria

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ABSTRACT | Primary dysmenorrhea is a gynecological disorder characterized by a cyclic pain in the lower back and abdomen, with a high prevalence among young women, which contributes to absenteeism. This study aimed to assess the effects of low and medium frequency electrotherapy in 30 women, aged from 18 to 26 years, who suffer from primary dysmenorrhea. Participants were divided into groups that received the transcutaneous electrical nerve stimulation current (frequency of 100Hz and 100μs pulses), Aussie current (4kHz carrier frequency, modulated at 100Hz, and 4ms bursts), and placebo (electrodes placed with the machine turned off). All treated groups received electrical current at the sensory threshold and its intensity was adjusted every five minutes. The treatment lasted 30 minutes. For the evaluation, pain during the menstrual cycle (via VAS), pain interference in activities of daily living (ADL), and sleep quality (via VAS sleep quality) were collected. After statistical analysis, pain reduced significantly in all groups evaluated, with better outcomes for the currents than for the placebo. Although all groups showed significant difference regarding ADL, the Aussie group was the only one that improved pain in all days evaluated. Sleep quality changed little after treatment, thus, further studies are required to assess this variable.

Keywords | Dysmenorrhea, Analgesia, Electric Stimulation Therapy.

RESUMO | A dismenorreia primária é um distúrbio ginecológico caracterizado por dores cíclicas na lombar e abdômen inferior, com alta prevalência entre jovens, contribuindo para o absenteísmo. O presente trabalho teve como objetivo avaliar os efeitos da eletroterapia de baixa e média frequência em 30 participantes do sexo feminino, entre 18 e 26 anos, com queixa de dismenorreia primária. As participantes foram divididas em grupos que receberam: corrente TENS (frequência de 100Hz e duração de pulso de 100μs), corrente aussie (portadora de 4kHz modulada em 100Hz com bursts de 4ms) e placebo (colocação dos eletrodos com o aparelho desligado). Todos os grupos eletroestimulados foram tratados com corrente no limiar sensorial e ajuste da intensidade a cada cinco minutos, sendo o tempo total de 30 minutos. Para a avaliação foi coletado a dor durante o ciclo menstrual (EVA), influência da dor nas atividades de vida diária e qualidade do sono (escalas visuais análogas do sono). Após análise estatística, conclui-se que houve redução significativa do quadro álgico em todos os grupos, sendo a corrente superior ao placebo. Em relação às AVD, todos os grupos apresentaram diferença significativa, e o grupo corrente aussie foi o único que obteve melhora nos três dias avaliados, mantendo o efeito analgésico tardio maior em comparação aos demais. A qualidade de sono pouco se alterou após os tratamentos propostos, necessitando de estudos futuros para fundamentar essa variável.

Descritores | Dismenorreia, Analgesia, Terapia por Estimulação Elétrica

RESUMEN | La dismenorrea primaria es un trastorno ginecológico caracterizado por dolores cíclicos en la zona lumbar y bajo abdomen, con alta prevalencia entre los jóvenes, lo que contribuye al absentismo. El presente estudio tuvo como objetivo determinar los efectos de la electroterapia de baja y media frecuencia en 30 participantes femeninas, de 18

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a 26 años, con queja de la dismenorrea primaria. Las participantes se dividieron en grupos que recibieron: corriente TENS (frecuencia de 100Hz y duración del pulso de 100μs), corriente aussie (4kHz modulada a 100Hz con disparos de 4 ms) y placebo (colocación de electrodos con el dispositivo apagado). Todos los grupos fueron tratados con corriente en el umbral sensorial y ajuste de intensidad cada cinco minutos, con un tiempo total de 30 minutos. El dolor durante el ciclo menstrual (Escala Visual Analógica), la influencia del dolor en las actividades de la vida diaria y la calidad del sueño (escalas visuales análogas del sueño) fueron recogidos para la evaluación. Después del análisis estadístico, se puede concluir que hubo una reducción significativa del dolor en todos los grupos que recibieron intervención, siendo la corriente más alta que el placebo. En cuanto a la influencia del dolor en las actividades de la vida diaria, todos los grupos mostraron una diferencia significativa, pero el grupo aussie fue el único que mejoró en los tres días evaluados. La calidad del sueño cambió poco después de los tratamientos propuestos, requiriendo más estudios para apoyar esta variable.

Palabras clave | Dismenorrea, Analgesia, Terapia por Estimulación Eléctrica.

INTRODUCTION

Dysmenorrhea is a gynecological disorder[1,2] popularly known as menstrual cramps. It is characterized by a cyclic pain in the lower back and abdomen, commonly associated with nausea, headache, and diarrhea, symptoms that persist from one to three days. Adolescents and young women are the most affected groups, with a prevalence ranging from 60% to 93%. It interferes both in their social and work/academic life, leading to a high rate of absenteeism[3].

Women in this condition present higher levels of prostaglandins in the first two days of menstruation, that causes increased uterine tone and high amplitude contractions, consequently leading to acute periodic pain[4,5].

The discomfort caused by dysmenorrhea directly affects daily activities and sleep quality, due to the reciprocal relationship between pain and sleep[6]. Therefore, electrotherapy becomes relevant as it is a possible method to easily control this pain and associated symptoms, in order to reduce or to eliminate the use of medications[7].

Transcutaneous electrical nerve stimulation (TENS) is a non-invasive therapy based on the passage of low-frequency electrical current over the skin by surface electrodes. Its effect derives from the stimulation of sensory nerve fibers, which modulate both the process of nerve conduction of pain and the increased release of endogenous opioids in the spinal cord and pituitary gland[8].

Aussie is a medium frequency alternating current in the kHz range that stimulates pain modulation as efficiently as TENS[9]. Among few studies that assesses the use of the Aussie current for analgesia, none aims at the dysmenorrhea-affected population, showing this study relevance.

Considering the high prevalence of primary dysmenorrhea in adolescents and young women, this study aimed to assess and to compare the effects of low- and medium-frequency electrotherapy on primary dysmenorrhea in young women, regarding the following variables: pain during menstrual cycle, pain interference in activities of daily living, and sleep quality.

METHODOLOGY

This is a prospective comparative study performed following all due ethical principles, as well as the privacy of its contents, in accordance with international documents and Resolution No. 466/2012, of the National Health Council of the Brazilian Ministry of Health.

A total of 30 university students aged from 18 to 26 years old who had primary dysmenorrhea participated in the study. They were chosen for convenience at the Universidade Presbiteriana Mackenzie. Level of pain equal to or greater than five in the visual analogue scale (VAS) and body mass index (BMI) ranging from 18.5 to 24.9kg/m^2 were the inclusion criteria. Exclusion criteria were women with other pelvic disorders or subjected to any previous therapeutic technique.

All appointments occurred in the physical therapy laboratory at the Universidade Presbiteriana Mackenzie, supervised by the professor in charge, and participants were divided into three groups of 10 women: Group 1 (Aussie current), Group 2 (TENS current), and Group 3 (placebo).

A Neurodyn electrostimulator was used in accordance with the electrostimulation treatment protocol, with two pairs of Carci self-adhesive electrodes, produced by the Indústria Brasileira de Equipamentos Médicos (IBRAMED). Two electrodes 5×10cm were placed in the lower back and two electrodes 5×5cm in the abdomen. The pair of electrodes in the lower back was placed 5cm away from the spine, starting from the L5-S1 vertebral

joint. The other pair of electrodes were placed in the margins of the anterior superior iliac spine. During treatment, the participants' position was lateral decubitus[8].

For the Group 2, the parameters used were 100Hz frequency and 100μs pulse duration. For the Aussie group, 4kHz carrier frequency, with a modulation at 100Hz, and 4ms bursts were used. The intensity in all electrostimulated groups was defined taking a strong paresthesia as a reference. The current was increased every five minutes, to avoid accommodation of the electrical current, according to the sensitivity threshold of each participant, without reaching the motor level. The total duration of the treatment was 30 minutes[8].

For the placebo group, electrodes were placed, but the device was turned off. Participants were explained that they could or could not feel a tingling in the region. Due to ethical reasons, in the month following the completion of data collection, participants of this group underwent TENS treatment (the current with the greatest scientific support so far).

The evaluation was carried out after the beginning of the first menstrual cycle without conducting the treatment, by questionnaires that evaluated pain interference in activities of daily living[7] and sleep quality[10], concerning the first three days of the cycle. In the next month, participants contacted the researcher so that the care was scheduled within 24 hours after the beginning of menstruation. The same evaluation criteria were considered in the month of the treatment. Pain was assessed by VAS before and after treatment, as well as two, six, and 24 hours after its performance. Participants were also requested not to use pain medications neither before nor within 72 hours after treatment.

Sleep quality was assessed using similar visual analogue scales, answered on the first, second, and third nights of the menstrual cycle. This tool is a self-administered questionnaire constituted of 16 items regarding three variables: disturbance, effectiveness, and supplementation[10]. In order to assess pain interference in activities of daily living, the parameters used were: 0=no interference, 1–3=little interference, 4–6=significant interference, and 7–10=unable to perform daily activities[8].

The Kolmogorov-Smirnov test was used for data analysis, in order to assess the normality of the sample. For age and BMI, the analysis of variance (ANOVA) test was used. For qualitative variables, the chi-square test was used. For pain and sleep quality, the ANOVA with Tukey's test was used. Finally, for pain interference in ADL, the Student's t-test was used, considering a $p<0.05$ significance level.

RESULTS

Regarding sociodemographic data, the mean age and BMI of the participants were respectively 21.4±2.1 years old and 21.5±2.2kg/m^2, without statistically significant differences between groups concerning age (p=0.616) and BMI (p=0.736), showing the homogeneity of the sample. Three (10%) women were self-declared mixed race and 27 (70%) were white. Two (6.6%) women were married and 28 (93.7%) were single. A total of 23 (77%) women presented normal menstrual cycle and 13 (43%) used oral contraceptive medication. Among them, 16 (53%) reported more intense pain on the first day of the cycle and 12 (40%) on the second day. No participant (0%) had undergone any treatment for dysmenorrhea until then, and 30 (100%) did not know anything about the role of physical therapy in this condition.

Regarding pain, all groups presented a statistically significant reduction immediately after the treatment ($p<0.001$ for both Aussie and TENS groups, and p=0.024 for the placebo group). TENS and Aussie groups presented lasting analgesia result (2h, 6h, and 24h after treatment) (Table 1).

Table 1. VAS values before and after treatments in the respective groups evaluated.

		Mean	Median	Standard-deviation	N	CI	p-value
	Before	5.9	6	0.88	10	0.54	
	After	0.5	0	1.27	10	0.79	
Aussie	2h	1.3	1.5	1.34	10	0.83	**<0.001***
	6h	1.1	0	1.52	10	0.94	
	24h	1.1	0.5	1.6	10	0.99	
	Before	6.1	6	0.99	10	0.62	
	After	0.3	0	0.95	10	0.59	
TENS	2h	1.4	0.5	1.84	10	1.14	**<0.001***
	6h	1.2	0	1.62	10	1	
	24h	1.6	1	1.84	10	1.14	

(continues)

Table 1. Continuation

		Mean	Median	Standard-deviation	N	CI	p-value
	Before	5.3	5.5	1.83	10	1.13	
	After	2.4	2.5	1.71	10	1.06	
Placebo	2h	3.8	4	2.2	10	1.36	**0.024***
	6h	3.2	3.5	2.35	10	1.46	
	24h	2.5	2	2.55	10	1.58	

All groups reported pain interference in activities of daily living. The Aussie group presented statistical significance in the three days evaluated, with greater reduction in the daily mean when compared with the control month. TENS and placebo groups showed significant difference only on the second day evaluated, compared with the control month (Table 2).

Table 2. Pain interference in ADL in the months before and after treatment in the groups evaluated.

ADL			Mean	Median	Standard-deviation	N	CI	p-value
Aussie	Day 1	Before	5.6	6	2.88	10	1.78	**0.02***
		After	3.1	4	2.08	10	1.29	
	Day 2	Before	3.7	4.5	2.87	10	1.78	**0.017***
		After	1.2	1	1.32	10	0.82	
	Day 3	Before	1.4	1	1.78	10	1.1	**0.024***
		After	0.2	0	0.42	10	0.26	
TENS	Day 1	Before	5.4	6	2.41	10	1.5	0.207
		After	4.1	4.5	2.23	10	1.38	
	Day 2	Before	5.5	6	2.32	10	1.44	**0.027***
		After	3.6	3.5	2.59	10	1.61	
	Day 3	Before	2.5	2	2.12	10	1.31	0.193
		After	1.3	0.5	1.7	10	1.06	
Placebo	Day 1	Before	5.8	6	2.35	10	1.46	0.626
		After	5.3	5.5	1.95	10	1.21	
	Day 2	Before	5.7	6	1.95	10	1.21	**0.007***
		After	3.5	3	2.51	10	1.55	
	Day 3	Before	2.9	3	2.47	10	1.53	0.373
		After	2.1	2	1.66	10	1.03	

Regarding sleep quality, the Aussie group presented statistical difference for the variable "effectiveness" (Table 3), with an increase from 240.9 to 290.8 on the second night of the cycle (p=0.034), comparing before and after treatment results. The other groups did not present significant results on any of the nights evaluated (Tables 3, 4, and 5).

Table 3. Sleep quality before and after treatment, for the variable "effectiveness."

Effectiveness			Mean	Median	Standard-deviation	N	CI	p-value
Aussie	Day 1	Before	240.9	226.5	66.2	10	41	0.109
		After	289.2	272.5	94.9	10	58.8	
	Day 2	Before	240.9	226.5	66.2	10	41	**0.034***
		After	290.8	285.5	106.5	10	66	
	Day 3	Before	307.8	322	104.5	10	64.8	0.707
		After	318.3	317.5	80.2	10	49.7	
TENS	Day 1	Before	283.8	284	53.7	10	33.3	0.117
		After	234.2	240.5	75.9	10	47.1	
	Day 2	Before	263	246	111.2	10	68.9	0.35
		After	298.7	304.5	97.5	10	60.4	
	Day 3	Before	327.7	311	205.3	10	127.3	0.496
		After	281.4	300	106.2	10	65.8	

(continues)

Table 3. Continuation

Effectiveness			Mean	Median	Standard-deviation	N	CI	p-value
Placebo	Day 1	Before	279.9	285.5	110	10	68.2	0.332
		After	261.3	251	92.4	10	57.3	
	Day 2	Before	284.9	274.5	98.9	10	61.3	0.621
		After	306.5	310.5	97.7	10	60.6	
	Day 3	Before	328.4	347	75.6	10	46.9	0.608
		After	346.7	341	73.3	10	45.4	

Table 4. Sleep quality before and after treatment, for the variable "disturbance."

Disturbance			Mean	Median	Standard-deviation	N	CI	p-value
Aussie	Day 1	Before	233.2	271	114.3	10	70.8	0.716
		After	213.9	203.5	144.4	10	89.5	
	Day 2	Before	233.2	271	114.3	10	70.8	0.752
		After	216.5	167.5	116	10	71.9	
	Day 3	Before	212.7	196	126.7	10	78.5	0.9
		After	206.2	202	81.2	10	50.3	
TENS	Day 1	Before	245.3	243.5	108.8	10	67.4	0.463
		After	215.4	224.5	71.3	10	44.2	
	Day 2	Before	284.2	307.5	145.1	10	89.9	0.412
		After	250	239	127.1	10	78.8	
	Day 3	Before	234.3	155.5	166.7	10	103.3	0.779
		After	209.8	161	176	10	109.1	
Placebo	Day 1	Before	293.3	280.5	182.2	10	112.9	0.099
		After	248.2	242	125.9	10	78.1	
	Day 2	Before	266.7	276	102.3	10	63.4	0.204
		After	190.7	144.5	136.7	10	84.7	
	Day 3	Before	211.7	197.5	112.4	10	69.7	0.762
		After	194.6	141	146	10	90.5	

Table 5. Sleep quality before and after treatment, for the variable "supplementation."

Supplementation			Mean	Median	Standard-deviation	N	CI	p-value
Aussie	Day 1	Before	129.4	113.5	72.5	10	44.9	0.111
		After	86	78.5	73.3	10	45.4	
	Day 2	Before	129.4	113.5	72.5	10	44.9	0.163
		After	100.2	98	81.1	10	50.2	
	Day 3	Before	90.4	74	69.9	10	43.3	0.926
		After	92.9	102.5	59.3	10	36.7	
TENS	Day 1	Before	94.6	84.5	49.4	10	30.6	0.672
		After	104.9	78.5	77.2	10	47.8	
	Day 2	Before	85.5	75	70.8	10	43.9	0.333
		After	113.1	67	113	10	70.1	
	Day 3	Before	81.1	45	92.9	10	57.6	0.744
		After	72.4	55.5	56.9	10	35.3	
Placebo	Day 1	Before	100.7	94	58	10	35.9	0.319
		After	129.5	124	55.7	10	34.5	
	Day 2	Before	117.2	92	73.1	10	45.3	0.842
		After	122.5	122	73.8	10	45.7	
	Day 3	Before	89.3	94	48.1	10	29.8	0.256
		After	125.4	96	93.6	10	58	

DISCUSSION

According to the literature, TENS is the most commonly used electrical current for primary dysmenorrhea in clinical practice aiming to reduce pain[11]. High-frequency TENS (100Hz) is efficient in the treatment of primary dysmenorrhea—corroborating with our results—justifying the choice of high frequency,

as it is more widely used in the treatment of acute diseases[7,8,11,12]. However, most studies do not assess the late effects of the current. In this study, we observed them in all evaluated periods and compared them with before treatment results.

Our study presented the long-lasting effects of analgesia in the groups under electrostimulation, in comparison with the placebo group. When evaluating different elapsed periods after treatment, we found fundamental data for an effective comparison between electrotherapy and the placebo effect, since other studies analyzed only after treatment effects, which increases the risk of error. Torrilhas et al.[13] presented no statistical difference between TENS and placebo groups when comparing before and immediately after treatment results in a population with dysmenorrhea. Probably, it is due to the immediate effect of placebo, which does not persist. In our study, the position chosen by the participants (relaxed) favors the relief of discomfort in the placebo group, whereas in the TENS group, besides the immediate effect promoted by the gate control theory, the technique ensures continuity in its effect by the release of endogenous opioids[14].

The Aussie current has also been analyzed regarding its analgesic potential and comfort level. However, the literature presents no scientific evidence involving the same population that we focused on, which makes our findings very relevant—although other currents are more established in the literature and reduce women's pain, the Aussie current presented longer lasting analgesic effect.

According to studies[9,15,16], 4kHz frequency with 4ms bursts, as used by us, reduces discomfort and is the most recommended and used technique for analgesia. The frequency of 1kHz is used to promote muscle contraction. Although the literature is scarce on the use of electrical currents for this purpose (and largest concerning strength gain), new studies have been showing positive results regarding spinal pain[17].

The literature comparing low- and medium-frequency currents—such as our study—is divergent. Silva et al.[18], when comparing Aussie and TENS currents regarding the pain threshold in healthy individuals, found no statistically significant differences. Facci et al.[19] observed the same results when comparing TENS and interferential currents (medium-frequency) for low back pain. On the other hand, Cheing and Hui-Chan[20], in their study with healthy individuals, observed long-lasting effects for the medium frequency current, when compared to TENS (a result similar to our study). This outcome is associated with a higher penetration capacity of the medium-frequency current[20]. Thus, studies with larger samples that evaluate the Aussie current at different times after treatment are necessary, since, due to our small sample, we may consider the possibility of this difference regarding the Aussie current to be a causality.

Analgesia by electrical currents is mainly related to the release of endorphins and both low- and high-frequencies promote increased nerve afferents and the release of endorphins. Increased intensity is essential to activate a greater number of afferent nerve fibers, ensuring effectiveness and reducing accommodation. Thus, in this study, intensity was adjusted every five minutes[8,17].

Several studies show that most women suffer significant interference in their activities of daily living[3]. Nunes et al.[21] showed that dysmenorrhea is greatly prevalent among Brazilian university students with limiting intensity disorder, leading to school absenteeism. These data corroborate with our results, as participants of all groups reported pain interference in academic, work, and social activities.

To evaluate sleep quality, we used visual analogue sleep scales, a self-applied tool developed as a modification of the Verran Snyder-Halpern sleep scale[10]. This tool is more sensitive for acute pain, as these scales assess a single night sleep at a time, enabling the analysis of the real effect of the reduction of pain on specific nights of the menstrual period.

In a study by Baker et al.[22], women with primary dysmenorrhea presented worse sleep quality when they were in pain, which corroborates our findings. However, although sleep quality seems to have an important physiological role in regulating pain processing, sleep can be affected by social, psychological, behavioral, and environmental influences[23], which explains changes that were not so effective in our study. Therefore, more studies are necessary to better support this variable.

Researching ways to improve this type of acute pain provides promising results, as the exaggerated use of pain medication to reduce this symptom is frequent and it might hide secondary dysmenorrhea, a gynecological pathology like endometriosis[24]. This study is important so that the worsening of the clinical picture of these women is not neglected.

Our study is pioneer in assessing the effect of the Aussie current on analgesia and the first to use this technique to treat dysmenorrhea. Our study showed

the late effects of electrostimulation by the evaluation of different moments after treatment, presenting electrotherapy as a viable option in opposition to the exaggerated use of pain medication. However, this study presented limitations and negative aspects. Thus, studies with larger samples are necessary. Moreover, sleep quality was difficult to assess, as several factors can interfere in this variable, making its results inaccurate when quantifying improvements. Thus, we recommend the use of more precise scales and questionnaires to better establish results.

CONCLUSION

Pain reduced in all groups evaluated, showing that electrical currents are better than placebo. All groups improved pain in ADL. The Aussie group presented higher late effect and was the only one to improve sleep quality regarding the variable "effectiveness."

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