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Review Article

Electroacupuncture Treatment for Primary Dysmenorrhea: A Review of Randomized Controlled Trials

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ABSTRACT

To evaluate the effectiveness of electroacupuncture treatment for primary dysmenorrhea (PD), a literature review of a randomized controlled trials (RCTs) was performed where electroacupuncture was used as a treatment intervention in patients diagnosed with PD. Relevant clinical studies (N = 226) were retrieved from multiple databases according to the study inclusion/exclusion criteria, and interventions and outcomes were analyzed. As a result of the review, there were 6 RCTs which met the criteria. In all 4 studies that measured pain indicators (visual analog scales), electroacupuncture showed significantly positive changes. In addition, positive changes were observed in most indicators (MMDQ, PGF2a, PGE2, 6-keto PGF1, TXB2, clinical efficacy score, uterine arterial blood flow parameters, and blood viscosity). 2 studies showed that electroacupuncture had a stronger therapeutic effect than NSAIDs. No major side effects were reported. Electroacupuncture may be an effective and safe treatment for PD however, further RCTs are required.

Introduction

Primary dysmenorrhea (PD) is defined as cramping or painful cramps in the lower abdomen which originate from the uterus, occur without a specific cause, and appear just before or at the onset of menstruation. Cramping is one of the most common symptoms in both teenage and adult women [1-3]. Secondary dysmenorrhea refers to dysmenorrhea caused by a specific pelvic lesion.

Onset of dysmenorrhea occurs mainly in adolescence, within 6 to 24 months of menarche [1]. Globally, the prevalence of PD is between 45% and 95% of women of childbearing age, with 2% to 29% experiencing extreme pain [3].

A previous study in the US reported that dysmenorrhea is one of the leading causes of absences from work (or school), costing 600 million hours and $2 billion annually [4]. In Korea, the number of patients coming forward with dysmenorrhea by year is increasing every year, and as a result, medical expenses are increasing every year. In 2021, there were 321,238 cases of dysmenorrhea reported in Korea [5].

In Western medicine, acetaminophen/paracetamol, non-steroidal anti-inflammatory drugs (NSAIDs), and hormonal contraceptives (HC) are recommended as a first-line treatment for PD. However,

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some patients taking NSAIDs have had side effects such as nausea, indigestion, headache, or drowsiness. In addition, HC cannot be used in women planning to conceive, and side effects from HC such as irregular uterine bleeding and nausea have been reported in some patients [6].

In oriental medicine, PD is "Tong Gyeong," "Gyeong Haeng Bog Tong," and "Gyeong Gi Bog Tong," and in Donguibogam, depending on the period, PD moves into deficiency and excess syndrome. Treatments include herbal medicine, acupuncture, electroacupuncture (EA), moxibustion, herbal and pharmacopuncture.

Electroacupuncture is a treatment used to reduce ischemia in the uterine layer by increasing blood flow in the skin of patients with PD [7]. Although there have been studies on the effectiveness of acupuncture for PD, reviews of randomized controlled trials (RCTs) on the effectiveness of electroacupuncture are lacking. In Korea, there is 1 study by Park et al [8] which reviewed RCTs on the electroacupuncture treatment for PD. However, this study reviewed RCTs that used electroacupuncture in both the treatment group and the control group, so there was no evidence for the effect of electroacupuncture treatment alone. Therefore, this review was conducted using domestic and international databases to review the efficacy and safety of electroacupuncture treatment alone for PD.

Materials and Methods

Selection and exclusion criteria

Inclusion Criteria: (1) Study of patients diagnosed with PD based on clinical evaluation; (2) RCTs of electroacupuncture regardless of stimulation intensity (Hz) or frequency, stimulation points (meridian acupoints, trigger points), duration, or number of treatments; and (3) Co-interventions were allowed only if they were given to both the treatment and the control group.

Exclusion criteria: (1) duplicate studies; (2) non-RCT studies; (3) studies without full text; (4) research published in non-academic journals; (5) A study using electroacupuncture as an "intervention" in both treatment and control groups (e.g., a study comparing the effects of electroacupuncture by acupuncture points, acupoint and non-acupoint effect comparison study); and (6) Studies not related to electroacupuncture or PD.

There were no restrictions on language, date of publication, or location of study, and there were no restrictions on the age, sex, or ethnicity of the patient.

Database and search method

The Cochrane Library, Embess, PubMed, CNKI, KISS, RISS, and OASIS databases were used to search for studies published from January 1, 2007 to December 31, 2021. 2 reviewers independently assessed the retrieved studies and differences in opinion regarding the inclusion of a study were resolved through discussion by these 2 reviewers.

The search terms (['dysmenorrhea' OR 'premenstrual syndrome'] AND ['electroacupuncture' OR 'electrical dry needling' OR 'electrical acupuncture' OR 'electric acupuncture' OR 'electro-acupuncture']) were used to retrieve articles from the databases.

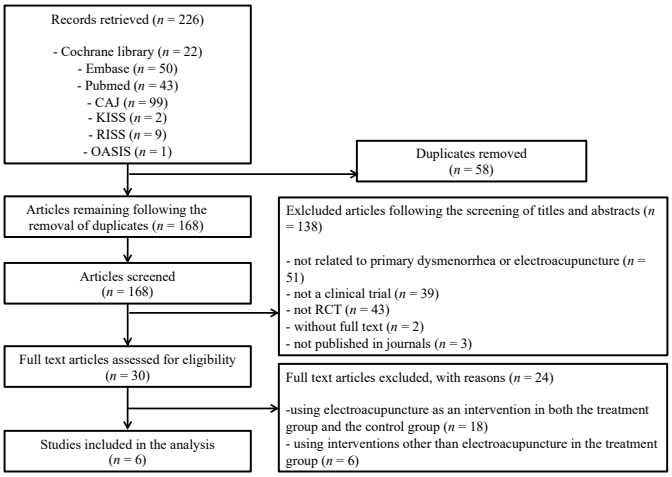

Fig. 1. Flowchart of the screening process.

Results

Study selection

This search retrieved 22 studies from the Cochrane database, 50 studies from Embess, 43 studies from PubMed, 99 studies from CAJ, 2 studies from KISS, 9 studies from RISS, and 1 study from OASIS.

A total of 226 studies were retrieved. Of these, 58 were duplicates. Of the remaining 168 studies, 117 were selected based on the title and abstract. Of these 117 studies, 43 were not RCTs, 39 were not clinical trials, 2 studies did not have full texts, and 3 studies were excluded because they were published in non-academic journals. Thereafter, several studies were excluded from the remaining 30 studies: 18 studies used EA as an intervention in both the treatment and control groups, and 6 studies used an intervention other than EA in the treatment group. After consideration of the abstract and experimental/control groups, 6 studies were finally included in the analysis for this review (Fig. 1).

Overview of selected studies

The 6 selected RCT studies were published between 2007 and 2018, retrieved from Embase, PubMed, and CAJ, and reported in Chinese or English. RCTs were performed in Iran (n = 1) and China (n = 5).

The 6 RCTs included in the review had a total of 723 participants diagnosed with PD. The study with the largest number of participants had 194 individuals [10,11]. 1 study conducted electroacupuncture and acupressure [9], and 1 study compared the effects of electroacupuncture, general acupuncture, and oral analgesics [12]. 1 study compared EA and oral analgesics [13], and the other 3 studies also included comparisons of acupoints, unrelated acupoints, and non-acupoints [10,11,14].

Criteria for inclusion/exclusion of participants were applied in all 6 studies. The main diagnostic criteria was that the patient had experienced symptoms such as pain in the lower abdomen before and after menstruation, dizziness, nausea, and experienced headaches for more than 6 months, and that there was no underlying disease-causing secondary dysmenorrhea.

Katayun et al [9] included female patients aged 18-26 years who had a definitive diagnosis of PD by their gynecologist and had regular menses for 2 years with a cycle between 28 ± 7 days. Song et al [10] reported on infertile females aged 15 to 30 years with a regular menstrual cycle (28 ± 7 days) who had been diagnosed with PD between 6 months and 15 years of the onset of symptoms, were according to the Canadian Association of Obstetricians and Gynecologists "Clinical Guidelines for Primary Dysmenorrhea" (2005). Liu et al [11] and Shi et al [15] included female patients aged 15-30 years who had been diagnosed with PD with a regular menstrual cycle (28 ± 7 days) and the VAS score was ≥ 4 for at least 6 months. Ren et al [13] included females aged 12-48 years who met the criteria for diagnosis of PD. Zhi et al [12] included unmarried female patients who met the diagnostic criteria for PD.

The baseline general characteristics of the control and treatment groups in all studies were similar and did not show any statistical differences (Table 1).

Intervention in the selected study

All 6 selected studies used electroacupuncture as a single intervention (Table 2). 3 of these studies included comparisons between electroacupuncture [10,11,14]. In all 3 studies, including comparisons between electroacupuncture, the control group received no treatment. As a control intervention, Katayun et al [9] received Acupressure and Ren et al [13] used oral analgesic. Zhi et al [14] used general acupuncture and oral analgesics as control interventions.

Treatment was usually given between 1 and 3 menstrual cycles. Typically, 3-5 treatments were administered per menstrual cycle.

Table 1. General Characteristics of the Selected Studies.

Author (y) [ref]	Type	Country	Sample size	Criteria	Age, mean (± SD)	onset period, mo (± SD)	Menarche, y (± SD)	VAS, mean (± SD)
Katayun (2018) [9]	RCT	Iran	TG 31 CG 33	18-26 y, single woman after menarche, regular menstrual cycle for 2 years (21-35 days)	TG 22.94 (2.85) CG 23.67 (3.01)	-	-	TG 5.02 (1.83) CG 5.49 (1.21)
Song (2013) [10]	RCT	China	TG1 49 TG2 49 TG3 48 CG 48	15-30 y, infertile woman, PD Diagnosis 6 month-15 years lapse, regular menstrual cycle (21-35 days), VAS ≥ 40	TG1 22.1 (2.2) TG2 21.2 (2.2) TG3 22.5 (2.4) CG 22.8 (2.7)	TG1 72.1 (33.3) TG2 72.0 (35.7) TG3 80.8 (33.5) CG91.5 (39.8)	TG1 13.1 (1.3) TG2 12.9 (1.2) TG3 13.2 (1.6) CG 12.7 (0.99)	-
Liu (2011) [11]	RCT	China	TG1 49 TG2 49 TG3 48 CG 48	15-30yfemale, regular menstrual cycle (21-35 days), VAS ≥ 40 at least 6 months	TG1 22.14 (2.28) TG2 21.28 (2.29) TG3 22.54 (2.45) CG 22.83 (2.74)	TG1 72.08 (33.28) TG2 72.04 (35.73) TG3 80.78 (33.56) CG 91.52 (39.80)	TG1 13.10 (1.27) TG2 12.90 (1.18) TG3 13.20 (1.61) CG 12.71 (0.99)	TG1 5.87 (1.58) TG2 5.41 (1.42) TG3 5.83 (1.26) CG6.05 (1.48)
Shi (2011) [14]	RCT	China	TG1 10 TG2 10 TG3 10 CG 10	15-30 y female, regular menstrual cycle (21-35 days), VAS ≥ 40 at least 6 months	TG1 21.81 (1.48) TG2 20.94 (1.29) TG3 22.42 (2.32) CG 22.43 (2.68)	TG1 67.26 (27.24) TG2 62.22 (23.56) TG3 82.83 (25.77) CG 65.51 (31.53)	-	TG1 6.30 (1.11) TG2 5.37 (0.94) TG3 5.71 (0.95) CG 5.73 (1.31)
Ren (2010) [13]	RCT	China	TG 30 CG 30	12-48 y female, PD diagnosis	TG 21.08 (2.75) CG 20.05 (2.64)	TG 42.24 (22.44) CG 44.16 (21.00)	-	-
Zhi (2007) [12]	RCT	China	TG 57 CG1 57 CG2 57	Unmarried woman, PD diagnosis	TG 19.72 (2.74) CG1 20.09 (2.84) CG2 20.05 (2.70)	TG 47.16 (23.40) CG1 44.52 (22.44) CG2 44.16 (22.20)	-	-

CG, control group; RCT, randomized controlled trial; TG, treatment group; VAS, visual analog scale.

Table 2. Results of Interventions and Selected Studies.

Author (y) [ref]	Intervention	Control	Outcome measure	Result	Adverse effect
Katayun (2018) [9]	EA	Acupressure	Reduction in VAS Reduction in MMDQ	TG > CG ($p < 0.001$) TG > CG ($p < 0.001$)	No
Song (2013) [10]	TG1 (EA in Acupoint Group) TG2 (EA in Unrelated Acupoint Group) TG3 (EA in None Acupoint Group)	No treatment	Reduction in VAS Reduction in RSS-COX2	TG1, TG2, TG3 > CG ($p < 0.001$) TG1, TG2, TG3 > CG ($p < 0.05$)	Not reported
Liu (2011) [11]	TG1 (EA in Acupoint Group) TG2 (EA in Unrelated Acupoint Group) TG3 (EA in None Acupoint Group)	No treatment	Reduction in VAS Reduction in RSS-COX1 Reduction in RSS-COX2	TG1, TG2, TG3 > CG ($p < 0.001$) No difference No difference	No severe events
Shi (2011) [14]	EA	No treatment	Reduction in VAS Increase in PGE2§, Reduction in PGF2α Increase in 6-keto PGF1α Reduction in TXB2	TG1, TG2, TG3 > CG ($p < 0.05$) No difference No difference No difference No difference	Not reported
Ren (2010) [13]	EA	Ibuprofen	Increase in clinical therapeutic effects Reduction in hemorheology	TG > CG ($p < 0.05$) TG > CG ($p < 0.05$) TG > CG ($p < 0.01$)	Not reported
Zhi (2007) [12]	EA	Ibuprofen Acupuncture	Reduction in cumulative points of symptoms Increase in clinical therapeutic effects	TG > CG2 > CG1 ($p < 0.001$) TG > CG2 > CG1 ($p < 0.001$)	Not reported

EA, electroacupuncture; VAS, visual analog scale; MMDQ, Moos menstrual distress questionnaire; PGE2, prostaglandin E2; PGF2α, prostaglandin F2α; PGF1α, prostaglandin F1α; TXB2, thromboxane B2.

Shi et al [14] performed only 1 treatment. There were 5 studies where electroacupuncture was applied symmetrically to both sides of the body [9-13], and there was 1 study which did not report this [14]. Treatment sites included SP6 in all 6 studies. The retention time was usually 30 minutes, but there was electroacupuncture performed whereby the needles were retained for 10 minutes. The depth of the needle varied from study to study and ranged between 15-40 mm. Shi et al [14] used needle depths of 0.5-1.2 cun (the unit of measurement; Table 3). The most frequently used acupuncture points were SP6 [9-14], followed by the bladder meridian (GB39 [1011,14], SP4 [9], and BL32 [13] (Table 4). The most frequently used meridians were the spleen meridians (Table 5).

Assessment indicators

The Visual Analog Scale (VAS) score (0-10) was used to rate the level of pain, whereby the highest score indicates the greatest level of pain. This is a method for measuring the patient's level of pain on a 10 cm horizontal line ranging from no pain (0) to extreme pain (10). In a study by Katayun et al [9], there was not a significant decrease in VAS score in the electroacupuncture group compared with the control group (EA = 3.38 ± 1.85, Acupressure = 4.01 ± 1.21, p = 0.068). In a study by Song et al [10], Liu et al [11] and Shi et al [14], there were significantly greater reductions in VAS scores in all 3 electroacupuncture groups following treatment (Acupoint Group, Unrelated Acupoint Group, and Nonacupoint Group) compared with the control group (Treatment group (TG)1 > No treatment (NT), −15.56 mm, 95% Confidence interval (CI) −22.16 to −8.95, $p < 0.001$, TG2 > NT, −18.14 mm, 95% CI −24.81 to −11.47, $p < 0.001$, TG3 > NT, −10.96 mm, 95% CI −17.62 to −4.30, $p = 0.001$ [11]; TG1 = 25.70 ± 12.96, TG2 = 34.30 ± 15.75, TG3 = 34.30 ± 13.52, NT = 48.20 ± 7.25, $p = 0.004$ [14]; details of data not shown [10]; Table 6).

Moos Menstrual Distress Questionnaire indicator was used in 1 study [9] to measure symptoms of discomfort during menstruation. This scale has 37 items, the score ranges from 0 (no symptoms at all) to 5 (extremely severe). In a study by Katayun et al [9], the electroacupuncture group had a greater reduction in Moos Menstrual Distress Questionnaire compared with the acupressure control group, however this difference was not statistically significant ($p = 0.057$; Table 7).

Cox retrospective symptom scale (RSS-COX) is a menstrual symptom scale, and there are 2 types: RSS-COX1, which is a total frequency rating score, and RSS-COX2, which is an average severity rating score. For both scores, lower scores indicate better health. In the study by Liu et al [11], there were no significant differences in RSS-COX1 scores and RSS-COX2 scores between the 3 electroacupuncture groups and the control group (Tables 8

Table 3. Implementation of Electroacupuncture Interventions.

Author (y) [ref]	Period	Electroacupuncture frequency	Acupoints	Side	Size of needles	Depth of insertion	Deqi	Wave form
Katayun (2018) [9]	3 menstruation cycle	3 trial/1 menstruation cycle, for 10 min	SP6, SP4	Both	Not reported	Not reported	Not reported	6 Hz and 1.5 sec intercals
Song (2013) [10]	1 menstruation cycle	3 trial/1 menstruation cycle, for 30 min	SP6, GB39, None acupoint	Both	0.25 × 40 mm and 0.25 × 20 mm	15-30 mm	Yes	2 Hz/100 Hz, 0.5-1.6 mA
Liu (2011) [11]	3 menstruation cycle	3 trial/1 menstruation cycle, for 30 min	SP6, GB39, None acupoint	Both	0.25 × 40 mm and 0.25 × 20 mm	Not reported	Yes	2 Hz/100 Hz, 0.5-1.6 mA
Shi (2011) [14]	1 menstruation cycle	1 trial/1 menstruation cycle, for 30 min	SP6, GB39, None acupoint	Not reported	0.25mm × 40mm	0.5-1.2 cun	Yes	2 Hz/100 Hz
Ren (2010) [13]	3 menstruation cycle	5 trial/1 menstruation cycle, for 30 min	SP6, BL32	Both	30gauge × 50 mm	25-40 mm	Yes	2 Hz/100 Hz, 0.5-2.5 mA
Zhi (2007) [12]	3 menstruation cycle	5 trial/1 menstruation cycle, for 30 min	SP6	Both	0.6	30 mm	Not reported	60 Hz, 2-3 V

Table 4. Frequency of Acupoints Connecting Electrodes Used in the Study.

Frequency	Acupoints
6	SP6
3	GB39
1	SP4, BL32

SP, spleen meridian; GB, gallbladder meridian; BL, bladder meridian.

Table 5. Frequency of Meridians Connecting Electrodes used in the Studies.

Frequency	Meridians	Acupoints
6	Spleen meridian	SP6, SP4
3	Gallbladder meridian	GB39
1	Bladder meridian	BL32

SP, spleen meridian; GB, gallbladder meridian; BL, bladder meridian

Table 6. VAS Results in Studies.

Author (y)	Treatment (± SD)	Control (± SD)	*p*
Katayun (2018) [9]	EA3.38 (1.85)	Acupressure 4.01 (1.21)	0.068
Song (2013) [10]	TG1 (EA in Acupoint Group) > NT TG2 (EA in Unrelated Acupoint Group) > NT TG3 (EA in None Acupoint Group) > NT		< 0.05
Liu (2011) [11]	TG1 (EA in Acupoint Group) > NT (−15.56 mm, 95% CI −22.16 to −8.95) TG2 (EA in Unrelated Acupoint Group) > NT (−18.14 mm, 95% CI −24.81 to −11.47) TG3 (EA in None Acupoint Group) > NT (−10.96 mm, 95% CI −17.62 to −4.30)		≤ 0.001
Shi (2011) [14]	TG1 (EA in Acupoint Group) 25.70 (12.96) TG2 (EA in Unrelated Acupoint Group) 34.30 (15.75) TG3 (EA in None Acupoint Group) 34.30 (13.52)	NT 48.20 (7.25)	0.004

EA, electroacupuncture; NT, no treatment.

Table 7. MMDQ Results in the Study.

Author (y)	Treatment (± SD)	Control (± SD)	*p*
Katayun (2018) [9]	EA21.37 (3.42)	Acupressure 20.19 (3.16)	0.057

EA, electroacupuncture.

Table 8. RSS-COX1 Results from the Study.

Author (y)	Treatment	Control	*p*
Liu (2011) [11]	TG1 (EA in Acupoint Group) 15.31 TG2 (EA in Unrelated Acupoint Group) 13.14 TG3 (EA in None Acupoint Group) 17.33	NT18.59	> 0.05

EA, electroacupuncture; NT, no treatment.

Table 9. RSS-COX2 Results from the Studies.

Author (y)	Treatment	Control	*p*
Song (2013) [10]	TG1 (EA in Acupoint Group) < NT TG2 (EA in Unrelated Acupoint Group) < NT TG3 (EA in None Acupoint Group) < NT		< 0.01
Liu (2011) [11]	TG1 (EA in Acupoint Group) 8.79 TG2 (EA in Unrelated Acupoint Group) 7.29 TG3 (EA in None Acupoint Group) 9.49	NT 11.17	> 0.05

EA, electroacupuncture; NT, no treatment.

Table 10. Clinical Efficacy Score Results in the Studies.

Author (y)	Treatment (%)	Control (%)	*p*
Ren (2010) [13]	EA 100	Ibuprofen 83.3	< 0.05
Zhi (2007) [12]	EA 96.43, 95% CI 96.34 to 96.51	Acupuncture 96.30, 95% CI 96.21 to 96.38 Ibuprofen 83.02, 95% CI 82.84 to 83.19	< 0.01

EA, electroacupuncture.

and 9). In the study by Song et al [10], all 3 electroacupuncture groups had significantly lower RSS-COX2 scores than controls, but details of the data were not shown ($p < 0.001$; Table 9).

The clinical therapeutic effect is a scale suggested by the Clinical Research Guidelines of Traditional Chinese Medicine of the Ministry of Health of China for the Treatment of Dysmenorrhea. To measure the clinical efficacy score of the treatment it is measured in as the treatment cured, was markedly effective, was effective, or failed. In the study by Ren et al [13] and Zhi et al [12], a significantly higher clinical efficacy score was reported in the electroacupuncture group compared with the control group (< 0.005; Table 10).

In the study by Shi et al [14], levels of prostaglandin F2α (PGF2α), prostaglandin E2 (PGE2), 6-keto prostaglandin F1α (6-keto PGF1α), and thromboxane B2 (TXB2) were measured. PGF2α is a potent stimulator of smooth muscle contraction that can increase uterine tension and cause hypercontraction by stimulating adrenergic smooth muscle receptors. In contrast, PGE2 relaxes the uterus during menstruation. An increase in the PGF2α/PGE2 ratio can cause strong uterine contractions, which can lead to dysmenorrhea. Serum TXB2 and 6-keto PGF1α prevent platelet aggregation and dilate blood vessels. The balance of TXB2 and 6-keto PGF1α in the vessel wall is very important in the pathology of thrombus formation. Shi et al [14] reported, overall, there were no significant differences between the electroacupuncture group and the control group.

Uterine artery hemodynamics and hemorheology were measured in the study by Ren et al [13]. Uterine artery hemodynamics consisting of pulsatile index, vascular resistance index, systolic peak/maximal diastole, and hemorheology consisting of whole blood viscosity, plasma viscosity, and hematocrit were measured. Uterine arterial blood flow in patients with PD causes ischemia in the uterine muscle wall due to its high pulsatile index and high blood flow resistance. This can cause convulsive contractions of the uterine muscles, which can lead to abdominal pain. Ren et al [13] reported the electroacupuncture group showed significant improvements in uterine artery blood flow parameters and hemorheology compared with the ibuprofen control group ($p < 0.05$: Table 2).

The Cumulative points of menstrual pain symptom score is a scale presented by the Chinese Traditional Medicine Clinical Research Guidelines of the Chinese Ministry of Health, Pharmacy Bureau for the Treatment of Dysmenorrhea which was used by Zhi et al [12]. The index scores dysmenorrhea symptoms and divides the severity according to the score, with higher scores indicating greater related disorders. In the study by Zhi et al [12], the electroacupuncture group had significantly lower scores compared with the 2 control groups (Acupuncture group and Ibuprofen group; $p < 0.001$; Table 2).

Adverse events

Adverse events were not observed in 3 of 6 studies [9,11,13] and adverse effects were not recorded in 3 studies [10,12,14]. The study by Liu et al [11] reported syncope after the 1st electroacupuncture treatment, but no serious side effects were observed.

Discussion

This review evaluated the clinical effects of electroacupuncture treatment of PD by examining RCTs that used electroacupuncture only as a treatment intervention. PD refers to the presence of pain or cramps in the lower abdomen before or during menstruation without identifiable organic pathology [1,15]. The onset of PD usually occurs in adolescence, 6–24 months after menarche. In general, pain is often accompanied by symptoms such as dizziness, vomiting, fatigue, and insomnia. PD is debilitating for many women and is one of the leading causes of absenteeism from work and school, which causes significant loss in economic productivity, academic activity, and quality of life and daily living, [15]. In the study by Kim et al [16], the prevalence of PD was 78.3% in 400 high school girls in Korea. Diagnosis of PD is primarily made by taking a history and performing a physical examination to make sure there is no pelvic pathology. Usually, PD is diagnosed when menstrual pain associated with the menstrual cycle is present in the absence of overt pelvic pathology.

Treatment of PD includes drug therapy and nonpharmacological therapy. Medication options include acetaminophen/paracetamol, NSAIDs and HC. 1 study reported that NSAIDs were 4.5 times more effective than the placebo for pain relief [18]. However, NSAIDs are ineffective in 20–25% of women, and side effects such as liver disease, kidney disease, and digestive disorders may occur when taken over a long period of time [20]. For patients who have side effects to NSAIDs, acetaminophen/paracetamol is considered. If acetaminophen/paracetamol and NSAIDs are ineffectual, HC are considered. HC are effective in the management of PD by inhibiting ovulation and endometrial proliferation, and blocking prostaglandin (PG) production. However, it cannot be used for women who wish to conceive, and with HC there are risks of side effects such as nausea, vomiting, and edema or venous thrombosis, making it difficult to take long-term [21]. For these reasons, nonpharmacological therapies are recommended for the long-term management of PD. Therefore, it is necessary to investigate nonpharmacological PD treatments.

The pathogenesis of dysmenorrhea is largely divided into excess syndrome for “Bul Tong Jeug Tong” and deficiency syndrome for “Bul Yeong Jeug Tong.” The principle of acupuncture treatment for PD is to relieve the menstrual pain (mainly caused by “Bul Tong Jeug Tong”) by harmonizing the “Qi” and the blood of the Penetration Meridian and Conception Vessel Meridian to treat the accumulation of stagnated blood and blockage of the flow of blood and “Qi” according to the pathogenesis. The pathogenesis of dysmenorrhea is increased by the secretion of PG from the uterus while the endometrium is peeling off, and this increases endometrium contraction and vasoconstriction, which leads to uterine ischemia and anaerobic metabolites [1]. Given that acupuncture relieves menstrual pain by harmonizing the "Qi" and the blood, it can be thought of as promoting blood circulation in the uterus, preventing ischemia, and inhibiting the production of anaerobic metabolites. Therefore, treatment that removes stagnated blood in the uterus and promotes blood flow and circulation of “Qi" should be implemented.

Acupuncture is a popular nonpharmaceutical treatment for dysmenorrhea in Korea. Acupuncture relieves pain by circulating “Qi" and the blood, and blocking the pain transmitter signals. In addition to acupuncture treatment, electroacupuncture is widely used along with acupuncture treatment. Electroacupuncture reduces ischemia in the myometrium by increasing blood flow to the area being treated, thereby resulting in an analgesic effect.

Although there have been studies that have reviewed the effectiveness of acupuncture treatment for PD, reviews of the effects of electroacupuncture on PD are limited. Park et al [8] reviewed RCTs for electroacupuncture, but could not determine the effect of electroacupuncture because the intervention treatment group and control group both received electroacupuncture treatment. Therefore, to elucidate the effectiveness of electroacupuncture, it was necessary to review RCTs which used electroacupuncture as an intervention in the treatment group only. A total of 226 studies were retrieved from 7 international databases and 6 studies were selected for analysis according to the inclusion and exclusion criteria for this review.

With regards to treatment intervention group in the selected studies, all 6 studies used electroacupuncture alone. Of these, 3 studies compared treatment groups according to the treatment area of electroacupuncture. Since there were no restrictions on the control group, there were various kinds of control groups, such as no treatment [1011,14], acupressure [9], and the study by Ren et al [13] used ibuprofen. The study by Zhi et al [12] compared both ibuprofen and acupuncture with electroacupuncture.

The results of electroacupuncture treatment for PD showed a statistically significant improvement in all 4 studies when the VAS evaluation index was used. It was reported that the RSS-COX index showed improvement in the study by Song et al [10], but no significant changes were reported in the study by Liu et al [11]. This indicates that electroacupuncture may be effective for the suppression of pain in patients with PD, however, more evidence is needed. Furthermore, more evidence is need to determine whether electroacupuncture treatment for PD improves quality of life. 1 study with 60 patients and 1 study with 171 patients showed that electroacupuncture had a significantly stronger therapeutic effect than NASIDs [12,13].

There were no significant differences between treatment groups in all 3 studies comparing treatment groups according to the treatment area of electroacupuncture [10,11,14]. Electroacupuncture was applied primarily to the lower body in the studies in this review. The acupuncture point where electrical stimulation is applied to the most was SP6. The most frequently used meridian was the spleen meridian, followed by the gallbladder meridian. SP6 invigorates the spleen, resolves dampness, and helps the liver and kidney be healthy. SP6 is widely used for conditions/diseases of the genitourinary system and is the eminet acupoint for common gynecological conditions/diseases [22]. In addition, SP6, “Gyohoehyeol” of eum

meridians, is linked with the Conception Vessel Meridian to help the normal circulation of "Qi" in the uterus and enable regular menstruation [23]. It is believed that this is the reason SP6 is frequently used to treat PD.

There were no adverse events in 3 out of 6 studies [9,11,13], and the rest of the studies did not report on adverse events.

The limitations of this study were that the number of studies included in this trial was small, the quality of the literature (risk of bias) was not evaluated, and the evaluation index of each study was not uniform. However, the results of this study suggest that electroacupuncture treatment may have a significant positive effect and appears to be safe. Future studies are needed to determine the effect of electroacupuncture treatment in patients with PD, and to elucidate the mechanisms of electroacupuncture treatment.

Conclusion

Electroacupuncture treatment may be effective in improving symptoms of primary dysmenorrhea. Electroacupuncture may be a safe treatment for PD, given that half the studies reviewed did not report any serious side effects from electroacupuncture. 2 studies showed that electroacupuncture was more effective than NSAIDs in terms of clinical efficacy. More clinical studies are needed to determine the effectiveness of electroacupuncture treatment for PD.

Author Contributions

Conceptualization: MKJ. Methodology: MKJ. Formal investigation: MKJ and JEP. Data analysis: MKJ and JEP. Writing original draft: MKJ. Writing – review and editing: MKJ and WYK.

Conflicts of Interest

The authors have no conflicts of interest to declare.

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Ethical Statement

This research did not involve any human or animal experiment.

Data Availability

All relevant data are included in this manuscript.

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