Journal of Acupuncture Research

Journal homepage: http://www.e-jar.org

Review Article

Sacral Acupuncture for Lower Urinary Tract Symptoms: A Systematic Review of Randomized Controlled Trials

Jiwon Park [1], Se-Eun Chun [2], Min-Cheol Park [3,4], Eun-Heui Jo [1,4,*]

1 Department of Acupuncture and Moxibustion Medicine, Jeonju Korean Medicine Hospital of Wonkwang University, Jeonju, Korea
2 Department of Internal Medicine, Jeonju Korean Medicine Hospital of Wonkwang University, Jeonju, Korea
3 Department of Ophthalmology, Otolaryngology and Dermatology, Iksan Korean Medicine Hospital of Wonkwang University, Iksan, Korea
4 Research Center of Traditional Korean Medicine, Wonkwang University, Iksan, Korea

Article history:
Submitted: October 05, 2021
Revised: October 25, 2021
Accepted: October 29, 2021

Keywords:
acupuncture,
Korean traditional medicine,
lower urinary tract symptoms

ABSTRACT

Lower urinary tract symptoms (LUTS) associated with storage, voiding, and post-micturition reduce quality of life and cause mental health problems. In traditional medicine, Baliao points have been empirically used to treat urinary system diseases. In this review, randomized controlled trials (RCTs) using sacral acupuncture on Baliao points with sham treatment, other remedies, or other acupoints were retrieved from 8 electronic databases up to June 2021. Sixteen RCTs met the inclusion criteria. The quality of the included studies was assessed using a risk-of-bias (ROB) tool. Most of the evaluation indicators used in the included RCTs showed that sacral acupuncture had a significant therapeutic effect compared with the sham control intervention groups, and other remedies. However, all studies using acupoints (other than the Baliao points) as a control intervention had a "high" ROB and only reported secondary processed information, making it difficult to evaluate the efficacy of sacral acupuncture treatment for LUTS. No serious adverse effects were reported for sacral acupuncture, and only a low number of minor side effects were observed. These results suggest that sacral acupuncture could be considered as an alternative to existing treatments, with the added benefit of low cost. Large-scale, long-term RCTs are required in the future.

https://doi.org/10.13045/jar.2021.00241
pISSN 2586-288X eISSN 2586-2898

Introduction

Lower urinary tract symptoms (LUTS) are associated with storage, voiding, and post-micturition as classified by the International Continence Society [1]. Symptoms associated with storage include urinary incontinence (UI), frequency, and urgency [1]. Symptoms associated with voiding include hesitancy, and slow or intermittent stream, and symptoms associated with post-micturition include a feeling of incomplete emptying, and post micturition dribble [1]. Patients with LUTS not only have a poor quality of life, but tend to experience mental health issues such as anxiety, and depression [2-5]. The economic loss to an individual caused by LUTS, may be significant in terms of loss of days at work and the burden of treatment costs. An internet survey conducted in 2015, reported the prevalence of LUTS among Koreans over 40 years of age was 68.2% (70.6% for men, 66.0% for women), and LUTS increased significantly with age [6].

Existing treatments related to LUTS include behavioral modifications, medications, devices, or surgery. Pelvic floor muscle training (PFMT) is a conservative treatment for UI and overactive bladder (OAB), and it can be more effective than pharmacological management [7], but patients do not typically adhere to PFMT

***Corresponding author.** Eun-Heui Jo
Jeonju Korean Medicine Hospital of Wonkwang University, 99, Garyeonsan-ro, Deokjin-gu, Jeonju, 54887, Korea
E-mail: freezo@wonkwang.ac.kr
ORCID: Jiwon Park https://orcid.org/0000-0002-7134-6143, Se-Eun Chun https://orcid.org/0000-0001-8444-0772,
Min-Cheol Park https://orcid.org/0000-0003-0448-4148, Eun-Heui Jo https://orcid.org/0000-0002-9078-7091

[8]. Anticholinergics, the 1st-line medication for urge incontinence, OAB, and neurogenic bladder, may cause dry mouth, tachycardia, nausea, constipation, or blurry vision. It was reported that these side effects resulted in only 18% of patients who continued taking anticholinergics after 6 months [9]. OnabotulinumtoxinA injected into the bladder detrusor reduced bladder overactivity and improved the quality of life of patients in RCTs for 6 to 9 months [10,11], but it was previously reported to carry the risk of urinary tract infection when incomplete drainage and urinary retention occurs, which requires self-catheterization [12]. Sacral neuromodulation (SNM) therapy, in which a permanent lead and battery are implanted subcutaneously in the sacral region, is costly and may require reoperation due to pain, lead migration, or infection which was reviewed to occur in 1/3 of patients [13].

Insurance companies require efficacy, safety, and cost be considered before supplementing existing treatments. Baliao points (BL31, BL32, BL33, and BL34) have been empirically used for urinary system diseases in traditional medicine [14]. Previously, there have been reviews on the effects of acupuncture on various body parts for each LUTS-related disease [15-18], but no review has focused on the effects of sacral acupuncture. Therefore, randomized controlled trials (RCTs) were reviewed to investigate the efficacy and safety of sacral acupuncture for LUTS based on the empirical use of Baliao points.

Materials and Methods

Data sources and search strategy

In this review, 3 English language databases [Medline (via Pubmed), EMBASE, and Cochrane Central Register of Controlled Trials (CENTRAL)], and 5 Korean databases [KoreaMed, Korea Medical Database (KMbase), Research Information Sharing Service (RISS), Korean Studies Information Service System (KISS), and ScienceON] were searched up to June 2021. Key search terms, "overactive bladder," "urinary incontinence," "neurogenic bladder," "benign prostatic hypertrophy," and "acupuncture (or electroacupuncture)" were used. The search formulas were modified according to the characteristics of the database (see Appendix A). All articles in each database were reviewed without restrictions on language.

Inclusion criteria

Types of studies

Only prospective RCTs were included in this review and quasi-RCTs were excluded. RCTs without a specific description of the randomization method were also included in this review.

Participants

Patients with LUTS regardless of gender, race, or severity and duration of disease were included in this review. To differentiate from enuresis observed in children, the age of included participants was limited to adults. Studies of patients with LUTS caused by inflammatory diseases such as cystitis and prostatitis, painful bladder syndrome, and cancer were excluded. Studies evaluating the therapeutic effect of temporary dysuria induced by childbirth or surgery were also excluded.

Experimental intervention

Only RCTs using acupuncture or electroacupuncture (EA) in the sacral region as an experimental intervention were included in this review. All studies using herbal medication, moxibustion, cupping, acupoint-injection, acupoint-block, acupressure, laser acupuncture, plum-blossom needle, catgut embedding, or massage as a experimental intervention were excluded from this review. In addition, studies where acupuncture was applied to an area other than the sacral region as the experimental intervention group rather than the control intervention group were excluded.

Study selection

A literature search was performed using key terms and phrases, and duplicate studies were removed. Two reviewers independently assessed the retrieved studies and differences in opinion regarding the inclusion of a study were resolved through discussion by these 2 reviewers.

Data extraction

The first author, publication year, country, language, sample size, details about the participants, outcome measures, results, and adverse events were extracted from each study. Experimental intervention details of needling, treatment regimen, and control interventions were also extracted according to the Standards for Reporting Interventions in Clinical Trials of Acupuncture (STRICTA) [19]. If the data were unclear, attempts were made to contact the corresponding authors via email.

Risk-of-bias assessment

The quality evaluation for the included studies was conducted using Cochrane's risk of bias (ROB) tool. There were 7 domains evaluated by 2 reviewers as being either "low risk," "unclear," or "high risk," these included: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, completeness of outcome data, selective reporting, and other bias. Disagreements between the reviewers were resolved through discussion between these 2 reviewers. When the random assignment was stated but no specific method was mentioned, the random sequence generation domain was evaluated as "unclear." Since most of the included RCTs reported objective values including urination volume and frequency of urination as the result, it was assumed that incomplete blinding would not affect the experimental intervention outcome. So, the blinding domains were evaluated as "low risk."

Results

Study description

A total of 1,511 articles were retrieved from the 8 databases, from which duplicate publications were removed. Amongst the

remaining 111 articles which were evaluated using the title and abstract, 95 articles were excluded based upon full-text assessment because they did not fulfill the inclusion criteria. There were 16 RCTs included in this review (Fig. 1).

Study characteristics

All included RCTs were performed in China and published between 1996 and 2019. The studies included patients diagnosed with UI, benign prostatic hyperplasia (BPH), OAB, or neurogenic bladder, all of which cause LUTS. There were 9 RCTs of patients with UI, 3 studies with BPH, 2 studies with OAB, and 2 studies with neurogenic bladder. Various disease specific evaluation tools were used to evaluate the therapeutic effect of the experimental intervention (treatment group).

All studies (except for 1 RCT which did not use electrical stimulation) used EA as the treatment group. In the treatment group, the average duration of treatment was about 5 weeks, and the needles were inserted deeply to 3 to 15 cm. In more than half of the studies, patients reported a sensation which radiated to the genitals or anus. In addition, after inducing the de-qi sensation, the needles were kept in place for 20 to 60 minutes. Most studies selected acupoints of the Bladder meridian on the sacrum (BL31 to BL35), and the most used acupoint was BL33, followed by BL35. However, in 4 studies, 4 sacrococcygeal points were selected to stimulate the pudendal nerve. The control intervention groups (control group) included various sham acupuncture treatments including different needle depth, other remedies, and other acupoints. Details are summarized in the following table [20-35] (Table 1).

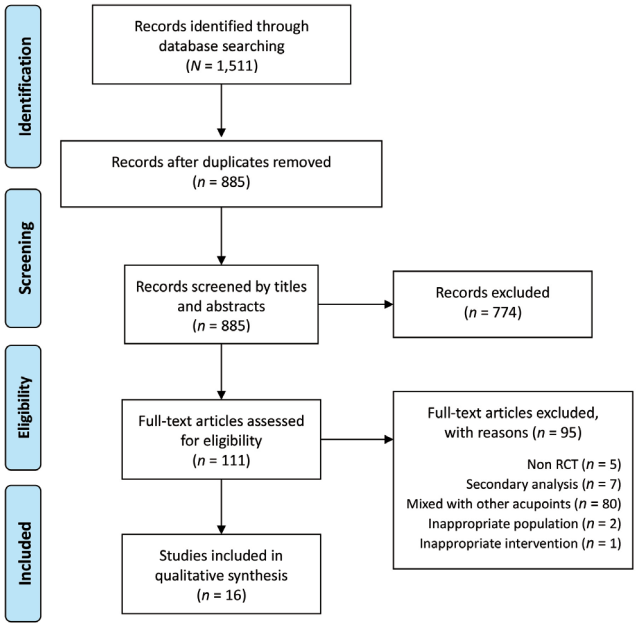

Fig. 1. Flow chart.

Risk-of-bias assessment

The ROB for the random sequence generation domain was evaluated as "unclear" in 3 studies that did not mention a specific randomization method, and "high" in 1 study which used an inappropriate method for allocation (assignment according to hospitalization order). Of the 16 studies, 7 studies did not explain the allocation concealment method. Due to the nature of acupuncture treatment, blinding is difficult, and since objective evaluation tools for urination symptoms were used as outcome indicators in all studies, the ROB for blinding was evaluated as "low." There were 5 studies in which participant dropouts or exclusions were not reported and so were evaluated as having an "unclear" ROB for the incomplete outcome data domain. Liu et al [33] and Zhang et al [34] only used the total effective rate as an outcome measure, and Wang et al [29] and Wang et al [30] had incomplete outcome reporting. So, these 4 studies were evaluated to have a "high" ROB for the selective reporting domain. He et al [22] and Feng et a l[35] did not use adequate evaluation tools e.g., disease-specific outcome measures, but the studies were evaluated as having an "unclear" ROB due to the absence of a protocol. In the other bias domain, the study of Zhang et al [34] was assessed as having a "high" ROB because statistical homogeneity of characteristics between randomly assigned groups was not reported, and the study of Liu et al [33] also had a "high" ROB where 2 groups of patients receiving different treatments were grouped into 1 control group (Figs. 2 and 3).

When grouped by the type of control used in the experimental design, the ROB was assessed as "low" in 7 studies comparing the effectiveness of sacral acupuncture with sham acupuncture, and "low" for 5 studies using other remedies as a control. In contrast, 3 studies comparing sacral acupuncture with other acupoints had a "high" or "unclear" ROB.

Control intervention

Sham acupuncture

There were 7 studies that used sham acupuncture as the control group, 4 of which were in patients with stress incontinence, and the remaining 3 studies were in patients with BPH, OAB, or neurogenic bladder caused by a spinal cord injury. In most of these 7 studies, the sham acupuncture control group did not penetrate the skin and no electrical output was used. Most of the results showed that the treatment group EA had a statistically significant therapeutic effect when compared with the sham acupuncture group. Yuan et al [27] compared differences between the efficacy of deep and shallow acupuncture, and also noted the presence or absence of a radiating sensation to the anterior genital area. It was reported that the deep needling group had statistically significantly more efficacy in half of the outcome indices compared with shallow needling [27].

Other remedies

There were 5 studies comparing sacral acupuncture with other remedies. The control groups included PFMT, transvaginal electrical stimulation, anogenital electrical stimulation, and pharmacotherapy. In these studies, with the exception of the study

Table 1. Summary of Included Studies.

Author (y) [reference]	Sample size (included→ analyzed)	Mean age (mean ± SD)	Population	Mean period of disease (mean ± SD)	Treatment intervention*	Control intervention	Outcome	Results†	Adverse events (%)
Comparison with sham acupuncture									
Liu (2017) [20]	504 (252:252) →504 (252:252)	TG: 54.5 ± 8.3 CG: 56.2 ± 8.4	Stress UI	Median (IQR) TG: 5.0 (2.6-9.8) CG: 5.2 (3.0-10.0)	EA (18×, 6 wks; BL33, BL35; 5-6 cm; 30 min; local region de-qi; 50 Hz, 1-5 mA)	Sham (2 cm lateral to BL33, BL35; no skin penetration, no de-qi, no electrical output)	(ITT) 1) 1-h pad test 2) 72-h IEF 3) ICIQ-SF score 4) Number of urine pads 5) Use of other treatments 6) self-evaluation	1) 2) 3) 6) TG‡ 4) 5) N.S.	Fatigue (0.8), sharp pain (0.4), palpitation (0.4)
Xu (2016) [21]	80 (40:40) →80 (40:40)	TG: 59.05 ± 7.91 CG: 57.97 ± 8.42	Stress UI	Mean (range) TG: 5.04 (2.54 to 8.81) CG: 5.00 (2.37 to 8.07)	EA (18 ×, 6 wks; BL33, BL35; 5-6 cm; 30 min; local region de-qi; 50 Hz, 1-5 mA)	Sham (2 cm lateral to BL33, BL35; no skin penetration, no electrical output)	(ITT) 1) 1-h pad test 2) 72-h IEF 3) ICIQ-SF score 4) self-evaluation	1) 3) 4) TG‡ 2) TG§ (wk 30) 2) N.S. (wk 6, 18)	Subcutaneous hematoma (5.0), persistent pain (2.5)
He (2016) [22]	42 (20:22) →42 (20:22)	TG: 56 ± 9 CG: 55 ± 8	Stress UI	TG: 6.3 ± 3.1 CG: 3.5 ± 3.7	EA (18×, 6 wks; BL33, BL35; 5-6 cm; 30 min; local region de-qi; 10 Hz/50 Hz, 1-5 mA)	Sham (3 cm lateral to BL33, BL35; no skin penetration, no electrical output)	1) UDI 2) VAS 3) frequency of nocturnal enuresis 4) TER	1) 2) 3) 4) TG§	NR
Tang (2016) [23]	84 (42:42) →83 (42:41)	TG: 56 ± 10 CG: 58 ± 12	Stress UI	TG: 3.4 ± 1.2 CG: 3.2 ± 1.3	EA (20×, 7 wks; BL33, BL35; 5-6 cm; 30 min; local region de-qi; 50 Hz, 1-5 mA)	Sham (3 cm lateral to BL33, BL35; no skin penetration, no electrical output)	1) 1-h pad test 2) ICIQ-SF score	1) 2) TG§	NR
Wang (2013) [24]	100 (50:50) →100 (50:50)	TG: 64.80 ± 7.05 CG: 65.94 ± 6.74	BPH	TG: 6.34 ± 4.80 CG: 6.14 ± 4.81	EA (16×, 4 wks; BL33; 6-8 cm; NR; sensation radiated to the genitalia; 20 Hz, current increased to the maximum tolerance)	Sham (6.7 cm lateral to BL33; other interventions were the same except for the radiating sensation)	(ITT) 1) IPSS 2) PVR 3) Qmax	1) TG‡ 2) 3) N.S.	None
	→87 (45:42)	NR		NR			(PP) 1) IPSS	1) TG‡	
Zhang (2015) [25]	50 (25:25) →45 (23:22)	TG: 39.0 ± 8.3 CG: 43.5 ± 10.3	OAB	TG: 2.07 ± 0.52 CG: 1.86 ± 0.48	EA (30×, 6 wks; BL32-34; 5 cm; 30 min; local region de-qi; 4 Hz/20 Hz, current increased to the maximum tolerance)	Sham (1.5 cm lateral to BL32-34; superficially penetrated, just pricking sensation, no electrical output)	1) OABSS 2) KHQ 3) FSF 4) 1st urge (to void) 5) MCC 6) Qmax 7) PVR	1) 2) 4) 5) TG‡ 3) TG§ 6) 7) N.S.	Minor pain (13.0)
Gu (2015) [26]	72 (34:38) →72 (34:38)	TG: 39.6 ± 7.6 CG: 40.75 ± 12.5	Urinary retention (SCI)	TG: 2.15 ± 0.20 CG: 2.13 ± 0.21	EA (3 mo, daily; BL31-34; 3 cm; 20 min; sensation radiated to the perineum and bladder; 20 Hz, NR)	Sham (needles were taping to the dermal surface by adhesive without insertion)	1) PVR 2) voided volume 3) frequency of CIC 4) the number of bladder balance patients	1) 2) 3) TG‡ 4) TG§	NR
Comparison with different needle depth									
Yuan (2019) [27]	131 (66:65) →120 (60:60)	TG: 65.32 ± 8.62 CG: 64.02 ± 8.04	BPH	TG: 7.68 ± 4.34 CG: 8.30 ± 4.00	EA; deep insertion (12×, 4 wks; BL32, BL33; 6-7.5 cm; 30 min; sensation radiated to the anterior genital area; 20 Hz, current increased to the maximum tolerance)	EA; shallow insertion (2.5-4 cm; just pricking sensation; other interventions were the same)	1) IPSS 2) QOL 3) Qmax 4) PVR 5) TER	1) 2) 5) TG‡ 3) 4) N.S.	NR
Comparison with other remedies									
Liu (2019) [28]	500 (250:250) →467 (239:228)	NR	Mixed UI	NR	EA (36×, 12 wks; BL33, BL35; 5-6 cm; 30 min; local region de-qi; 10/50 Hz, 0.1-0.5 mA)	PFMT (36 wks) solifenacin (5 mg/d)	(PP) 1) 72-h IEF	1) < 0.001 for noninferiority	Subcutaneous hematoma (4.0)
	→497 (249:248)	TG: 54.7 ± 10.1 CG: 53.7 ± 9.4		Median (IQR) TG: 3.7 (2.5-8.0) CG: 4.0 (2.3-7.2)			(FAS) 1) 72-h IEF 2) ICIQ-SF 3) 1-h pad test 4) use of urine pads (% of participants, number of pads) 5) participant-reported satisfaction and improvement degree	1)2)3) N.S. 4) TG§ (percent of participants at wks 1-12)¶ 5) TG§ (satisfaction at wks 1-12)¶	

Table 1. (continued).

Author (y) [reference]	Sample size (included→ analyzed)	Mean age (mean ± SD)	Population	Mean period of disease (mean ± SD)	Treatment intervention*	Control intervention	Outcome	Results†	Adverse events (%)
Comparison with other remedies									
Wang (2017) [29]	120 (80:40) →120 (80:40)	TG: 65.8 ± 13.6 CG: 62.2 ± 11.9	Urgency UI	Median (IQR) TG: 2.6 (2.0-5.0) CG: 3.2 (1.7-8.0)	EPNS (9×, 3 wks; 4 sacrococcygeal points; 8-11 cm; 60 min; sensation radiated to the urethra or the anus; 2 Hz, 25-35 mA)	TES (12×, 4 wks; 45 min; 12.5-30 Hz, < 60 mA)	1) UI score (severity of symptoms, QOL) 2) TER	1) 2) TG‡	NR
Wang (2016) [30]	42 (21:21) →42 (21:21)	NR	Stress UI	Median (IQR) TG: 4.0 (1.5-10.0) CG: 4.0 (1.4-9.0)	EPNS (12×, 4 wks; 4 sacrococcygeal points; 8-11 cm; 60 min; sensation radiated to the urethra or the anus; 2.5 Hz, 45-55 mA)	BF-assisted PFMT (4 wks) TES (12×, 4 wks; 20 min; 15-85 Hz, < 60 mA)	1) UI score (severity of symptoms, QOL) 2) TER	1) 2) TG‡	NR
Yang (2008) [31]	93 (47:46) →91 (46:45)	TG: 67.4 ± 8.43 CG: 69.65 ± 8.70	BPH	TG: 4.40 ± 3.95 CG: 3.82 ± 3.32	EA (6×, 2 wks; BL33, BL35; 7.5-10.5 cm; 30 min; NR; 20 Hz, current increased to the maximum tolerance)	Medication; Terazosin HCl (4 wks, 2 mg/d)	1) IPSS 2) Qmax 3) PVR 4) BS 5) times of difficulties for holding urine 6) times of night-urinating 7) size of prostate gland	1) 2) 3) 4) 5) 6) TG‡ 7) N.S.	Injection pain (4.3)
Li (2017) [32]	60 (40:20) →60 (40:20)	TG: 47.90 ± 16.27 CG: 51.05 ± 17.05	NLUTD	NR	EPNS (12×, 4 wks; 4 sacrococcygeal points; 8-11 cm; 45 min; sensation radiated to the urethra or the anus; 2.5 Hz, 25-35 mA)	AES (12×, 4 wks; 45 min; 12.5-35 Hz, < 60 mA)	(ITT) 1) ICIQ-LUTS score 2) ICIQ-LUTSqol score 3) Residual urine volume	1) 2) TG‡ 3) TG§	NR
Comparison with other acupoints									
Liu (1998) [33]	30 (15:15) →30 (15:15)	TG: 66.73 ± 5.38 CG: 68.75 ± 7.11	UI (senile)	TG: > 1 y (7), < 0.5 y (8) CG: > 1 y (4), < 0.5 y (11)	EA (1-3× per week, < 4 wks; BL32, BL35; 7.5-12 cm; 30 min; sensation radiated to the perineum; 50 Hz, current increased to the maximum tolerance)	Acupuncture (1-3× per wk, < 4 wks; (2 types) BL23, CV4, CV3, BL32, KI3 + mox (abd region) / BL39, SP6, CV3; 30 min)	1) TER	1) TG‡	NR
Zhang (1996) [34]	57 (32:25) →57 (32:25)	TG: 52 to 78 CG: 53 to 76	UI (stroke)	NR	Acupuncture (24×, 4 wks; BL32; 15 cm; 50 min; sensation of raising and contraction in the anus)	Acupuncture (CV4, CV3, SP6, BL23, BL28; 4.5 cm; 50 min)	1) TER	1) TG§	NR
Feng (2014) [35]	62 (30:32) →62 (30:32)	mean (range) TG: 59.3 (45 to 82) CG: 58.8 (46 to 85)	OAB	Mean (range) TG: 0.6 (0.3 to 1.5) CG: 0.6 (0.3 to 22)	EA (10×, daily; 4 sacrococcygeal points; 8-8.5 cm; 40 min; sensation radiated to the urethra or the anus; 2.5 Hz, current increased to the maximum tolerance)	Warm needle (10×, daily; CV6, CV5, CV4, CV3, CV2 with mox box / ST28, ST30, SP6, SP9, ST36 without mox box; 2-3 cm; 30-40 min)	1) OABSS 2) TER	1)2) CG§	NR

* Listed in order: total number of times, period of treatment; selected acupoints; depth of insertion (If there is no indication in cm, cun is converted to 3 cm and inch is converted to 2.54 cm); retention time; de-qi sensation; EA setting.
† Regardless of the actual value of the evaluation index, the group judged to have a better therapeutic effect is indicated.
‡ and § significant differences between 2 groups, $p > 0.01$ and $p > 0.05$, respectively.
‖ N.S. no significant difference between 2 groups, $p > 0.05$.
¶ others except those indicated have no significant difference between 2 groups, $p > 0.05$.
abd, abdominal; AES, anogenital electrical stimulation; BF, biofeedback; BPH, benign prostatic hyperplasia; BS, urinary symptom bother score; CG, control group; CIC, Clean intermittent catheterization; EA, electroacupuncture; EPNS, electrical pudendal nerve stimulation; FAS, full analysis set; FSF, first sensation of bladder filling; ICIQ-LUTS, International Consultation on Incontinence-Lower Urinary Tract Symptoms; ICIQ-SF, International Consultation on Incontinence Questionnaire-Short Form; IEF, urinary incontinence episode frequency; IPSS, International Prostate Symptom Score; IQR, interquartile range; ITT, intent to treat; KHQ, King's Health Questionnaire; MCC, maximum cystometric capacity; mox, moxibustion; NLUTD, neurogenic lower urinary tract disease; NR, not recorded; OAB, overactive bladder; OABSS, overactive bladder symptom score; PFMT, pelvic floor muscle training; PP, per protocol; PVR, postvoid residual urine volume; Qmax, maximum urine flow rate; QOL, quality of life; SCI, spinal cord injury; TER, total effective rate; TES, transvaginal electrical stimulation; TG, treatment group; UDI, Urinary and reproductive simple score; UI, urinary incontinence; VAS, visual analogue scale.

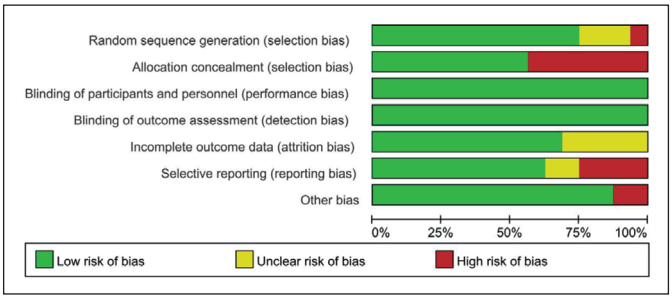

Fig. 2. Risk-of-Bias in the Included Studies.

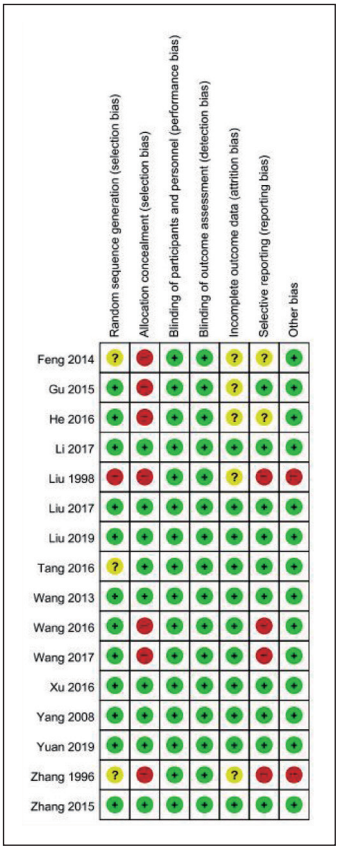

Fig. 3. Risk-of-Bias Summary.

by Liu et al [28], the EA treatment group showed a statistically significant effect in almost all indicators compared with the control group. Liu et al [28] conducted a noninferiority trial for patients with mixed UI and reported that EA is not inferior to PFMT and solifenacin in combination, but rather, EA has a better therapeutic effect using some indicators.

Other acupoints

There were 3 studies comparing the therapeutic effects of acupoints in the sacral region with acupoints in other regions. In the studies by Liu et al [33] and Zhang et al [34], the treatment group had a higher therapeutic effect than the control group, whereas in the study by Feng et al [35], the control group using warm acupuncture had a higher therapeutic effect than the treatment group.

Adverse events

Adverse events were reported in 6 studies. Among the reported adverse events, only acupuncture-related adverse events in the treatment group were listed in Table 1 with the event incidence rates. The most frequently reported side effects were pain-related including pain during insertion and persisting pain after treatment. The 2nd most frequently reported side effect was subcutaneous hematoma. In addition, fatigue and palpitations were also reported by Liu et al [20]. In the study by Wang et al [24], there were no side effects in the treatment group.

Discussion

There were 16 RCTs reviewed to evaluate the efficacy and safety of sacral acupuncture in the treatment of LUTS. Sacral acupuncture appears to relieve LUTS in patients with UI, BPH, OAB, or neurogenic bladder. Most of the evaluation indicators used in the RCTs selected for this review showed that sacral acupuncture had a significantly better treatment effect than sham acupuncture. Inserting needles as deep as 3-8 cm at the correct acupoints and using electrical stimulation can enhance the therapeutic effect. In addition, deep needling (to stimulate the deep nerve) causes a radiating sensation in the genital area or anus. Sacral acupuncture was more effective than physical therapy (such as transvaginal electrical stimulation and anogenital electrical stimulation), therapeutic exercise (such as PFMT), or pharmacotherapy. In the study by Liu (2019) [28], the effect of EA was not inferior to exercise plus medication therapy, which suggests the possibility that EA can be an effective alternative for existing treatments. There were 3 studies comparing the effects of acupuncture treatment on the sacral area and other areas, but all these studies had a "high" ROB and only provided information on the secondary processed total effective rate, making it difficult to derive conclusions about the treatment effect. No serious side effects were reported for sacral acupuncture, and minor side effects were observed at a low frequency.

BL31-BL34 anatomically corresponds to the 1st-4th posterior sacral foramen, and BL35 is located 0.5 cun lateral to the tip of the coccyx. There were 4 studies which did not use traditional acupoints (BL31-BL35) and selected "4 sacrococcygeal points" as treatment points [29,30,32,35]. These studies used "4 sacrococcygeal points," 2 upper points were inserted perpendicularly at 1 cm bilateral to the sacrococcygeal joint to stimulate the main trunk of the pudendal nerve and caused a sensation which referred to the urethra or the anus; 2 lower points were inserted obliquely toward the ischiorectal fossa at 1 cm bilateral to the tip of the coccyx and aroused a sensation which referred to the urethra by stimulating the perineal nerve [29,30,32,35]. It is not yet fully understood how acupuncture at the posterior sacral foramen improves LUTS. However, since sacral acupuncture is similar to SNM therapy in that it stimulates the sacral nerve, it is thought that the mechanism of sacral acupuncture is similar.

SNM is an invasive therapy for patients with UI, retention, urgency, and frequency symptoms who do not respond to behavioral or pharmacological therapy. The needle is usually inserted to stimulate the unilateral S3 nerve root [36]. SNM is thought to have therapeutic effects by modulating spinal cord reflexes and brain involvement through afferent signaling, rather than directly stimulating the bladder detrusor or urethral sphincter [37]. The most widely accepted theory is that SNM inhibits detrusor overactivity by blocking or interfering with the bladder afferent input to the sacral cord by stimulating somatic afferents [38]. As a result, it relieves urinary frequency and urgency. In neurogenic bladder, afferent C fibers become sensitive to bladder distension and activate voiding reflexes [39]. SNM is thought to suppress the abnormal voiding reflex by blocking C fiber activity [40]. Conversely, SNM also induces urination by inhibiting the urethral guarding reflex [41] and relaxing the pelvic floor muscles and urethra [38,42] in patients with urinary retention or incomplete emptying. These previous studies provide an explanation of how sacral acupuncture may be effective in both OAB and urinary retention.

Needling at BL35 and the 4 sacrococcygeal points also modulate reflex pathways on the spinal and supraspinal level by stimulating the pudendal nerve (PN) afferents [43]. PN innervates the external genitalia and the skin around the anus, therefore, it is thought that a sensation radiating to the urethra or anus would occur during acupuncture. Groen's pilot study (2005) reported that pudendal neuromodulation is more effective than SNM for urinary dysfunction in women [44]. In addition, bilateral electrical pudendal nerve stimulation was effective in patients who failed SNM treatment after an initial success [45]. A recent study suggested that the contraction of the pelvic floor muscles induced by stimulation of the PN was not due to the activation of the afferents but was due to the activation of the direct efferents [46,47]. So, sacral acupuncture can simulate pelvic floor muscle training [48] and may strengthen the pelvic floor muscles in patients with UI.

This review has an advantage in that other interventions that could affect the treatment outcome were ruled out such as herbal medicine or acupuncture at a site other than sacral acupuncture. This allowed the observation of treatment efficacy due to sacral acupuncture alone. Studies using different acupoints for each patient according to patient characteristics were also excluded. To date, there have been no studies examining the efficacy of acupuncture on LUTS by limiting the needling points to the sacral region alone. The safety of this technique was also considered by collecting reported adverse events data. This review suggested that sacral acupuncture was safe and effective and may be an alternative to surgical intervention for patients who do not respond to conservative treatment or pharmacotherapy; moreover, it is less costly. In addition, this study provides a good reference for many Korean medicine doctors who treat patients with various LUTS in the primary care setting using a selection of acupoints, depth of needles, sensation of de-qi, retention time, and use of electrical stimulators. The results of this review, suggest that selecting BL31-BL35, especially BL33 and BL35 as treatment points, and needling at the acupoint to a depth of 5-8 cm may result in a therapeutic effect. In addition to the traditional acupoints, needling at 1 cm bilateral to the sacrococcygeal joint or the tip of the coccyx to a depth of 8–11 cm may be appropriate for deep nerve stimulation. Induction of a radiating sensation to the genitals or anus during acupuncture, confirms to the doctor that the needle has been inserted in the correct location, enabling the required therapeutic effect. When performing sacral acupuncture, the retention time should be longer than 30 minutes and the amount of stimulation should be enhanced using EA. Sacral acupuncture may be presented as a 1st-line option for patients who have LUTS symptoms but are reluctant to take medications in a clinical setting, and can be used as a complementary treatment for patients already receiving other treatments, or for patients who have not responded to existing treatments. In addition, this technique has the advantage that it is therapeutic and safe with a low number of side effects.

This review has limitations. Firstly, conclusive evidence on whether sacral acupuncture is an effective therapy for LUTS cannot be determined because of the limited number of studies included in this review. A meta-analysis was not performed because there was significant heterogeneity in the study populations, the control interventions, and the outcome assessment tools used among the selected studies. So, only extraction and description of the clinical outcomes was performed. Secondly, all the included RCTs were conducted in China, so there may be limitations by generalizing the results, and the possibility of publication bias cannot be ignored. Publication bias could not be determined using funnel plots because the number of studies with similar characteristics was too small.

In the future, as more RCTs are performed for each disease related to LUTS, the efficacy of sacral acupuncture should be quantitatively evaluated. Furthermore, additional studies are needed to determine how much sacral acupuncture can improve LUTS when combined with existing treatments such as medicinal drugs or behavioral therapy, and whether it can substitute existing treatments. Information on the persistence of therapeutic effects should be collected through a long-term follow-up, and safety evaluation should be continuously evaluated through a standardized adverse event reporting system.

Conclusion

Sacral acupuncture improved LUTS compared with the sham acupuncture group or other remedy groups, but a quantitative evaluation of the treatment effect could not be performed. This review provides reference information on sacral acupuncture techniques to Korean medicine doctors. Sacral acupuncture may in the future, be used as the main treatment or adjuvant therapy in LUTS, further studies are required to confirm its efficacy and safety.

Conflicts of Interest

The authors have no conflicts of interest to declare.

Acknowledgments

This research was supported by Wonkwang University's internal research fund in 2021.

Ethical Statement

This research did not involve any human or animal experiment.

References

[1] Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, Ulmsten U et al. The standardisation of terminology in lower urinary tract function: Report from the standardisation sub-committee of the International Continence Society. Urology 2003;61:37-49.

[2] Jeong WS, Choi HY, Nam JW, Kim SA, Choi BY, Moon HS et al. Men With Severe Lower Urinary Tract Symptoms Are at Increased Risk of Depression. Int Neurourol J 2015;19:286-292.

[3] Lee KS, Choo MS, Seo JT, Oh SJ, Kim HG, Ng K et al. Impact of overactive bladder on quality of life and resource use: Results from Korean Burden of Incontinence Study (KOBIS). Health Qual Life Outcomes 2015;13:89.

[4] Kim TH, Han DH, Ryu DS, Lee KS. The Impact of Lower Urinary Tract Symptoms on Quality of Life, Work Productivity, Depressive Symptoms, and Sexuality in Korean Men Aged 40 Years and Older: A Population-Based Survey. Int Neurourol J 2015;19:120-129.

[5] Martin S, Vincent A, Taylor AW, Atlantis E, Jenkins A, Januszewski A et al. Lower Urinary Tract Symptoms, Depression, Anxiety and Systemic Inflammatory Factors in Men: A Population-Based Cohort Study. PLoS One 2015;10:e0137903.

[6] Yoo TK, Lee KS, Sumarsono B, Kim ST, Kim HJ, Lee HC et al. The prevalence of lower urinary tract symptoms in population aged 40 years or over, in South Korea. Invest Clin Urol 2018;59:166-176.

[7] Burgio KL, Locher JL, Goode PS, Hardin JM, McDowell BJ, Dombrowski M et al. Behavioral vs drug treatment for urge urinary incontinence in older women: A randomized controlled trial. Jama 1998;280:1995-2000.

[8] Bø K, Kvarstein B, Nygaard I. Lower urinary tract symptoms and pelvic floor muscle exercise adherence after 15 years. Obstet Gynecol 2005;105:999-1005.

[9] Kelleher CJ, Cardozo LD, Khullar V, Salvatore S. A medium-term analysis of the subjective efficacy of treatment for women with detrusor instability and low bladder compliance. Br J Obstet Gynaecol 1997;104:988-993.

[10] Chapple C, Sievert KD, MacDiarmid S, Khullar V, Radziszewski P, Nardo C et al. OnabotulinumtoxinA 100 U significantly improves all idiopathic overactive bladder symptoms and quality of life in patients with overactive bladder and urinary incontinence: A randomised, double-blind, placebo-controlled trial. Eur Urol 2013;64:249-256.

[11] Cruz F, Herschorn S, Aliotta P, Brin M, Thompson C, Lam W et al. Efficacy and safety of onabotulinumtoxinA in patients with urinary incontinence due to neurogenic detrusor overactivity: A randomised, double-blind, placebo-controlled trial. Eur Urol 2011;60:742-750.

[12] Anger JT, Weinberg A, Suttorp MJ, Litwin MS, Shekelle PG. Outcomes of intravesical botulinum toxin for idiopathic overactive bladder symptoms: A systematic review of the literature. J Urol 2010;183:2258-2264.

[13] Brazzelli M, Murray A, Fraser C. Efficacy and safety of sacral nerve stimulation for urinary urge incontinence: A systematic review. J Urol 2006;175:835-841.

[14] Lee HY, Min KY, Im JH, Cho IY, Kim SJ, Park YJ et al. A Clinical Study of 3 Cases of Patients who have Neurogenic Bladder wih Nocturia Treated by Electroacupuncture. J Int Korean Med 2008;29:161-167. [in Korean].

[15] Zhong D, Tang W, Geng D, He C. Efficacy and safety of acupuncture therapy for urinary incontinence in women: A systematic review and meta-analysis. Medicine (Baltimore) 2019;98:e17320.

[16] Mak TC, Chen HY, Cho WC. Acupuncture for overactive bladder in adults: A systematic review and meta-analysis. Acupunct Med 2019;37:321-331.

[17] Yang GF, Sun D, Wang XH, Chong L, Luo F, Fang CB. Effectiveness of rehabilitation training combined acupuncture for the treatment of neurogenic bladder secondary to spinal cord injury. Medicine (Baltimore) 2019;98:e17322.

[18] Zhang W, Ma L, Bauer BA, Liu Z, Lu Y. Acupuncture for benign prostatic hyperplasia: A systematic review and meta-analysis. PLoS One 2017;12:e0174586.

[19] MacPherson H, Altman DG, Hammerschlag R, Youping L, Taixiang W, White A et al. Revised STandards for Reporting Interventions in Clinical Trials of Acupuncture (STRICTA): extending the CONSORT statement. PLoS Med 2010;7:e1000261.

[20] Liu Z, Liu Y, Xu H, He L, Chen Y, Fu L et al. Effect of Electroacupuncture on Urinary Leakage Among Women With Stress Urinary Incontinence: A Randomized Clinical Trial. JAMA 2017;317:2493-2501.

[21] Xu H, Liu B, Wu J, Du R, Liu X, Yu J et al. A Pilot Randomized Placebo Controlled Trial of Electroacupuncture for Women with Pure Stress Urinary Incontinence. PLoS One 2016;11:e0150821.

[22] He E, Chen Y, Tian H, Zhao J. Effective observation of electroacupuncture with different courses for female stress urinary incontinence. Zhongguo Zhen Jiu 2016;36:351-354. [in Chinese].

[23] Tang KM, Shen R, Jiang F, Wang Q, Xie XB, Chen YL. Therapeutic Evaluation of Acupuncture for Female Stress Urinary Incontinence. Shang Hai Zhen Jiu Za Zhi 2016;35:1439-1441. [in Chinese].

[24] Wang Y, Liu B, Yu J, Wu J, Wang J, Liu Z. Electroacupuncture for moderate and severe benign prostatic hyperplasia: A randomized controlled trial. PLoS One 2013;8:e59449.

[25] Zhang J, Cheng W, Cai M. Effects of electroacupuncture on overactive bladder refractory to anticholinergics: A single-blind randomised controlled trial. Acupunct Med 2015;33:368-374.

[26] Gu XD, Wang J, Yu P, Li JH, Yao YH, Fu JM et al. Effects of electroacupuncture combined with clean intermittent catheterization on urinary retention after spinal cord injury: A single blind randomized controlled clinical trial. Int J Clin Exp Med 2015;8:19757-19763.

[27] Yuan H, Wei N, Li Y, Yu L, Zhang Y, Ong WL et al. Effect of Depth of Electroacupuncture on the IPSS of Patients with Benign Prostatic Hyperplasia. Evid Based Complement Alternat Med 2019;2019:1439141.

[28] Liu B, Liu Y, Qin Z, Zhou K, Xu H, He L et al. Electroacupuncture Versus Pelvic Floor Muscle Training Plus Solifenacin for Women With Mixed Urinary Incontinence: A Randomized Noninferiority Trial. Mayo Clin Proc 2019;94:54-65.

[29] Wang S, Lv J, Feng X, Lv T. Efficacy of Electrical Pudendal Nerve Stimulation versus Transvaginal Electrical Stimulation in Treating Female Idiopathic Urgency Urinary Incontinence. J Urol 2017;197:1496-1501.

[30] Wang S, Lv J, Feng X, Wang G, Lv T. Efficacy of Electrical Pudendal Nerve Stimulation in Treating Female Stress Incontinence. Urology 2016;91:64-69.

[31] Yang T, Zhang XQ, Feng YW. Efficacy of electroacupuncture in treating 93 patients with benign prostatic hyperplasia. Zhongguo Zhong Xi Yi Jie He Za Zhi 2008;28:998-1000. [in Chinese].

[32] Li T, Feng X, Lv J, Cai T, Wang S. Short-term Clinical Efficacy of Electric Pudendal Nerve Stimulation on Neurogenic Lower Urinary Tract Disease: A Pilot Research. Urology 2018;112:69-73.

[33] Liu ZH, Shao SJ, Ye YM, Li YS, Huang M, Zhang H et al. Analysis of the curative effect of electro-acupuncture at Ciliao and Huiyang points to treat senile urinary incontinence. Shanghai Zhenjiu Zazhi 1998;17:14-15. [in Chinese].

[34] Zhang W, Xu N, Dong Y. Elongated-Needle Treatment of Urinary Incontinence Caused by Apoplexy. World J Acupunct Moxibustion 1996;6:33-35.

[35] Feng QT, He B, Chen XL, Li RH. Clinical observation of different acupuncture methods for treating overactive bladder syndrome. Xin Zhongyi 2014;46:188-190. [in Chinese].

[36] Li LF, Ka-Kit Leung G, Lui WM. Sacral Nerve Stimulation for Neurogenic Bladder. World Neurosurg 2016;90:236-243.

[37] Kessler TM, Fowler CJ. Sacral neuromodulation for urinary retention. Nat Clin Pract Urol 2008;5:657-666.

[38] Elkelini MS, Abuzgaya A, Hassouna MM. Mechanisms of action of sacral neuromodulation. Int Urogynecol J 2010;21 Suppl 2:S439-446.

[39] Yoshimura N. Bladder afferent pathway and spinal cord injury: Possible mechanisms inducing hyperreflexia of the urinary bladder. Prog Neurobiol 1999;57:583-606.

[40] Wang Y, Hassouna MM. Neuromodulation reduces c-fos gene expression in spinalized rats: a double-blind randomized study. J Urol 2000;163:1966-1970.

[41] Leng WW, Chancellor MB. How sacral nerve stimulation neuromodulation

works. Urol Clin North Am 2005;32:11-18.
[42] Aboseif S, Tamaddon K, Chalfin S, Freedman S, Mourad MS, Chang JH et al. Sacral neuromodulation in functional urinary retention: An effective way to restore voiding. BJU Int 2002;90:662-665.
[43] Bosch JL. Electrical neuromodulatory therapy in female voiding dysfunction. BJU Int 2006;98 Suppl 1:43-48; discussion 9.
[44] Groen J, Amiel C, Bosch JL. Chronic pudendal nerve neuromodulation in women with idiopathic refractory detrusor overactivity incontinence: Results of a pilot study with a novel minimally invasive implantable mini-stimulator. Neurourol Urodyn 2005;24:226-230.
[45] Wang S, Zhang S, Zhao L. Long-term efficacy of electrical pudendal nerve stimulation for urgency-frequency syndrome in women. Int Urogynecol J 2014;25:397-402.
[46] Vaganée D FE, Voorham J, Van de Borne S, Voorham-van der Zalm P, De Wachter S. Behind the scenes: An electromyographic interpretation of the pelvic floor contractions seen by the naked eye upon stimulation in sacral neuromodulation patients. Neurourol Urodyn 2019;38:S446-449.
[47] De Wachter S, Vaganee D, Kessler TM. Sacral Neuromodulation: Mechanism of Action. Eur Urol Focus 2020;6:823-825.
[48] Wang S, Zhang S. Simultaneous perineal ultrasound and vaginal pressure measurement prove the action of electrical pudendal nerve stimulation in treating female stress incontinence. BJU Int 2012;110:1338-1343.