Systematic Review and Meta-Analysis

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Efficacy and safety of electroacupuncture for urinary retention

A systematic review and meta-analysis

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Abstract

Background: Electroacupuncture (EA) is considered as an effective treatment for urinary retention (UR).

Methods: Up to April 7, 2023, randomized controlled trials (RCTs) of EA for UR were extensively searched in 8 databases, including Pubmed, Cochrane, Embase, Web of Science, Chinese Biomedical Literature Database, Chinese Journal Full-text Database, Wanfang Data, and VIP Full-text e-Journals Database. The Cochrane Risk of Bias tool and the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) were utilized to evaluate the quality of all included RCTs. Meta-analysis was conducted using Stata 15.0 software.

Results: A total of 23 trials were included, and the meta-analysis results suggested that compared with the control group, EA can effectively treat various types of UR (risk ratio [RR] = 1.22, 95CI%: 1.14, 1.31) and promote bladder function recovery, with a significant reduce in residual urine volume (weighted mean differences [WMD] = –49.60, 95CI%: –64.10, –35.11), an increase in maximum bladder capacity (WMD = 47.00, 95CI%: 12.76, 81.24), a shorten in the first urination time (standardized mean difference [SMD] = –1.42, 95CI%: –2.08, –0.76), and less adverse reactions (RR = 0.21, 95CI%: 0.07, 0.65).

Conclusion: EA has significant advantages in treating UR, but the efficacy and safety are still needed to be further verified through large-sample and high-quality RCTs.

Abbreviations: CI = confidence interval, EA = electroacupuncture, RCTs = randomized controlled trials, RR = risk ratio, SMD = standardized mean difference, UR = urinary retention, WMD = weighted mean differences.

Keywords: electroacupuncture, meta-analysis, systematic review, urinary retention

1. Introduction

Urinary retention (UR) is a condition in which untimely emptying of the bladder leads to retention of residual urine, characterized by autonomic dysuria and with or without pain in the bladder region.[1,2] In standardizing the terminology for lower urinary tract function, the Standardisation Sub-Committee of the International Continence Society (ICOS) has classified it into 2 categories: "acute urinary retention" and "chronic urinary retention."[3] There are many causes of UR, including obstructive factors, neurogenic factors (sensory or motor nerve injury of the bladder), iatrogenic factors (pharmacological and non-pharmacological effects), infectious factors, and others.[4,5] Among them, benign prostatic hyperplasia is the most common obstructive etiology of UR in men, accounting for approximately 53% of total cases.[6] Neurogenic bladder is a neurogenic factor for UR, and is reported to be found in 37% to 72% of patients with Parkinson syndrome and 15% of patients with stroke.[7] Moreover, 70% to 84% of patients with spinal cord injury suffer from bladder dysfunction. The incidence of UR increases significantly with increasing age, severely affecting the quality of life and mental health of individuals, and therefore, improving the awareness and importance of UR is very urgent and necessary.

At present, the main treatment in Western medicine is timely bladder decompression, including urethral or suprapubic catheterization. However, complications such as hematuria, infection, and postobstructive diuresis exist.[4] Other Western medical therapies include bladder training therapy, surgical treatment, and pharmacotherapy, but some experiments show

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that compared with short-term catheterization, bladder training by catheter clamping has limited effect and no obvious advantages.[8] Therefore, seeking more effective and safe treatment methods is an urgent problem for clinicians to solve today. In recent years, as one of the acupuncture methods, electroacupuncture (EA) has been considered an effective treatment for UR. Studies have shown that EA can bi-directionally regulate bladder function and anti-urinary tract infection,[9] improve the tension and compliance of the detrusor muscle, and maintain the normal contractile activity of the bladder.[10] Although an increasing number of trials have shown the efficacy of EA in treating UR, there is still a lack of high-quality clinical evidence to explore the effect of EA in patients with various types of UR. Therefore, this review aims to conduct a meta-analysis of the existing literature to confirm the efficacy and safety of EA for UR and to explore the advantageous parameters of EA therapy through subgroup analysis.

2. Methods

This report is designed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[11] It has been registered for meta-analysis on the Prospero website (Registration number: CRD42023421002).

2.1. Database search

Four English databases were searched including PubMed, Cochrane, Embase, Web of Science and 4 Chinese-language databases Chinese Biomedical Literature Databases, Chinese Journal Full-text Database, Wanfang Data, and VIP Full-text e-Journals Database from the database construction to April 7, 2023. In the search, the language is limited to Chinese and English. The search strategy consists of the research topic (UR) and the intervention measure (EA), using subject words and free words. The English database search terms included "Urinary Retention," "Retention, Urinary," "electroacupuncture," and "EA," and the Chinese search terms included "Niaozhuliu" and "Dianzhen" etc. The search strategy was adjusted for different databases.Meanwhile, we reviewed the reference lists of all identified thesis for more relevant studies. See Supplementary Text 1, http://links.lww.com/MD/M760 for the specific search strategy.

2.2. Inclusion and exclusion criteria

Relevant clinical trials were included if the following criteria were met: Study subjects: patients clearly diagnosed with UR according to the diagnostic criteria provided by the International Continence Society (ICS)[12]including UR due to various factors. There were no restrictions on age, gender, or race. Interventions: the treatment group mainly receives EA, which can be combined with conventional Western medicine treatment, including intermittent catheterization, lower abdominal massage, bladder function training, and rehabilitative training, etc. Comparators: there are no limitations on the intervention methods of the control group, but the only difference with the treatment group is EA. Treatment acupoints, duration, etc, are not restricted; Outcomes: the main outcome index is residual urine volume, which is used to evaluate bladder voiding function, and the degree of residual urine volume is positively correlated with the severity of UR. Secondary outcome measures include first urination volume, maximum bladder capacity, first urination time, clinical response rate, and incidence of adverse events. Study type: randomized controlled trial (RCT).

The exclusion criteria are as follows: literature with consistent and duplicate content, comparison of the therapeutic effects of different acupoints and frequency of EA, treatment groups using EA combined with other acupuncture therapy, Chinese medicine, etc., non-RCTs, semi-RCTs, efficacy observations, reviews, guidelines, abstracts, conference papers, opinions, letters, case reports, and other articles. Studies only reported clinical response rate without other relevant outcome measures.

2.3. Literature screening and data extraction

Two reviewers, XHY and WLN, searched the literature and imported them into EndnoteX9. After deleting duplicates, we read the titles and abstracts and exclude irrelevant literature. After reviewing the full texts, the literature meeting the criteria were included. The selected literature was used for data extraction, including author, publication year, country, sample size, population characteristics, intervention measures, outcome measures, etc. If the data in the study were unclear, the corresponding author of the literature was contacted by email by one of the reviewers for information. The above steps will be conducted independently by 2 reviewers and cross-checked. In case of disagreement, we resolved the issue with a third reviewer.

Initially, a total of 1650 articles were retrieved from 8 databases, and after removing duplicates, 750 articles were reviewed by title and abstract. Out of these, 669 articles were excluded for not meet the inclusion criteria, while 81 were carefully reviewed in the full text. Ultimately, 23 studies were included in this meta-analysis. The study selection process is illustrated in Figure 1.

2.4. Quality evaluation

The risk and bias for inclusion will be evaluated by 2 independent reviewers (XHY and WLN) using the Risk of Bias tool in Cochrane Handbook for Systematic Reviews of Interventions (Version 5.0.2).[13] The device includes 7 domains: random sequence generation, allocation concealment, blinding of participants and personnel, incomplete outcome data, selective reporting bias, and other biases. The quality of the report was classified into 3 levels: low risk of bias, unclear risk of bias, and high risk of bias. After cross-checking the above steps, if disagreements occur, discuss with the third reviewer.

The biased risk assessment included in the study is shown in Figure 2. Regarding random sequence generation, 17 studies used methods with low risk of bias, for instance, random number tables, 2 studies[14,15] were grouped in the order of visits and 2 studies[16,17] were grouped according to the patients' preference, resulting in a high risk of bias. 2 studies[18,19] were unclear. Regarding allocation concealment, 2 studies[16,17] were grouped according to patient preference, with a higher risk of bias and the remaining studies were unclear. Due to the objective reasons of acupuncture, the operators could not be blinded, but 2 studies[18,20] had blind subjects, resulting in a lower risk of bias; 2 studies[16,17] were not blinded, with a high risk of bias, and the others were unclear. The blinding status of the assessors was not mentioned in any of the studies. Except for a study with a high loss to follow-up[21] and one study[22] with selective reporting and a high risk of bias, the remaining studies had low risk of bias in incomplete outcome measures, selective reporting, and other sources of bias.

2.5. Level of evidence

The overall quality of the evidence was assessed using the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE). The GRADE guidelines encompass 5 domains: risk of bias, inconsistency, indirectness, imprecision, and publication bias. The quality of evidence is classified into 4 levels: high, moderate, low, and very low. Two reviewers (XHY and WLN) independently conducted the assessment using Review Manager 5.4 and GRADEpro (https://gradepro.org/),and a third evaluation was subsequently reviewed by the

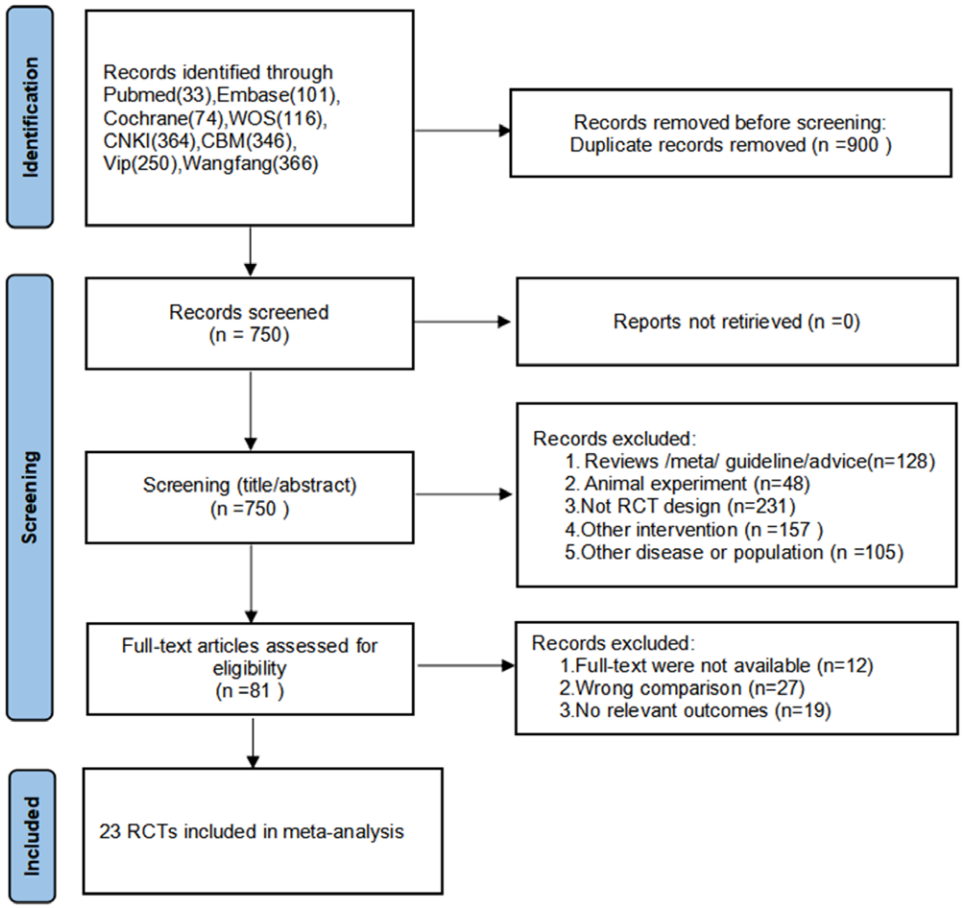

Figure 1. Flow diagram of literature retrieval and selection: 1650 potential citations were initially captured and eventually 23 RCTs were incorporated into our systematic review and meta-analysis. RCTs = randomized controlled trials.

investigator. Any discrepancies were resolved through discussion with the professionals.

2.6. Statistical analysis

The Stata15.0 software (Stata Corp, College Station, TX) was used to analyze all the extracted data. For continuous data (bladder residual urine volume, first urination volume, maximum bladder capacity, and first urination time), the weighted mean difference (WMD) of 95% confidence interval (CI) was used for the same scale, and the standardized mean difference (SMD) was used for different scales. For binary variables (clinical efficacy and adverse events), Risk Ratio (RR) was used as the effect indicator for meta-analysis Heterogeneity of studies was assessed using the I^2 test, where a fixed-effect model was used for $I^2 < 50\%$ and $P > .1$. Otherwise, a random-effect model was employed for merging. Meanwhile, the source of heterogeneity was found by subgroup analysis, sensitivity analysis, and meta-regression. Sensitivity analysis was used to evaluate the robustness of the meta-analysis results. Begg or Egger tests were used to assessing publication bias, and for results with significant publication bias, trim, and fill methods were used to measure the impact of publication bias on the results.

3. Results

3.1. Literature characteristics

Two of the included RCT articles were published in English and 21 in Chinese. Subjects: A total of 1985 patients were involved, ranging from 20 to 200 patients per study, all of the studies were conducted in China. Among them, 3 studies for UR after stroke,[15,23,24] 10 for postoperative UR, 2 for postpartum UR,[17,25] 1 for prostatic hyperplasia UR,[26] 6 for spinal cord injury, and 1 for neurogenic bladder UR.[27] Interventions: the treatment group mainly received EA or combined with western medicine conventional treatment, including intermittent catheterization, routine care, rehabilitation training, and bladder function training methods, etc. In the control group, 15 studies used conventional western treatments, 4 studies used pharmacotherapy, 2 studies used conventional acupuncture,[18,24] one study used ear seed pressure treatment,[28] 2 studies used sham acupuncture,[20,25] and one study was a blank control.[17] Outcomes measurement: 20 articles reported the residual urine volume of the bladder, 5 articles explained the first urination volume and the maximum bladder capacity, 6 articles determined the time of the first urination, 16 articles assessed the effective rate, and 3 articles reported the occurrence of adverse events. The basic characteristics of the included studies are shown in Table 1.

3.2. Meta-analysis

3.2.1. Residual bladder urine volume. Eighteen publications[14–17,20,24,25,27,29,31–34,36] including 20 studies reported on residual bladder urine volume, and the combined data analysis resulted in WMD = −49.60, 95% CI: −64.10, −35.11, $P < .001$, $I^2 = 98.9\%$ (Fig. 3). The results indicated that the EA group was significantly better than the control group in reducing residual urine retention volume, and the difference was statistically significant. Sensitivity analysis demonstrated that

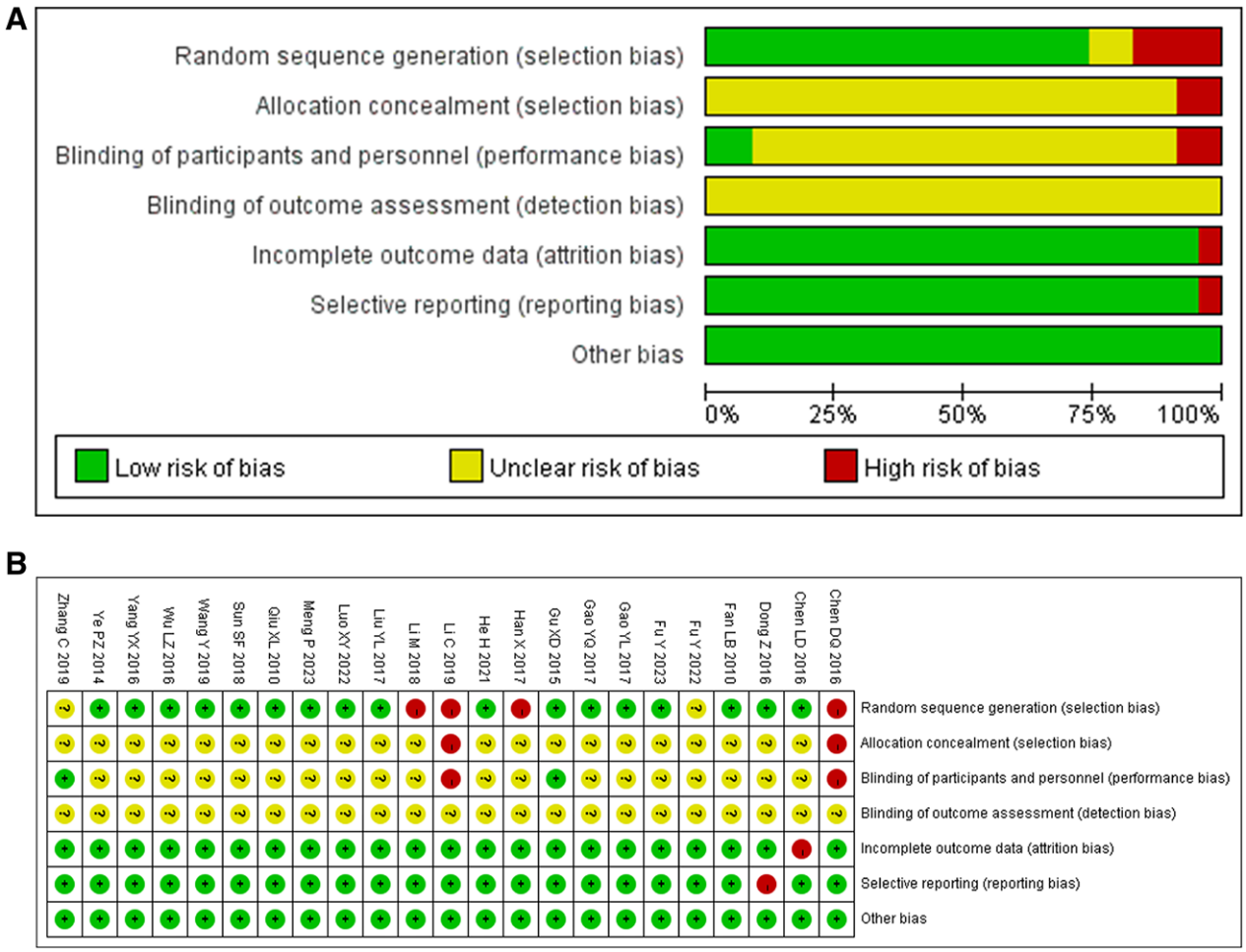

Figure 2. Assessment of risk of bias in included studies: (A) risk of bias graph and (B) risk of bias summary.

this conclusion was robust, and did not change after excluding individual trials (Fig. 4). The publication bias test suggested that the publication bias was insignificant: Begg ($P = .112$), Egger ($P = .112$).

Subgroup analysis was performed according to the different EA treatment parameters of the included studies. The subgroup factors included control measures, types of UR, treatment duration, and different acupoint locations, as shown in Table 2. Through the analysis, it was found that in different control measures, the EA had significant differences and statistically significant results ($P < .05$) compared with the conventional treatments, conventional acupuncture, sham acupuncture, blank control and rehabilitation training in improving bladder function and reducing residual urine volume; there was no difference with the pharmacotherapy group ($P = .40$). In different types of UR, except for UR due to prostatic hyperplasia, EA had better therapeutic effects on all the other types of UR. In terms of different treatment courses, the efficacy of the EA was better than that of the control group in all treatment course groups. In terms of acupoint selection, according to the different acupoints selected in the included studies, they were divided into 3 subgroups, including one group with "Zhongji" (RN3) and "Guanyuan" (RN4) acupoints, one group with "Baliao" acupoints, and one group with other acupoints. The results revealed that the intervention effect of EA had significant advantages over different acupoint selections ($P < .05$).

3.2.2. First urination volume. Five studies[14,19,25,30,31,35] reported the first urination volume and the data combination analysis showed WMD = 37.07, 95% CI: −5.51, 79.64, $P > .05$, and $I^2 = 94.3\%$, suggesting no significant difference in the first urination volume between EA and control group, as shown in Figure 5. After sensitive analysis, the removal of Gao Yinqiu study indicated that the first urination volume of the EA was significantly higher than that of the control group (WMD = 56.17, 95% CI: 34.81–77.53; $P < .001$, $I^2 = 62.1\%$). The analysis showed that Gao study suggested that the first urination volume in the control group was more than that in the EA observation group, and the results of the meta-analysis were not significant. Therefore, whether EA can increase the first urination volume needs more high-quality research to explore.

3.2.3. Maximum bladder capacity. Five studies[15,18,21,22,24] reported the maximum bladder capacity and the results of data combination analysis were WMD = 47.00, 95% CI: 12.76, 81.24, $P < .001$, and $I^2 = 95.2\%$. The results showed that the maximum bladder capacity in the EA group was greater than that in the control group. In the search for sources of heterogeneity, the study was divided into 2 subgroups based on different control measures, and heterogeneity was significantly reduced (Fig. 6).

3.2.4. First urination time. Six studies reported[14,25,28,30–32] the first urination time, and the results of data combination analysis were SMD = −1.42, 95% CI: −2.08, −0.76, $P < .001$, $I^2 = 91.8\%$ (Fig. 7). The results indicated that the first urination time in the EA group was shorter than that in the control group. When searching for sources of heterogeneity, it was found that

Table 1

Basic characteristics of 23 RCTs included in this study.

		Sex (male/female)			Treatment				
First author	Publication yr	Case	Control-1	Control-2	Case	Control-1	Control-2	Main disease background (n/N)	Main outcomes
Yang YX[23]	2016	21/11	21/8		CIC + EA: once daily for 20 d, 30 min	CIC		Post-stroke urinary retention: (61/61)	RUV, effectiveness
Fan LB[29]	2010	6/4	5/5		EA: 5 times a week for 4 wk, 20 min	CT		Postoperative urinary retention: (20/20)	RUV
Fu Y[30]	2023	58/42	56/44		EA: once daily for 1 wk, 30 min	pharmacotherapy		Postoperative urinary retention: (200/200)	FUV, FUT, Effectiveness
Meng P[24]	2023	24/21	23/22		EA: once daily for 2 wk, 40min	CA		Post-stroke urinary retention: (90/90)	RUV, MBC, Effectiveness
Gao YQ[31]	2017	26/24	27/23		EA:1 time, 30 min	CT		Postoperative urinary retention: (100/100)	FUV, MBC, FUT
Han X[14]	2017	28/10	26/12		CT + EA: once daily for 3 d, 20 min	pharmacotherapy		Postoperative urinary retention: (76/76)	RUV, FUV, FUT, Effectiveness
He H[25]	2021	0/36	0/36		EA: twice a day for 3 d, 30 min	SA		Postpartum urinary retention: (72/72)	RUV, FUV, FUT, Effectiveness, AE
Li M[15]	2018	20/18	19/17		EA: once daily for 20 days,30min	CIC		Post-stroke urinary retention: (80/74)	RUV, MBC, Effectiveness
Wu LZ[28]	2016	12/18	13/17		EA: twice a day for 3 d, 30 min	Ear seed pressure treatment		Postoperative urinary retention: (60/60)	FUT, Effectiveness
Liu YL[26]	2017	39/0	31/0		EA: once daily for 3 wk, 15–20 min	Pharmacotherapy		Urinary retention due to prostatic hyperplasia: (70/70)	RUV, Effectiveness
Sun SF[32]	2018	0/42	0/42		EA: 1 time, 30 min	CT		Postoperative urinary retention: (84/84)	RUV, FUT, Effectiveness
Wang Y[27]	2019	16/14	17/13		CIC + EA: 20 d	CIC		Neurogenic bladder retention: (60/60)	RUV, Effectiveness
Ye PZ[33]	2014	0/74	0/33		CT + EA: once daily for 10 d	CT		Postoperative urinary retention: (107/107)	RUV, Effectiveness
Zhang C[18]	2019	23/7	24/6		RT + EA: every other day for 2 mo, 30 min	CA + RT		Urinary retention after spinal cord injury: (60/60)	MBC, AE
Fu Y[19]	2022	49/51	53/47		EA: once daily for 2 mo, 30 min	pharmacotherapy		Postoperative urinary retention: (200/200)	Effectiveness
Gu XD[20]	2015	27/7	25/13	28/7	CIC + EA: once daily for 3 mo, 20min	CIC + SA	CIC	Urinary retention after spinal cord injury: (107/107)	RUV
Chen DQ[16]	2016	25/17	12/18		RT + EA: once daily for 15 d	RT		Urinary retention after spinal cord injury: (72/72)	RUV, Effectiveness
Gao YL[34]	2017	14/16	17/13		EA + RT: once daily for 4 wk, 30 min	RT		Urinary retention after spinal cord injury: (60/60)	RUV
Li C[17]	2019	0/46	0/45	0/47	EA + RT: once daily for 3 d, 30 min	RT	No treatment	Postpartum urinary retention: (138/138)	RUV, Effectiveness
Luo XY[35]	2022	21/9	23/7		EA + RT:5 times a week for 8 wk, 30 min	RT		Postpartum urinary retention: (60/60)	RUV, FUV, Effectiveness, AE
Qiu XL[36]	2010	0/31	0/31		EA + RT: once daily for 5 d, 30 min	RT		Postoperative urinary retention: (62/62)	RUV, Effectiveness
Dong Z[22]	2016	18/12	19/11		EA + RT:6 times a week for 8 wk, 30 min	RT		Urinary retention after spinal cord injury: (60/60)	RUV, MBC
Chen LD[21]	2016	NM	NM		EA + CT: once daily for 6 d, 30 min	CT		Postoperative urinary retention: (65/90)	RUV, MBC

AE = adverse effects, CA = conventional acupuncture, CT = conventional treatments, EA = electro-acupuncture, FUT = first urination time, FUV = first urination volume, IC = Intermittent Catheterization, MBC = maximum bladder capacity, NM = not mention, RT = rehabilitation training, RUV = residual urine volume, SA = sham acupuncture.

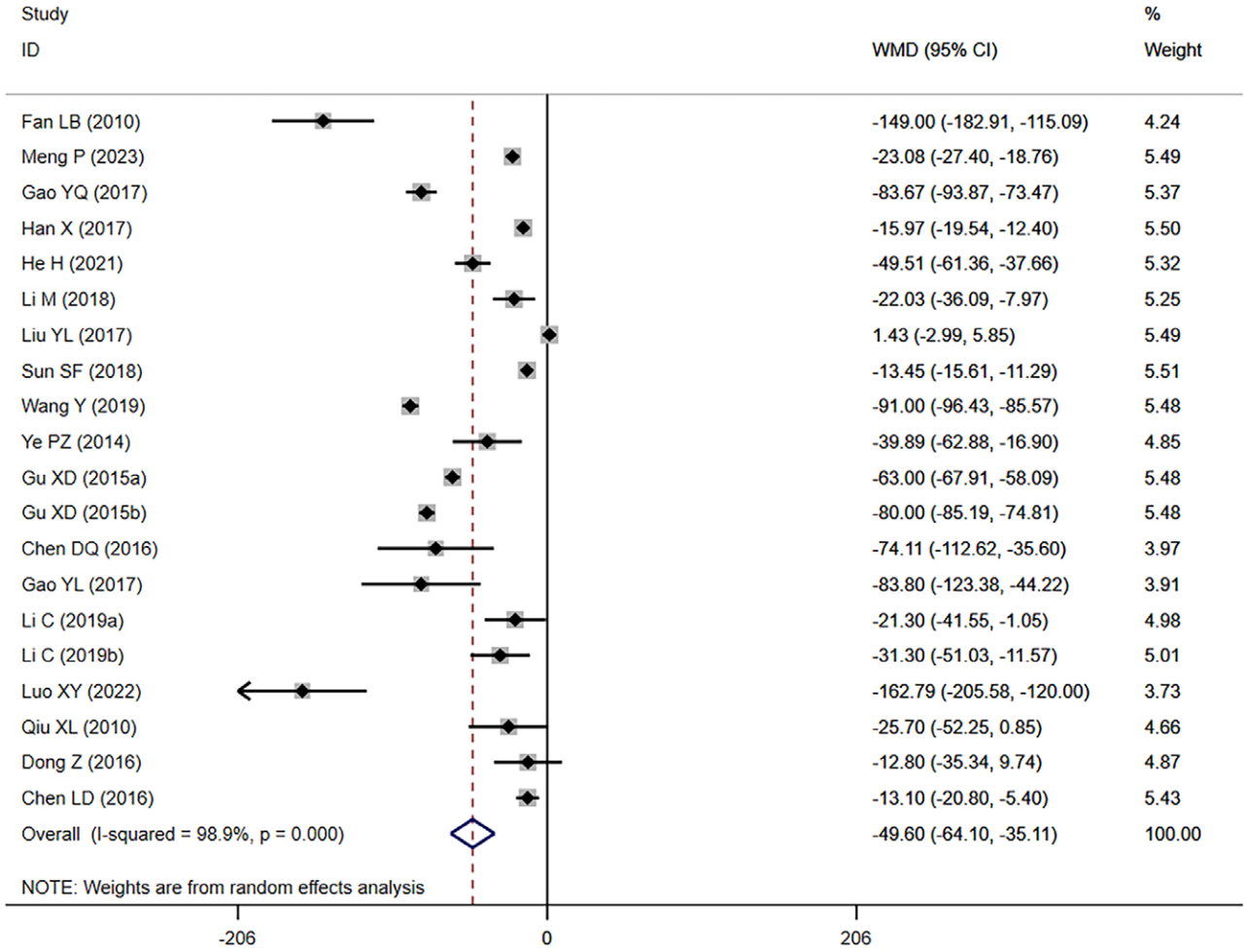

Figure 3. Forest plot for the residual bladder urine volume.

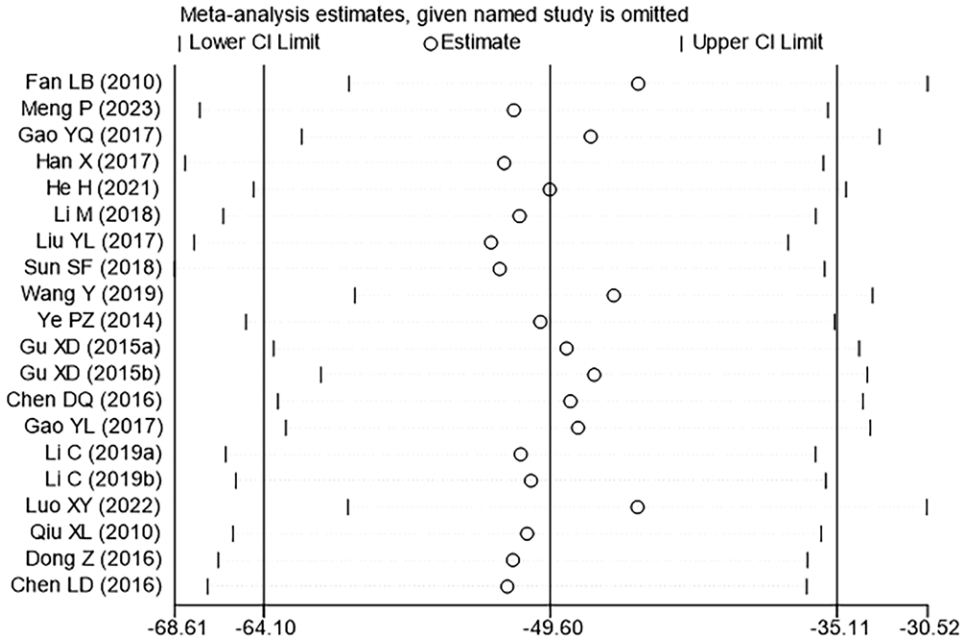

Figure 4. Results of sensitivity analysis of residual bladder urine volume.

Table 2

Subgroup analyses of residual bladder urine volume results based on different control groups, types of urinary retention, treatment duration, and acupoint locations.

Subgroups	Number of RCT	WMD/SMD	95%CI	I^2	*P*
Control group					
Conventional treatments	7	−63.12	−96.29, −29.96	99.5%	.000
Conventional acupuncture	1	−23.08	−27.40, −18.76	-	.000
Pharmacotherapy	2	−7.32	−24.37, 9.73	97.2%	.400
Sham acupuncture	2	−57.38	−70.41, −44.34	76.5%	.000
Blank control	2	−34.94	−49.92, −19.97	0.0%	.000
Rehabilitation training	6	−60.31	−97.82, −22.80	89.9%	.002
Types of urinary retention					
Postoperative urinary retention	7	−42.66	−58.36, −26.96	97.5%	.000
Post−stroke urinary retention	2	−22.99	−27.12, −18.86	0.0%	.000
Postpartum urinary retention	3	−35.59	−53.35, −17.83	69.2%	.000
Urinary retention due to prostatic hyperplasia	1	1.43	−2.99, 5.85	-	.526
Urinary retention after spinal cord injury	6	−72.24	−90.48, −54.00	92.3%	.000
Treatment duration					
0-2 wk	10	−31.28	−41.47, −21.09	95.9%	.000
2-4 wk	6	−68.51	−118.13, −18.89	99.3%	.007
Over 4 wk	4	−70.49	−91.91, −49.09	95.4%	.000
Acupoint locations					
RN3, RN4	10	−66.15	−96.32, −35.99	98.6%	.000
Baliao	5	−45.70	−78.48, −12.96	99.5%	.006
Other acupoints	5	−20.60	−36.06, −5.15	94.6%	.009

WMD = weighted mean differences.

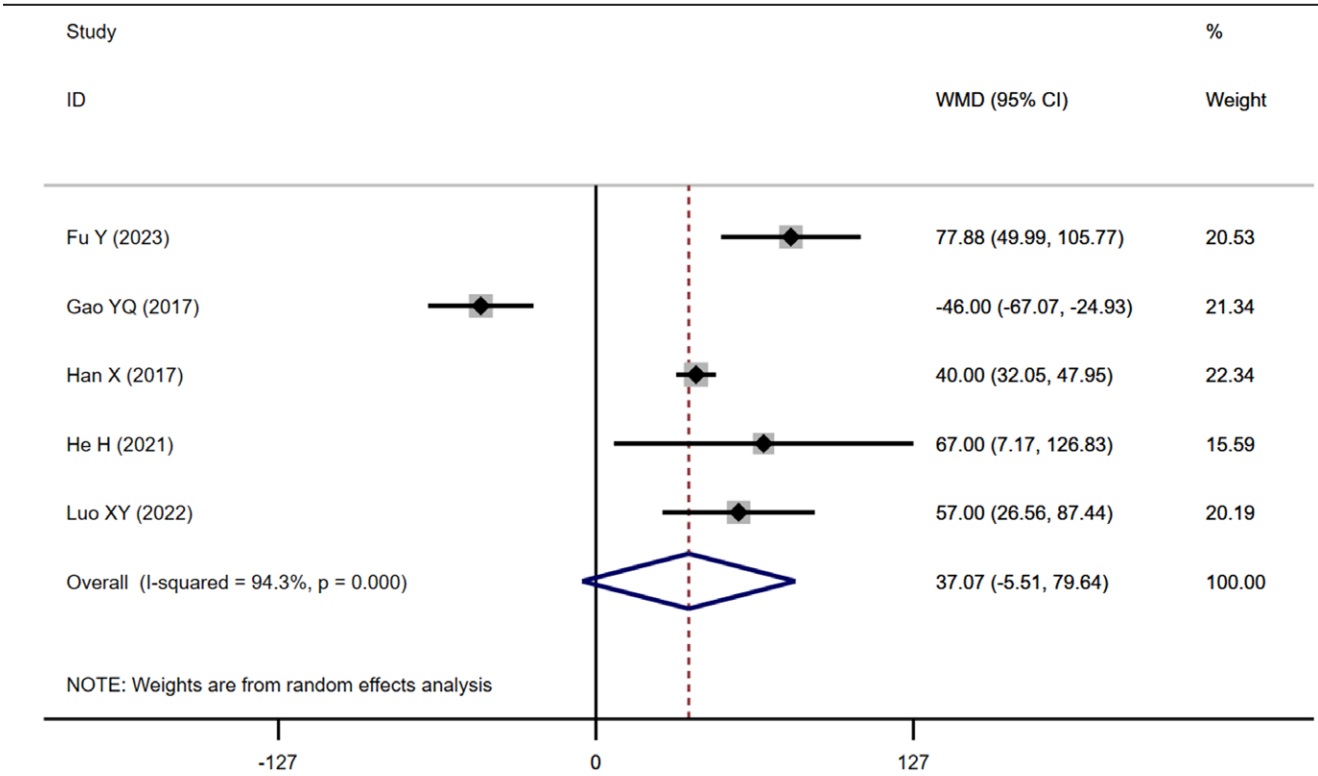

Figure 5. Forest plot for the first urination volume.

Wu Lanzhen study[15] had a significant effect on heterogeneity, and after removal, the result was SMD = −0.93, 95% CI: −1.24, −0.62, $P < .001$, and $I^2 = 63.1\%$.

3.2.5. Clinical response rate. Sixteen studies reported 17 clinical efficacy outcomes,[14–17,19,23–25,27,28,30,32,33,35,36] with 2 studies[28,30] using the *Diseases Diagnostic and Therapeutic Criteria for Traditional Chinese Medicine*, 2 studies[24,27] *the Guidelines for Clinical Studies of New Traditional Chinese Medicine*, one study[33] the efficacy evaluation criteria in *Obstetrics and Gynecology*, and the remaining 12 studies using self-defined evaluation criteria. Although different standards were used, the invalid evaluation criteria were basically consistent. Therefore, the effective, significantly effective, and curative indexes reported were categorized as "effective," and ineffective indexes were classified as "ineffective." The data combination showed that the EA could significantly improve clinical efficacy (RR = 1.22, 95% CI: 1.14–1.31, $P < .001$, $I^2 = 56.8\%$), as shown in Figure 8. The results were relatively stable after sensitive analysis, and thus the conclusion was

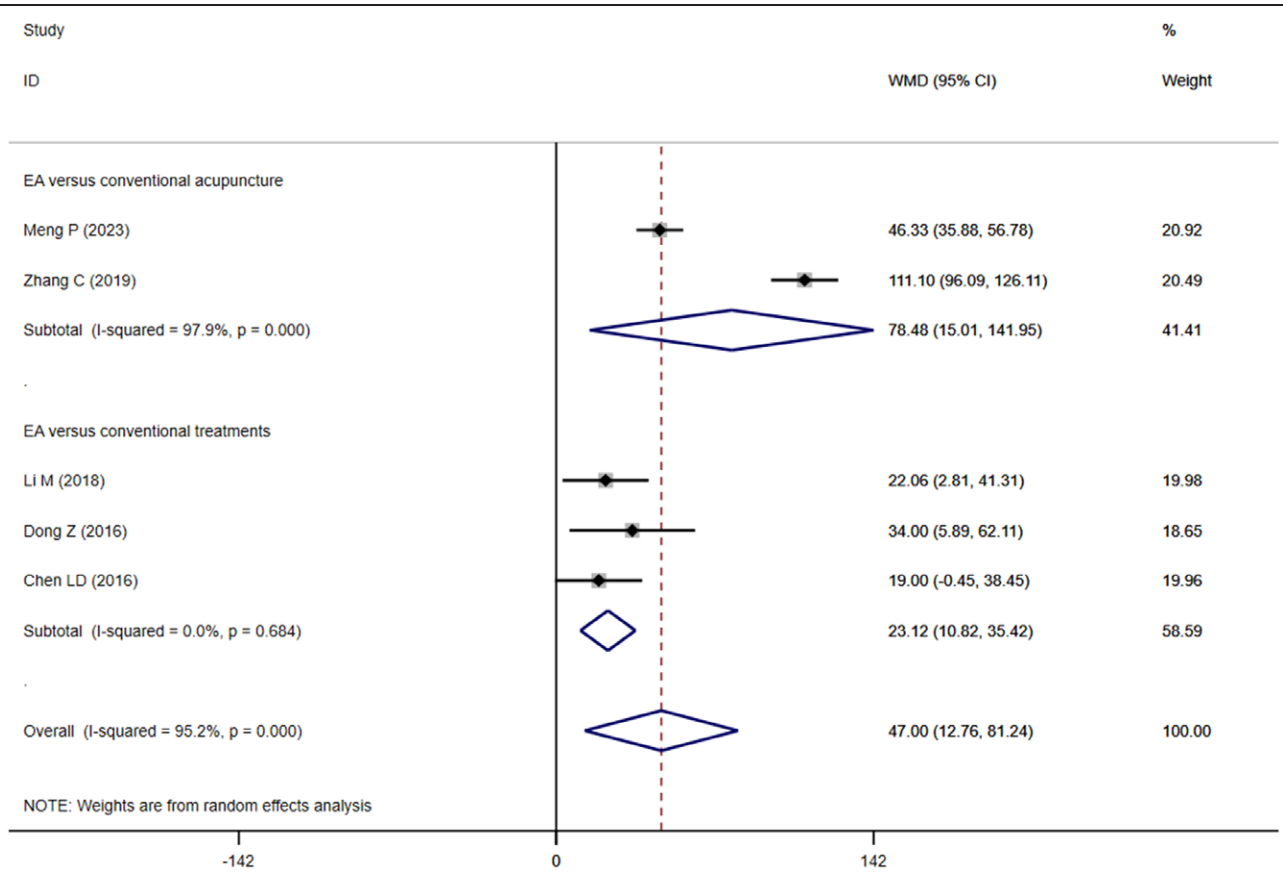

Figure 6. Forest plot for the maximum bladder capacity.

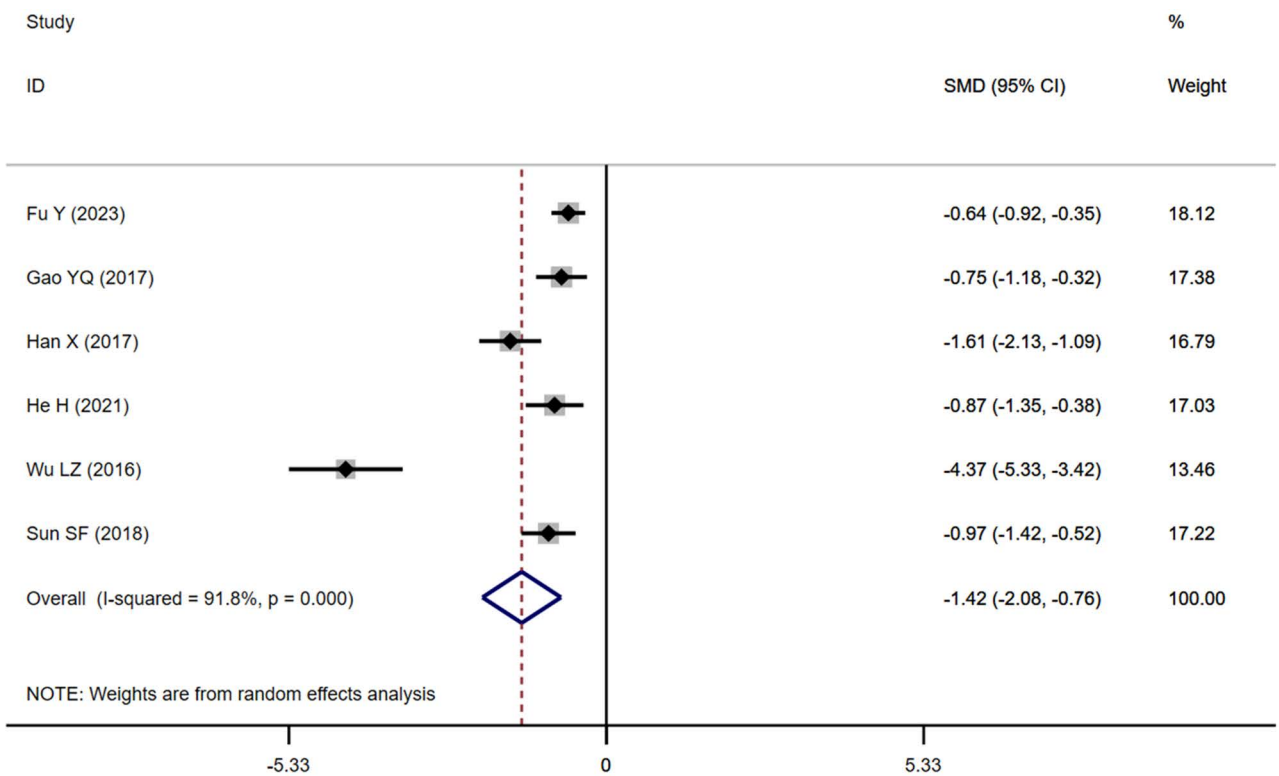

Figure 7. Forest plot for the first urination time.

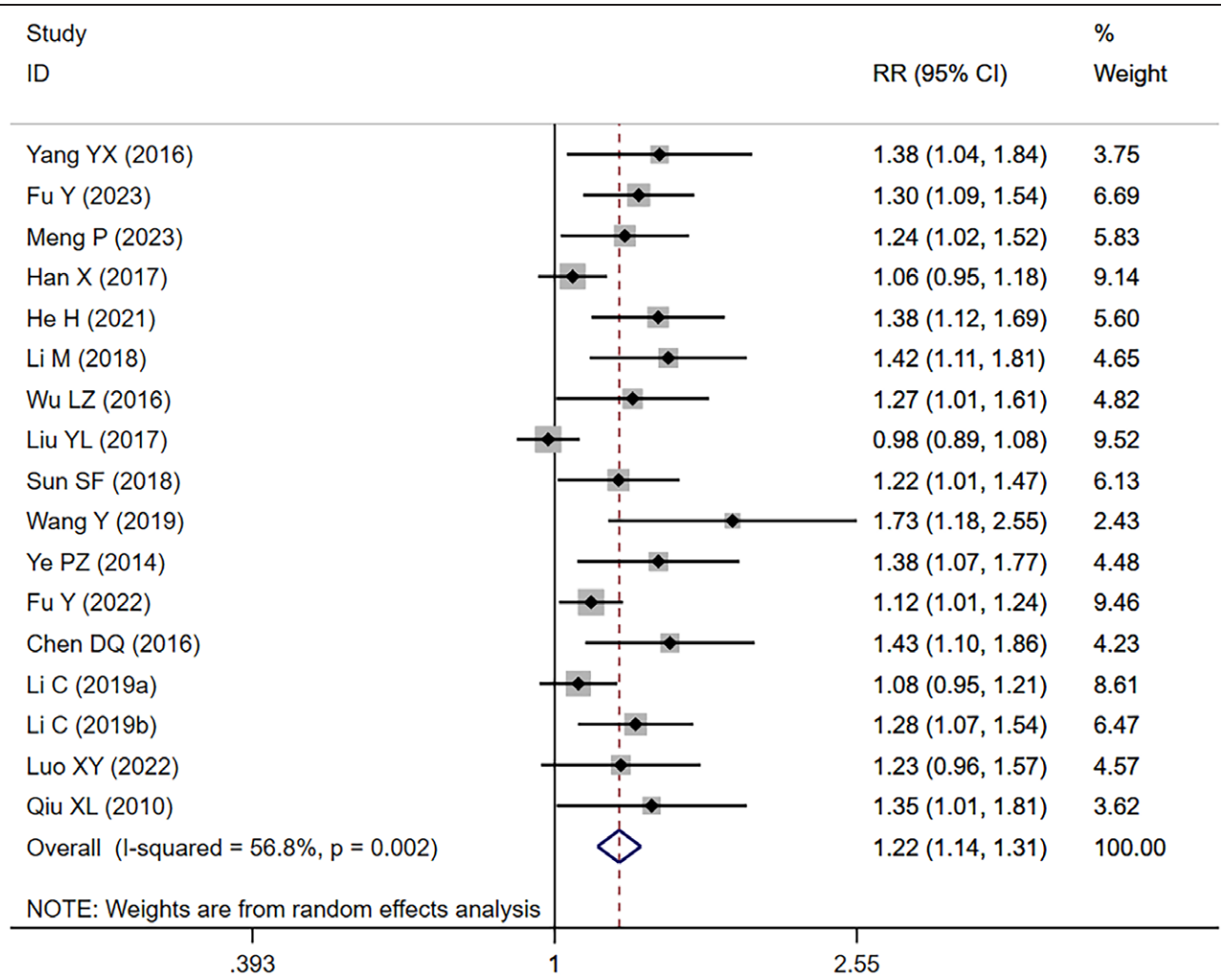

Figure 8. Forest plot for the clinical response rate of electroacupuncture compared with other control groups.

reliable (Fig. 9). Publication bias analysis suggested possible publication bias: Begg (P = .006), and the results did not change after supplementing 7 missing articles.

3.2.6. Incidence of adverse events. As shown in Figures 10, 3 studies[18,25,35] reported the incidence of adverse events mainly related to urinary tract infections. The meta-analysis shows that the incidence of adverse events in the EA group was significantly lower than that in the control group (RR = 0.21, 95% CI: 0.07, 0.65, P < .001, I^2 = 0).

3.2.7. Evaluation of evidence quality. According to the GRADE quality assessment, the evaluation of adverse event incidence is of moderate quality, while the evaluation of residual bladder urine volume, first urination volume, maximum bladder capacity, first urination time, and clinical response rate is of very low quality, as shown in Table 3. This is mainly due to the high risk of bias in randomization and blinding in most studies. Additionally, apart from adverse event incidence, the other meta-analysis results exhibit high heterogeneity, ultimately leading to low-quality evidence.

4. Discussion

4.1. Discussion of meta-analysis results

This systematic review identified 23 articles involving 1985 participants strictly following the PRISMA guideline, and conducted a meta-analysis on the efficacy and safety of EA or combined EA and conventional Western medicine treatments for UR. The comprehensive results showed that the EA could effectively reduce residual urine volume, increase bladder capacity, shorten first urination time, and promote bladder function recovery, with considerable curative effect compared with other control groups.

There are many causes of UR, such as postoperative complications, spinal cord injuries, and postpartum conditions. On the one hand, it may be caused by nerve damage between the brain and bladder, and the bladder lose regulation; on the other hand, urinary control nerve dysfunction may affect the normal function of the bladder and ureter, leading to the occurrence of UR.[37]

EA has been an effective acupuncture method of clinical treatment of UR in recent years, and its mechanism of action may be as follows: EA improves bladder function by regulating central or peripheral nerves. According to research reports, EA may stimulate the sacral cord central region, enhance the outgoing signals of the pelvic nerves, thereby increase the contractile force of the bladder detrusor muscle, and achieve the purpose of treating UR.[38] EA regulates bladder function by affecting cell apoptosis. Lu research showed that EA could enhance the expression of HSP20, promote phosphorylation, enhance Akt activity, inhibit cell apoptosis, restore spinal cord nerve function, and further improve bladder contraction.[10]

This study focused on residual urine volume as the main outcome index. After subgroup analysis based on different control measures, types of UR, treatment duration, and acupoint

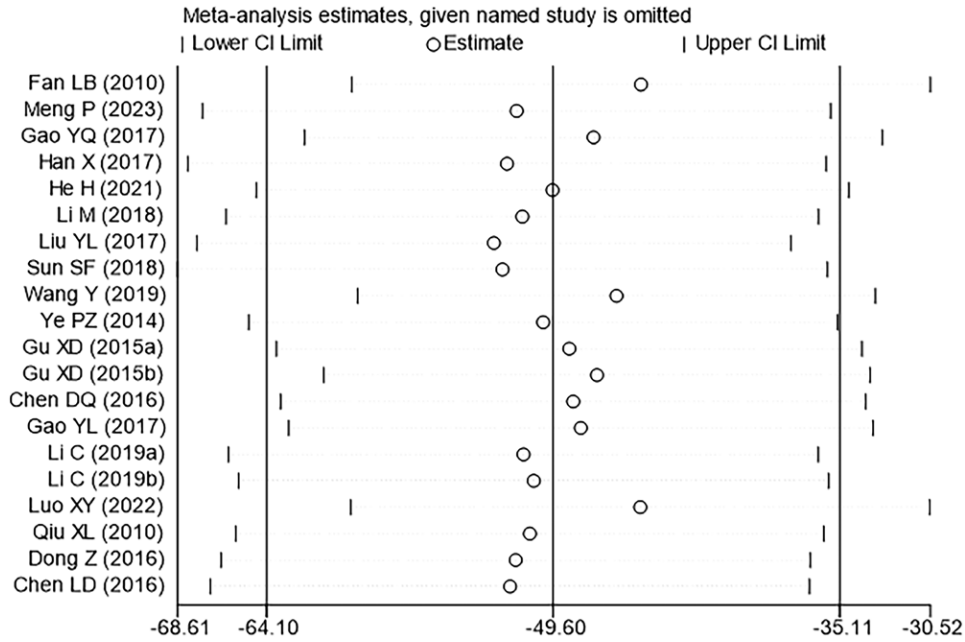

Figure 9. Sensitivity analysis results of clinical response rate of electroacupuncture compared with other control groups.

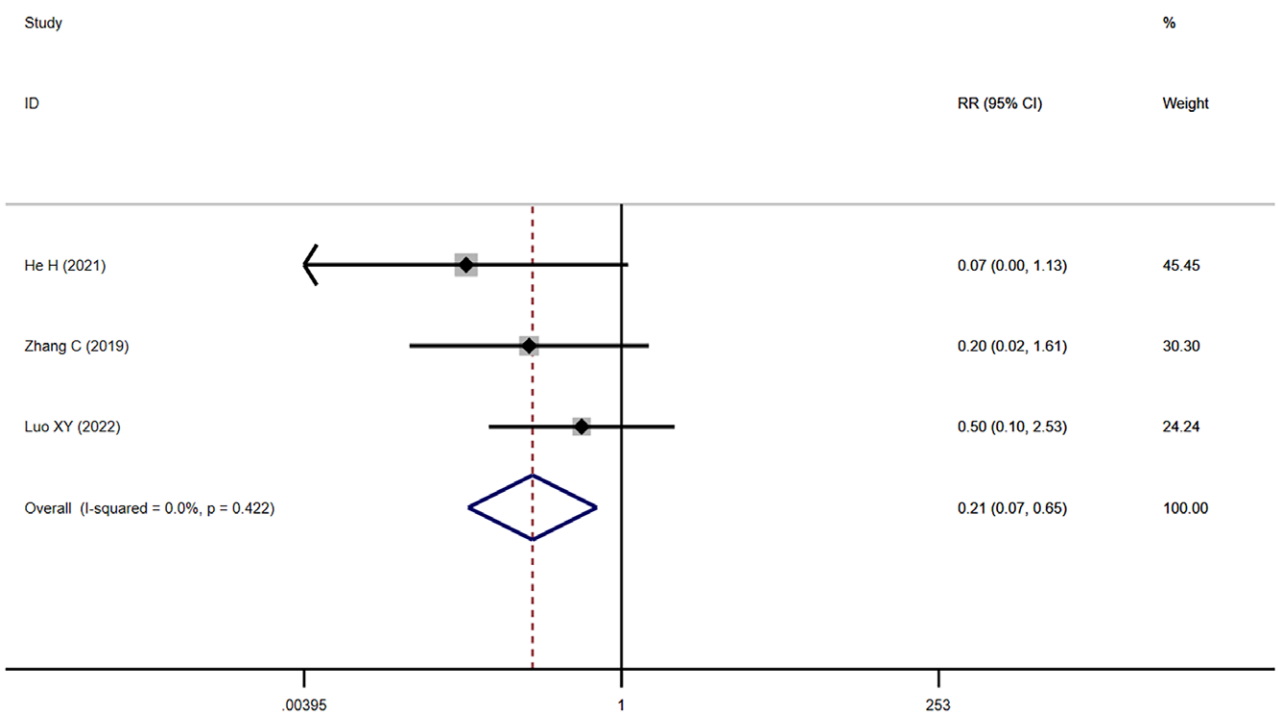

Figure 10. Incidence of adverse events in electroacupuncture group compared with other control groups.

selection, the results showed: The therapeutic effect of the EA group was significantly better than that of other control groups, but there was no significant difference compared with the pharmacotherapy. Liu Yanling study[26] showed no substantial advantage of EA over pharmacotherapy and thus impacted the final comprehensive results. Therefore, the conclusion needs to be treated with caution. EA can effectively treat most types of UR and may have advantages for UR after spinal cord injury. However, the treatment effect for UR due to prostatic hyperplasia still needs to be clarified and requires further exploration because of limited literature and poor quality. In different treatment courses, EA can reduce residual urine volume and restore bladder function, and the treatment effect may improve with more prolonged courses. EA has therapeutic effects on different acupoint selection methods, with better efficacy observed in "Zhongji" (RN3), "Guanyuan" (RN4), and "Baliao," providing a guidance for clinical acupoint selection. Modern researches show that the sympathetic nerves at T_{11}-L_2 and the parasympathetic at $S_{2\text{-}4}$ jointly innervate the bladder smooth muscle.[39] RN3 and RN4 are acupoints located in the lower abdomen of the human body, with somatic nerves originating from the $T_{11\text{-}12}$ segments. Therefore, stimulation of these acupoints can regulate

Table 3

GRADE evaluation of evidence quality.

Outcome	Certainty assessment							No. of patients		Effect			Importance
	Studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other consideration	EA group	Control group	Relative (95% CI)	Absolute (95% CI)	Certainty	Critical
Residual bladder urine volume	18	Randomized trial	Very serious*	Very serious†	Not serious	Not serious	None	777	700	-	WMD 49.6 lower (64.1 lower to 35.11 lower)	⊕○○○ Very low	Not important
First urination volume	5	Randomized trial	Very serious*	Very serious†,‡	Not serious	Serious§	None	253	246	-	WMD 37.07 higher (5.51 lower to 79.64 higher)	⊕○○○ Very low	Not important
Maximum bladder capacity	5	Randomized trial	Very serious*	Very serious†	Not serious	Not serious	None	188	186	-	WMD 47 higher (12.76 higher to 81.24 higher)	⊕○○○ Very low	Not important
First urination time	6	Randomized trial	Very serious*	Very serious†	Not serious	Not serious	None	295	288	-	SMD 1.42 lower (2.08 lower to 0.76 lower)	⊕○○○ Very low	Not important
Clinical response rate	16	Randomized trial	Very serious*	Serious†	Not serious	Not serious	Publication bias strongly suspected‖	736/799 (92.1%)	543/733 (74.1%)	RR 1.22 (1.14–1.31)	163 more per 1000 (from 104 more to 230 more)	⊕○○○ Very low	Critical
Incidence of adverse events	3	Randomized trial	Not serious	Not serious	Not serious	Serious¶	None	3/96 (3.1%)	16/96 (16.7%)	RR 0.21 (0.07–0.65)	132 fewer per 1000 (from 155 fewer to 58 fewer)	⊕⊕⊕○ Moderate	important

EA = electroacupuncture, SMD = standardized mean difference, WMD = weighted mean differences.
*High risk of unblinding and allocation concealment.
†Heterogeneity across the studies is fairly high.
‡Consequence was influenced when one of study was removed.
§95% confidence intervals included no effect.
‖The test results indicate a risk of bias.
¶Small simple size.

neural excitability, improve nerve function, and promote the recovery of bladder function.[40] The "Baliao" points, which include 8 acupoints including "Shangliao"(BL31), "Ciliao" (BL32), "Zhongliao" (BL33), and "Xialiao"(BL34) on both sides, are located in the sacral foramen. In the deep layer of "Baliao" is the S_{1-4} posterior branch of nerve fibers. EA promotes the regular movement of the bladder detrusor and internal sphincter muscles supported by these nerves, forms a normal micturition reflex and treats the disease.[41] In the secondary outcome measures of this study, the results of the first urination volume differed from previous studies,[42] and the reason for this difference may be related to individual study results, which requires more high-quality and large-sample studies to explore. However, the remaining outcome measures indicated that EA can shorten the first urination time, increase bladder capacity, and significantly improve clinical effectiveness in patients with UR. Meanwhile, the incidence of adverse events in the EA group, mainly urinary tract infections, was significantly lower than that in the control group, further demonstrating the efficacy and safety of EA.

This study conducted a subgroup analysis of outcome measures, but heterogeneity was not completely eliminated, which may be due to multiple reasons. First, different diagnostic criteria were used. The diagnostic criteria of the included literature in this systematic evaluation were different, with some studies not reporting their diagnostic criteria. Second, the measurement methods were not specified. In the literature, measurement methods for residual urine volume included ultrasound, urodynamic testing, and catheterization, etc, but 4 articles did not specify their measurement method. The heterogeneity was still high after subgroup analysis. In addition, intervention measures, including acupoint selection, needle depth, and electrical waveform, may also contribute to heterogeneity.

4.2. Highlights

Compared with previous researches, this study analyzed the efficacy of EA for various types of UR, further expanding the scope of EA for UR. At the same time, the dominant parameters of EA therapy were discussed from the aspects of control measures, types of UR, treatment courses, and acupoint selection, so as to provide a theoretical basis for the clinical choice of EA.

4.3. Limitations

This paper has several limitations. First, the quality of some of the included literature is poor, because they were unclear in terms of random sequence generation and allocation concealment, leading to low methodological quality. However, due to the particularity of its operation, EA cannot achieve blinding of the acupuncture practitioners, and some studies did not implement blinding of participants or assessors, resulting in a high risk of bias, which ultimately leads to the very low quality of evidence. Second, due to the limitations of the treatment courses in the included literature, this study failed to fully explore the optimal treatment course of EA for UR. Third, most of the literature reported less on adverse events, which could affect the strength of the evidence. In addition, the included literature was all from China, with the problems of small sample sizes, single centers, and low research quality, which could affect the quality evaluation.

Future research can be carried out from the following 3 aspects: Large sample, high-quality RCTs are needed to support the conclusions of this study. The correctness of the systematic analysis results can be ensured through strict experimental design, such as unified diagnostic criteria, adequate randomization and allocation concealment, appropriate blinding methods for participants and acupuncturists, and standardized acupuncture protocols. Actively conduct basic

experiments, deeply explore the mechanism of EA in the treatment of UR, and provide solid theoretical support for clinical treatment.3. Explore the optimal parameters of EA to treat different types of UR, such as acupoint selection, needle insertion direction, depth, EA frequency, waveform, time selection, retention time, treatment course, etc, so as to maximize the effects of acupuncture.

5. Conclusion

This systematic review indicates that EA has a definite and good therapeutic effect on UR and can reduce the occurrence of adverse reactions, making it worthy of clinical application and promotion. At the same time, EA can be applied to most types of UR, with potentially better efficacy for UR after spinal cord injury. In clinical practice, RN3, RN4, and Baliao may become primary acupoints for EA. A longer treatment course may result in better efficacy. However, a large sample of high-quality RCTs is needed to further verify the efficacy and safety of EA.

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