

Review Article

Ultrasound guided needle aspiration and cavity washing versus incision and drainage to treat breast abscesses: a meta-analysis

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Received January 15, 2017; Accepted April 3, 2017; Epub June 15, 2017; Published June 30, 2017

Abstract: *Objective:* To evaluate the clinical effect of ultrasound guided puncture irrigation (UGPI) and traditional incision and drainage (TID) in the treatment of breast abscess. *Methods:* Electronic databases: China National Knowledge Infrastructure (CNKI), Wanfang Database, China Biological Medicine (CBM), PubMed, Cochrane Library, Web of Science, Embase and Google databases were searched within a date range from their inception up to December 2016. Any randomized controlled trials (RCTs) about comparison between UGPI versus TID to treat the breast abscesses were retrieved and collected. Data related to clinical outcomes were extracted by two reviewers independently. Statistical analyses were carried out using Stata 12.0. *Results:* Eight studies were included, involving 373 participants according to the inclusion criteria. UGPI was associated with more cure rate (RR=1.20, 95% CI=1.01-1.44; P=0.042), effective rate (RR=1.28; 95% CI=1.12-1.46; P=0.000). What's more, UGPI was associated with less healing time (WMD=-9.90; 95% CI=-12.55-7.25; P=0.000) and the length of the scar (WMD=-2.88; 95% CI=-3.43-2.33; P=0.000). There was no significant difference between the complications (RR=0.20; 95% CI=0.06-0.67; P=0.009). *Conclusions:* Compared with TID, UGPI has more cure rate, more effective rate, the less healing time and scars as well as complications.

Keywords: Breast abscess, ultrasound guided, puncture, incision and drainage, meta-analysis

Introduction

Breast abscess is a common clinical disease of women who are breast feeding [1]. It is mostly developed from untimely or incomplete treatment of acute mastitis [2]. The traditional treatment method is abscess incision and drainage, which is accompanied by long surgical incisions, large trauma and pain on dressing change [3]. Moreover, patients often suffer great pain and psychological trauma due to postoperative scars and even breast deformation. In recent years, with the improvement of ultrasound equipment and medical staff technology, Ultrasound-guided puncture and irrigation (UGPI) is widely used in clinical practice because of its advantages like small trauma, high cure rate, less complications, and little changes in breast appearance. In this project, evidence-based medicine is used to comprehensively search for randomized controlled tri-

als (RCTs) of breast abscesses under two treatment methods-ultrasound-guided puncture and irrigation, and traditional incision and drainage (TID). A meta-analysis was made on the cure rate, effective rate, wound healing time, scar length and postoperative complications, with the purpose of providing a reference for clinicians.

Material and methods

Search strategy

Electronic databases, including China National Knowledge Infrastructure (CNKI), Wanfang Database, China Biological Medicine (CBM), PubMed, Cochrane Library, Web of Science, and Embase were searched for relevant studies published from the time of the establishment of these databases up to November 2016. In addition, the Google database was searched

Table 1. The general characteristic of the included studies

Reference	No. of patients		Mean age, y	Course	Outcomes	Study design	Follow up
	UGPI	TID					
Naeem 2012	32	32	28.4	6.5 month	a, c, e	RCTs	3.9 month
Wu 2014	20	20	25.6	8.3 month	c, d, e	RCTs	NS
Chandika 2012	33	32	23.4	NS	a, e	RCTs	1 month
Feng 2014	17	17	27.9	NS	a, b	RCTs	NS
Niu 2012	21	21	29.8	NS	a, b, c, d, e	RCTs	3 month
Sui 2015	30	30	28.3	4.3 month	a, b	RCTs	NS
Yan 2014	18	18	28.5	4.1 month	a, b, c, d	RCTs	NS
Zhao 2014	16	16	33.7	NS	a, b, c, d	RCTs	NS

a, cure rate; b, effective rate; c, healing time; d, the length of scar; e, complications. NS, not stated; RCTs, randomized controlled trials; UGPI, ultrasound-guided puncture and irrigation; TID, traditional incision and drainage.

for additional literature. The reference lists of all the full-text studies literatures were reviewed to identify any initially omitted studies, and there was no restriction on the language of the publication. The search keywords were ultrasound guided needle aspiration and cavity washing, incision and drainage. The relevant medical subject heading (Mesh) terms were used to maximize the specificity and sensitivity of the search. These keywords and mesh terms were combined with the Boolean operators AND or OR.

Eligibility criteria and study quality

Study selection was performed according to the following inclusion criteria: (1) published RCTs about of patients who underwent breast abscesses; (2) employed interventions that including included ultrasound guided needle aspiration and cavity washing versus incision and drainage for breast abscesses; and (3) reported outcomes, including cure rate, effective rate, healing time, the length of scar, and complications. All of the included studies must had to include at least one of the outcomes above. Two reviewers independently scanned the quality of the eligible studies, and discrepancies were solved by a senior reviewer. A risk of bias assessment was conducted for each involved RCTs according to the Cochrane Handbook for Systematic Reviews of Interventions and listed in corresponding tables. The assessment items included: (1) the randomization method; (2) allocation concealment; (3) blinding of participant, personnel, and asses-

sor; and (4) complete outcome data and other bias.

Data extraction

The following data were extracted and recorded: (1) demographic data about the patients in the literature, author's names, publication date, the patient sample size in the ultrasound guided needle aspiration and cavity washing and incision and drainage groups, the number of male

patients in the two groups; (2) course of breast abscesses; (3) study type, length of follow up and cure rate, effective rate, healing time, the length of scar and complications.

Outcome measures and statistical analysis

The main outcomes were cure rate, effective rate and healing time. The secondary outcomes were the length of scar and complications. Continuous outcomes (healing time and length of scar) were expressed as the mean as the mean differences (MD) and respective 95% confidence intervals (CIs). Dichotomous outcomes (cure rate, effective rate and the occurrence of complications) were expressed as relative risks (RR) with 95% CIs. Statistical significance was set at $P < 0.05$ to summarize findings across the trials. The meta-analysis was performed using Stata software, version 12.0 (Stata Corp., College Station, TX). Statistical heterogeneity was tested using the chi-squared test and I^2 statistic. When there was no statistical evidence of heterogeneity ($I^2 < 50\%$, $P > 0.1$), a fixed-effects model was adopted; otherwise, a random-effects model was chosen. If the heterogeneity was large, a sensitivity analysis was conducted to further seek out the source of heterogeneity. Publication bias was assessed by a funnel plot and quantitatively assessed by Begg's test. There was will be considered no publication bias if the funnel plot was symmetrical and the P value drawn from Begg's test was greater than 0.05.

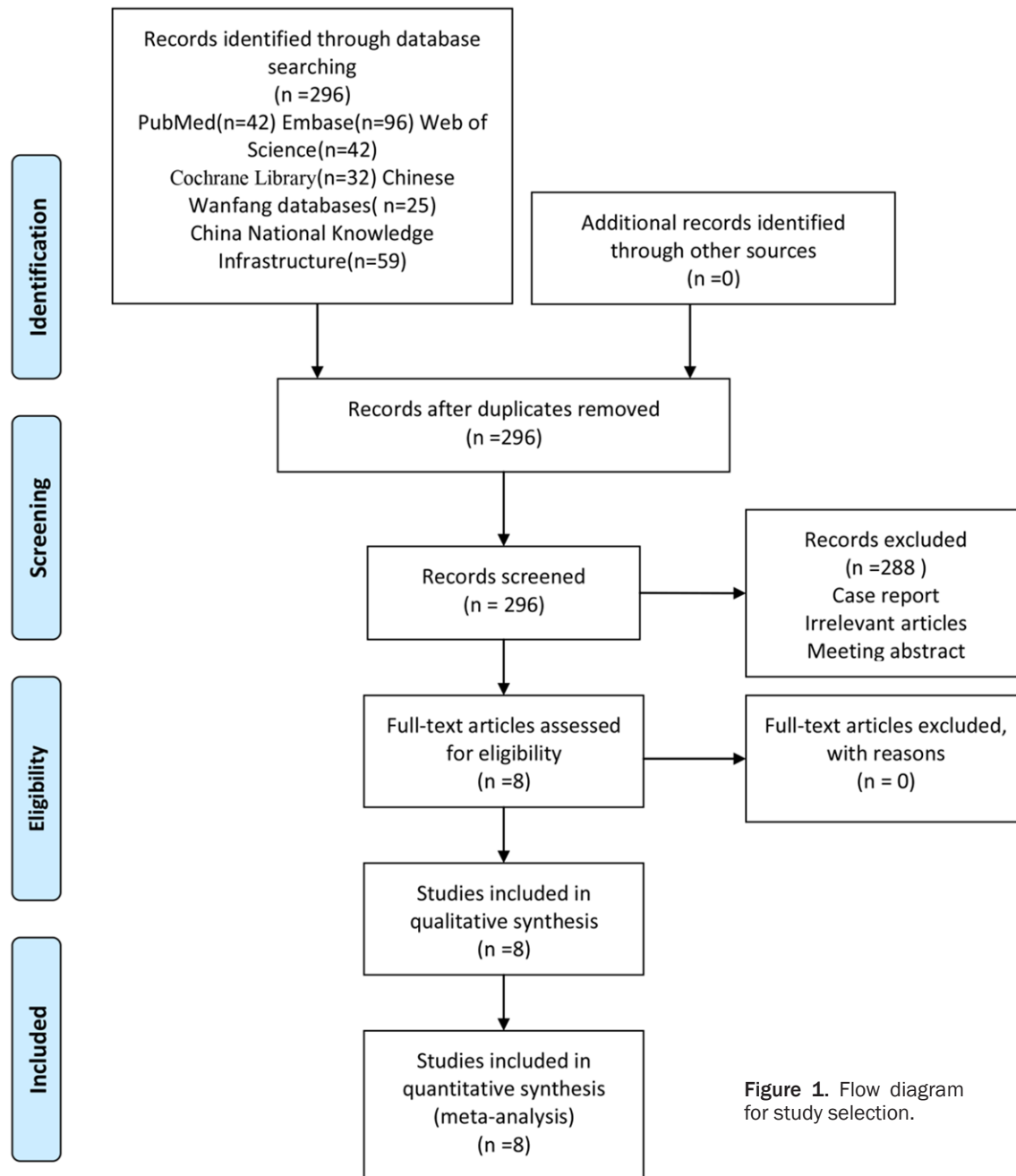


Figure 1. Flow diagram for study selection.

Results

Search results and quality assessment

Initially, a total of 238 studies were identified, and 183 studies were screened after duplicates were removed. A total of 164 papers were excluded according to the title and abstracts. Then, a total of 7 non-RCTs were excluded according to the inclusion and exclusion criteria. Finally, we identified 8 RCTs [3-10] with 333 patients (UGPI=187, TID=186) that

were associated with breast abscesses. The general characteristic of the included studies can be seen in **Table 1**. The flow diagram for study selection can be seen in **Figure 1**. The risk of bias for the included studies can be seen in **Figures 2** and **3**. Two studies did not describe the random sequence generation and three studies did not introduce the allocation concealment. All of the included studies did not blinded to the participants and outcome assessment.

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Chandika 2012	?	+	?	?	?	?	?
Feng 2014	+	+	?	?	?	?	?
Naeem 2012	?	+	?	?	+	+	+
Niu 2012	+	?	?	?	+	+	+
Sui 2015	+	?	?	?	+	+	+
Wu 2014	+	?	?	?	+	+	+
Yan 2014	+	+	?	?	+	+	+
Zhao 2014	+	+	?	?	+	+	+

Figure 2. Risk of bias summary.

Results of meta-analysis

Cure rate: Cure rate was examined in 7 trials [3-7, 9, 10] with 333 patients. These trials randomly selected 167 patients to receive UGPI and 166 patients to received TID. Pooled results revealed that ultrasound guided puncture irrigation can increase the effective rate (RR=1.20, 95% CI=1.01-1.44, P=0.042, **Figure 4**) with high heterogeneity ($I^2=50.8\%$, P=0.058). A random-model was performed to compile the data. A funnel plot was then obtained and results indicated that there was no publication bias between the included studies (**Figure 5**).

The P value obtained from Begg's test (0.452, **Figure 6**) was greater than 0.05, this outcome also indicated that there was no publication bias between the studies. To further analysis analyze the large heterogeneity, a sensitivity analysis was conducted to analyze the source of heterogeneity (**Figure 7**). The results indicated that no studies affected the heterogeneity.

Effective rate: Data on blood transfusion were available in 5 studies [4, 6, 7, 9, 10], which included a total of 204 patients. The ultrasound guided puncture irrigation group was associated with a significant increase in the effective rate compared with the traditional incision and drainage group (RR=1.28, 95% CI=1.12-1.46, P=0.000, **Figure 8**) with a low heterogeneity ($I^2=0.0\%$, P=0.971).

Healing time: Data on hemoglobin drop were available for 5 trials [5, 6, 8-10], including a total of 214 patients. A pooled WMD for all patients was completed, and the data showed high significant heterogeneity ($I^2=70.3\%$). UGPI was associated with less healing time compared to TID (WMD=-9.90; 95% CI=-12.55=-7.25; P=0.000, **Figure 9**).

The length of scar: Four studies [6, 8-10] involving 150 patients reported the data on length of scar between the ultrasound guided puncture irrigation group and traditional incision and drainage group. Pooled results indicated that ultrasound guided puncture irrigation can decrease the length of scar by a mean of 2.88 cm (MD=-2.88, 95% CI=-3.43 to -2.33, P=0.000, **Figure 10**). The heterogeneity between the studies was high ($I^2=81.0\%$, P=0.001); thus, a random-model was performed.

Complications: Data on blood transfusion were available in 4 studies [3, 5, 6, 8], which included a total of 111 patients. The pooled results

UGPI versus TID for breast abscesses

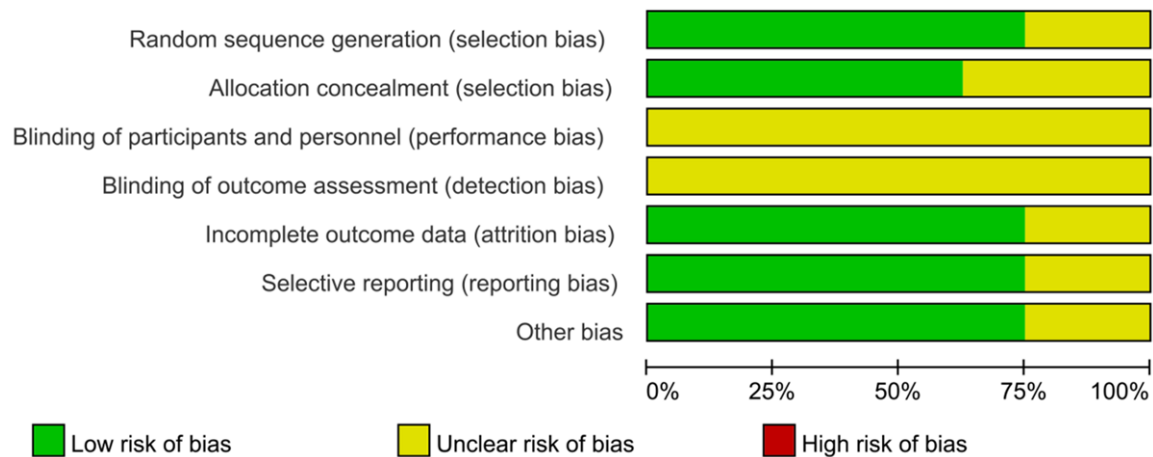


Figure 3. Risk of bias graph.

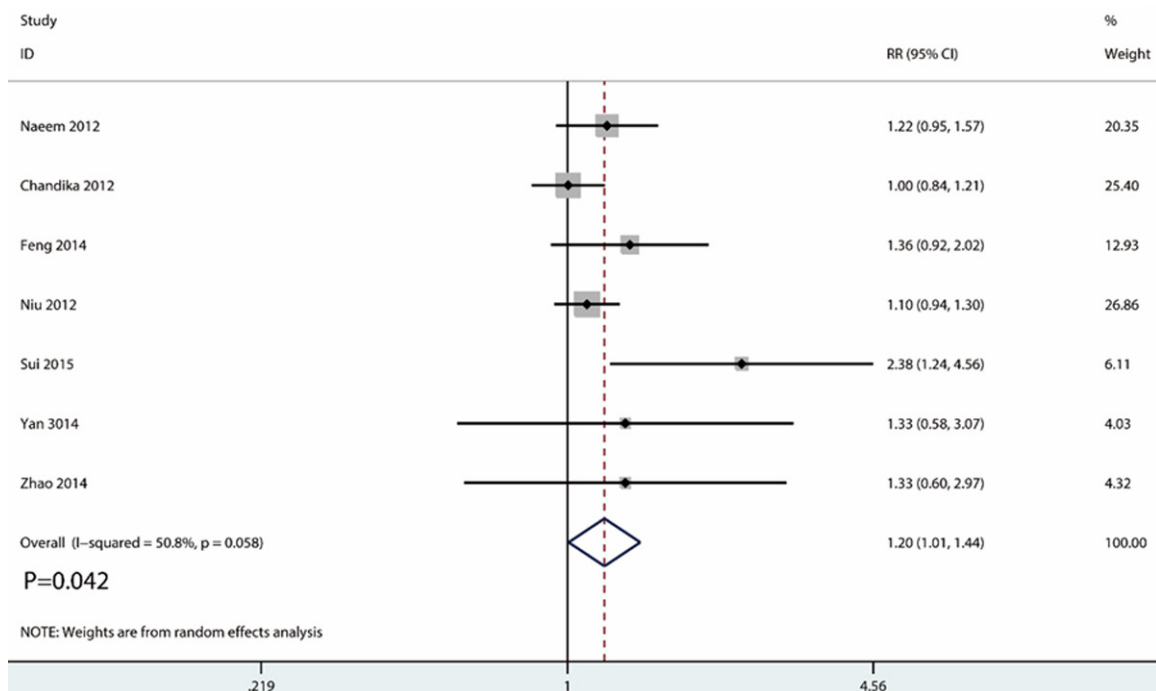


Figure 4. Forest plots comparing cure rate between UGPI and TID from the included studies.

indicated that ultrasound guided puncture irrigation decreased the occurrence of complications (RR=0.20, 95% CI=0.06-0.67, P=0.009, **Figure 11**). The heterogeneity between the included studies was low ($I^2=0.0\%$, $P=0.797$), a fixed-model was adopted to analysis analyze the data.

Discussions

Breasts are an important female reproductive organ and have unique value and functions. To

treat breast diseases we should try to keep its good appearance and functions. The breast abscess has been reduced in developed countries due to improvements in hygiene, diet, living and medical conditions, but it remains a common disease in developing countries [3, 11]. Some patients suffer great pain and psychological burden due to postoperative scar formation, and even breast deformation. It is more common in primiparas with an incidence of 0.4% to 11%, often as a result of delayed or incomplete treatment of mastitis [12]. When

UGPI versus TID for breast abscesses

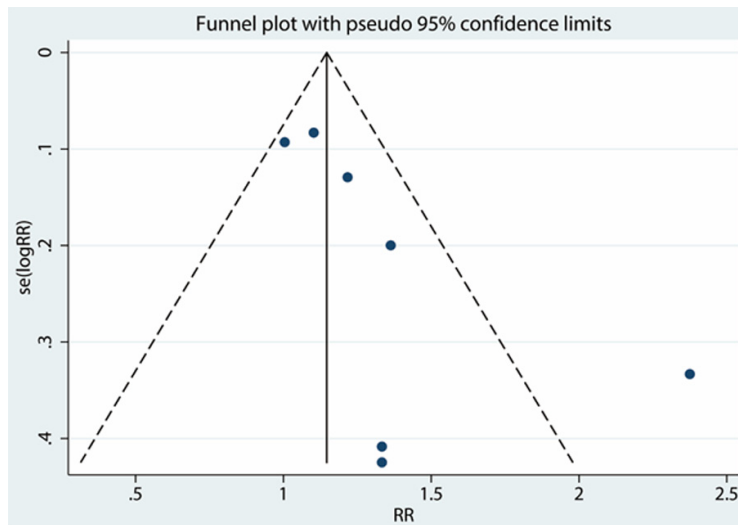


Figure 5. Funnel plot for cure rate.

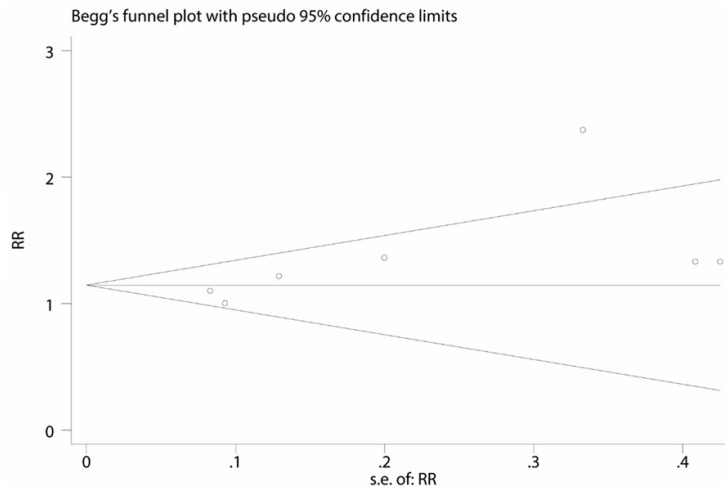


Figure 6. The results of Begg's test for cure rate.

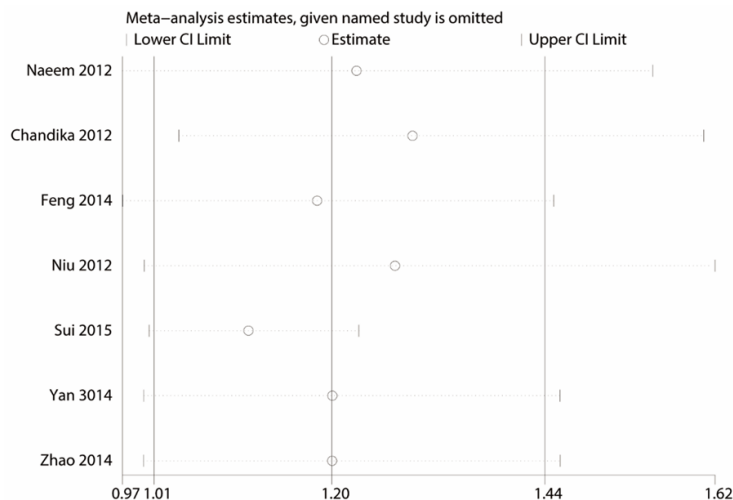


Figure 7. The sensitivity analysis of the cure rate.

the abscess is small or deep, it is always difficult to distinguish from mastitis. If not treated in time, it can cause nipple perforation and extend the healing time [13]. The traditional treatment method is abscess incision and drainage, which requires general anesthesia, and is accompanied by long surgical incisions, large trauma and slow recovery [14, 15]. Moreover, patients often suffer great pain and psychological trauma due to postoperative scars and even breast deformation. Although percutaneous drainage, intraluminal irrigation, multiple punctures, and intracavitary injection of antibiotics for the treatment of breast abscesses have been reported by Battle *et al.* [16]. in 1963 and Florey *et al.* in 1946 [17], these were not widely recognized by clinicians. With the continuous development of ultrasound technology, ultrasound-guided abscess puncture is gradually applied in clinical practice. Since Karstrup *et al.* [18] first reported the treatment of breast abscesses with ultrasound-guided puncture in 1990, a number of similar clinical studies have been carried out. Ultrasound-guided puncture for the treatment of breast abscesses have gradually been accepted by clinicians due to its many advantages, such as small trauma, high cure rate, low recurrence rate, and high patient satisfaction [19]. The application of ultrasound can not only confirm the diagnosis, but also accurately determine the location and size of the abscess, locate puncture points, and determine whether the puncture is complete. At the same time, puncture therapy can quickly reduce tension in the cavity, relieve pain, while repeated washing can not only clean the vomica, but also damage the fibrous septum, which is conducive to drainage.

UGPI versus TID for breast abscesses

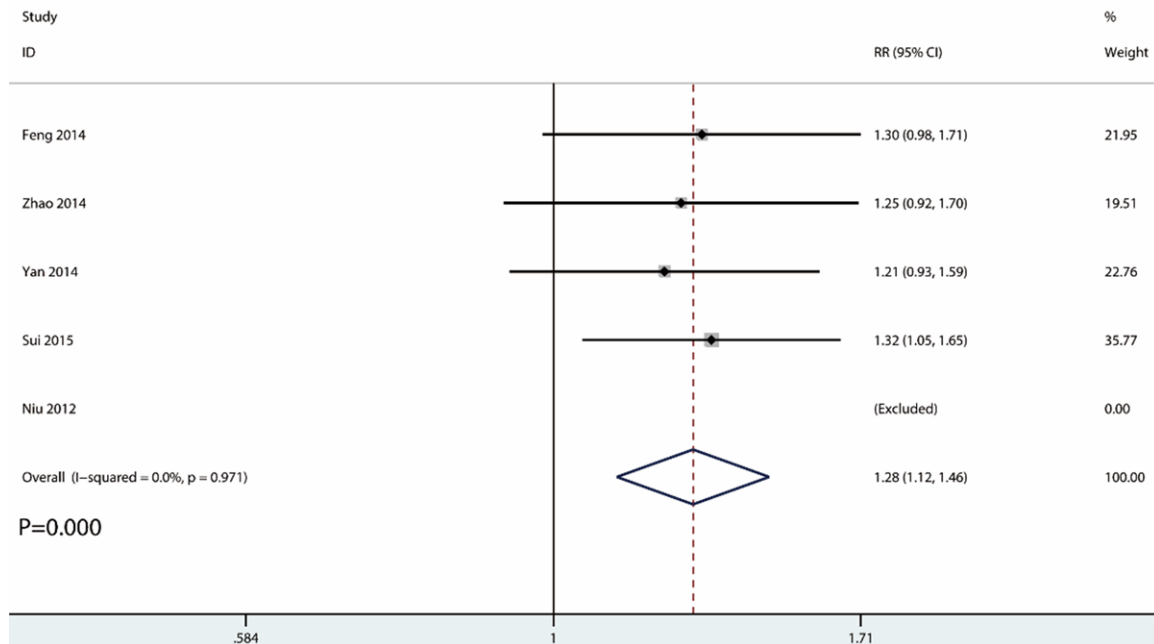


Figure 8. Forest plots comparing effective rate between the included studies.

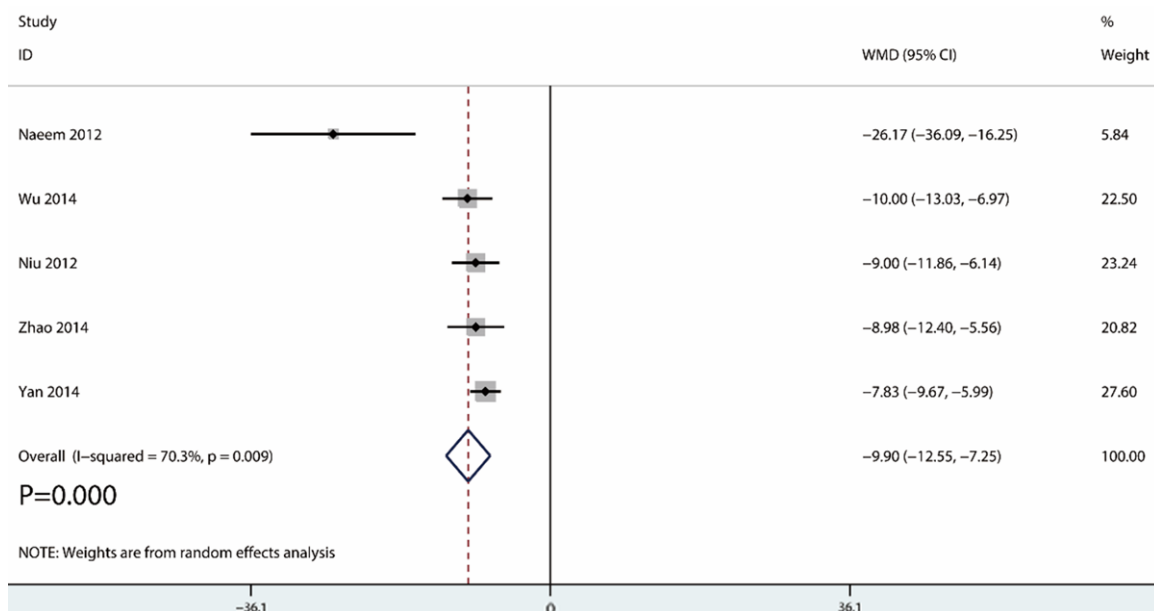


Figure 9. Forest plots comparing healing time between the included studies.

Elagili et al. [20] performed the puncture procedure for 30 patients presenting with 31 breast abscesses. The results found that 15 cases were cured by a puncture, and 7 patients were cured by 2 punctures. Christensen et al. [21] applied ultrasound-guided puncture in 89 cases of lactating and 62 cases of non-lactating women presenting with breast abscesses;

in the former group 86 cases (97%) were cured after receiving one treatment, and in the latter group 50 cases (81%) were cured after receiving one treatment. Ullitzsch et al. [22] performed ultrasound-guided puncture treatment for 14 patients presenting with 23 breast abscesses, and successfully cured 22 abscess in 13 patients. Schwarz et al. [26] performed

UGPI versus TID for breast abscesses

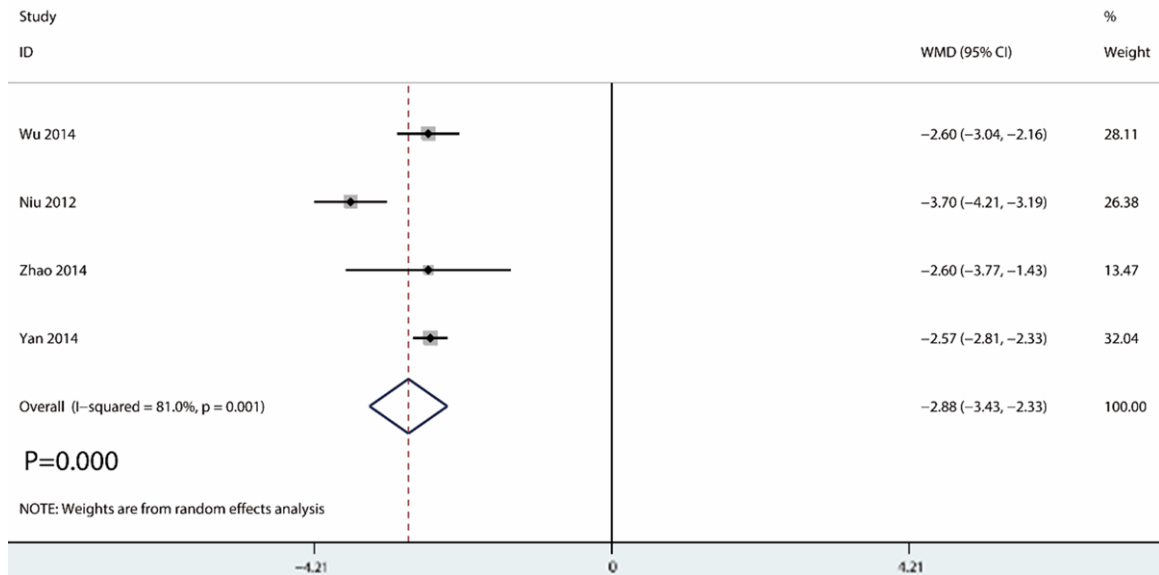


Figure 10. Forest plots comparing the length of scar between two groups.

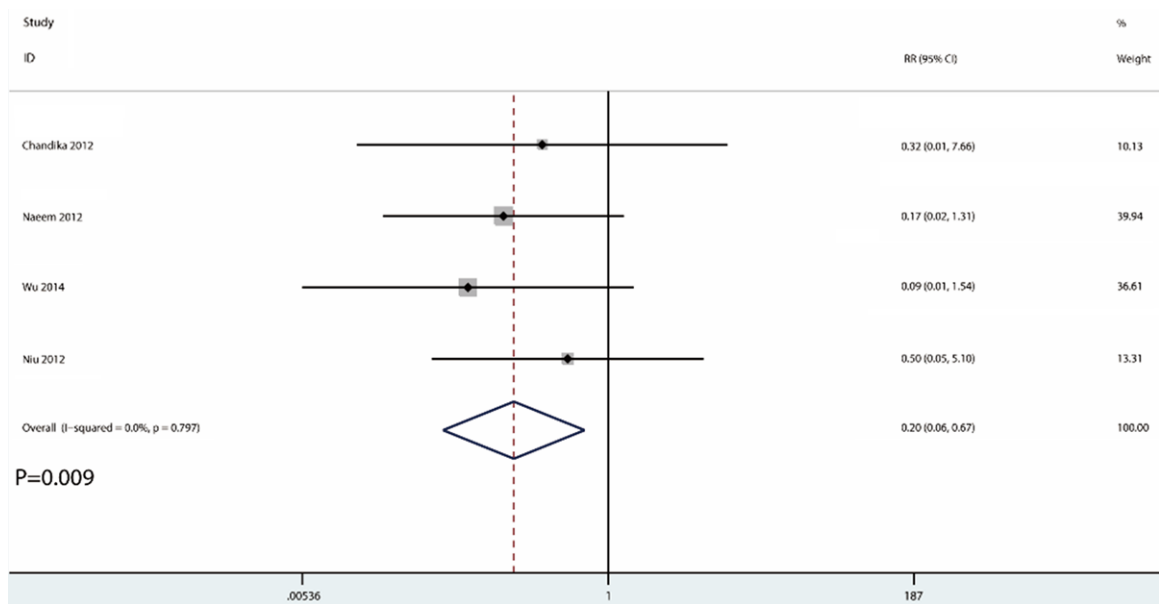


Figure 11. Forest plots comparing the complications between the two groups.

the puncture procedure for 30 patients presenting with 33 breast abscesses and successfully cured 27 cases (82%). The Meta analysis showed that for the treatment of abscesses in the breast, puncture therapy has a higher cure rate and efficiency than incision and drainage treatment. Recovery from the treatment of breast abscesses by traditional incision and drainage often takes several weeks or even months. The meta-analysis shows that punc-

ture treatment of breast abscesses is slower to recover than incision and drainage. The author believes that after incision and drainage, new granulation tissue grows from the inside out; when dressing it will inevitably damage the new tissue, so it is slow to recover; after the puncture treatment, the granulation tissue grows inward near the abscess, and there is very few dressing or no damage to granulation tissue during dressing, so it is quick to recover.

Postoperative scar formation and even deformation of the breast are the main reasons for women's psychological anxiety. The survey by Eryilmaz *et al.* [12] shows that 70% of women were not satisfied with the scar. This meta-analysis shows that a scar formed by ultrasound-guided puncture was significantly smaller than that by incision and drainage. For lactating women, postoperative galactorrhea is the main cause of cessation of breast-feeding, and stopping breast-feeding leads to galactostasis that is complicated by mastitis or breast abscess, thus forming a vicious circle. It has been reported that the treatment of breast abscesses by traditional incision and drainage has a recurrence rate of 10% to 38%. The meta-analysis results show that ultrasound-guided puncture has a lower incidence of postoperative complications than traditional incision and drainage.

Schwarz *et al.* [23] argue that delayed treatment and large abscesses are two risk factors for puncture treatment of breast abscesses; the smaller the abscesses are, the sooner the treatment is, and the higher the cure rate is. However, Elagili *et al.* [20] state that the risk factor for the failure of ultrasound-guided puncture in treating breast abscess is multilocular abscess, but not the size of the abscess.

The limitations of this meta-analysis are: (1) A total of eight studies with 373 patients were included, which consisted of 187 cases in the study group and 186 cases in the control group, so the sample size is small. Although all of the included trials were randomized controlled trials, only two studies referred to randomized methods, and none of the eight studies referred to allocation concealment or report whether the intentional analysis was done. (2) Because this study belongs to the surgical field, it is difficult to implement blind method and allocation concealment. (3) The duration of breast abscesses reported by each institute was different. The size of abscesses was different. Some of the abscesses were not mentioned, and each did not mention the level of the surgeons and the proficiency of operations, so there was large clinical heterogeneity.

In summary, ultrasound-guided puncture for the treatment of breast abscesses is superior to incision and drainage in terms of the cure rate, effective rate, healing time, length of post-

operative scar and complications. In a later study, we will focus on researching randomized controlled trials of breast abscesses and investigating large breast abscesses by ultrasound-guided puncture and irrigation. As many advantages of the ultrasound-guided puncture and irrigation in the treatment of breast abscesses have been accepted by more and more clinicians, this treatment method is likely to be first-line therapy for breast abscesses. Meanwhile, we recommend that we should propagate universal knowledge regarding breastfeeding and promote prompt treatment once breast abnormalities occur.

Disclosure of conflict of interest

None.

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