



### Systematic Review

## Comparing The Efficacy of Incision and Drainage (I & D) Vs. Ultrasound-Guided Needle Aspiration (UGNA) Methods to Manage Puerperal Breast Abscess

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### ABSTRACT

Puerperal breast abscess poses a significant challenge in clinical care as they refer to painful, inflamed lesions that occur in lactating women stemming from untreated mastitis complications and often require expedited intervention to alleviate pain and avert adverse effects. The management of puerperal breast abscess is a medical dilemma that ranges from non-invasive therapy to surgical intervention. **Objective:** To compare the efficacy of ultrasound-guided needle aspiration (UGNA) and incision and drainage (I & D) in the management of puerperal breast abscess. **Method:** A systematic review was performed based on Preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines. Epidemiological studies published from 2013 to 2023 were included from five databases based on the presence of qualitative and quantitative data. **Results:** UGNA demonstrated efficacy compared to I & D. The observed cure rate of UGNA was 83% to 92% and an acceptable failure rate of 17.5% was associated with more than one aspiration. Conversely, the I & D method was associated with a prolonged healing period, pain, interrupted breastfeeding, more visits to the hospital, regular wound dressing, scarring, and fistula development however, more suitable for larger abscesses. **Conclusions:** The UGNA method appears to be an effective first-line treatment for managing unilocular puerperal breast abscesses, particularly those smaller than 5 cm, due to its shorter healing time, fewer hospital visits, and better cosmetic outcomes compared to traditional surgical methods. However, future research on large-scale RCTs with extended monitoring is needed.

### INTRODUCTION

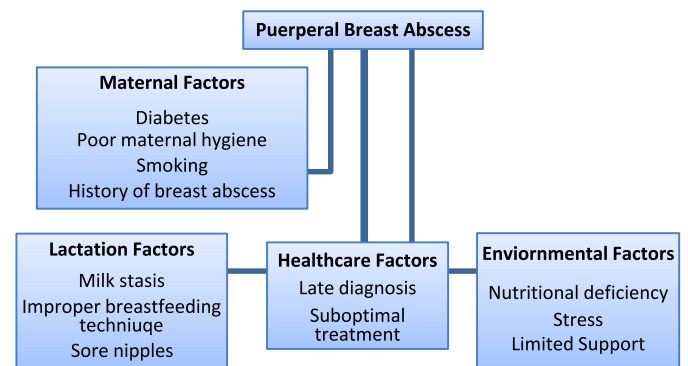
Breast Abscess (BA) denotes the inflammation of the breast commonly affecting lactating women. It is accompanied by painful and tender abscesses with systemic manifestations and challenges encountered during breastfeeding [1]. The breast abscess is further divided into puerperal and non-puerperal breast abscesses. Puerperal breast abscess (PBA) refers to the localized accumulation of purulent within breast tissue. It causes acute inflammation due to aggravations of mastitis, typically during the postpartum period. The prevalence of BA among breastfeeding women is 0.1-3%

[2]. Puerperal mastitis is mostly reported during the initial postpartum weeks [3], with progression to PBA in 0.4% to 3% of all cases [4]. Traditionally, nipple fissures and milk stasis were considered the common contributors to acute mastitis during breastfeeding [5]. However, recent research has unveiled a more intricate picture, showing mastitis as a multifaceted condition influenced by a combination of factors; including individual variations in immune response, hormonal balance, and nipple anatomy along with dysbiosis, an imbalance in the microbiome of the breast, contribute to inflammation and mastitis

development [6]. Due to a decline in their resistance ability, bacteria that enter through the terminal duct of the nipple are provided with lactoserum culture derived from milk stagnation, which penetrates mammary glands and causes deep tissue infection within the breast. Patients frequently exhibit symptoms of breast redness, swelling, tenderness, and insufficient milk secretion in the early stage. As the disease advances, it exhibits the formation of breast lumps and is associated with fevers, chills, fatigue, headache, and other clinical signs. If the inflammation is not managed promptly, the symptoms ultimately lead to puerperal breast abscess [7]. The most common microorganisms associated with the risk of infection are *Staphylococcus aureus* and methicillin-resistant *Staphylococcus aureus* [8]. Identifying other risk factors with particular emphasis in the context of Pakistan, a prospective study included advancing age, diabetes, and smoking with statistically significant association to PBA [9]. The other risk factors are poor breastfeeding techniques, sore nipples, and a gestational age of more than 41 weeks (Figure 1). If the abscess is left untreated it becomes severe and may lead to pus discharge from the skin, fistula formation, breastfeeding cessation due to loss of milk, and pain among lactating women indicating a significant infection and need for medical treatment. The diagnosis of puerperal breast abscess is clinical and established by ultrasound scan when available [10]. Despite improvements in maternal hygiene, nutrition, and early use of antibiotics, the true management of breast abscess remains a significant problem in developing countries [11]. Traditionally, lactational breast abscesses have been managed with surgical incision and drainage which involves the drainage of the purulent material with antibiotic administration [12]. However, this treatment is associated with massive trauma, prolonged healing time, multiple visits to the hospital for regular dressing, increased risk of breastfeeding cessation, milk fistula, intolerable pain during wound dressing, and suboptimal cosmetic outcomes with ugly scarring, which negatively impacts the patient's quality of life [13]. Now, in the era of image-guided therapy and minimally invasive surgery, UGNA is providing a better alternative to the I & D method. The minimally invasive aspiration involves the insertion of a thick needle into the abscess cavity under the guidance of ultrasound for precise targeting of the abscess and aspiration of pus buildup [14]. This approach has the advantage of minimal trauma, early healing, less pain and visits to the hospital, uninterrupted breastfeeding, no scar formation, and satisfactory cosmetic outcomes [15]. Therefore, UGNA is recommended as first-line treatment with surgical drainage being retained for larger-size abscesses that are not resolved with aspirations and in cases of tissue necrosis [16]. The question of whether to opt for

conventional I & D treatment or UGNA is a point of contention and lacks a unified stance from the surgical community. To date, limited comprehensive studies are comparing the effectiveness of I & D and UGNA on puerperal breast abscess. Therefore, this systematic review aims to augment the existing literature by providing a comprehensive comparison of the efficacy of two approaches for the management of puerperal breast abscess. This will involve the evaluation of factors of healing period, scar formation, pain levels, patient satisfaction, and cosmetic outcomes.

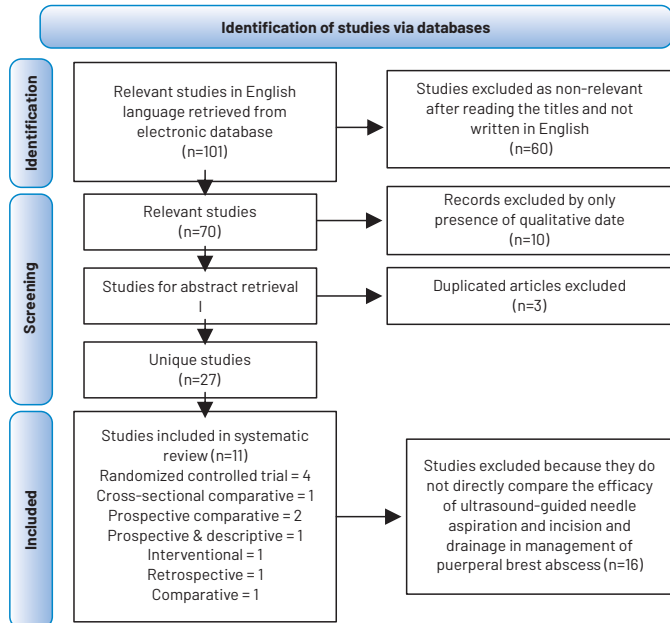
This systematic review aimed to assess the efficacy of the UGNA and I & D approach will provide valuable information to healthcare professionals in determining which approach yields better outcomes in the management of lactational breast abscess and in optimizing treatment protocol.



**Figure 1:** Risk Factors Associated with Puerperal Breast Abscess

## METHODS

Preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines were followed to write this systematic review. The data from 2013-2023 was collected using several databases (PubMed, Google Scholar, Sci-hub, and Science Direct) using Boolean logic "AND" and "OR", Medical Subject Headings (MeSH Terms). Different keywords were used to explore the literature including "Efficacy", "Ultrasound-guided needle aspiration", and "Incision and drainage" combined with "Puerperal or lactational breast abscess" A total of 101 articles were retrieved from the included databases. Out of these, 60 studies were excluded as non-relevant after reading the titles and not written in English, 10 were based only on the presence of qualitative data, 3 after being duplicates, and then 16 more were excluded because they do not directly compare the efficacy of UGNA and I & D in management of puerperal breast abscess. After applying all these inclusion/exclusion criteria, only 11 articles were considered eligible after applying inclusion/exclusion criteria and deleting the duplicates and irrelevant articles (Figure 2).



**Figure 2:** PRISMA Flowchart Depicting the Study Selection Process

## RESULTS

All of the identified studies [1, 16, 19-27] compare the effectiveness of ultrasound-guided needle aspiration and incision and drainage methods in the management of puerperal breast abscesses by comparing the outcomes of patients who underwent UGNA against patients treated with surgical drainage. The endpoints of the study included success rate, pain level, reoccurrence rate, hospital visits, fistula development, healing time, and scar formation. The UGNA method has a success rate of 83%, 92%, and 91%, and an acceptable success rate of 70% [1, 19, 20, 27]. However, UGNA associated with an acceptable failure rate and reoccurrences, required repeated aspirations sometimes for complete recovery and even a switch to surgical drainage [20, 24]. Overall studies reveal that the UGNA offers less pain, faster recovery in terms of shorter healing time, fewer hospital visits, better cosmetic outcomes [1, 16-27], and lower incidence of fistula development [21] as compared to I & D. UGNA could be an effective alternative and first-line treatment especially for smaller abscess <5cm [19, 20] and incision and drainage should reserve for larger and delayed abscesses [26]. The available data compares the UGA and incision and drainage methods in the management of puerperal breast abscess (Table 1).

**Table 1:** Summary of Comparison Between UGNA and I & D Methods in the Management of Puerperal Breast Abscess

Sr. No.	Age	Patients	Healing Period	Scar	Pain	Mammary Fistula	Patients Treated	Key Outcomes	Remarks	Study	Reference
1	<b>UGNA Group</b>							Mean healing time & pain are lesser in the UGNA group as compared to the I & D group/Patient satisfaction /Cost-effective/Needle aspiration is effective for small abscess	UG-Needle Aspiration is Effective Method/ Success Rate 83%	Prospective comparative	Ranjeesh and Kotha [17]
	30y	30	19.20/ Shorter	no	Pain Relieved Persistent to Next Follow-Up	NR	25				
1	<b>I &amp; D group</b>							For larger abscess should consider I & D/Prolonged healing time /Scar formation	UG-Needle Aspiration is Effective Method /Success Rate 92%		
	30	30	30.1677 /Longer	yes/5had	Pain Relieved Intolerable Pain During Dressing	NR	30				
2	<b>UGNA group</b>							Mean healing time & pain lesser in the UGNA group as compared to the I & D group/Fewer hospital visits/No scar/ Reparative aspiration required/ Effective for small abscess <5cm	UG-Needle Aspiration is Effective Method /Success Rate 92%	Comparative perspective	Voruganti et al [18]
	25y	25	Shorter	no	Pain Relieved/ No Dressing Required	NR	25				
2	<b>I &amp; D group</b>							Prolonged healing time/ Scar formation/More visits to hospital	UG-Needle Aspiration is Effective Method/ Success Rate 92%	Comparative perspective	Voruganti et al [18]
	25y	25	Longer	yes	Painful/ Wound Dressing Required	NR	25				
3	<b>UGNA group</b>							Mean healing time & pain were lesser in the UGNA group as compared to the I & D group	Needle Aspiration is Effective for Small Abscess	Cross-sectional comparative	Manzoor et al [1]
	25y	52	Shorter	5.67 %	Pain Relieved	NR	52				

	<b>I &amp; D group</b>							100% scar formation/ Longer healing time			
25y	56	Longer	YES / 100 %	Intolerable During Dressing	NR	56					
4	<b>UGNA group</b>							Healing time is shorter as compared to the I & D group	UG-Needle-Aspiration is Effective	Randomized controlled trial	Dar et al [14]
	25-30y	35	Shorter	NR	NR	NR	NR				
	<b>I &amp; D group</b>							Prolonged healing time			
25-30y	35	Longer	NR	NR	NR	NR					
5	<b>UGNA group</b>							UGNA yields better outcomes/less incidence of fistula development	UG-Needle-Aspiration is Effective	Prospective comparative	Bhatti et al [19]
	25y	28	Shorter	No	NR	No	47% Complete Resolution				
	<b>I &amp; D group</b>							Development of fistula is higher			
25y	28	Longer	yes	NR	Yes/ 5%	47% Complete Resolution					
6	NR	59 UG NA group	91.10%	NO	2 Patients had Pain	NR	5.3% had Complication	Minimally invasive/ 91.1% cure rate/good cosmetic results	UGNA is Effective	Prospective & descriptive	Tran et al [20]
7	<b>UGNA group</b>							UGNA yields better outcomes/ early success rate	UFND is an Effective Alternative to I & D	Randomized controlled trial	Khan et al [21]
	28y	35	Shorter	NR	NR	NR	94.10%				
	<b>I &amp; D group</b>							77.14%			
29y	35	Longer	NR	NR	NR						
8	<b>UGNA group</b>							Better outcome results/Higher failure rate for abscesses >5 cm	UFND is an Effective Alternative to I & D with an Acceptable Failure Rate	Interventional	Suthar et al [22]
	NR	35	Shorter	No	Pain Relieved	Yes	6 Patients Required I & D				
	<b>I &amp; D group</b>							pain & Fistula /scar formation are drawbacks			
NR	35	Longer	yes	Intolerable During Dressing	yes/3 patients	All					
9	33y	UG NA group	NR	NR	NR	NR	ALL/Single Aspiration was Sufficient in 643% of Cases	Effective alternative to surgery/ UGNA group continued breastfeeding	Effective	Retrospective	Rigourd et al [23]

10	UGNA group							Early healing/less hospital visits/ resumption of breastfeeding	UGNA is an Effective and First-Line Treatment for Smaller Breast Abscesses	Randomized	Saharan et al [24]
	24.8y	25	Shorter /11.4 Days	No	NR	NR	92% Cure Rate/ Failure 7 %				
10	I & D group							Surgical scar formation/more hospital visits/should be considered for larger abscesses			
	24.8y	25	longer /11.4 Days	No	NR	NR	100%				
1	UGNA group							Healing time & pain are lesser in UGNA	UGNA is an Effective Alternative/Acceptable Success Rate	Randomized	Fathy et al [25]
	29.79	17	Shorter /11.6	No	Less Pain	No	70% of Patients Treated				
1	I & D group							Prolonged healing time/Scar formation			
	29.79	24	Longer /22.21	Yes	Intolerable Pain	NR	100% of Patients Treated				

**Abbreviations:** UGNA ultrasound-guided needle aspiration, I & D: incision and drainage, NR: Not reported, BA: Breast Abscess, SD: Standard deviation.

In consideration of the homogeneity of the data, the standard deviation (SD) of the healing time outcome was taken for the comparison of the efficacy of both methods. The reported SD was recorded from five studies [1, 16, 20,23, 27]. The standard deviation of healing time was statistically converted to the SD ratio and mean days of healing time were compared. Based on the less variability and lower mean healing time of the UGNA group compared to the I & D group, the UGNA method appeared to be more consistent and effective in prompting faster recovery in terms of the healing period. However, for a comprehensive assessment of the overall efficacy of both methods, other relevant clinical and statistical factors are important and should be considered. Here in the context of homogeneity of data, only the healing outcome was included. The SD ratio of 0.462 which is less than 1 shows that the UGNA group has approximately 0.462 times the variability of the I &D in terms of healing time and less spread in data around the mean compared to the I &D group. The UGNA group has a lower mean healing time of 8.59 days compared to the I &D group of 18.6 days which suggests that the UGNA group to a shorter time to heal than the I & D group. The UGNA group indicates less variability compared to the I &D group which demonstrates higher consistency in outcome healing time. The mean healing time was lower in the UGNA group implying that the UGNA method is more effective in promoting faster healing compared to the I &D group. Based on variability and mean healing time the UGNA method appears to be more consistent and effective or has higher efficacy compared to the Incision and drainage method (Table 2).

**Table 2:** Comparison of Mean Healing Days and Standard Deviation Ratio for Determining the Efficacy of UGNA and I & D

Sr. No	UGNA S.D.	I & D S.D.	S.D Ratio	UGNA / Mean Days	I & D / Mean Days	Standard Deviation Ratio	Reference
1	14.44 ± 4.28	24.68 ± 5.07	0.5847	14.44	24.68	<b>UGNA Group:</b> 8.59 ± 1.89 <b>I &amp; D Group:</b> 18.6 ± 5.00 <b>SD Ratio =</b> SD of UGNA/SD of I & D <b>SD Ratio =</b> 8.59/18.6= 0.462	Voruganti et al [18]
2	8.59 ± 1.89	18.6 ± 5.00	0.4618	8.59	18.64		Manzoor et al [1]
3	21.0 ± 1.97	44.23 ± 3.15	0.473	21	4.23		Dar et al [14]
4	22.0 ± 1.86	43.2s1 ± 2.14	0.509	22	43.21		Khan et al [21]
5	11.16 ± 2.01	22.2 ± 13.12	0.502	11.6	22.2		Fathy et al [25]

## DISCUSSION

To compare the efficacy of ultrasound-guided needle aspiration (UGNA) and incision and drainage (I & D) in the management of Puerperal breast abscess, Voruganti et al., conducted a 3-year comparative prospective trial [18] at

Pinnamaneni Siddhartha Medical College in India. The study included a total of 50 cases of young women of age 25 with small breast abscesses < 5cm and were divided into two groups of 25 each. Group A was managed by UGNA



using a 16G needle and Group B was managed by I & D. According to the findings of the study, UGNA had better outcomes with a recovery of 92%. The mean duration of the healing period was lower  $14.44 \pm 4.28$  in group A as compared to group B  $24.68 \pm 5.07$ . The number of hospital visits was lower in group A,  $3.96 \pm 0.97$  as compared to group B  $8.72 \pm 1.54$ , due to the need for regular wound dressing and intense pain. The results of the study are similar to a comparative study conducted by Kumar *et al.*, on 100 female patients aged 18-60, stating UGNA as statistically significant ( $p < 0.05$ ) compared to I & D [26, 27]. A randomized controlled trial (RCT) was conducted by Dar *et al.*, at Holy Family Hospital Pakistan to compare the healing period outcomes between UGNA and I & D ( $n = 35$  each) in the management of PBA [14]. The study found a lower healing period in the UGNA group  $21.0 \pm 1.97$  as compared to the I & D group  $44.23 \pm 3.15$ . It is in line with the findings of a 2-year RCT conducted by Muhammad Naeem *et al.*, in the hospital of Karachi, which reported a mean healing time of  $19.13 \pm 15.56$  of patients who underwent UGNA as compared to  $45.3 \pm 24.04$  in patients of I & D [10]. Both studies concluded that UGNA is a better treatment method supplemented with antibiotic coverage. An interventional study was undertaken by Suthar *et al.*, in India to compare the management of puerperal breast abscess by UGNA versus I & D with the outcome of resolution and complication [22]. The study reported that patients ( $n=35$ ) in the I & D group experienced pain and needed daily hospital visits for wound dressing, mammary fistula in 3 patients, and scarring. No scar or mammary fistula was observed in the UGNA group. However, resolution time was less in the aspiration group and 6 patients were moved to surgical drainage after aspiration. The study concluded that UGNA has an acceptable failure rate of 17.14% for larger abscesses and is an effective alternative to I & D for small and early abscess sizes. Bhatti *et al.*, conducted a 1-year comparative investigation at Liaquat University Hospital of Karachi to compare the efficacy of UGNA and surgical drainage approach in the management of lactational breast abscess among 59 female patients [19]. The patients in the I & D group developed a mammary fistula (5.0%) and the resolution rate was 44.06%, whereas in the UGNA group resolution was 47.45% and no fistula formation was observed. The study findings suggested that UGNA is a better treatment intervention than the I & D in terms of low incidence of fistula development. At any site and time where an ultrasound facility is accessible, ultrasound-guided needle aspiration should be the first-line treatment as it is minimally invasive, cost-effective, precise, and reduces the risk of mammary fistula development [28, 29]. Allied Hospital Pakistan reported

the higher efficacy of the UGNA group at 87.5% ( $n=30$ ) as compared to the I & D group at 82% ( $n = 29$ ). The limitations of the systematic review include limited availability of recent research, variations in study designs, outcomes, and patient population, small sample sizes, and limited follow-up, across studies included. Furthermore, heterogeneity in outcome measures can significantly impact the overall conclusions [30, 31]. A 1-year retrospective study was conducted by Rigourd *et al.*, at the Duroc Breast Imaging Center in France. The study aimed to analyze the effectiveness of UGNA among puerperal breast abscess patients ( $n=28$ ) and breastfeeding continuation after the intervention [23]. From a total of 28 patients, 7 were referred to surgical drainage and avoided surgery in 75% of cases. The results showed that a single aspiration was sufficient in 64.3% of patients whereas others required two to three aspirations. The delay between the development of abscesses and the decision for abscess drainage was higher among patients who underwent I & D. A study showed that out of 43 patients with abscesses, 24 patients were able to avoid surgical intervention. The drainage procedure was effective in clearing the abscess cavity in 39 patients [32]. All patients continued breastfeeding after aspiration intervention and considered it an effective approach. The results are similar to a retrospective study [12]. Some studies measure the frequency and risk factors of lactational mastitis [33]. Among 54 patients, 80.6% were successfully treated with UGNA. Saharan *et al.*, executed a randomized controlled trial to compare the effectiveness of UGNA and I & D in young women ( $n=25$  each) of age 24 with puerperal breast abscesses [24]. The study found that patients in the UGNA group had early healing and resumption of breastfeeding, no surgical scar, fewer visits to the hospital, less pain, and resolution of breast abscesses with one or two aspirations as compared to the I & D group. The ultrasound-guided needle aspiration is an effective treatment method especially for unilocular breast abscesses whereas I & D is specifically reserved for multilocular abscesses. Breast abscesses pose a significant healthcare challenge, particularly in South Asia. Khan *et al.*, conducted a 6-month randomized trial at Allied Hospital Pakistan, evaluating the efficacy of both approaches as outcomes [21]. Of a total of 70 patients, 35 patients of age 28 underwent UGNA and 35 patients of age 29 underwent I & D intervention. The healing period was significantly lower in the UGNA group  $22.0 \pm 1.86$  as compared to I & D,  $43.21 \pm 2.14$ , whereas the efficacy of ultrasound aspiration 94.29% was higher than I & D, 77.14%. A meta-analysis performed by Fu Bing *et al.* [29] in the ultrasonography department in China encompassed 8 randomized controlled trials. It showed that the mean

healing time in the UGNA group was less than in the I & D group. A six-month Randomized controlled trial undertaken by Randhawa *et al.*, at From August 2019 to March 2020 a comparative investigation was led by Fathy *et al.*, in Kasir Al-Ainy Hospital of Egypt to compare UGNA and I & D methods in the management of acute-puerperal breast abscesses among 48 female patients [25]. Most of the abscesses develop as a complication of lactational mastitis but over recent years the availability of clinic-based ultrasound has made diagnosis easier [34, 35]. The mean age of patients included was 29. The results showed the mean time of intervention was less in the UGNA group than I & D group and healing time was 11.6 in the UGNA and 22.21 in the I & D group. The patients from the UGNA group had less pain and all were satisfied with cosmetic outcomes as compared to patients of the I & D group which had a 54% satisfaction rate. However, the success rate of UGNA was 70%, and surgical drainage was 100%. The study concluded the ultrasound aspiration method could be an effective approach with an acceptable success rate and better outcomes than I & D.

## CONCLUSIONS

In comparison, ultrasound-guided needle aspiration emerges as an effective approach with an acceptable success rate in the management of puerperal breast abscesses. It offers advantages, especially for small breast abscesses in terms of less healing time, fewer hospital visits, lower incidence of fistula development, no scarring early, breastfeeding resumption, and better cosmetic outcomes compared to the I & D method. However, due to limitations in small sample sizes and limited follow-up, future research on large-scale RCTs with extended monitoring and assessment of patient outcomes such as pain, satisfaction, and impact on quality of life should be performed.

## Authors Contribution

Conceptualization: HA

Methodology: SM, SQ

Formal analysis: MA, MI

Writing review and editing: HA

All authors have read and agreed to the published version of the manuscript

## Conflicts of Interest

All the authors declare no conflict of interest.

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