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The efficacy and safety of radiofrequency ablation for allergic rhinitis: a systematic review and meta-analysis

Xi Zhang[1], Min Yan[2], Qicheng Deng[3] and Ling Yang[4]

[1]Department of Otolaryngology Head and Neck Surgery of Nanchong Central Hospital, Nanchong, China, [2]Nanchong Central Hospital, Nanchong, China, [3]Public Health Clinical Center of Chengdu, Chengdu, China and [4]Department of Otolaryngology Head and Neck Surgery of Dazhou Central Hospital, Dazhou, China

Review Article

Ling Yang takes responsibility for the integrity of the content of the paper

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Corresponding author:
Ling Yang;
Email: 1019473909@qq.com

Abstract

Objective. This systematic review aims to synthesise findings from randomised, controlled trials and assess the efficacy and safety of radiofrequency ablation in treating allergic rhinitis.
Methods. A thorough search was conducted across PubMed, the Cochrane Library, Embase, Web of Science, China National Knowledge Infrastructure, WanFang, Chinese Scientific Journal, and Chinese Biomedical Literature databases from their inception until October 2023. The primary outcome measure was the total effective rate, with secondary outcomes including adverse events.
Results. This review included 15 randomised, controlled trials involving 1430 patients. The pooled analysis revealed a statistically significant effect on the total effective rate (odds ratio = 3.27, 95 per cent confidence interval = 2.37 to ~4.51). However, no statistical significance was observed in adverse events (odds ratio = 1.18, 95 per cent confidence interval = 0.67 to ~2.08).
Conclusions. Based on the analytical results, radiofrequency ablation emerges as an efficacious and safe treatment modality for allergic rhinitis. Given the constraints posed by a limited sample size, it is imperative that forthcoming clinical trials adhere rigorously to the gold standard of randomised, controlled trials for the purpose of corroborating these conclusions.

Introduction

Allergic rhinitis, an immune response mediated by immunoglobulin E (IgE), affects an estimated 10 to ~40 per cent of the global population, demonstrating a sustained upward trend.[1–3] Common allergic rhinitis symptoms include nasal itching, sneezing, runny nose, and nasal congestion. Additionally, some patients may encounter symptoms of allergic nasal conjunctivitis such as tearing, eye itching and/or eye redness. Severe allergic rhinitis can significantly impair physical and mental function, leading to diminished quality of life and economic repercussions.[4,5] The treatment of allergic rhinitis varies depending on the severity of the symptoms, including avoiding contact with allergens, medication, immunotherapy, surgical treatment, and combination therapy.[6,7] Pharmacological intervention is widely employed as the primary approach for managing allergic rhinitis, with commonly used medications including H1 antihistamines, leukotriene receptor antagonists, glucocorticoids, anticholinergics, decongestants, and specific immunotherapy.

Despite the good results shown by drug therapy, approximately 10 to ~22 per cent of allergic rhinitis patients still do not respond effectively to such treatment measures.[8,9] Therefore, surgical treatment has emerged as a viable alternative for situations where there is no response to medication or low adherence, drowsiness, and decreased efficacy due to long-term continuous use of medication.[10] Various surgical treatment options for allergic rhinitis exist, including inferior turbinate ablation or partial turbinate resection for the inferior turbinate, alar nerve resection or posterior nerve resection for the posterior nasal nerve, and inferior turbinate surgery combined with posterior nasal nerve resection.[9] Among these, radiofrequency ablation of the inferior turbinate is a frequently employed surgical technique in clinical practice.

Radiofrequency ablation is a well-established technology that enables precise targeting of narrow areas while preserving the integrity of surrounding healthy mucosal tissue. It has been widely employed in various medical disciplines, including otolaryngology. This innovative approach involves localised heating of submucosal tissue without causing any damage to its epidermal and mucosal layers. As part of the healing process, it induces fibrosis and promotes tissue volume reduction. Moreover, radiofrequency ablation offers the advantages of simplicity in operation and minimally invasive techniques, making it suitable for outpatient settings under local anesthesia.[11,12]

Numerous researchers have reported the favourable therapeutic effect of radiofrequency ablation on allergic rhinitis, with no significant increase in adverse reactions. However, there is a lack of a comprehensive systematic review and meta-analysis that assesses the safety and efficacy of radiofrequency ablation for allergic rhinitis, leaving a

void in solid evidence supporting its use as a treatment alternative. Therefore, this study aims to fill this gap by conducting an extensive systematic review and meta-analysis that includes original research listed in major databases. Our goal is to synthesise size effects and expand the sample size to draw more dependable conclusions about the safety and effectiveness of radiofrequency ablation in the treatment of allergic rhinitis. These results will provide valuable insights for clinical practice.

Material and methods

Registration

The systematic review and meta-analysis protocol has been officially registered on the international prospective register of systematic reviews (PROSPERO) platform with registration number CRD42023486427. This study strictly adhered to the guidelines set forth by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses ('PRISMA') protocols statement.[13]

Search strategy

To ensure a comprehensive search for relevant studies, we conducted an extensive search across multiple databases, spanning from inception until October 2023. These included PubMed, the Cochrane Library, Embase, Web of Science, China National Knowledge Infrastructure Database (CNKI), WanFang Database (WF), Chinese Scientific Journal Database (VIP) and Chinese Biomedical Literature Database (CBM). In addition to these databases, we also performed supplementary searches on Baidu Scholar, Google Scholar and the Chinese Clinical Trials Registry. The complete literature retrieval strategy, exemplified by our approach with PubMed, is presented in Table 1.

Eligibility criteria

Inclusion criteria

Following the population, intervention, comparator, outcome, and study (PICOS) design format, we established the following inclusion criteria for our investigation. (1) Patient: individuals ≥ 18 years of age with allergic rhinitis. (2) Intervention: the intervention group underwent radiofrequency ablation or a combination of radiofrequency ablation and medication treatment. (3) Comparison: the control group received conventional drug treatment or other non-surgical treatments such as immunotherapy. (4) Outcome: we assessed both primary and secondary outcomes. The primary outcome measure was the total effective rate, defined as the combined cure rate, significant improvement rate, and overall response rate. Secondary outcomes included adverse events and recurrence rate. (5) Study design: randomised, controlled trial. Additionally, eligible studies needed to be published in either English or Chinese.

Table 1. Searching strategy.

Search	Query
#1	("Rhinitis, Allergic" [Mesh]) OR (Allergic Rhinitides [Title/Abstract]) OR (Rhinitides, Allergic [Title/Abstract]) OR (Allergic Rhinitis [Title/Abstract])
#2	("Radiofrequency Ablation" [Mesh]) OR (Ablation, Radiofrequency [Title/Abstract]) OR (Radio Frequency Ablation [Title/Abstract]) OR (Ablation, Radio Frequency [Title/Abstract]) OR (Radio-Frequency Ablation [Title/Abstract]) OR (Ablation, Radio-Frequency [Title/Abstract])
#3	(randomized controlled trial [Publication Type] OR randomized [Title/Abstract] OR placebo [Title/Abstract])
#4	#1 AND #2 AND #3

Exclusion criteria

The following conditions led to the exclusion of studies: (1) patients with allergic rhinitis who had complications related to asthma or other severe atopic diseases; (2) publications that contained duplicated experimental data; (3) publications with incomplete data that could not be fully retrieved through various sources; (4) review articles and literature based on animal experiments; (5) individuals undergoing concurrent nasal surgeries, such as septoplasty, polypectomy, sinusotomy, etc.; (6) non-randomised, controlled experiments; and (7) publications for which full-text materials were unattainable through any means.

Study selection and data extraction

The process of literature screening and data extraction was independently carried out by two researchers, adhering strictly to the pre-established inclusion and exclusion criteria. In case of any disagreements, a third researcher was consulted for resolution. Data extraction was facilitated using Excel 2019 software. The extracted information included various details such as title of the literature, first author, year of publication, average age, follow-up duration, sample size, intervention measures employed in both experimental and control groups, number of observed effective cases, reported adverse events, and recurrence size in both groups. Whenever significant gaps or incompleteness were identified in the reviewed literature sources, proactive communication via phone or email with either the first author or corresponding author was initiated to obtain complete information. The specific approach used for literature selection was in adherence to the Preferred Reporting Items for Systematic Review and Meta-Analyses ('PRISMA') extension for scoping reviews guidelines.[14]

Assessment of the methodological quality

The Cochrane Risk of Bias Assessment Tool[15] was utilised in this study to conduct quality evaluation of the included literature. This tool scrutinises six crucial aspects to determine the quality of the literature: (1) methods of randomisation used, (2) concealment of allocation, (3) implementation of blinding, (4) completeness of the outcome data, (5) selective reporting of outcomes, and (6) any other potential sources that could introduce bias. Each of these criteria is classified as having a low, high, or unclear risk of bias. Furthermore, the quality of evidence related to primary outcomes was graded using the grading of recommendations assessment, development and evaluation ('GRADE') system and specifically analysed with GRADEprofiler version 3.6 software (Informer Technologies, Los Angeles).

Data synthesis

For data analysis, we utilised the Revman 5.4.1 software, freely available on the official Cochrane website. We employed the Cochrane Q test statistics (chi squared) and I^2 to assess heterogeneity among the original literature when integrating research data.[16] Heterogeneity levels are categorised according to

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Cochrane's classification[17] as follows: 0–40 per cent (mild heterogeneity), 30–60 per cent (moderate heterogeneity), 50–90 per cent (significant heterogeneity), and 75–100 per cent (extreme heterogeneity). If the probability value (p) of the statistic is > 0.1 and I^2 is < 50 per cent, it indicates no significant heterogeneity among the included studies, leading us to use a fixed-effect model. Conversely, if there significant heterogeneity was present, we applied a random-effects model.

To assess result stability, we conducted a sensitivity analysis, which involves sequentially excluding one study at a time and conducting statistical analyses on the remaining original literature through multiple iterations. In our analysis of binary variables such as overall effectiveness rate, incidence rate of adverse events, and recurrence rate, we employed odds ratio as the effect measure. The 95 per cent confidence interval (CI) represents the potential range of this effect measure with a 95 per cent level of confidence. The combined statistical results are determined by the 95 per cent CI of the combined statistics displayed in a forest plot. We utilised Stata 15.1 (StataCorp, College Station, Texas) software to generate Begg's funnel plots and conduct Egger's tests, assessing publication bias by examining symmetry within the funnel-plot distribution. In cases where asymmetry indicated potential publication bias, we employed the trim-and-fill method to adjust for size effect.

Results

Study selection

Our initial search yielded 483 literature sources. These were distributed as follows: 9 from PubMed, 9 from the Cochrane Library, 9 from Embase, 12 from Web of Science, 95 from China National Knowledge Infrastructure Database (CNKI), 138 from WanFang, 101 from Chinese Scientific Journal Database (VIP), and 110 from Chinese Biomedical Literature Database (CBM). We utilised NoteExpress 3.8 (Aegean Software, Beijing) software for the classification and screening process, discarding reviews that did not meet our inclusion standards. Ultimately, we incorporated 15 randomised, controlled trials[18–32] into the analysis (Figure 1).

Study characteristics

All characteristics of the included trials were meticulously documented. The study encompassed a total sample size of 1430 participants. Of these, 726 individuals were assigned to the intervention group and received radiofrequency ablation, while 704 individuals were allocated to the control group and treated with medication. Table 2 summarises an in-depth overview of the included studies.

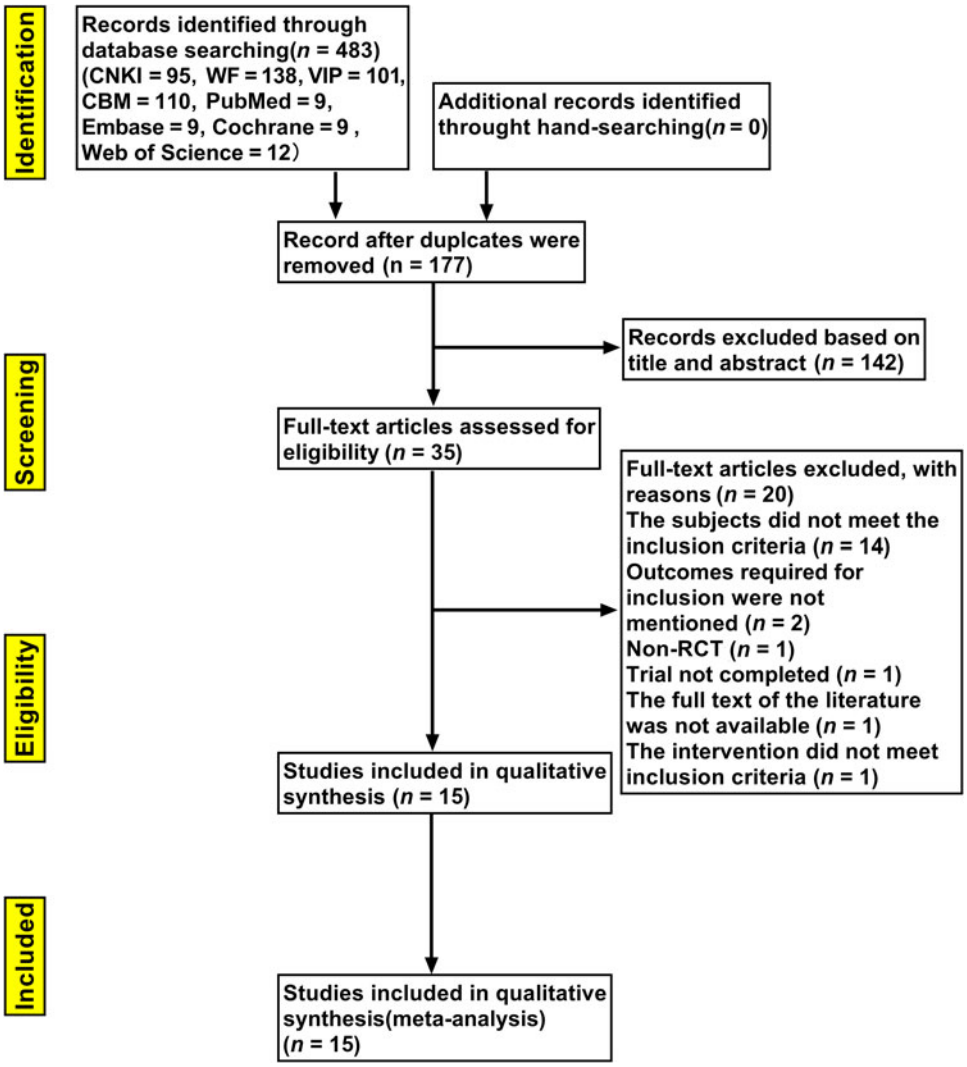

Figure 1. Flowchart of literature selection; CNKI = China National Knowledge Infrastructure Database; WF = WanFang Database; VIP = Chinese Scientific Journal Database; CBM = Chinese Biomedical Literature Database.

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Table 2. Basic characteristics of eligible randomised, controlled trials; I = intervention; C = comparison.

Study	Sample size (intervention/ comparison)	Average age (intervention/ comparison)	Interventions	Comparisons	follow-up time (months)	Total effective size (intervention/ comparison)	Adverse events (intervention/ comparison)	Recrudescence (intervention/ comparison)
[18]Liu, 2006	58/56	I: 18~55 (30) C: 22~55 (32)	RFA + (H1 antihistamine + intranasal corticosteroids + decongestants 1 week)	H1 antihistamine + Intranasal corticosteroids + decongestants 1 week	Not reported	51/40	Not reported	Not reported
[19]Li *et al.*, 2009	51/51	18~62 (34.85)	RFA	Intranasal corticosteroids 4 weeks	3	Not reported	3/6	Not reported
[20]Li, Xie, 2009	42/42	I: 30 ± 6 C: 32 ± 8	RFA + allergen-specific immunotherapy 3 months	allergen-specific immunotherapy 3 months	6	38/36	Not reported	Not reported
[21]Xu, 2010	50/48	I: 19~61 (36.4) C: 19~61(36.4)	RFA	H1 antihistamine 20 days + allergen-specific immunotherapy 4weeks	Not reported	49/41	Not reported	Not reported
[22]Zhao *et al.*, 2012	38/45	20~65 (35.6)	RFA	Intranasal corticosteroids 1 month	12	30/30 (22)	Not reported	Not reported
[23]Zhan *et al.*, 2014	53/53	39.3 ± 2.7	RFA	H1 antihistamine 20 days + allergen-specific immunotherapy 44 days	Not reported	50/43	Not reported	Not reported
[24]Wang, 2014	49/49	I: 34.82 ± 4.51 C: 34.83 ± 4.47	RFA + Intranasal corticosteroids 4 weeks	Intranasal corticosteroids 4 weeks	Not reported	46/39	12/8	Not reported
[25]Zeng, 2015	60/56	I: 42.4 ± 5.1 C: 42.1 ± 4.9	RFA	Intranasal corticosteroids 1 month	3	53/40	Not reported	4/11
[26]Feng, 2016	40/40	43.87 ± 3.01	RFA	Intranasal corticosteroids 1 month	Not reported	36/29	Not reported	3/8
[27]Du *et al.*, 2016	70/50	39.8 ± 7.6	RFA + Intranasal corticosteroids 1 month	Intranasal corticosteroids 1 month + H1 antihistamine 1 month	6	61/32	Not reported	Not reported
[28]Zeng, 2017	50/50	I: 39.8 ± 6.8 C: 39.4 ± 6.7	RFA	H1 antihistamine 2 weeks	12	48/41	Not reported	1/6
[29]Liu, 2018	26/26	I: 36.43 ± 4.05 C: 34.17 ± 4.25	RFA + H1 antihistamine 2 weeks	Intranasal corticosteroids 3 months + H1 antihistamine 2 weeks	6	23/21	5/4	Not reported
[30]Wang, 2019	59/58	I: 28.45 ± 4.31 C: 29.01 ± 4.26	RFA + Intranasal corticosteroids 1 month	Intranasal corticosteroids 1 month	3	58/47	3/2	Not reported
[31]Ku, 2020	30/30	I: 40.78 ± 10.23 C: 40.56 ± 10.14	RFA	Intranasal corticosteroids + H1 antihistamine	Not reported	29/23	Not reported	Not reported
[32]Li *et al.*, 2023	50/50	I: 30.12 ± 5.51 C: 31.01 ± 5.72	RFA	Mast cell stabilisers 4 weeks	1	40/39	7/6	Not reported

Risk of bias assessment

We employed the Cochrane bias risk assessment tool to evaluate the quality of the literature included in this study. Among the 15 studies, the completeness of outcome data and selective outcome reporting were satisfactorily implemented. However, the random allocation methods, allocation concealment, and blinding were inadequately addressed. Detailed evaluation results can be found in Table 3. A bias-risk graph was generated using Revman 5.4.1 software, as displayed in Figure 2.

Effects of interventions

Total effective rate

Fourteen studies reported the total effectiveness rate as an outcome indicator. We performed a meta-analysis on these 14 papers using Revman 5.4.1 software. The total effectiveness rate, which can be categorised as effective or ineffective, represents a binary variable. We utilised the odds ratio as the combined statistic and selected the fixed-effect model for calculation using the Mantel–Haenszel method. Heterogeneity testing results demonstrated homogeneity among the 14 studies containing the outcome indicator of total effectiveness rate (chi squared = 10.50, $p = 0.65$, $I^2 = 0$ per cent), thus validating the choice of employing a fixed-effect model for combining statistics. Our analysis revealed a statistically significant difference between the experimental group and control group (odds ratio = 3.27, 95 per cent CI = 2.37∼4.51, p 0.00001). This indicates that radiofrequency ablation exhibited an overall higher effectiveness rate in treating allergic rhinitis compared to drug-treatment methods. The forest plot generated by Revman 5.4.1 software is presented in Figure 3.

Adverse events

Adverse events were documented as outcome indicators in five studies. These studies exhibited homogeneity (chi squared = 2.11, $p = 0.72$, $I^2 = 0$ per cent), and the odds ratio was used as the combined statistic. Using a fixed-effect model, we synthesised effect sizes. The meta-analysis results revealed no statistically significant difference in adverse reaction incidence between the experimental and control groups (odds ratio = 1.18; 95 per cent CI = 0.67–2.08; $p = 0.57$), indicating that the observed difference lacked statistical significance (Figure 4).

Rate of recurrence

Three studies investigated recurrence rates post-treatment, and the heterogeneity test results showed no significant variation (chi squared = 0.37, p= 0.83, $I^2 = 0$ per cent). Consequently, a fixed-effect model was chosen for meta-analysis. The findings demonstrated that the experimental group exhibited markedly reduced recurrence rates following treatment compared to the control group (odds ratio = 0.27; 95 per cent CI = 0.12∼0.62; $p = 0.002$), as depicted in Figure 5.

Data synthesis

Publication bias

Data on the overall effectiveness rate was contributed by 14 studies, which served as an indicator for constructing a funnel plot to analyse publication bias. We employed Begg's funnel plot and conducted Egger's test to assess bias in the literature.[33] The regression diagram of Egger's test is depicted in Figure 6. The results indicated T = 2.54 and $p = 0.026$, suggesting a low likelihood of symmetry in the funnel plot and a high probability of publication bias. To adjust for potential size-effect distortion, we applied the trim-and-fill method. After adjustment, the odds ratio remained stable at 2.60 with a 95 per cent CI of 1.89–3.57. Notably, there was no significant change compared to before adjustment, implying that publication bias had minimal effect on our meta-analysis results and ensuring their stability.[34] The trim-and-fill funnel plot is displayed in Figure 7.

Sensitivity analysis

We utilised sensitivity analysis to evaluate the stability of our meta-analysis findings. This analysis was performed using

Table 3. Risk of bias in the included randomised, controlled trials.

Study	Random sequence generation	Allocation concealment	Blinding	Outcome data integrity	Selective outcome reporting	Other bias
[18]Liu, 2006	Uncertain	Uncertain	Uncertain	Low risk	Low risk	Low risk
[19]Li *et al*., 2009	Low risk	High risk	High risk	Low risk	Low risk	Low risk
[20]Li, Xie, 2009	Uncertain	Uncertain	Uncertain	Low risk	Low risk	Low risk
[21]Xu, 2010	Uncertain	Uncertain	Uncertain	Low risk	Low risk	Low risk
[22]Zhao *et al*., 2012	Uncertain	Uncertain	Uncertain	Low risk	Low risk	Low risk
[23]Zhan *et al*., 2014	Uncertain	Uncertain	Uncertain	Low risk	Low risk	Low risk
[24]Wang, 2014	Low risk	High risk	High risk	Low risk	Low risk	Low risk
[25]Zeng, 2015	Low risk	High risk	Uncertain	Low risk	Low risk	Low risk
[26]Feng, 2016	Low risk	Uncertain	High risk	Low risk	Low risk	Low risk
[27]Du *et al*., 2016	Uncertain	Uncertain	High risk	Low risk	Low risk	Low risk
[28]Zeng, 2017	Uncertain	Uncertain	Uncertain	Low risk	Low risk	Low risk
[29]Liu, 2018	Uncertain	Uncertain	Uncertain	Low risk	Low risk	Low risk
[30]Wang, 2019	Low risk	High risk	High risk	Low risk	Low risk	Low risk
[31]Ku, 2020	Uncertain	Uncertain	Uncertain	Low risk	Low risk	Low risk
[32]Li *et al*., 2023	Uncertain	Uncertain	Uncertain	Low risk	Low risk	Low risk

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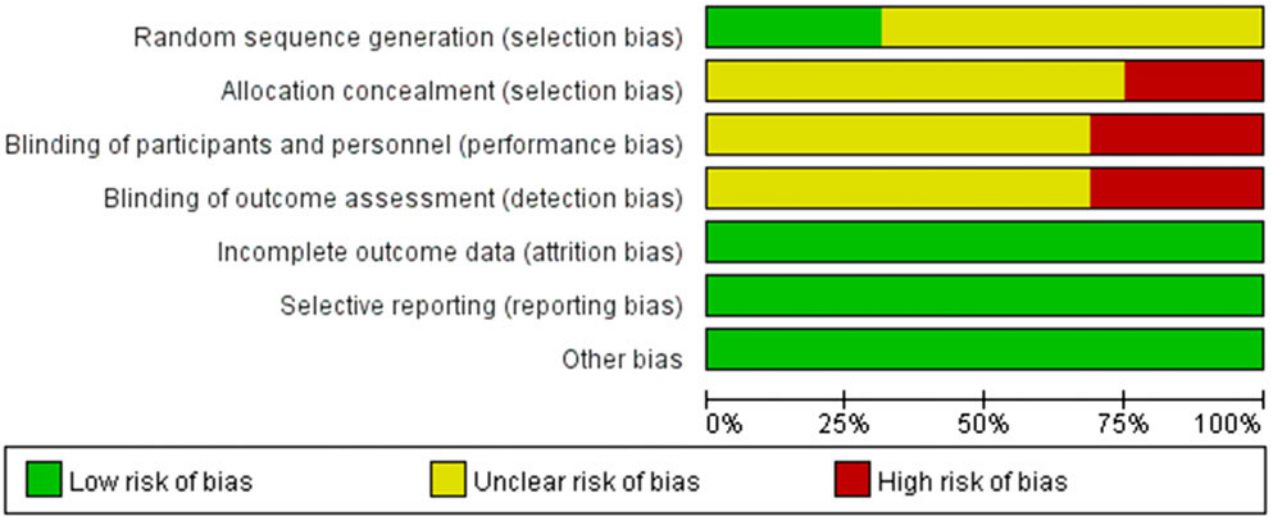

Figure 2. Risk-of-bias graph.

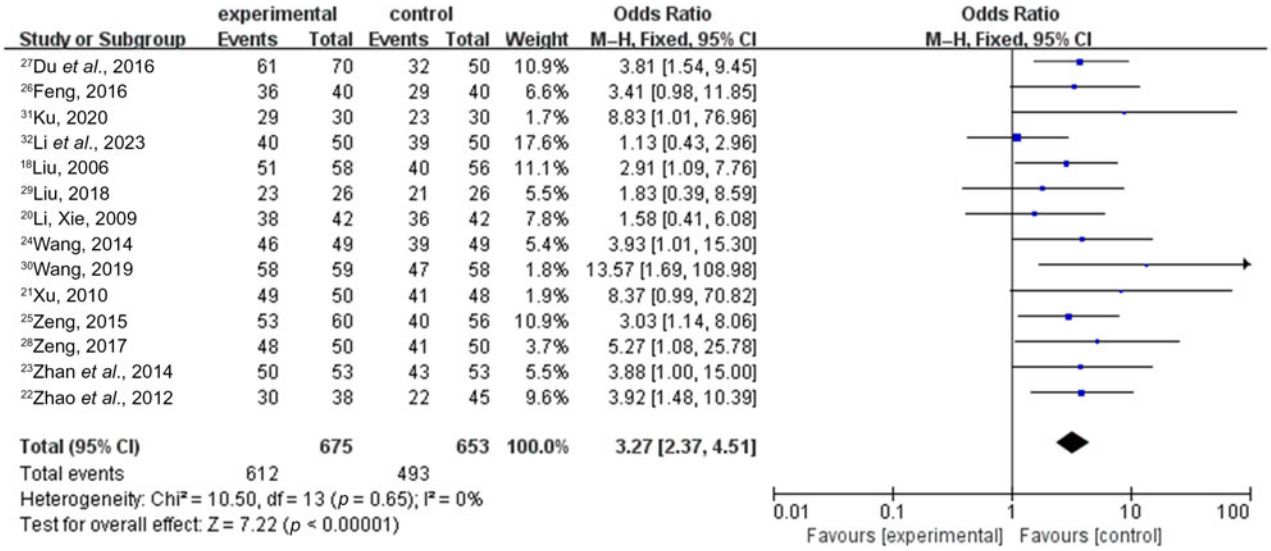

Figure 3. Forest plots of total effective rate; CI = confidence interval; df = degrees of freedom; M–H = Mantel–Haenszel.

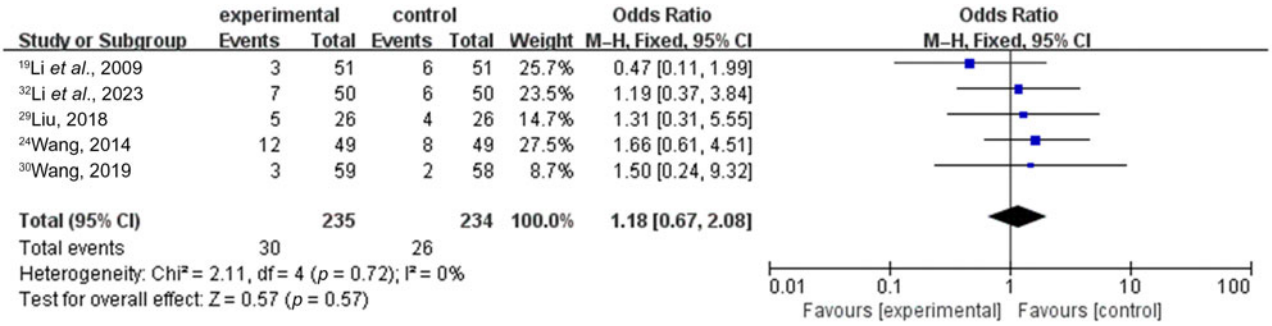

Figure 4. Forest plots of adverse events; CI = confidence interval; df = degrees of freedom; M–H = Mantel–Haenszel.

Stata 15.1 software, with a particular emphasis on the overall effective rate. The outcomes consistently indicated a robust total effective rate. Figure 8 provides a visual representation of the sensitivity analysis plot.

Level of evidence

We utilised GRADEprofiler 3.6 software to assess evidence quality associated with the total effectiveness rate, which served as an outcome indicator. This tool evaluates quality

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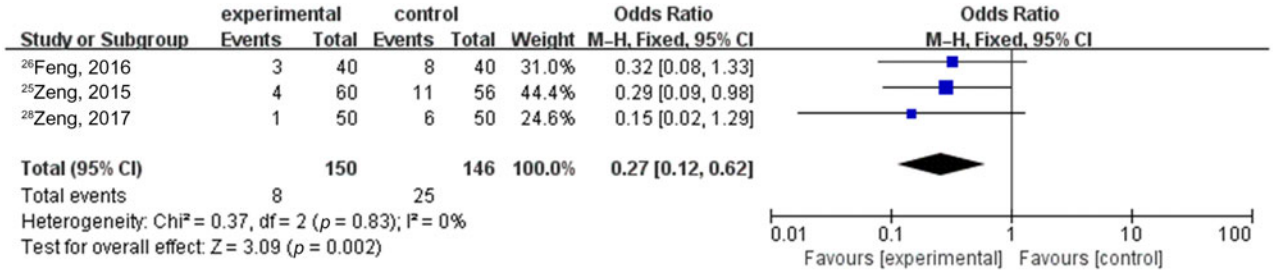

Figure 5. Forest plots of rate of recurrence; CI = confidence interval; df = degrees of freedom; M–H = Mantel–Haenszel.

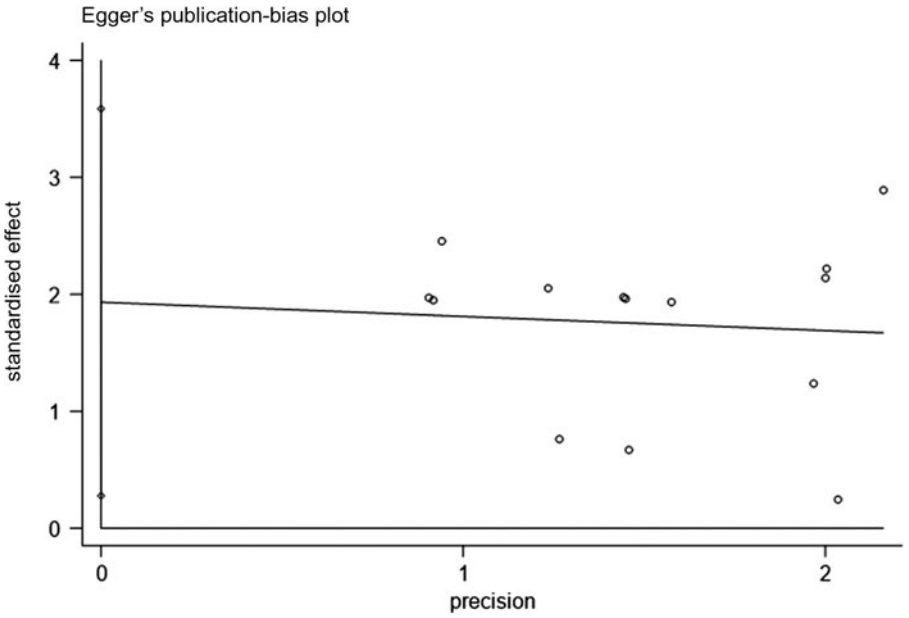

Figure 6. Regression diagram of Egger's test.

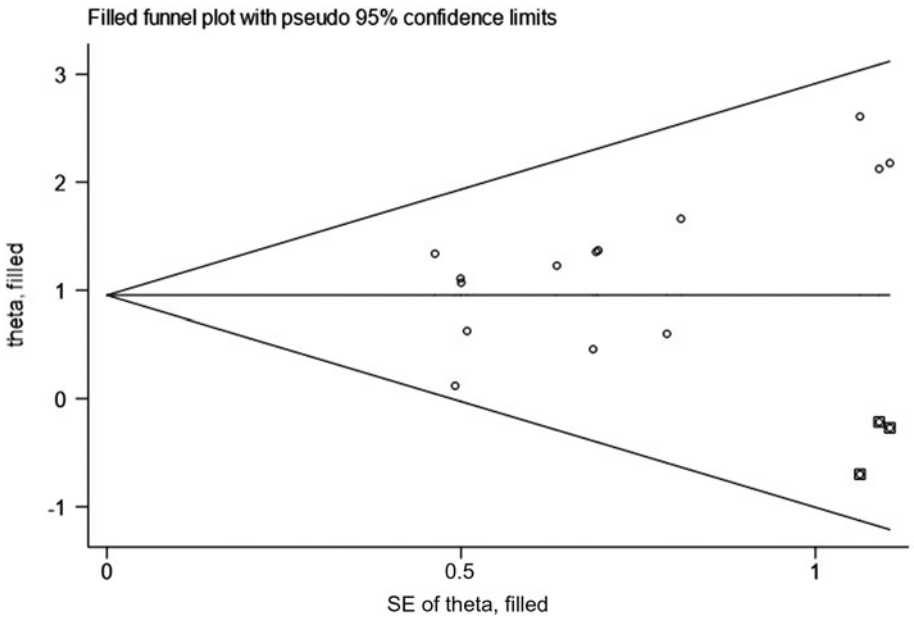

Figure 7. Funnel plot after trimming and filling; SE = standard error. These three data points with squares around them are the dummy studies added by the trim-and-fill method, and the funnel plot is able to achieve symmetry if the three dummy studies are added.

by examining various factors, including risk of bias, inconsistency in research, indirectness of evidence, precision of results, and publication bias. When multiple influencing factors affect the total effectiveness rate in this study, a downgrade in the evidence quality is justified.[35] Figure 9 outlines detailed evaluation specifics. The evidence grade for the total effectiveness rate, when used as an outcome indicator, is categorised as low.

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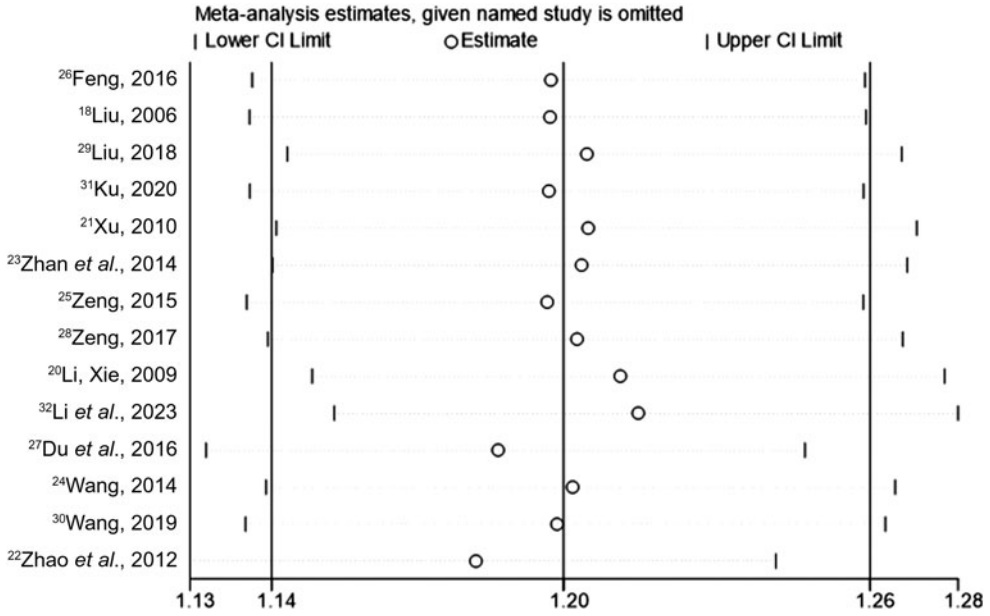

Figure 8. Sensitivity analysis plot; CI = confidence interval.

experimental compared to control for allergic rhinitides

Patient or population: patients with allergic rhinitides
Settings:
Intervention: experimental
Comparison: control

Outcomes	Illustrative comparative risks* (95% CI) Assumed risk Control	Corresponding risk Experimental	Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
total effective rate	Study population		OR 3.27 (2.37 to 4.51)	1328 (14 studies)	⊕⊕⊖⊖ low[1,2]	
	755 per 1000	910 per 1000 (880 to 933)				
	Moderate					
	788 per 1000	924 per 1000 (898 to 944)				

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval; **OR:** Odds ratio;

GRADE Working Group grades of evidence
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

[1] Three original studies did not conceal the allocation concealment, and 4 original studies did not implement the blinding
[2] The funnel plot suggested publication bias

Figure 9. Level of evidence.

Discussion

By integrating the effect sizes derived from the 15 studies included, we obtained the following results: total effectiveness rate (odds ratio = 3.27, 95 per cent CI 2.37–4.51); recurrence rate (odds ratio = 0.27, 95 per cent CI 0.12–0.62); and incidence of adverse events (odds ratio = 1.18, 95 per cent CI 0.67–2.08). For binary variable data, the odds ratio for values less than one suggests that intervention measures in the intervention group can decrease event occurrence; odds ratio values equal to one suggest no effect on event occurrence; and values greater than one suggest an increased event occurrence due to intervention measures in the intervention group.

Our findings show that both the upper and lower limits of the odds ratio for the total effectiveness rate exceed one, while both the upper and lower limits of the odds ratio for the recurrence rate are less than one. The upper and lower limits of the odds ratio for the incidence of adverse events encompass one. In conclusion, radiofrequency ablation may exhibit superior treatment effectiveness rates and reduced recurrence rates compared to drug treatment without significantly increasing adverse reaction incidence levels when compared clinically.

The grading of recommendations assessment, development and evaluation ('GRADE') evaluation system classifies evidence levels and clearly presents evaluation items, aiding clinicians in understanding the effectiveness and feasibility of intervention measures for clinical decision-making.[35] For the outcome indicator of total effectiveness rate, we used GRADEprofiler 3.6 software to evaluate the evidence quality. The grading result was of moderate quality, not high quality, due to the lack of sufficiently high-quality papers containing this outcome indicator. Among these 14 papers, 10 did not explicitly state their randomisation methods, while 3 employed

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an open random list method that failed to implement allocation concealment. Furthermore, blinding was not mentioned in 10 papers and was unachievable in 4 others because patients signed informed consent forms or group agreements.

Egger's test indicated a high probability of publication bias (T = 2.54, $p = 0.026$). However, after conducting initial screening and post-retrieval re-screening, as per our appeal process, we obtained literature with trim-and-fill analysis results consistent with those prior to the analysis. We thus concluded that, despite potential publication bias concerns, radiofrequency ablation treatment is more effective for managing allergic rhinitis. If future research produces additional high-quality original papers on this topic, we will perform further analyses incorporating them into our meta-analysis to boost credibility and potentially elevate the grade level assigned based on evidence quality.

Nasal patency, intact mucosa, and active mucociliary clearance are vital for optimal nasal airflow. The turbinates, which maximise the respiratory surface area, play a critical role in nasal functioning, including air warming, moistening, and filtration. However, enlarged turbinates can diminish nasal airflow, impair function, and cause nasal obstruction.[36]

Allergic rhinitis triggers a series of events characterised by type 2 inflammation. These events involve the recruitment of effector cells, release of mediators, and production of cytokines, leading to vasodilation, vascular congestion, inflammatory swelling, and eventual tissue remodelling. These factors collectively contribute to the enlargement of the turbinates.[37,38]

Radiofrequency ablation is a preferred surgical method for reducing inferior turbinates. By decreasing their size, radiofrequency ablation enhances the nasal airway and improves nasal symptom perception.[39] Radiofrequency ablation has been reported to alleviate sneezing symptoms in allergic rhinitis by damaging the posterior branches of the nasopalatine nerve.[40] Moreover, an imbalance in the regulation of sympathetic, parasympathetic and nociceptive nerves that innervate the nasal mucosa is implicated in controlling vascularity and glandular secretion within the mucosa. When radiofrequency energy is applied to submucosal regions, it obliterates small vessels and destroys mucosal glands, leading to circumferential scar formation, which is a significant contributor to the observed benefits of radiofrequency ablation.

While some studies attribute sneezing alleviation after radiofrequency ablation to the destruction of post-nasal nerve branches, it remains intriguing that turbinate reduction alone yields such remarkable results, given that the posterior nasal nerve innervates the entire nasal mucosa. Furthermore, the involvement of sympathetic, parasympathetic and nociceptive nerves in nasal mucosa regulation has been proposed. By applying radiofrequency energy to the submucosal layer of inferior turbinates, radiofrequency ablation achieves scar formation, contributing to its positive effects.[40–42] However, the precise mechanisms by which radiofrequency improves itching perception, rhinorrhoea symptoms, and sneezing in allergic rhinitis patients remain unclear.

While the procedure of radiofrequency ablation of the nasal concha is relatively simple and can be conducted in outpatient settings, it remains an invasive surgical intervention for patients. Factors such as intra-operative bleeding, post-operative pain, and other immediate or delayed reactions may lead to a less-than-optimal patient experience. Moreover, radiofrequency ablation carries a certain risk of recurrence, which could present challenges for patients who may be hesitant to undergo repeat radiofrequency ablation procedures. As a result, current treatment strategies for allergic rhinitis primarily favour pharmacological interventions.

Compared to radiofrequency ablation, drug therapy provides a non-invasive approach that enables self-medication. Radiofrequency ablation of the nasal concha should only be considered as an alternative option when drug treatment is ineffective or when patient compliance is poor.[43,44] Some studies have suggested that combined drug therapy following radiofrequency ablation yields superior efficacy compared to radiofrequency ablation alone.[45] This meta-analysis also shows that radiofrequency ablation outperforms standalone drug treatment in terms of effectiveness. Patients with good compliance can consider combining drug therapy with radiofrequency ablation of the nasal concha to further enhance therapeutic outcomes in allergic rhinitis.

- Based on previous reports, efficacy and safety of radiofrequency ablation are compared to nonsurgical medical therapy for treating allergic rhinitis
- Radiofrequency ablation is a safe and effective method for managing allergic rhinitis
- Utilisation of radiofrequency ablation presents a viable alternative for patients suffering from allergic rhinitis who exhibit inadequate response to pharmacotherapy or demonstrate suboptimal adherence

Conclusion

This systematic review and meta-analysis provide the first comprehensive evaluation of radiofrequency ablation for treating allergic rhinitis. Although radiofrequency ablation has proven to be effective and safe in managing allergic rhinitis, careful consideration is required due to methodological limitations and the quality of evidence. As a result, future research should focus on large-scale, multicentre, high-quality randomised, controlled trials to validate these conclusions.

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