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Impact of Obstructive Sleep Apnea and Its Treatment on Atrial Fibrillation Recurrence Following Catheter Ablation: A Systematic Review and Meta-Analysis

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Abstract

Background and Aims:

Obstructive sleep apnea (OSA) is common among patients with atrial fibrillation (AF) and may adversely affect outcomes following catheter ablation. Although continuous positive airway pressure (CPAP) therapy has been associated with improved rhythm outcomes in observational studies, its effect remains uncertain. We evaluated the association between OSA and AF recurrence following catheter ablation and the association between CPAP therapy and recurrence among patients with OSA.

Methods

Ovid MEDLINE, Embase, and Emcare were searched from inception to 27 September 2026 for studies reporting AF recurrence following catheter ablation according to OSA or CPAP treatment status. Random-effects meta-analyses using restricted maximum likelihood estimation were performed to calculate pooled risk ratios (RRs) with 95% confidence intervals (CIs). Heterogeneity, prediction intervals, small-study effects, and sensitivity analyses were assessed. Risk of bias was evaluated using the Methodological Index for Non-Randomized Studies and Joanna Briggs Institute tools.

Results

Twenty-two studies met the inclusion criteria, of which 19 studies comprising 5,748 patients contributed to the quantitative synthesis. OSA was associated with an increased risk of AF recurrence following catheter ablation across 16 studies (RR 1.43, 95% CI 1.30–1.58; I^2 = 16.3%), with a 95% prediction interval of 1.16–1.75. Among patients with OSA, CPAP use was associated with a lower risk of AF recurrence across eight studies (RR 0.60, 95% CI 0.48–0.75; I^2 = 47.1%); however, the 95% prediction interval (0.33–1.09) included the null. Findings were stable in sensitivity analyses.

Conclusion

OSA was associated with increased AF recurrence following catheter ablation. CPAP use was associated with lower recurrence among patients with OSA, although moderate heterogeneity, a prediction interval crossing unity, and predominantly observational evidence limit causal inference. Further adequately powered randomized trials are needed to determine whether CPAP directly improves post-ablation rhythm outcomes.

Introduction

Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia and is associated with substantial morbidity, including an increased risk of stroke, heart failure, hospitalization, and mortality.[1]

Catheter ablation has become an established rhythm-control strategy for symptomatic AF; however, recurrent atrial arrhythmia following ablation remains an important clinical challenge.[1,2] Outcomes following catheter ablation are influenced not only by AF phenotype and underlying atrial substrate, but also by modifiable cardiovascular risk factors and comorbidities. Among these, obstructive sleep apnea (OSA) has emerged as an important and potentially modifiable factor associated with the development, progression, and recurrence of AF.[3]

OSA is highly prevalent among patients with AF and may frequently remain undiagnosed.[4] Several pathophysiological mechanisms provide a plausible link between OSA and atrial arrhythmogenesis. Recurrent upper airway obstruction results in intermittent hypoxemia, large negative intrathoracic pressure swings, autonomic nervous system activation, oxidative stress, and inflammation.[3,5] Over time, these processes may promote atrial stretch, fibrosis, and electrical and structural remodeling, thereby creating a substrate that facilitates the initiation and maintenance of AF.[3,5] These mechanisms may also adversely affect the durability of rhythm control following catheter ablation.

Previous observational studies and meta-analyses have demonstrated higher rates of AF recurrence following catheter ablation among patients with OSA compared with those without OSA.[6,7] Continuous positive airway pressure (CPAP), the principal treatment for OSA, has therefore been investigated as a potential strategy to improve post-ablation outcomes. Several observational studies and pooled analyses have suggested lower AF recurrence among patients with OSA treated with CPAP.[7,8] However, randomized evidence has not consistently demonstrated a reduction in AF recurrence with CPAP therapy, and uncertainty remains regarding the magnitude and consistency of its potential benefit.[9] Contemporary AF guidelines consequently recognize the high prevalence and potential clinical importance of OSA while acknowledging that the effect of OSA treatment on maintenance of sinus rhythm remains uncertain.[1,2]

Given the expanding evidence base and continued uncertainty regarding the influence of OSA treatment on post-ablation outcomes, an updated synthesis of the available literature is warranted. The primary objective of this systematic review and meta-analysis was to evaluate the association between OSA and AF recurrence following catheter ablation. A secondary objective was to evaluate the association between CPAP therapy and AF recurrence among patients with OSA undergoing catheter ablation.

Methods

Search Strategy

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[10] A comprehensive search of Ovid MEDLINE, Embase, and Emcare was performed from database inception to September 21, 2025, with an updated search performed on 27 September 2026. The search strategy combined terms related to atrial fibrillation (AF), catheter ablation, obstructive sleep apnea (OSA), and treatment of OSA. AF-related terms included “atrial

fibrillation," "AF," and "AFib," while ablation-related terms included "catheter ablation," "radiofrequency ablation," and "cryoablation." OSA-related terms included "obstructive sleep apnea," "obstructive sleep apnoea," "sleep apnea," "sleep apnoea," and "OSA." Treatment-related terms included "continuous positive airway pressure," "CPAP," "positive airway pressure," and "PAP." Boolean operators (AND, OR) were used to systematically combine search concepts.

Eligibility Criteria and Study Selection

Studies were eligible for inclusion if they evaluated patients undergoing catheter ablation for AF and reported post-ablation outcomes according to the presence or absence of OSA and/or OSA treatment status. Studies comparing patients with OSA to those without OSA, as well as studies comparing treated and untreated OSA, were eligible for inclusion. OSA treatment included CPAP or other forms of positive airway pressure therapy as defined by the individual studies.

Studies were required to report AF recurrence following catheter ablation according to OSA status or OSA treatment status. Studies reporting sufficient group-specific event counts and denominators were eligible for quantitative synthesis. Studies reporting recurrence using time-to-event analyses or adjusted effect estimates without sufficient data to calculate risk ratios were retained in the systematic review and synthesized narratively. Studies were excluded if they did not report outcomes following catheter ablation or did not provide recurrence outcomes according to OSA status or treatment status. Reviews, editorials, commentaries, conference abstracts, case reports, and non-human studies were excluded.

When studies reported multiple relevant patient groups, data were extracted separately for patients without OSA, patients with untreated OSA, and patients with treated OSA when available. Potentially overlapping study populations were assessed by comparing study centres, recruitment periods, and eligibility criteria. When substantial cohort overlap was identified, the study with the larger sample size and/or more comprehensive outcome reporting was preferentially included to minimize double-counting of patients.

Following duplicate removal, titles and abstracts were screened independently by two reviewers. Full-text articles meeting inclusion criteria or requiring further assessment were subsequently reviewed independently by two reviewers. Disagreements regarding study eligibility were resolved through discussion or, when necessary, consultation with a senior author AH. Inter-reviewer agreement was quantified using Cohen's kappa (κ) statistic and interpreted according to standard thresholds: slight (0.00–0.21), fair (0.21–0.40), moderate (0.41–0.60), substantial (0.61–0.80), and almost perfect agreement (0.81–1.00).[11]

Data Extraction

Data were extracted using a standardized data extraction form. Extracted study characteristics included author, year of publication, study design, and sample size. Patient characteristics included age, sex,

duration of follow-up, OSA status, and OSA treatment status. Where reported, details regarding the method of OSA diagnosis and the type and/or adherence to OSA treatment were also collected.

The primary outcome of interest was recurrence of AF following catheter ablation. Recurrence was defined according to the criteria used by each individual study and was extracted at the longest available follow-up unless otherwise specified. Recurrence outcomes were extracted according to OSA and treatment status, permitting comparisons between patients with and without OSA and between treated and untreated OSA.

Additional outcomes of interest included repeat ablation, complications, mortality, and quality-of-life outcomes; however, these were extracted only when reported and were not quantitatively synthesized because of limited and heterogeneous reporting across studies.

When studies reported multiple relevant OSA groups, outcomes were extracted separately for each group when subgroup-specific data were available. Where reported, adjusted effect estimates for the association between OSA and/or OSA treatment and AF recurrence were also extracted along with the variables included in the adjusted analyses.

Quality Assessment

The methodological quality and risk of bias of included studies were assessed according to study design. Non-randomized studies were evaluated using the Methodological Index for Non-Randomized Studies (MINORS), while randomized controlled trials were evaluated using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Randomized Controlled Trials.[12,13] For this review, non-comparative studies were classified as poor (≤ 8), moderate (9–14), or good quality (15–16), while comparative studies were classified as poor (≤ 14), moderate (15–22), or good quality (23–24).[12] The methodological quality of included studies was assessed independently by two reviewers, with disagreements resolved through discussion and consensus.

Data Synthesis and Statistical Analysis

Continuous variables were summarized as weighted means and pooled standard deviations (SDs), while categorical variables were summarized as frequencies and percentages. Weighted mean age and follow-up duration were calculated using study sample size as the weighting factor. Pooled SDs were calculated using both within-study variance and between-study variation.

The primary meta-analysis evaluated AF recurrence following catheter ablation in patients with OSA compared with patients without OSA. A secondary meta-analysis evaluated AF recurrence among patients with OSA treated with CPAP compared with patients not receiving CPAP therapy.

For studies reporting separate OSA subgroups (e.g., CPAP-treated and untreated patients), event counts and sample sizes were combined to generate a single OSA cohort for the primary OSA versus non-OSA analysis in order to avoid double-counting participants. These studies were analyzed separately in the CPAP versus no-CPAP comparison.

Studies reporting sufficient group-specific recurrence events and denominators were included in the quantitative synthesis. Studies reporting recurrence using time-to-event analyses, including Kaplan–Meier estimates or hazard ratios, without sufficient raw data to calculate risk ratios were not pooled with studies reporting dichotomous outcomes and were instead synthesized narratively. Adjusted hazard ratios were reported as presented by the individual studies. Pooled demographic characteristics were calculated for studies contributing to the quantitative synthesis to characterize the population represented in the meta-analyses.

Risk ratios (RRs) with corresponding 95% confidence intervals (CIs) were calculated for each study using raw event counts. Meta-analyses were performed on the natural logarithm of the RR using inverse-variance weighting under a random-effects model. Between-study variance (τ^2) was estimated using restricted maximum likelihood (REML), which was prespecified as the primary estimator because of its favorable statistical properties compared with traditional DerSimonian–Laird estimation, particularly in the presence of moderate heterogeneity.

Statistical heterogeneity was assessed using Cochran's Q statistic, the I^2 statistic, and τ^2.[14] I^2 values of approximately 25%, 50%, and 75% were interpreted as representing low, moderate, and high heterogeneity, respectively. In addition to pooled effect estimates, 95% prediction intervals were calculated to estimate the range of treatment effects expected in future comparable studies.

Fixed-effect inverse-variance meta-analyses were performed as sensitivity analyses. Hartung–Knapp adjusted confidence intervals were also calculated to evaluate the robustness of the random-effects estimates, particularly for analyses containing relatively few studies.[15]

Potential small-study effects were assessed visually using funnel plots and statistically using Egger's regression test.[16] Because of the limited number of studies in the CPAP analysis, these assessments were interpreted cautiously.

Influence analyses were performed using leave-one-out sensitivity analyses, in which each study was sequentially removed and the pooled effect estimate recalculated to determine whether any individual study disproportionately influenced the overall findings.

All statistical analyses were performed using R version 4.6.1 (R Foundation for Statistical Computing, Vienna, Austria) with the metafor package. A two-sided p-value < 0.05 was considered statistically significant.

Results

Search Results

A systematic search across three electronic databases identified 637 potentially relevant articles. After excluding 203 duplicate articles, 434 articles were available for title and abstract screening. Agreement between reviewers was moderate at the title and abstract stage (κ = 0.47) and almost perfect at the full-text stage (κ = 1.00). Following title and abstract screening, 58 articles underwent full-text assessment for eligibility. Of these, 36 were excluded, resulting in 22 studies that satisfied the inclusion criteria and were included in the systematic review (Fig. 1).[9,17–37] Nineteen contributed to the quantitative synthesis, while three were synthesized narratively.

[Figure 1]

Study Quality

The 21 non-randomized studies were evaluated using the MINORS. As all were comparative studies, each was assessed across 12 domains, with a maximum possible score of 24. Total scores ranged from 17 to 21, with a median score of 19, indicating moderate methodological quality. All studies reported clearly stated aims, appropriate endpoints, contemporary comparison groups, and adequate statistical analyses. The most frequent limitations were the absence of prospective sample-size calculations, lack of blinded outcome assessment, incomplete reporting of prospective data collection, and residual baseline differences between comparison groups. Detailed MINORS assessments are presented in Supplementary Table 1.

The single randomized controlled trial, Hunt et al., was assessed using the Joanna Briggs Institute critical appraisal checklist for randomized controlled trials. Six of 13 criteria were satisfied, five were not satisfied, and two were unclear. The trial used consistent and reliable outcome measurements and appropriate statistical analyses; however, the method of random-sequence generation and allocation concealment were insufficiently reported. The open-label design precluded blinding of participants and treatment providers, while blinding of the primary outcome assessor was not reported. In addition, 26 participants were excluded after randomization, with disproportionate exclusions between groups, and the primary analysis was not conducted according to the intention-to-treat principle. The study was therefore retained but considered to have important methodological limitations. This is presented in Supplementary Fig. 1.

Study Characteristics

Twenty-two studies met the inclusion criteria and were included in the systematic review. Nineteen studies comprising 5,748 patients provided sufficient data for quantitative synthesis and were included in the pooled study-characteristic calculations.[9,17–34] Three additional studies were included in the narrative synthesis but were not incorporated into pooled descriptive characteristics because they did not contribute to the quantitative meta-analyses.[35–37] Across the overall study population, the weighted

mean age was 60.2 ± 11.0 years, and 4,022 of 5,537 patients (72.6%) with available sex data were male. The weighted mean follow-up duration was 21.3 months. Because several studies reported aggregate cohort characteristics without subgroup-specific data, subgroup denominators did not necessarily sum to the overall study population.

Among patients with obstructive sleep apnea (OSA), 1,951 patients had a weighted mean age of 61.7 ± 10.6 years and a mean follow-up of 24.2 months, with 1,270 of 1,761 (72.1%) patients with available sex data being male. The no-OSA group comprised 1,705 patients, with a weighted mean age of 57.1 ± 11.2 years and mean follow-up of 25.5 months; 1,171 of 1,684 (69.5%) patients with available sex data were male.

Among patients with OSA stratified according to CPAP use, 467 patients receiving CPAP had a weighted mean age of 62.2 ± 10.3 years, with 307 of 370 (83.0%) being male and a weighted mean follow-up of 12.9 months. In comparison, 632 patients with OSA not receiving CPAP had a weighted mean age of 64.0 ± 10.0 years, with 422 of 539 (78.3%) being male and a weighted mean follow-up of 29.6 months. Detailed demographic and follow-up characteristics are presented in Table 1.

[Table 1]

Total AF Recurrence

Across studies reporting extractable dichotomous recurrence data, 1,877 of 5,353 patients (35.1%) experienced recurrent atrial fibrillation following catheter ablation. Among studies comparing patients with and without obstructive sleep apnea (OSA), the crude recurrence rate was 39.9% (855/2,145) in patients with OSA compared with 32.0% (842/2,630) in patients without OSA. Among studies evaluating continuous positive airway pressure (CPAP) therapy, recurrent atrial fibrillation occurred in 28.0% (160/572) of patients receiving CPAP compared with 46.1% (310/673) of patients not receiving CPAP. These crude recurrence rates are descriptive and unadjusted; associations between OSA status or CPAP use and AF recurrence were evaluated using random-effects meta-analysis of study-level risk ratios.

AF Recurrence according to OSA status

Sixteen studies evaluated AF recurrence following catheter ablation in patients with OSA compared with patients without OSA. Random-effects meta-analysis demonstrated that OSA was associated with a significantly increased risk of AF recurrence following catheter ablation (RR 1.43, 95% CI 1.30–1.58; $p < 0.001$) (Fig. 2).

Between-study heterogeneity was low ($I^2 = 16.3\%$; $\tau^2 = 0.0066$; Cochran's Q = 17.92, p = 0.27). The corresponding 95% prediction interval ranged from 1.16 to 1.75, indicating that the expected range of effects in future comparable studies remained consistent with an increased risk of AF recurrence associated with OSA.

Sensitivity analyses using a fixed-effect model produced similar findings. Hartung–Knapp adjustment likewise demonstrated a significant association (RR 1.43, 95% CI 1.29–1.59). Leave-one-out analyses

showed that sequential removal of individual studies did not materially alter the pooled estimate, indicating that no single study disproportionately influenced the overall result (Supplementary Fig. 2).

Visual inspection of the funnel plot demonstrated no substantial asymmetry, and Egger's regression test did not identify evidence of small-study effects (p = 0.563) (Supplementary Fig. 3).

[Figure 2]

Three additional studies evaluated the association between OSA and post-ablation recurrence but could not be included in the risk-ratio meta-analysis because sufficient group-specific event counts were not available. Braghieri et al. evaluated 7,020 patients undergoing AF ablation and found that OSA was associated with greater recurrence among patients with paroxysmal AF (HR 1.303, 95% CI 1.114–1.525; p < 0.001), whereas no significant association was observed among patients with persistent AF (HR 0.970, 95% CI 0.850–1.106; p = 0.648).[35] Matiello et al. found that severe OSA was independently associated with arrhythmia recurrence following ablation (HR 1.870, 95% CI 1.106–3.161; p = 0.019).[36] Similarly, Minami et al. reported that an apnea-hypopnea index ≥ 20 was associated with increased recurrence following ablation in patients with persistent AF (HR 5.66, 95% CI 1.11–24.73; p = 0.036).[37] These studies were synthesized narratively because their time-to-event outcomes could not be directly combined with the dichotomous risk ratios used in the primary meta-analysis.

AF Recurrence According to CPAP Use

Eight studies compared AF recurrence following catheter ablation between patients with OSA treated with CPAP and those not receiving CPAP therapy. Random-effects meta-analysis demonstrated that CPAP use was associated with a significantly lower risk of AF recurrence (RR 0.60, 95% CI 0.48–0.75; p < 0.001) (Fig. 3).

Moderate between-study heterogeneity was observed (I^2 = 47.1%; τ^2 = 0.0466; Cochran's Q = 13.24, p = 0.07). The 95% prediction interval ranged from 0.33 to 1.09, indicating that although the pooled estimate favored CPAP therapy, the effect in a future comparable study could include no significant reduction in AF recurrence.

Sensitivity analyses using Hartung–Knapp adjustment remained statistically significant (RR 0.60, 95% CI 0.46–0.78). Leave-one-out analyses demonstrated stable pooled estimates following sequential exclusion of each study, suggesting that the overall findings were robust (Supplementary Fig. 4). Funnel plot inspection did not demonstrate marked asymmetry, and Egger's regression test did not identify evidence of small-study effects (p = 0.787); however, these findings should be interpreted cautiously given the limited number of included studies (Supplementary Fig. 5).

[Figure 3]

Discussion

Summary of Key Results

This systematic review included 22 studies evaluating the association between OSA, its treatment, and AF recurrence following catheter ablation, of which 19 studies comprising 5,748 patients contributed to the quantitative synthesis. Among studies with extractable dichotomous recurrence data, AF recurrence occurred in approximately one-third of patients during follow-up. OSA was associated with a significantly greater risk of AF recurrence following catheter ablation, with a pooled RR of 1.43 (95% CI 1.30–1.58). This association was accompanied by low between-study heterogeneity and remained robust across fixed-effect, Hartung–Knapp, and leave-one-out sensitivity analyses. Furthermore, the 95% prediction interval (1.16–1.75) remained entirely above the null, suggesting that the association between OSA and increased AF recurrence is likely to persist across comparable clinical populations.

Among patients with OSA, CPAP use was associated with a significantly lower risk of AF recurrence compared with no CPAP therapy (RR 0.60, 95% CI 0.48–0.75). This finding was also robust to sensitivity analyses; however, heterogeneity was greater than in the primary analysis, and the 95% prediction interval ranged from 0.33 to 1.09. Thus, while the pooled evidence suggests a potentially clinically important association between CPAP use and lower post-ablation AF recurrence, the magnitude and consistency of this association remain less certain across different populations.

Relation to Previous Literature

The present findings are consistent with previous evidence identifying OSA as an important risk factor for AF recurrence following catheter ablation. An earlier meta-analysis by Li et al. reported a 31% greater risk of AF recurrence among patients with OSA compared with those without OSA (RR 1.31), although this analysis included only five studies.[7] More recent evidence has continued to demonstrate an association between OSA and poorer post-ablation rhythm outcomes. The larger number of studies included in the present analysis, together with the low observed heterogeneity and prediction interval remaining above unity, further supports the consistency of this association across study populations.

Previous meta-analyses have similarly suggested that treatment of OSA with CPAP may be associated with improved outcomes following AF ablation. Deng et al. pooled 10 studies involving 1,217 patients and reported lower AF recurrence among patients receiving CPAP (RR 0.60, 95% CI 0.51–0.70).[8] More recently, Li et al. reported a pooled RR of 0.58 for AF recurrence with CPAP therapy across eight studies involving 1,231 patients.[38] These estimates are similar to the RR of 0.60 observed in the present analysis and support a potential association between CPAP use and improved maintenance of sinus rhythm following catheter ablation.

The three studies included exclusively in the narrative synthesis generally supported an association between OSA and post-ablation recurrence, although the magnitude and consistency of this association varied according to OSA severity and AF phenotype. Notably, Braghieri et al. observed an independent association between OSA and recurrence among patients with paroxysmal AF but not persistent AF,

suggesting that the relationship between OSA and post-ablation outcomes may vary according to AF subtype.

Importantly, however, the predominantly observational evidence supporting CPAP is not fully concordant with randomized data. In the randomized controlled trial by Hunt et al., which was included in our analysis, CPAP substantially reduced the apnea-hypopnea index but did not reduce AF recurrence following pulmonary vein isolation, with recurrence occurring in 57% of both the CPAP and standard-care groups.[9] This discrepancy may reflect differences in patient selection, OSA severity, CPAP adherence, AF phenotype, follow-up duration, and residual confounding within observational studies. It also raises the possibility that patients who adhere to CPAP differ systematically from untreated or non-adherent patients in other cardiovascular risk factors and health behaviours. Accordingly, although the pooled association observed in the present study favors CPAP, these findings should not be interpreted as definitive evidence of a causal reduction in post-ablation AF recurrence.

This uncertainty is reflected in contemporary clinical practice guidelines. The 2023 ACC/AHA/ACCP/HRS guideline states that screening for OSA may be reasonable in patients with AF because of its high prevalence, while acknowledging that the role of sleep-disordered breathing treatment in maintaining sinus rhythm remains uncertain.[1] Similarly, contemporary European guidance emphasizes identification and management of OSA as part of comprehensive AF risk-factor management.[2] The present findings reinforce the importance of OSA within the AF population while also highlighting the need for stronger randomized evidence to establish whether CPAP itself improves post-ablation rhythm outcomes.

Clinical Implications

These findings have several potential clinical implications. First, the consistent association between OSA and recurrent AF suggests that OSA should be considered an important component of risk assessment in patients undergoing catheter ablation. Recognition of OSA before or following ablation may help identify patients at greater risk of recurrence and provide an opportunity to address a potentially modifiable comorbidity as part of comprehensive AF management. Given that OSA may be clinically unrecognized in patients with AF, appropriate diagnostic assessment may be particularly relevant in patients with risk factors or clinical features suggestive of sleep-disordered breathing.

Second, the observed association between CPAP use and a 40% lower relative risk of AF recurrence supports continued attention to OSA treatment among patients undergoing AF ablation. CPAP remains indicated for appropriate patients with OSA independent of its potential effects on AF, and the present findings suggest that improved post-ablation rhythm control may represent an additional potential benefit. Nevertheless, treatment decisions should not be based on the pooled estimate alone. The prediction interval crossing unity, moderate heterogeneity, and discordance between observational and randomized evidence indicate that the magnitude of any rhythm-related benefit remains uncertain. Future adequately powered randomized trials incorporating objective measures of CPAP adherence and

standardized AF monitoring are needed to determine whether treatment of OSA directly reduces AF recurrence and to identify which patient subgroups are most likely to benefit.

Strengths and Limitations

This study has several strengths. The review incorporated evidence from 22 studies, including 19 studies comprising 5,748 patients that contributed to the quantitative synthesis, allowing evaluation of both the association between OSA and AF recurrence and the potential effect of CPAP therapy within the same systematic framework. Separate meta-analyses were performed for OSA status and CPAP use, while patients reported in multiple OSA treatment subgroups were appropriately combined for the primary comparison to avoid double-counting. The statistical analysis incorporated random-effects modeling using restricted maximum likelihood estimation, 95% prediction intervals, Hartung–Knapp adjustments, fixed-effect sensitivity analyses, and leave-one-out influence analyses. The primary OSA analysis demonstrated low statistical heterogeneity, and its findings remained stable across sensitivity analyses. Risk of bias was also assessed according to study design using the MINORS and JBI critical appraisal tools.

Several limitations should also be considered. First, the evidence base was predominantly observational, with only one randomized controlled trial, limiting causal inference and leaving the pooled estimates susceptible to residual confounding and selection bias. This is particularly important for the CPAP analysis, as patients who receive and adhere to CPAP may differ systematically from untreated patients in cardiovascular risk factors, healthcare engagement, and other health behaviours. Second, OSA diagnosis, severity, and CPAP treatment definitions varied across studies, and adherence to CPAP was inconsistently reported. Third, definitions and methods of detecting AF recurrence were not uniform, and differences in rhythm-monitoring intensity may have influenced recurrence ascertainment. Follow-up duration also varied across studies and between treatment subgroups; notably, weighted mean follow-up was shorter among CPAP-treated patients than untreated patients (12.9 vs. 29.6 months). Because longer follow-up provides greater opportunity to detect AF recurrence, differences in follow-up duration may have contributed to the observed differences in recurrence and introduce additional clinical heterogeneity. Fourth, patient characteristics, AF subtype, ablation techniques, and management strategies differed among studies and could not be fully accounted for using aggregate study-level data. Fifth, although the pooled CPAP estimate was statistically significant, moderate heterogeneity was present and the 95% prediction interval crossed unity, indicating uncertainty regarding whether a similar benefit would be observed in every future population. Finally, funnel plots and Egger's regression did not identify substantial small-study effects; however, these analyses, particularly for the eight-study CPAP comparison, have limited power and cannot exclude publication bias.

Conclusion

OSA was associated with a significantly increased risk of AF recurrence following catheter ablation, with consistent findings across studies and sensitivity analyses. Among patients with OSA, CPAP use was associated with a lower risk of AF recurrence; however, greater between-study heterogeneity, a prediction

interval crossing unity, and discordance with randomized evidence limit causal inference. These findings support consideration of OSA in the management of patients undergoing AF ablation while highlighting the need for adequately powered randomized trials to determine whether CPAP therapy directly improves post-ablation rhythm outcomes.

Declarations

Conflict of interest

Conflict of interest: none declared.

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Author contributions

Pathik Wahi: Investigation, Data curation, Writing - original draft. Justin Gilbert: Investigation, Data curation, Formal analysis, Writing - original draft. Michael Borean: Formal analysis, Writing – review & editing. Maan Almaghrabi: Formal analysis, Writing – review & editing. Adnan Hameed: Conceptualization, Supervision, Writing – review & editing.

Data availability

The data underlying this article are available within the article and its online supplementary material.

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Tables

Table 1 is available in the Supplementary Files section.

Figures

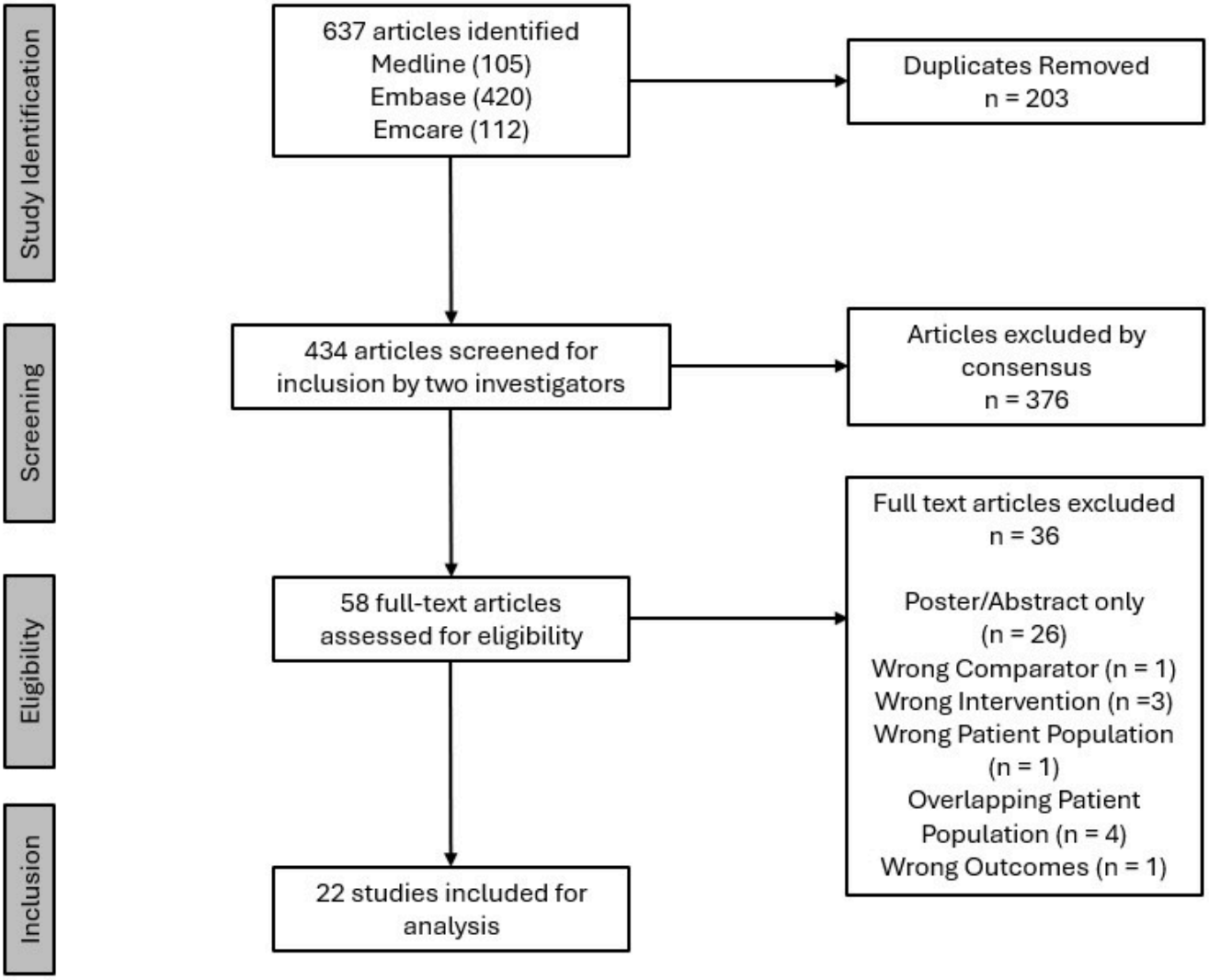

Figure 1

PRISMA flow diagram of study identification, screening, eligibility assessment, and inclusion.
Alt text: PRISMA flow diagram showing 637 records identified, 434 records screened after duplicate removal, 58 full-text articles assessed for eligibility, and 22 studies included in the systematic review.

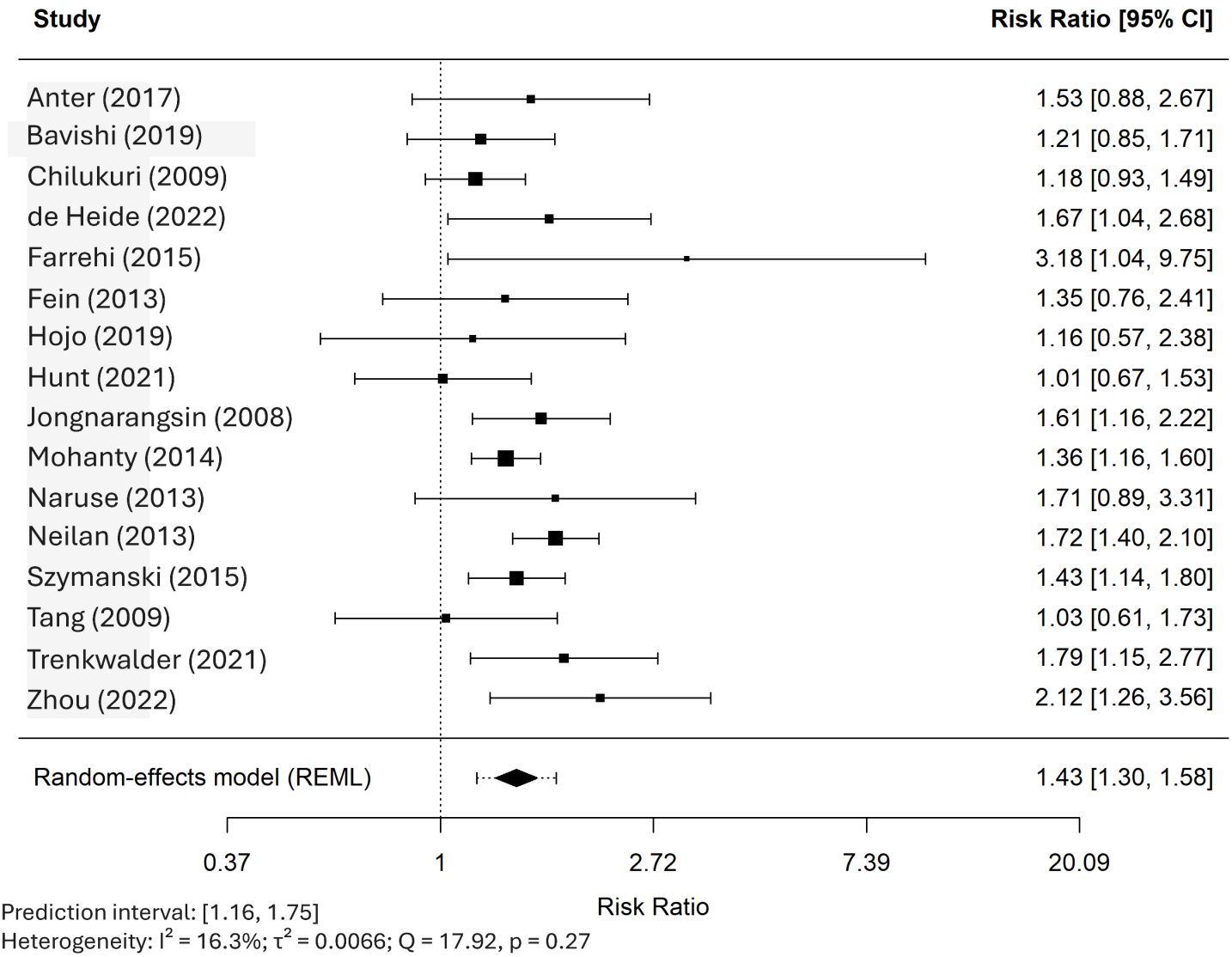

Figure 2

Forest plot comparing atrial fibrillation recurrence following catheter ablation in patients with obstructive sleep apnea and those without obstructive sleep apnea. Individual and pooled risk ratios with 95% confidence intervals are shown. The pooled estimate was calculated using a random-effects model with restricted maximum likelihood estimation.

Alt text: Forest plot of 16 studies demonstrating a pooled risk ratio of 1.43 (95% confidence interval 1.30–1.58) for atrial fibrillation recurrence in patients with obstructive sleep apnea compared with those without obstructive sleep apnea.

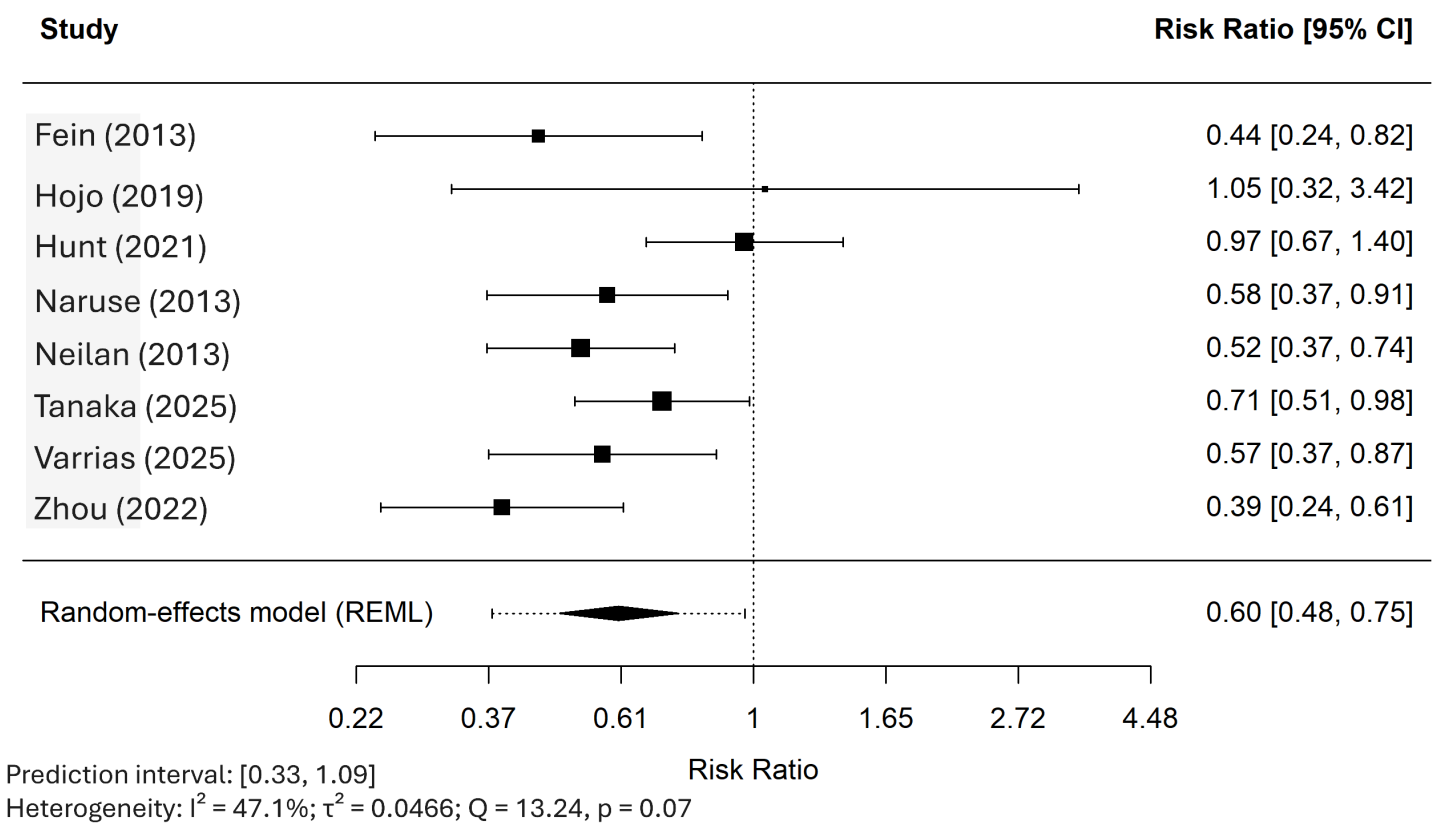

Figure 3

Forest plot comparing atrial fibrillation recurrence following catheter ablation among patients with obstructive sleep apnea treated with continuous positive airway pressure and those not receiving continuous positive airway pressure. Individual and pooled risk ratios with 95% confidence intervals are shown. The pooled estimate was calculated using a random-effects model with restricted maximum likelihood estimation.

Alt text: Forest plot of eight studies demonstrating a pooled risk ratio of 0.60 (95% confidence interval 0.48–0.75) for atrial fibrillation recurrence among patients receiving continuous positive airway pressure compared with those not receiving continuous positive airway pressure.

Supplementary Files

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- SupplementaryFigure1AFJBI.png
- SupplementaryFigure2.png
- SupplementaryFigure3.png
- SupplementaryFigure4.png

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