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Treatment of nasal polyps with biological therapies (dupilumab and omalizumab) – A comparison

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ABSTRACT

Introduction: Nasal polyps (NP) are a shared condition caused by ongoing inflammation, and they often does not respond well to standard treatments. Newer medicines like dupilumab, omalizumab, and mepolizumab, which target parts of the immune system, are showing promise, but how well they work and how safe they are compared to each other are still being studied. *Results*: Recent studies show that dupilumab provides the most consistent and robust improvements in reducing nasal polyps, easing a stuffy nose, and improving loss of smell. Omalizumab helps, especially for people with allergies, while mepolizumab works moderately well for people with certain types of inflammation. All three medicines are generally safe, with only mild reactions at the time of injection and a few serious side effects. However, differences in how the studies were conducted and a few direct comparisons make it hard to draw firm conclusions. Real-world reports show these medicines work well and are safe for many different patients. *Conclusions*: Biological therapy, especially dupilumab, is a big step forward in dealing with severe NP. Personalized treatment plans tailored to the specific sort of inflammation and the particular patient's situation. It is important to continue researching to identify the best biologic options and develop long-term management plans for this chronic and burdensome disease.

Keywords: nasal polyps, biologics, dupilumab, omalizumab, mepolizumab, type 2 inflammation, comparative efficacy, safety, personalized medicine

1. INTRODUCTION

Nasal polyps are non-cancerous, swollen growths of inflamed mucous membrane tissue in the sinuses, which are often associated with chronic rhinosinusitis (CRS). CRS causes blocked passages, loss of smell, nasal discharge, and facial pressure. Chronic rhinosinusitis with nasal polyps (CRSwNP) affects 1–4% of people overall and up to 40% of those with asthma, with the rate varying by region. CRSwNP can greatly diminish quality of life by causing persistent symptoms. Ongoing symptoms may result in financial and work-related problems. Symptoms may require frequent doctor visits and interfere with patients' ability to perform daily activities (Pfaar et

al., 2023). Type 2 inflammation is the main cause of CRSwNP. This is characterised by the accumulation of eosinophils and is driven by the cytokines IL-4, IL-5 and IL-13. Other immune factors lead to changes in the tissue, increased goblet cell numbers, and higher immunoglobulin E (IgE) levels (Bachert et al., 2020). These processes support the use of targeted biologic treatments. Usual care includes nasal and oral corticosteroids, which help with symptoms but can cause side effects and often lead to symptom recurrence when stopped.

Dupilumab and omalizumab have changed the treatment of inflammatory diseases by targeting key components of the immune response. Dupilumab stops IL-4 and IL-13 from working by blocking the IL-4 receptor alpha subunit. This reduces type 2 inflammation in the mucosa. This action can make polyps smaller, reduce swelling and help you to start smelling again (Harb & Chatila, 2020; Matsunaga et al., 2020). Omalizumab prevents the binding of a type of allergy antibody (IgE) to the FcεRI receptors on certain immune cells. This can help to stop allergic reactions, reduce swelling and itching (Okayama et al., 2020). Both drugs have been thoroughly researched in trials and real-world settings (Bachert et al., 2020; Zuberbier et al., 2023).

A recent international study called the EVEREST study compared two medicines called dupilumab and omalizumab. Dupilumab is more effective at reducing nasal polyp scores and improving sense of smell in patients with severe CRSwNP and asthma over 24 weeks than omalizumab (Li et al., 2021; Pongdee & Li, 2025). Experts say that doctors should only give patients biologic treatments if they are right for it (Pfaar et al. 2023; Fokkens et al., 2020). They say that to get the best results, doctors need to choose patients based on what disease they have, what signs there are of the disease, and other health problems the patient may have.

This review brings together what we already know about the causes of CRSwNP, and looks in detail at the molecular and clinical features of dupilumab and omalizumab treatments. It also compares how well these treatments work and the safety of using them, and discusses how this information can be used in practice and in future research.

CRSwNP is characterised by persistent type 2 inflammation. Its defining feature is the presence of eosinophils (white blood cells) in the tissue. Eosinophils appear to be attracted to, as well as accumulate in, areas where epithelial cells are interacting. CRSwNP is a disease that causes type 2 inflammation to continue. Its main feature is the building up of a type of white blood cell called eosinophils. This is driven by epithelial cells, T helper 2 lymphocytes, mast cells, and innate lymphoid cells that produce IL-4, IL-5, and IL-13 (Bachert et al., 2020). It has been approved for the treatment of moderate-to-severe atopic dermatitis, asthma, and CRSwNP (Matsunaga et al., 2020).

The key phase 3 LIBERTY NP SINUS-24 and NP SINUS-52 studies showed that dupilumab greatly reduced nasal polyp size, nasal congestion, and improved sense of smell compared to placebo over 24 and 52 weeks (Bachert et al., 2020). Dupilumab significantly reduced the need for systemic corticosteroids and surgical intervention, suggesting a potential disease-modifying effect. Patients said they felt much better and their asthma was much more under control.

Recombinant humanized monoclonal antibody omalizumab binds with extreme potency to the Cε3 domain of free immunoglobulin E (IgE), preventing interaction between IgE and the high-affinity IgE receptor (FcεRI) on mast cells and basophils (Okayama et al., 2020). Basically, this inhibition prevents IgE from sensitizing these effector cells and prevents allergen-induced degranulation, mediator release, and downstream IgE-driven inflammation (Kim et al., 2017; Okayama et al., 2020). Omalizumab reduces the levels of a certain protein (IgE) in the blood, and this also reduces the activity of certain cells (mast cells and basophils) that can cause hypersensitivity reactions. Omalizumab is currently FDA-approved for moderate-to-severe allergic asthma and chronic spontaneous urticaria, with growing clinical use in chronic rhinosinusitis with nasal polyps (CRSwNP).

The EVEREST trial was the first randomized study to directly compare dupilumab and omalizumab, showing that dupilumab is better at improving nasal polyp scores and sense of smell after 24 weeks in CRSwNP patients with asthma. Both drugs were safe, with mostly mild side effects. Earlier studies and real-world data also indicate that dupilumab is more effective at reducing polyp size and controlling symptoms, likely because it blocks more type 2 cytokines. Omalizumab, however, works very well in patients with high IgE and allergic disease (Bachert et al., 2020). Dupilumab is well tolerated, but injection-site reactions and eosinophilia have been reported. Omalizumab is generally safe, but adverse consequences after injection are still a risk (Li et al., 2021; Pongdee & Li, 2025). At the moment, there have been no big differences in how often the treatments cause serious side effects.

The latest clinical guidelines declare that biologic therapy is best for patients with severe, hard-to-control CRSwNP, with or without asthma, especially those with high type 2 inflammation who don't respond well to corticosteroids or surgery (Pfaar et al., 2023). Dupilumab is usually the go-to choice for patients with a bunch of type 2 conditions and high eosinophil counts. Omalizumab is still a good choice for those whose disease is mainly driven by IgE-mediated allergies.

2. REVIEW METHODS

This review synthesises all the available evidence on biological treatment options chronic rhinosinusitis with nasal polyps (CRSwNP), based on systematic reviews and network meta-analyses. Most of the relevant literature from 2021 to 2025 was retrieved from electronic databases such as PubMed and Google Scholar. Search terms related to nasal polyps, chronic rhinosinusitis, biologics (dupilumab, omalizumab and mepolizumab), efficacy and safety outcomes were used.

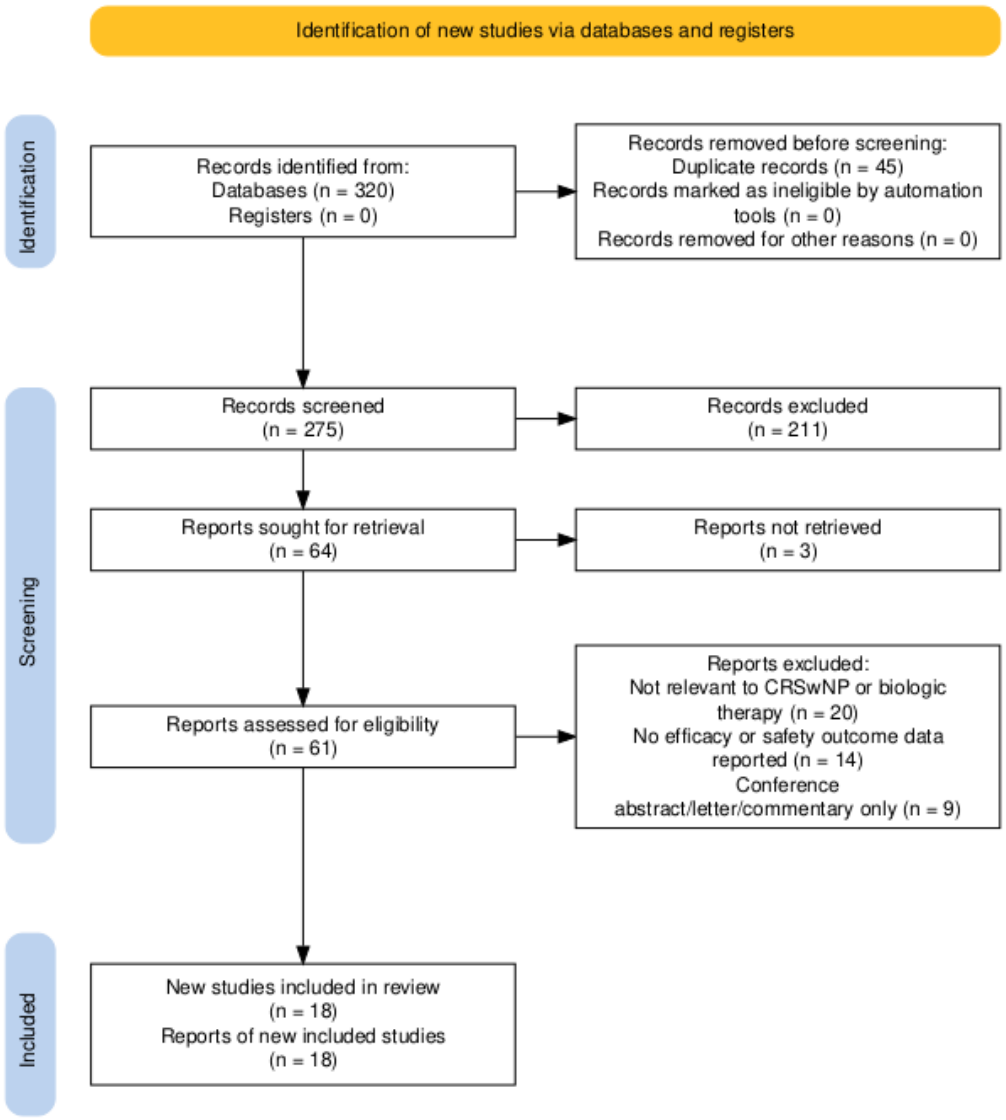

Figure 1. PRISMA flow diagram

Inclusion Criteria

Studies were included if they:

- Safety data was provided, including the incidence and severity of adverse events (AEs).
- They were randomised controlled trials, systematic analyses, meta-analyses, or observational real-world studies.
- Comparative methods, for example, network meta-analysis or indirect treatment comparisons, were used when information from direct head-to-head trials was unavailable.

The meta-analytic integration of the quantitative data from the included studies was achieved by standardising the outcome measures, which included least squares mean differences find out more about these and other statistics here dichotomous outcomes. If available, intention-to-treat analyses were favoured to minimise bias.

Two tools, the Cochrane Risk of Bias 2.0 and the AMSTAR 2.0, were used to assess the quality of the RCTs and meta-analyses. The Newcastle-Ottawa Scale was used to check for selection bias, comparability, and how well the study outcomes were assessed. To see if anything was hidden, another test was used: a funnel plot asymmetry analysis and an Egger's regression study. The article screening process followed the PRISMA guidelines (Figure 1).

The process of checking articles was done following the Preferred Reporting Items for Systematic Reviews & Meta-Analyses (PRISMA) 2020 guidelines. A total of 320 records were found through database searches (using PubMed and Google Scholar). After removing 45 copies, 275 records were checked to see if they were relevant. 211 of these were found to be irrelevant and so were taken out. The search found 64 full-text articles, but 3 were not available. After looking at all 61 articles to see if any of them could be included, it was decided that 43 of them were not suitable. The main reason for not including them was that the articles were not relevant to CRSwNP or biologic therapy, and a large number of cases (20 out of 45, 45.45%) fell into this category. In addition, articles without information about how well or safely the products worked (14 out of 32, 32.56%) or those that only had conference summaries, letters or commentaries (9 out of an original 32, 21.33%) were not included. The literature was reviewed in detail, and 18 studies were included (Figure 1).

3. RESULTS & DISCUSSION

The inclusion criteria were met by 18 studies. Included designs were randomised controlled trials, frequent reviews, network meta-analyses, indirect treatment comparisons and real-world observational cohorts. The publication years ranged from 2021 to 2025 (Wu et al., 2022; Peters et al., 2021; Papacharalampous et al., 2024).

These studies collectively evaluated three major biologic agents—dupilumab, omalizumab, and mepolizumab—administered to adult patients with chronic rhinosinusitis with nasal polyps (CRSwNP). Patient populations varied by severity of polyp disease, eosinophilic status, and presence of comorbid asthma or allergies. It's better at reducing the size of nasal polyps than a placebo and other biologics. However, a study by Wu et al., (2022) found that dupilumab is the best drug for this. Dupilumab was much better than a placebo at reducing nasal polyp scores (mean difference: -3.07; 95% credible interval [CrI]: -3.68 to -2.46). This was based on changes in nasal congestion and sense of smell. Papacharalampous and his team (2024) also reported significant advances in both objective and patient-reported outcomes.

Table 1 shows how safe and effective these biologics are. It also shows how they compare to each other and what they can and can't do. Recent meta-analyses/real-world studies provided this info.

Table 1. Summary of Key Clinical Outcomes and Safety Profiles for Biologic Agents in CRSwNP

Biologic Agent	Nasal Polyp Score Reduction	Nasal Congestion Improvement	Olfactory Function Improvement	Common Adverse Events	Anaphylaxis Risk	Time to Onset	Key Evidence Sources
Dupilumab	-3.07 (95% CrI: -3.68, -2.46) [High]	Significant [High]	Marked [High]	Injection site reaction, nasopharyngitis	Very low	2–4 weeks	Wu et al., 2022; Papacharalampous et al., 2024
Omalizumab	Moderate [Moderate]	Moderate [Moderate]	Moderate [Moderate]	Injection site reaction, nasopharyngitis	Rare but notable	8–12 weeks	Peters et al., 2021; Cai et al., 2022
Mepolizumab	Moderate [Moderate]	Moderate [Low to Moderate]	Limited data	Injection site reaction, headache	Very low	8–12 weeks	Bakakos et al., 2022; Wu et al., 2022

Omalizumab has proved to be very effective in reducing the size of these polyps and the symptoms they cause. However, the effect sizes observed were usually smaller than those reported for dupilumab (Cai et al., 2022; Zuberbier et al., 2023). Mepolizumab has been demonstrated to enhance nasal polyp scores and decrease systemic corticosteroids. It has been shown in studies that dupilumab works better (Wu et al., 2022; Bakakos et al., 2022).

Research by Peters et al., (2021) backs up these findings. The drug dupilumab worked best for nasal congestion and quality of life. Studies that observed patients in the real world had similar results to trials. De Santis et al., (2025) reported that symptoms improved quickly and for a long time with dupilumab, and that omalizumab and mepolizumab were effective.

All the groups taking part had bad reactions, including the group that didn't get the real medicine. The most frequent of these were reactions at the injection site, swollen glands, and headaches (Tănase et al., 2025). Some patients have had serious problems, but these are few and far between. A review of reports on side effects found that omalizumab was linked to more reports than different types of biologics (Fang et al., 2025).

According to WHO-Vigi Access pharmacovigilance data, dupilumab appears to be safer than omalizumab and mepolizumab (Fang et al., 2025). Real-world data from various settings, including Saudi Arabia, did not reveal any new safety signals (Abuelhassan et al., 2024).

Response times were all over the place among the agents we tested, and dupilumab showed significant improvements in the nasal symptoms as early as a couple of weeks after starting (De Santis et al., 2025). Omalizumab and mepolizumab might not work straight away, but they're effective within 8 to 12 weeks. Longitudinal data show that the benefits of the treatment last for longer than 52 weeks. Of all the drugs tested, dupilumab was the most effective in treating CRSwNP, especially in patients with severe type 2 inflammation and asthma. Omalizumab was most effective in people with IgE-mediated allergic disease, while mepolizumab was moderately beneficial in eosinophilic phenotypes.

Biologics are changing treatment of chronic rhinosinusitis with nasal polyps (CRSwNP). There has been a lot of research done to see how well dupilumab works in clinical trials. Research shows this is the best treatment for nasal polyps (Wu et al., 2022; Peters et al., 2021). The treatment worked in many cases (Wu et al., 2022; Cai et al., 2022). The results of this study are in line with what doctors have already seen. Dupilumab is probably going to stop the two main signals that cause inflammation and swelling.

The efficacy of omalizumab in CRSwNP has been demonstrated. The treatment has been shown to produce moderate improvements in polyp size and symptom scores, though typically with a somewhat smaller magnitude than dupilumab. It targets specific allergens, which reduces the inflammation they cause. However, it does not reduce the wider range of inflammation caused by dupilumab. Mepolizumab targets IL-5 and has shown moderate benefits for patients with eosinophilic inflammation.

Future research priorities include conducting larger direct comparison studies to understand better how well and how safely these medicines work. Scientists also want to find tests that can predict which treatment will work best for each person and create treatment plans that fit each patient's needs, including their other health problems and costs. New real-world evidence will also help guide doctors and improve patient care. Dupilumab is still the best biologic for CRSwNP, while omalizumab and mepolizumab are good options, especially when the dose is right for each patient. A precision medicine approach is key to maximising benefits and minimising side effects in this chronic disease.

4. CONCLUSION

Recent evidence indicates that biologic therapies represent a significant step forward in the management of nasal polyps. Dupilumab, omalizumab, and mepolizumab have been shown to reduce polyp size, ease nasal congestion, and improve smell compared to a placebo and standard care. Of all these, dupilumab seems to work best, probably because it blocks IL-4 and IL-13 from signaling to cause type 2 inflammation. It looks like omalizumab and mepolizumab are pretty good, especially for certain types of inflammation, but they seem less effective than dupilumab, at least according to some studies. All three agents are safe, with common side effects including mild injection site reactions and upper respiratory tract infections. Although rare, there are some serious risks with omalizumab, like anaphylaxis, so you need to keep an eye on things. These biologics give patients with symptoms that don't get better with steroids or surgery a better quality of life. But you usually need to keep going with the therapy to keep the benefits, which shows that nasal polyps can come back. Biologic therapies, especially dupilumab, are changing how nasal polyps are managed. If we add these agents to the standard treatment plans for this tricky chronic condition, we might achieve better results.

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Natalia Brzozowska - Writing - rough preparation
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Data and materials availability
All data associated with this study will be available based on the reasonable request to corresponding author.

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