

# Treatment outcome of oral tofacitinib and ruxolitinib in patients with alopecia areata: A systematic review and meta-analysis

*Da-Ae Yu, Ye Eun Kim, Ohsang Kwon, Hyunsun Park*[1]

Department of Dermatology, Seoul National University College of Medicine, [1]Department of Dermatology, SMG-SNU Boramae Medical Center, Seoul, Korea

## Abstract

**Background:** Tofacitinib and ruxolitinib have been used off-label to treat alopecia areata. Although a number of case reports and small studies have been published, there are no comprehensive reviews examining the outcomes of using tofacitinib and ruxolitinib for the treatment of alopecia areata.

**Aims:** The aim of the study was to examine the outcome of patients with alopecia areata treated with oral tofacitinib or ruxolitinib in previously published studies.

**Methods:** A search of MEDLINE, Embase and Cochrane library was conducted. A systematic review and meta-analysis were performed focusing on the Severity of Alopecia Tool $_{50}$ achievement rate, the frequency of adverse events and recurrence after discontinuation of treatment.

**Results:** A total of 1244 studies were identified of which only 12 studies met the inclusion criteria. Of the 346 patients in these 12 studies, 288 had received oral tofacitinib and 58 had received oral ruxolitinib. The overall Severity of Alopecia Tool$_{50}$ achievement rate was 66% (95% confidence interval, 54%–76%). Subgroup analysis revealed that drug choice, mean age, sex ratio and alopecia areata subtype ratio did not significantly affect the treatment response. Infections and laboratory abnormalities were the most common adverse events (98 and 65 cases of 319 patients, respectively). Patients treated for more than six months had a greater frequency of laboratory abnormalities as compared to those treated for shorter durations (24% vs. 7%; $P = 0.04$). Recurrence of alopecia areata was observed within three months after discontinuation of treatment in the majority (74%) of patients.

**Limitations:** This analysis was limited by the small number of observational studies available for review, the heterogeneity of patient characteristics and the lack of long-term data.

**Conclusion:** Both oral tofacitinib and ruxolitinib are effective and well tolerated in the treatment of alopecia areata. Clinicians should be aware of the expected efficacy, adverse events and high recurrence rate of oral JAK inhibitors for alopecia areata to effectively counsel these patients before starting therapy.

**Key words:** Alopecia areata, meta-analysis, ruxolitinib, systematic review, tofacitinib

## Plain Language Summary

Alopecia areata is a relatively common disorder resulting in hair loss. Treatment of moderate-to-severe alopecia areata is challenging as it is often refractory to conventional therapy. Recently, oral Janus kinase inhibitors, including tofacitinib and ruxolitinib, have been used off-label to treat alopecia areata. However, there have been few comprehensive reviews that have summarized treatment outcomes of Janus kinase inhibitors for alopecia areata. Thus the authors performed a systematic review and meta-analysis. We pooled 346 patients (288 receiving oral tofacitinib and 58 oral ruxolitinib) from 12 studies. The overall proportion of patients who achieved more than 50% hair regrowth from the baseline was 66%. Infections and laboratory abnormalities were the most common adverse events (98 and 65 cases of 319 patients, respectively). Patients with longer treatment duration (at least 6 months) showed higher frequency of laboratory abnormalities than those with shorter duration. Most patients (74%) experienced recurrence within 3 months after discontinuation of treatment. Despite of the small number of studies and lack of long-term data, this study suggests that both oral tofacitinib and ruxolitinib are effective and tolerable for alopecia areata treatment.

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**Corresponding author:** Prof. Hyunsun Park, Department of Dermatology, SMG-SNU Boramae Medical Center, Seoul, Korea. snuhdm@gmail.com

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## Introduction

Alopecia areata is a relatively common disorder resulting in hair loss, with a lifetime risk of approximately 2%.[1] Although not life-threatening, significant psychological distress often results from the cosmetically disfiguring loss of hair.[2]

There is no established cure for alopecia areata. Treatment of moderate-to-severe alopecia areata is particularly challenging as it is often refractory to conventional immunosuppressive and immunomodulatory therapy such as corticosteroids, cyclosporine, methotrexate and diphenylcyclopropenone.

Recent genome-wide association studies and preclinical studies have provided evidence for the essential role of Janus kinase/signal transducers and activators of the transcription pathway in alopecia areata.[3-5] These studies have paved the way for introducing Janus kinase inhibitors as a treatment for alopecia areata,[6] and a recent alopecia areata treatment protocol recommended oral Janus kinase inhibitors for alopecia areata patients with more than 50% hair loss.[7] Although a number of open prospective trials, retrospective studies and case reports on the use of oral Janus kinase inhibitors in alopecia areata have been published, no randomized controlled trials have yet been reported.

The aim of this study was to review the available studies to estimate the overall treatment outcome and quantify adverse events according to standardized criteria.

## Methods

### Search strategy

This systematic review and meta-analysis were performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines.[8] We performed a literature search using MEDLINE, Embase and Cochrane library and included all articles published until January 28, 2019. In combining key terms, the final search string was "alopecia" AND ("Janus kinase inhibitor" OR "JAK inhibitor" OR "tofacitinib" OR "baricitinib" OR "ruxolitinib").

The study was exempted from the institutional review board approval of SMG-SNU Boramae Medical Center as all the data used in the analysis had been previously published.

### Study selection

Two reviewers (D.Y. and H. P.) independently screened all the identified articles using the title and abstract. After screening, the full-text articles were thoroughly assessed for eligibility and all article references to further screened to identify relevant studies.

Inclusion and exclusion criteria are detailed in Table 1.

**Table 1: Study selection criteria**

| Inclusion criteria | Exclusion criteria |
|---|---|
| 1. Published in English with human participants | 1. Preclinical studies, abstracts, reviews, conference presentations, case reports ($n$<6), or unrelated to alopecia areata |
| 2. Use of oral Janus kinase inhibitors for alopecia areata | 2. Studies of topical Janus kinase inhibitors |
| 3. Open prospective trials and retrospective studies, including case series with at least 6 patients | 3. Studies with duplicate data<br>4. Studies with treatment outcomes not relevant to this study (e.g., eyebrows, eyelashes and nails) |

### Data extraction and quality assessment

Two authors (D.Y. and H. P.) independently reviewed each article and extracted data from eligible studies. Any discrepancy between the authors was resolved by discussion.

We summarized the following data: patient characteristics, treatment regimen (oral Janus kinase inhibitor, dose and treatment duration), treatment response, frequency of adverse events and recurrence rate. Because the criteria for successful response varied according to each study, we standardized the response rates using the Severity of Alopecia Tool $_{50}$ ($SALT_{50}$) achievement rate, defined as the proportion of alopecia areata patients who achieved >50% hair regrowth from the baseline. $SALT_{50}$ is considered as an acceptable endpoint for trials involving extensive alopecia areata and systemic agents.[9,10]

For quality assessment, we used a modified Newcastle–Ottawa Scale.[11]

### Data synthesis and analysis

A meta-analysis was conducted using the $SALT_{50}$ achievement rate, frequency of adverse events and recurrence rate. A DerSimonian-Laird method with a random effect model was used to incorporate the differences among the included studies. We used a funnel plot and Egger's regression test to assess publication bias. All analyses were performed using Rex Version 3.0.3 (RexSoft, Seoul, Korea). $P < 0.05$ was considered statistically significant.

A subgroup analysis was performed to evaluate the impact of study characteristics on the main outcome.[12] Studies were divided into two groups based on the following criteria:

- Patient age (mean age ≥ 18 vs. < 18)
- Sex ratio (male to female ratio ≥ 1 vs. <1)
- alopecia areata subtype ratio (the number of patients with alopecia totalis or alopecia universalis to the number of alopecia areata patients [AT, AU: alopecia areata ratio] ≥ 3 vs. <3)
- Mean duration of treatment (≥ six months vs. < six months).

In the subgroup analysis of adverse events, studies were divided according to the type of Janus kinase inhibitors and mean treatment duration.

## Results

A total of 1244 articles were identified through literature searches. After screening the records by title and abstract, we assessed 61 full-text articles for eligibility. Only 12 studies with a total 346 cases (288 treated with oral tofacitinib and 58 with oral ruxolitinib) met the inclusion and exclusion criteria [Figure 1]. Studies with oral baricitinib were excluded because they involved fewer than six patients. The main characteristics of these 12 studies are summarized in Table 2.[13-24]

The quality of included studies was evaluated using the modified Newcastle– Ottawa Scale.[11]

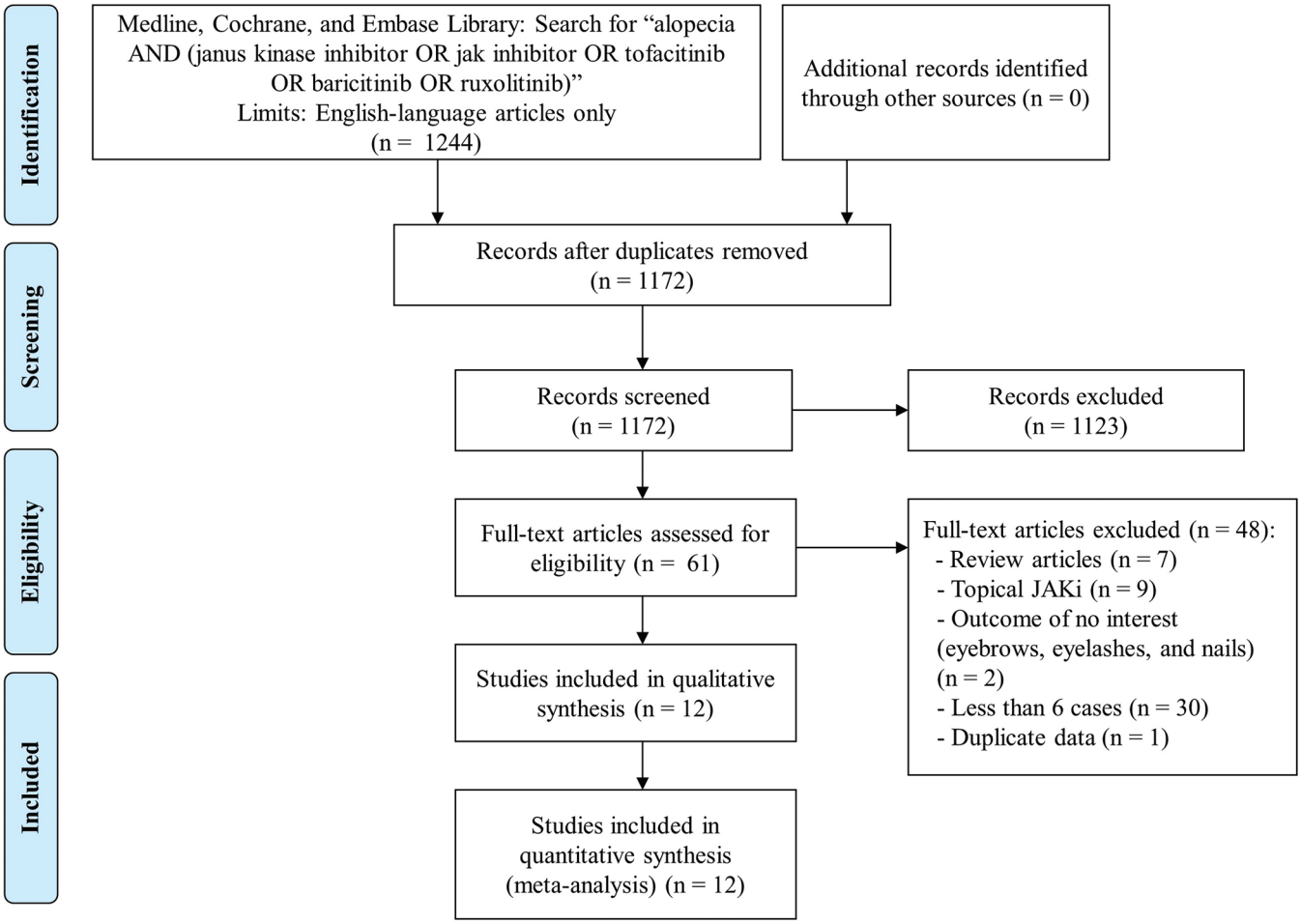


**Figure 1:** PRISMA flow diagram. PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses, JAK: Janus kinase

**Table 2: Patient characteristics and treatment regimen of included studies on oral tofacitinib and ruxolitinib for the treatment of alopecia areata**

| Study | Patient characteristics | | | | | Treatment regimen | | |
|---|---|---|---|---|---|---|---|---|
| | *n* | Males | Females | AA | AU/AT | Oral JAK inhibitor | Dosage | Duration of treatment (months) |
| Jabbari 2018 | 12 | 4 | 8 | 7 | 5 | Tofacitinib | 5–10 mg bid | 6–18 |
| Kennedy 2016 | 66 | 35 | 31 | 14 | 52 | Tofacitinib | 5 mg bid | 3 |
| Castelo-Soccio 2017 | 8 | NR | NR | 0 | 8 | Tofacitinib | 5 mg bid | 5–18 |
| Craiglow 2017 | 13 | 10 | 3 | 6 | 7 | Tofacitinib | 5 mg bid | 6.5 (2–16) |
| Ibrahim 2017 | 13 | 1 | 12 | 4 | 9 | Tofacitinib | 5 mg bid–30 mg/d | 3.7 (1.3–13) |
| Liu 2017 | 65 | 33 | 32 | 13 | 52 | Tofacitinib* | 5–10 mg bid | 12 (4–18) |
| Park 2017 | 32 | 16 | 16 | 11 | 21 | Tofacitinib | 5 mg bid–20 mg/d | 7.5 (4–17) |
| Cheng 2018 | 11 | 3 | 8 | 0 | 11 | Tofacitinib† | 5 mg qd–11 mg bid | 14.4 (4.5–27) |
| Shivanna 2018 | 6 | 3 | 3 | 0 | 6 | Tofacitinib | 5–10 mg bid | 3–6 |
| Almutairi 2018 | 37 | 22 | 15 | 15 | 22 | Tofacitinib | 5 mg bid | 6 |
| | 38 | 21 | 17 | 18 | 20 | Ruxolitinib | 20 mg bid | 6 |
| Mackay-Wiggan 2016 | 12 | 5 | 7 | NR | NR | Ruxolitinib | 20 mg bid | 3–6 |
| Liu 2019 | 8 | 4 | 4 | 2 | 6 | Ruxolitinib | 10–25 mg bid | 13.9 (5–31) |

Data are presented as medians (ranges). *Eighteen patients (27.7%) were treated with tofacitinib plus adjuvant prednisone (300 mg once monthly for 3 doses except in a single patient taking prednisone 10 mg daily for arthropathy), †Five patients (45.5%) were treated with tofacitinib plus adjuvant intralesional triamcinolone acetonide at the physician's discretion (5–10 mg/ml to recalcitrant patches). AA: Alopecia areata, AT: Alopecia totalis, AU: Alopecia universalis, JAK: Janus kinase, NR: Not reported

### Assessment of $SALT_{50}$ achievement

The rate of $SALT_{50}$ achievement was identified in all included studies. The overall $SALT_{50}$ achievement rate was 66% (95% confidence interval 54%–76%). Although the response rate to ruxolitinib was higher (79%, 95% confidence interval 66%–87%) than tofacitinib (62%, 95% confidence interval 49%–

74%), the difference was not significant ($P$ = .06) [Figure 2]. Heterogeneity was high ($I^2$ = 69%) in the tofacitinib group, but negligible ($I^2$ = 0%), in the ruxolitinib group; and the random effects model was conservatively used.

There were no statistically significant differences in the $SALT_{50}$ achievement rate when studies were grouped by age, sex and alopecia areata subtype ($P$ = 0.37, $P$ = 0.81 and $P$ = 0.91, respectively). Although lower $SALT_{50}$ achievement rates were noted with shorter treatment durations (<six months, 51%, 95% confidence interval 23%–79%) as compared to longer treatment durations (≥six months, 70%, 95% confidence interval 58%–79%), the difference was not statistically significant ($P$ = 0.25).

#### Assessment of adverse events

The reported adverse events in each study are presented in Table 3. Infections, including upper respiratory infections, urinary tract infections, herpes zoster and herpes simplex infections, were the most common adverse events in both the groups (tofacitinib 84/269; and ruxolitinib 14/50). Laboratory abnormalities, including alterations in hemoglobin, blood cell count, liver transaminase and lipids, were observed in 59 cases in the tofacitinib group and in six cases in the ruxolitinib group. Other mild symptoms (neurologic, gastrointestinal and cutaneous symptoms) were also reported in both groups. No case of malignancy was reported. Subgroup analyses did not reveal any significant differences in the frequency of adverse events between ruxolitinib and tofacitinib including total infections ($P$ = 0.77), laboratory abnormalities ($P$ = 0.42), neurological symptoms ($P$ = 0.30), gastrointestinal symptoms ($P$ = 0.43), and cutaneous symptoms ($P$ = 0.47).

Laboratory abnormalities were significantly more frequent with treatment durations over six months (24%, 95% confidence interval 13%–39%) as compared to those less than six months (7%, 95% confidence interval 2%–18%) ($P$ = 0.04). However, other adverse events (infection, neurological symptoms, gastrointestinal symptoms and cutaneous symptoms) were not associated with treatment duration.

#### Assessment of recurrence

Only four prospective studies reported recurrence rates after discontinuation of Janus kinase inhibitors. Recurrences were noted in 74% (95% confidence interval 64%–82%) of patients within three months[13,15,16] and in 85.7% (six of seven patients) at six months.[14]

#### Assessment of publication bias

As there were only three studies with oral ruxolitinib in this meta-analysis, we used all included studies to make a funnel plot.[25] Funnel plot visualization was slightly asymmetric because of two retrospective studies[17,24] with a small number of patients, but Egger's test showed no evidence of publication bias ($P$ = 0.17).

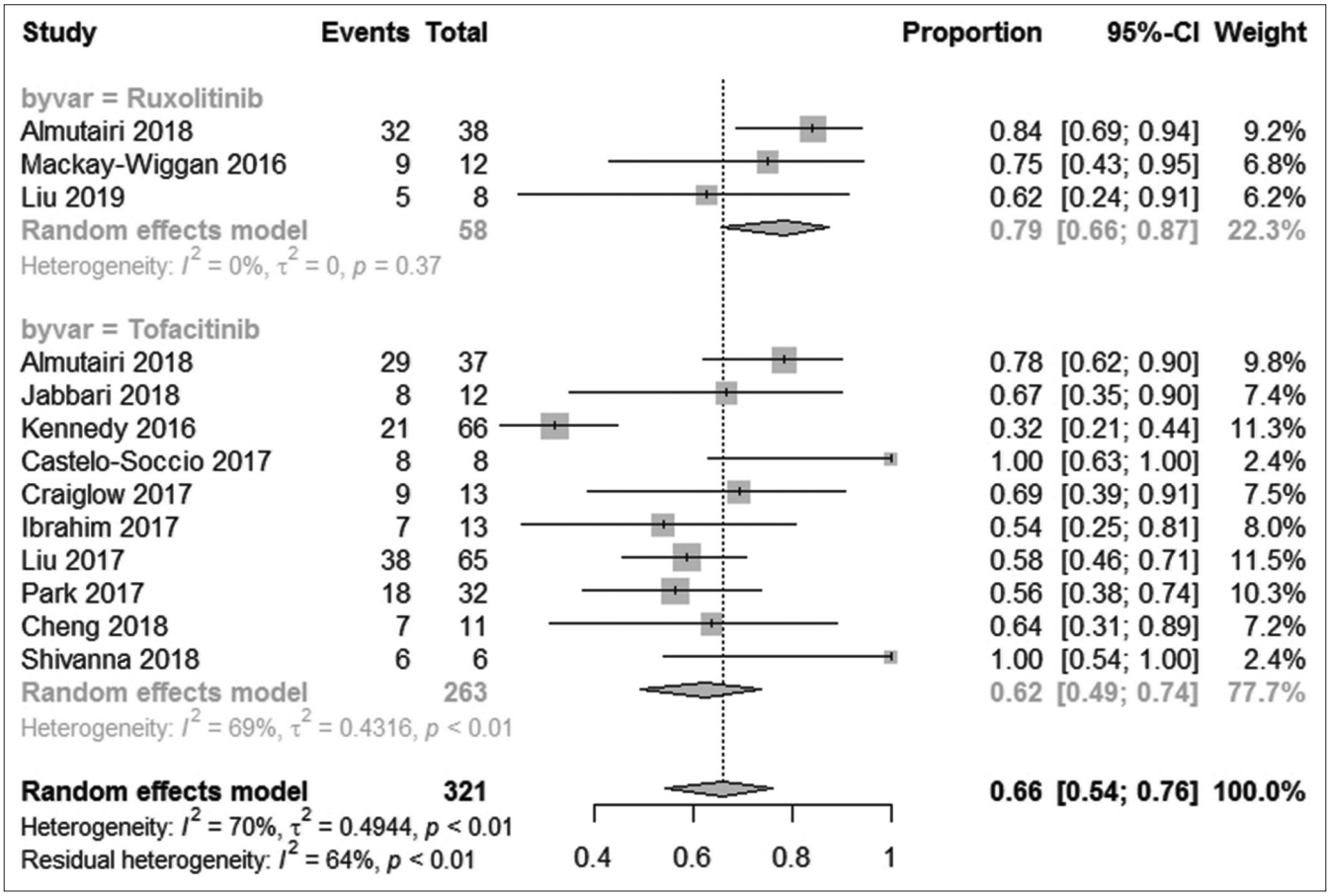


**Figure 2:** Forest plot assessing the severity of alopecia tool $_{50}$ achievement rate on oral ruxolitinib and oral tofacitinib in patients with alopecia areata. CI: Confidence interval

**Table 3: Summary of adverse events reported in the included studies**

| Study | Oral JAK inhibitor | Treatment duration (months) | Total infections* | Laboratory abnormalities† | Neurologic Sx‡ | Gastrointestinal Sx§ or weight gain | Cutaneous Sx‖ | Malignancy |
|---|---|---|---|---|---|---|---|---|
| Almutairi 2018 | Tofacitinib | 6 | 12/37 | 7/37 | 2/37 | 2/37 | 4/37 | 0/37 |
| Jabbari 2018 | Tofacitinib | 6–18 | 12/12 | 5/12 | 3/12 | 11/12 | 3/12 | 0/12 |
| Kennedy 2016 | Tofacitinib | 3 | 17/66 | 1/66 | 11/66 | 11/66 | 12/66 | 0/66 |
| Craiglow 2017 | Tofacitinib | 6.5 (2–16) | 4/13 | 4/13 | 3/13 | 0/13 | 0/13 | 0/13 |
| Ibrahim 2017 | Tofacitinib | 3.7 (1.3–13) | 0/13 | 2/13 | 0/13 | 0/13 | 1/13 | 0/13 |
| Liu 2017 | Tofacitinib | 12 (4–18) | 35/90 | 38/90 | 21/90 | 10/90 | 12/90 | 0/90 |
| Park 2017 | Tofacitinib | 7.5 (4–17) | 4/32 | 2/32 | 0/32 | 1/32 | 2/32 | 0/32 |
| Shivanna 2018 | Tofacitinib | 3–6 | 0/6 | 0/6 | 0/6 | 0/6 | 2/6 | 0/6 |
| | Total | | 84/269 | 59/269 | 40/269 | 35/269 | 36/269 | 0/269 |
| Almutairi 2018 | Ruxolitinib | 6 | 8/38 | 5/38 | 4/38 | 3/38 | 1/38 | 0/38 |
| Mackay-Wiggan 2016 | Ruxolitinib | 3–6 | 6/12 | 1/12 | 0/12 | 0/12 | 2/12 | 0/12 |
| | Total | | 14/50 | 6/50 | 4/50 | 3/50 | 3/50 | 0/50 |

*Total infections: upper respiratory infection; urinary tract infection, zoster, herpes simplex, genital warts, conjunctivitis, pneumonia, bronchitis, tonsillitis, †Laboratory abnormalities: AST/ALT elevation, elevated LDL/HDL/TG/cholesterol, changes in blood cell number, haemoglobin level, creatine phosphokinase level, creatinine level, ‡Neurologic Sx: headache, numbness, fatigue, neuropathic pain, dizziness, tinnitus, §Gastrointestinal Sx: abdominal pain/discomfort, increased bowel movement, nausea, diarrhea/loose stools, ‖Cutaneous Sx: skin rash, acne, hot flashes, urticaria, pruritus, folliculitis, palmoplantar desquamation. Adverse events were classified based on the following criteria regardless of what the authors labeled the events in their studies. Total numbers of adverse events/total number of patients; JAK: Janus kinase, Sx: Symptoms, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, TG: Triglycerides, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase

## Discussion

Our systematic review and meta-analysis of current evidence suggests that both oral tofacitinib and ruxolitinib are effective and well tolerated in patients with alopecia areata. Longer treatment durations of over six months were associated with both better response rates and an increased risk of laboratory abnormalities. Discontinuation of Janus kinase inhibitors resulted in recurrence of alopecia areata within three months in the majority of patients (74%).

Previous articles have suggested potential prognosis factors for Janus kinase inhibitors in alopecia areata such as the type of Janus kinase inhibitor used, the severity of alopecia areata, treatment duration and patient characteristics such as age and sex. Thus, we selected several parameters that can affect the treatment outcome of JAK inhibitors and performed subgroup analyses. Both the Janus kinase inhibitors studied have different molecular targets – while tofacitinib is a pan-Janus kinase inhibitor that strongly inhibits Janus kinase 3, ruxolitinib inhibits both Janus kinase 1 and 2 to a similar extent.[26] However, subgroup analysis did not show any significant differences in the treatment response or tolerability between tofacitinib and ruxolitinib. With the development of more selective second-generation Janus kinase inhibitors, further studies would be necessary to assess the relative efficacy and safety of selective Janus kinase inhibition.

Earlier studies have shown that the severity of alopecia areata may affect treatment outcome. However, our subgroup analysis, grouped by alopecia totalis/alopecia universalis to alopecia areata ratios did not reveal a significant difference in $SALT_{50}$ achievement rates.

The duration of the current episode may be another prognostic factor in patients with alopecia areata[21] but we were unable to perform subgroup analyses due to the variable episode duration in the patients in these studies.

Treatment duration may also affect the treatment outcome. In the present meta-analysis, studies with long-term treatment duration (≥ six months) demonstrated higher $SALT_{50}$ achievement rates than those with shorter treatment durations. At least a 6-month treatment period may be required to assess adequate treatment response.[27]

The half-lives of oral tofacitinib and ruxolitinib are short and since alopecia areata recurred in the majority of patients within three months after discontinuation of treatment, maintenance therapy with lower doses may be explored to prevent recurrence.

Although the age and sex of the patient did not influence the treatment outcome in our meta-analysis, this result should be interpreted with caution as the number of studies included in this analysis was small and younger age at onset has been consistently reported as a poor prognostic factor in alopecia areata.[28-30]

Serious side effects including fatal infections and thromboembolism have been reported with oral Janus kinase inhibitors when used in the treatment of such diseases as rheumatoid arthritis and the tofacitinib package insert now contains a boxed warning describing the increased risk of thrombosis. Fatal adverse effects have been more frequently reported with ruxolitinib.[31-33] As alopecia areata is not a life-threatening disorder and oral Janus kinase inhibitors are used as off-label for this condition, constant vigilance is necessary while using these drugs for alopecia areata. Infections and laboratory abnormalities were common in our meta-analysis but there were no life-threatening adverse events and the frequency of adverse events was similar for both drugs. The better tolerance of oral Janus kinase inhibitors in alopecia

areata may be both due to the lower dosage used[34] as well as the fact that alopecia areata does not impair general health.

Janus kinase inhibitors can induce variable changes in laboratory parameters (blood cell count, hemoglobin, liver transaminase, creatine phosphokinase and lipids)[35] and pooled data from two long-term extension studies of tofacitinib for rheumatoid arthritis have shown gradual progression of some laboratory parameters over 60 months.[36] A longer treatment duration with Janus kinase inhibitors was associated with more frequent laboratory abnormalities in our analysis and such patients need close observation for adverse events.

### Limitations

This study has some limitations. Only a small number of studies were available and most of these were retrospective and the prospective trials were single-arm studies without a control group. There was substantial heterogeneity in patient characteristics, drug dose and protocol among the studies – in several included studies[14,18,20-24] the drug dose was increased according to patient response and durability, resulting in considerable differences in dose between the studies. There was also a lack of long-term data that hampered a sound assessment of efficacy and tolerability. Nonetheless, this study quantitatively reports the treatment outcomes of oral Janus kinase inhibitors according to standardized parameters, enabling clinicians to give more

**Table 4: Ongoing or completed clinical trials of oral Janus kinase inhibitors in alopecia areata**

| Drug (s) | Dose | Time frame* | Phase | Status (completion date) | Number of participants† | Clinical trial identifier | Study |
|---|---|---|---|---|---|---|---|
| Ruxolitinib | 20 mg bid | three–six months | 2 | Completed[16] (April 2016) | 12 | NCT01950780 | Pilot Study to Evaluate the Efficacy of Ruxolitinib in Alopecia Areata |
| Tofacitinib | 5 mg bid | three months | 2 | Completed[15] (July 2015) | 30 | NCT02197455 | Tofacitinib for the Treatment of Alopecia Areata and Variants |
| | 5 mg bid | three months | Not applicable | Completed[15] (August 2015) | 40 | NCT02312882 | Tofacitinib for the Treatment of Alopecia Areata and Its Variants |
| | 5–10 mg bid | six months | 2 | Completed[14] (December 2017) | 12 | NCT02299297 | Study To Evaluate The Efficacy Of Tofacitinib In Moderate To Severe Alopecia Areata, Totalis And Universalis |
| | 5 mg bid | 24 weeks | 4 | Active, not recruiting | 19 | NCT03800979 | Effectiveness and Safety of Tofacitinib in Patients With Extensive and Recalcitrant Alopecia Areata |
| Baricitinib | Low/high dose | 36 weeks | 2/3 | Active, not recruiting | 725 | NCT03570749 | A Study of Baricitinib (LY3009104) in Participants With Severe or Very Severe Alopecia Areata |
| | Low/high dose | 36 weeks | 3 | Active, not recruiting | 476 | NCT03899259 | A Study of Baricitinib (LY3009104) in Adults With Severe or Very Severe Alopecia Areata |
| CTP-543 | 4 mg/8 mg/12 mg bid | 24 weeks | 2 | Completed (July 2019) | 149 | NCT03137381 | Study to Evaluate the Safety and Efficacy of CTP-543 in Adult Patients With Moderate to Severe Alopecia Areata |
| | 16 mg qd/8 mg bid | 24 weeks | 2 | Completed (November 2019) | 57 | NCT03811912 | Efficacy and Tolerability Study of Two Dose Regimens of CTP-543 in Adults With Alopecia Areata |
| | 24 mg qd/12 mg bid | 24 weeks | 2 | Active, not recruiting | 66 | NCT03941548 | Efficacy and Tolerability Study of Two Dosing Regimens of CTP-543 in Adults With Alopecia Areata |
| | qd/bid | 52 weeks | 2 | Recruiting | 100 | NCT03898479 | Extension Study to Evaluate Safety and Efficacy of CTP-543 in Adults With Alopecia Areata |
| ATI-501 | Low/mid/high dose | 24 weeks | 2 | Completed (June 2019) | 87 | NCT03594227 | ATI-501 Oral Suspension Compared to Placebo in Subjects With Alopecia Areata, Alopecia Universalis or Alopecia Totalis |
| PF-06651600 PF-06700841 | 200 mg→50 mg qd 60 mg→30 mg qd | 24 weeks | 2 | Completed (May 2019) | 142 | NCT02974868 | Study To Evaluate The Efficacy And Safety Profile Of PF-06651600 And PF-06700841 In Subjects With Alopecia Areata |
| PF-06651600 | 200 mg→50 mg qd | 24 weeks | 2b/3 | Recruiting | 660 | NCT03732807 | PF-06651600 for the Treatment of Alopecia Areata |
| | 200 mg→50 mg qd | 24 months | 3 | Recruiting | 860 | NCT04006457 | Long-Term PF-06651600 for the Treatment of Alopecia Areata |
| Jaktinib hydrochloride | 150 mg qd/200 mg qd | six months | 2 | Recruiting | 104 | NCT04034134 | Jaktinib Dihydrochloride Monohydrate in Severe Alopecia Areata |

*Time frame is described based on the observation time for primary outcome in each study, †The number of participants is estimated value in the recruiting studies. JAK: Janus kinase

information to patients with alopecia areata. In the future, better designed, randomized, placebo-controlled clinical trials and with long-term follow-up are required to confirm these results. A number of clinical trials are completed or ongoing [Table 4] and the results are anticipated to be published presently.

## Conclusion

Our systematic review and meta-analysis of current evidence suggests that oral ruxolitinib and tofacitinib elicit positive responses and are tolerable for the treatment of alopecia areata. Patients with longer treatment duration significantly showed a higher frequency of laboratory abnormalities and recurrence was frequent within three months after discontinuation of treatment. Thus, clinicians should closely monitor for adverse events especially during long-term treatment and inform patients of frequent relapse.

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### Conflicts of interest

There are no conflicts of interest.

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