Original Article

Clinical Outcomes and Safety of Secukinumab in Thai Patients with Plaque Psoriasis: A 16-Week, Multicenter, Retrospective, Real-World Study

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Background: Secukinumab, an interleukin 17A-inhibitor approved for the treatment of moderate-to-severe plaque psoriasis, has been well-studied in phase II and III trials and shown to have a sustained high-level of clinical efficacy with good safety profile and positive impact on patients' quality of life. Nevertheless, current knowledge regarding efficacy and safety of secukinumab in a real-world setting in Thai population is still limited.

Objective: To evaluate real-world clinical outcomes and safety profile of secukinumab in Thai patients with moderate to severe plaque psoriasis.

Materials and Methods: A multicenter retrospective medical chart review was performed in moderate to severe plaque psoriasis patients aged 18 years or older treated with secukinumab therapy using subcutaneous injections with dosage of 300 mg at weeks 0, 1, 2, 3, and 4, and every four weeks thereafter, for at least 16 weeks between September 2017 and September 2020 at four dermatologic centers in Thailand. Clinical response, psoriasis area and severity index (PASI), and percentage of body-surface area (BSA) involved were recorded at baseline and at the fourth and sixteenth weeks after the first injection. Adverse events were also documented.

Results: Eighteen patients were included in the present study. Their median (interquartile range) baseline PASI score was 21.0 (15.0). Most previously received treatment with oral systemic drugs and phototherapy. Overall, their PASI and BSA scores were significantly improved from baseline to weeks 4 and 16 (both $p<0.001$). PASI 75, PASI 90, and PASI 100 were achieved in 81.3%, 56.3%, and 31.3% of patients, respectively at week 4, and 100%, 100%, and 72.2% at week 16, respectively. No adverse event was reported.

Conclusion: The present real-world study suggested good clinical outcomes, safety, and rapidity of action of secukinumab in Thai patients with moderate to severe plaque psoriasis.

Keywords: Secukinumab; Psoriasis; Clinical outcomes; Safety; Real-world

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Psoriasis is a chronic immune-mediated inflammatory disease that affects approximately 125 million people worldwide with an increasing trend in the number of cases[1]. There are wide ranges of clinical manifestations of psoriasis including cutaneous and extracutaneous findings. The cutaneous manifestations of psoriasis can be classified into four main forms, plaque-type, guttate, pustular psoriasis, and erythrodermic psoriasis. Among various types of psoriasis, plaque-type is the most common form and is characterized by symmetrically-distributed, well-demarcated erythematous plaques with silvery scale on the body and scalp[2,3]. Apart from the burden patients suffer from cutaneous manifestations, long-standing psoriasis is associated with an increased risk of comorbidities such as arthritis, depression, inflammatory bowel disease, and cardiovascular diseases[3]. Accordingly, psoriasis is considered a systemic inflammatory disease[3-6].

The pathogenesis of psoriasis involves multiple

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factors including genetic susceptibility, environmental factors, and immunologic disarrangement[4]. It is now clear that interleukin (IL)-17A, produced mainly by T helper type 17 cells (Th17), plays a critical role in the pathogenesis of psoriasis and several immune-mediated diseases[7-9]. It stimulates an accelerated keratinocyte proliferation and differentiation and acts as a master cytokine in promoting the release of chemokines, antimicrobial peptides and other proinflammatory cytokines that further recruit additional inflammatory cells such as neutrophils, Th17 cells, dendritic cells, and innate lymphoid cells[8,10-12].

Secukinumab, a fully human recombinant monoclonal antibody that selectively binds and neutralizes IL-17A, is approved for the treatment of plaque psoriasis and psoriatic arthritis[13]. The substantial data from previous well-known clinical trials, ERASURE and FIXTURE, have shown a superior efficacy of secukinumab over etanercept and placebo in patients with moderate to severe plaque psoriasis with sustained high response rates in most patients[8,9,13]. In Thailand, the prevalence of psoriasis is approximately 2%, based on expert opinion. Among these, moderate to severe psoriasis accounts for 20%. Secukinumab has been approved for the treatment of moderate to severe plaque psoriasis since 2017 by the local health authority. Despite a remarkable efficacy and favorable safety profile from phase II and III clinical trials, current knowledge about the efficacy and safety of secukinumab in real-world clinical practice in Thai population is still limited. The present study, therefore, aimed to explore real-life clinical outcomes and tolerability following a 16-week period of secukinumab for moderate to severe plaque psoriasis in Thai population.

Materials and Methods

Study design and population

The present study was a multicenter, observational, retrospective study conducted in moderate to severe plaque psoriasis patients that received secukinumab for at least 16 weeks between September 2017 and September 2020 at four dermatologic university centers in Thailand. Data were retrospectively reviewed from the hospital medical records at each study site and recorded without patient identification. Inclusion criteria were patients aged 18 years or older diagnosed with moderate to severe plaque psoriasis and treated with secukinumab according to the local approved posology, which is subcutaneous injections of secukinumab 300 mg at weeks 0, 1, 2, 3 and 4, and every four weeks thereafter. Patients included were obliged to have available baseline Psoriasis Area and Severity Index (PASI) score of more than 10 within seven days prior to the index date of first secukinumab injection and available PASI score at week 16 after the injection. Patients who received disease modifying anti-rheumatic drugs (DMARDs) or biologics for psoriatic arthritis concomitantly with secukinumab during 16-week period of the study were excluded.

The present study was conducted in accordance with the Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects. The study protocol was initially approved by the Central Research Ethics Committee (CREC; COA-CREC092/2020), and subsequently approved by the local Institutional Review Board of each participating institute [Chulalongkorn University (IRB No. 712/63), Ramathibodi Hospital (COA-CREC092/2020), Institute of Dermatology (IRB No. 002/2564), and Srinagarind Hospital (IRB No. HE631534)]. A waiver of informed consent was also approved.

Data collection and outcomes

Patients' demographic data including age, gender, weight, height, and body mass index (BMI) and baseline clinical characteristics regarding comorbidities such as Crohn's disease, diabetes mellitus, dyslipidemia, hypertension, inflammatory bowel disease, latent tuberculosis, and psoriatic arthritis, treatment history, and concomitant therapies were retrieved from the hospital medical records at each study site. PASI score and percentage of body-surface area (BSA) involved were recorded at baseline as pre-treatment, then at 4 and 16 weeks after the first secukinumab injection. Adverse events were also collected throughout the treatment period.

The primary endpoint of the present study was the proportion of patients achieving 90% or greater improvement in PASI score (PASI 90) at week 16 after initiation of secukinumab therapy. Secondary endpoints included the proportion of patients achieving 75%, 90%, and 100% improvement in PASI score (PASI 75, PASI 90, PASI 100) at week 4 after treatment and proportion of patients achieving PASI 75 and PASI 100 at week 16.

Statistical analysis

Descriptive statistics were performed on each variable. Categorical variables, including gender, co-morbidities, treatment history, concomitant therapy, adverse effects, and number of patients achieving PASI 75, PASI 90, and PASI 100, were presented as

Table 1. Demographics and baseline clinical characteristics of the study population

Characteristics	Total (n=18)
Sex; n (%)	
Male	9 (50.0)
Female	9 (50.0)
Age (year); median (IQR)	46.5 (19.0)
Weight (kg); median (IQR)	73.4 (25.0)
Height (cm); median (IQR)	165.0 (9.0)
BMI (kg/m^2); median (IQR)	27.97 (6.83)
PASI score	21.0 (15.0)
% BSA involved	45.0 (55.0)
Comorbidities (within the past 3 months); n (%)	
Hypertension	7 (38.9)
Dyslipidemia	5 (27.8)
Obesity	3 (16.7)
Diabetes Mellitus	2 (11.1)
Fatty liver	2 (11.1)
Hepatitis B	3 (16.7)
Hepatitis C	1 (5.6)
Psoriatic arthritis	1 (5.6)
Asthma	1 (5.6)
Chronic kidney disease	1 (5.6)
Hypothyroidism	1 (5.6)
Osteoarthritis	1 (5.6)
Pituitary adenoma	1 (5.6)
Renal stone	1 (5.6)
Vitiligo	1 (5.6)
Previous treatment (3 months prior to index date)	
Topical therapy; n (%)	
• Topical corticosteroid	13 (72.2)
Topical therapy (continued)	
• Coal tar	4 (22.2)
• Salicylic acid	2 (11.1)
• Vitamin D analogs	2 (11.1)
• Others	
10% urea cream	1 (5.6)
Cream base	1 (5.6)
Liquid paraffin	1 (5.6)
Olive oil	1 (5.6)
• 1 Topical therapy	5 (27.8)
• >1 Topical therapy	9 (50.0)
Phototherapy; n (%)	5 (27.8)
Systemic oral therapy; n (%)	
• Methotrexate	4 (22.2)
• Ciclosporin	2 (11.1)
• Acitretin	1 (5.6)
• Prednisolone	1 (5.6)
• 1 Systemic therapy	4 (22.2)
• >1 Systemic therapy	1 (5.6)
Biologic agents; n (%)	
• Ixekizumab	1 (5.6)
• Secukinumab	1 (5.6)
Combination therapy; n (%)	
• Phototherapy + Topical therapy	5 (27.8)
• Systemic therapy + Topical therapy	4 (22.2)
• Phototherapy + Systemic therapy	3 (16.7)
• Phototherapy + Systemic therapy +Topical therapy	3 (16.7)
• Biologic therapy + Topical therapy	1 (5.6)

BMI=body mass index; BSA=body surface area; IQR=interquartile range; PASI=Psoriasis Area and Severity Index

frequencies and proportion. For continuous variables, including age, BMI, PASI score and BSA involved, data were described as median (interquartile range, IQR). The significance of differences in mean values of PASI score and BSA involved at different time points was analyzed by Friedman test. A p-values of less than 0.05 was considered to be statistically significant. To assess the clinical outcomes of secukinumab, PASI scores at weeks 4 and 16 were compared to baseline PASI as the percentage of PASI improvement and the proportion of patients achieving PASI 75, PASI 90, and PASI 100 at weeks 4 and 16 were calculated and described in percentage with the 95% confidence interval (CI). All analyses were carried out with SAS version 9.4 (SAS Institute Inc.).

Results

Eighteen patients were included in the analysis. Their demographics and baseline clinical characteristics are shown in Table 1. They aged from 26 to 63 years. Their ranges of PASI score and % BSA involved at baseline were 10 to 60 and 10 to 95, respectively.

The most frequent comorbidities were hypertension, dyslipidemia, obesity, and hepatitis B. One patient had concomitant psoriatic arthritis, and none had any concomitant psychiatric disorder.

Regarding treatment in 3-month period prior to the study, only two patients had received previous biologics treatment. The one who previously received ixekizumab received only a single dose of 80 mg one month before the present study enrollment. The other patient was previously treated with irregular dosing and intervals of secukinumab and still had PASI score of more than 10 at the present study enrollment. The last dose of secukinumab in this patient was three months before entering the present study. Moreover, 16 (89%) patients received combination treatment.

According to the treatment history provided, trends regarding the initiation of each psoriasis treatment in the present study population were revealed. Among topical therapies, topical corticosteroid was most prescribed as the first treatment, followed by salicylic acid, vitamin D analogs, and coal tar. Methotrexate and acitretin were first two choices of systemic oral therapy among the enrolled patients. Most of the present study patients (16 of 18) were naïve to biologics.

Clinical outcomes

In the present retrospective study, 18 patients had available PASI scores at baseline and at 16 weeks, which were the key assessment time points of the present study. At week 4, only 16 of 18 patients had available PASI scores.

PASI scores and BSA involved measurements decreased markedly at weeks 4 and 16 after secukinumab therapy, compared to baseline ($p<0.001$). In accordance with PASI score, there was also a statistically significant reduction of the involved BSA at weeks 4 and 16, compared to baseline ($p<0.001$) (Table 2).

To further emphasize the clinical outcomes of secukinumab, proportions of patients achieving PASI 75, PASI 90, and PASI 100 through different time points were analyzed (Table 3). Most patients (over 80%) achieved PASI 75 or higher at week 4 of secukinumab therapy.

The response rate continued to rise over time, and over 72% of patients achieved PASI 100, considering as a clearance of disease, at week 16.

Clinical improvement at specific areas including head, trunk, upper extremities, and lower extremities were also recorded (Table 4). Through the 16-week study period of secukinumab therapy, both the number of sites and area of cutaneous involvement decreased over time at all sites. In addition, scalp psoriasis was the most reported manifestation, followed by nail psoriasis. Though these locations were considered as hard-to-treat areas of psoriasis, secukinumab strongly showed a favorable effect as the number of patients with affected nails, scalp, and palm and soles continuously decreased from week 0 to week 4 and week 16.

Safety

Neither adverse event of special interest nor serious adverse event was reported throughout the 16-week study period.

Table 2. Summary of PASI Score and BSA involved

	Week 0	Week 4	Week 16	p-value
PASI score				<0.001*
n	18	16	18	
Median (IQR)	21.0 (15.0)	2.0 (3.5)	0.0 (1.0)	
% Score reduction; median (IQR)		91.95 (20.87)	100.00 (2.70)	
% BSA involved				<0.001*
n	15	13	16	
Median (IQR)	45.0 (55.0)	5.0 (9.0)	0.0 (1.0)	
% Score reduction; median (IQR)		88.89 (20.12)	100.00 (8.00)¶	

BSA=body surface area; IQR=interquartile range; PASI=Psoriasis Area Severity Index

* p-value based on Friedman test, p≤0.05 is considered statistically significant

¶ Calculated from n=15 (one patient had no recorded BSA at week 0)

Table 3. Proportion of patients achieving in PASI 75, PASI 90, PASI 100 at week 4 and week 16 after secukinumab therapy initiation

PASI improvement	Week 4 (n=16)		Week 16 (n=18)	
	n (%)	95% CI	n (%)	95% CI
PASI 75	13 (81.3)	62.1 to 100.0	18 (100)	100.0 to 100.0
PASI 90	9 (56.3)	31.9 to 80.6	18 (100)	100.0 to 100.0
PASI 100	5 (31.3)	8.5 to 54.0	13 (72.2)	51.5 to 92.9

CI=confidence interval; PASI=Psoriasis Area Severity Index

Table 4. Clinical cutaneous manifestations of psoriasis and area of cutaneous involvement at week 0, 4, and 16 after secukinumab therapy

Disease Characteristics	Week 0 (n=18)	Week 4 (n=16)	Week 16 (n=18)
% Area involvement; n (%)			
Head	10 (55.6)	3 (18.8)	1 (5.6)
• Median (IQR)	17.5 (15.0)	3.0 (4.0)	2.0 (0.0)
Trunk	10 (55.6)	4 (25.0)	2 (11.1)
• Median (IQR)	40.0 (20.0)	7.5 (20.0)	4.0 (2.0)
Upper extremities	10 (55.6)	2 (12.5)	0 (0.0)
• Median (IQR)	22.5 (20.0)	12.5 (15.0)	-
Lower extremities	10 (55.6)	4 (25.0)	4 (22.2)
• Median (IQR)	32.5 (20.0)	5.0 (14.0)	6.5 (6.0)
More than one area	10 (55.6)	5 (31.3)	1 (5. 6)
Manifestation; n (%)			
Nail psoriasis	13 (72.2)	8 (50.0)	1 (5.6)
Scalp psoriasis	17 (94.4)	8 (50.0)	3 (16.7)
Palmoplantar psoriasis	1 (5.6)	1 (6.3)	0 (0.0)
More than one manifestation	12 (66.7)	5 (31.3)	0 (0.0)

IQR=interquartile range

Discussion

A better understanding of the pathogenesis of psoriasis and advancement in targeted medicine have revolutionized the treatment of moderate-to-severe psoriasis[14]. Biologic agents targeted specific cytokines involved in psoriasis lead to significant improvement and change in the treatment paradigm[15]. Secukinumab, a fully human monoclonal antibody that targets explicitly IL-17A, is one of the biologic agents that offer a promising outcome in the management of psoriasis. Its efficacy and safety profile have been well demonstrated in clinical trials, showing a rapid onset of action with long-lasting control of disease and well tolerated safety profile[14]. Secukinumab has been approved in treatment of moderate-to-severe psoriasis by the European Medicines Agency (EMA) and the U.S. Food and Drug Administration (FDA) in 2015[16]. In several phase III clinical trials, the clinical efficacy of secukinumab was superior to other biologic agents such as etanercept and ustekinumab[7,17,18].

Despite substantial evidence from large clinical trials, the clinical outcome might differ in a real-world setting of distinct patient characteristics. There have been real-world studies assessing the efficacy and safety of secukinumab among psoriasis patients with diverse characteristics[19]. In 2019, Augustin et al conducted a meta-analysis of 43 real-world evidence studies of secukinumab in psoriasis treatment. The overall percentage of patients achieving PASI 75, PASI 90, and PASI 100 were 72%, 50%, and 36% at three months, 79%, 53%, and 46% at six months, and 80%, 60%, and 51% at 12 months, respectively[20]. In both short-term and long-term real-world studies, secukinumab is generally reported to be well-tolerated with a rapid and high efficacy[14,19,21-23]. Secukinumab has been approved by the Thai FDA in 2017. However, current knowledge about secukinumab in a real-life setting among the Thai population is still limited.

The response rate of biologics was evaluated at week 12 and rarely week 16 in the previous phase III clinical trials[7,24,25]. According to ERASURE, FIXTURE, and other clinical studies, secukinumab achieved maximum effects at week 12 and stabilized thereafter[7,25]. Only the CLEAR phase III clinical trial demonstrated cumulative efficacy of secukinumab at week 16[18]. In the present study, the authors evaluated the clinical outcomes of secukinumab over 16 weeks. Moreover, the authors also evaluated a timepoint of week 4 to explore the rapid onset of psoriasis clearance after secukinumab initiation[26].

In the present study, secukinumab demonstrated a rapid onset and high clinical response with the proportion of patients achieving PASI 75, PASI 90, and PASI 100 was 81.3%, 56.3%, and 31.3% at week 4, and 100.0%, 100.0%, and 72.2% at week 16, respectively. The response rate was higher than the CLEAR phase III clinical trial, where 50%, 21%, and 4.2% of patients achieved PASI 75, PASI 90, and PASI 100 at week 4, and 93.1%, 79%, and 44.3% of patients achieved PASI 75, PASI 90, and PASI 100 at week 16[18,24]. The heterogeneity of patient demographics may affect the clinical outcomes in different clinical studies. First, psoriasis patients with high body weight may have a lower response rate than patients with low body weight[27]. Patients in the CLEAR study had a higher body weight than the present study. Their median weight and BMI (IQR) were 87.4 (19.95) kg and 29.1 (5.87) kg/m² in the CLEAR study and 73.4 (25.0) kg and 27.97 (6.83) kg/m² in the present study. Second, biologic-naïve patients are shown to have a superior clinical response than those with previous exposures[7]. Most patients in the present study were biologic-naïve, whereas 10.7% of patients in CLEAR study failed previous biologic agents[18].

Besides the above-mentioned desirable results, secukinumab also has advantages in treating psoriasis located in difficult-to-treat areas, including the scalp, palms and soles, and nails[28,29]. The present study demonstrated a considerable reduction in the proportion of patients with nail, scalp, and palmoplantar psoriasis at week 4 and week 16, compared to the baseline, which highlight remarkable advantage of secukinumab in these areas of psoriasis. Nevertheless, there was missing data at weeks 4 and 16 in difficult-to-treat areas, which may be considered as a limitation of a retrospective study.

There were limitations in the present study such as the retrospective observational design, without a controlled group, and its small sample size that limited generalizability of the present study results. The absence of a washout period and concomitant use of psoriasis therapies, especially systemic therapies, might affect baseline PASI and consequently affect the final therapeutic outcome. In addition, since the authors included only patients who received labelled regimens of secukinumab for 16 weeks, no reported data regarding secukinumab treatment discontinuation was available. Although the present study had potential biases and may not serve as robust evidence to prove effectiveness of secukinumab, it was the first study to provide real world data of clinical outcomes and safety of secukinumab among psoriasis patients in Thailand. Further studies should be conducted on a longitudinal basis, with comparison groups and a

larger sample size, to determine if the present study results could be confirmed.

Conclusion

In conclusion, secukinumab appears to be an effective treatment option with a rapid-onset high clinical responses and favorable safety profile among the study patients with moderate to severe plaque psoriasis. PASI scores and BSA involved measurement significantly decreased at week 4 and week 16, compared to baseline. Most patients (over 80%) achieved PASI 75 or higher at week 4 and over 72% of patients achieve PASI 100 at week 16. No adverse event was reported throughout the 16-week study period.

What is already known on this topic?

Secukinumab, a fully human monoclonal antibody that selectively neutralizes IL-17A, has shown excellent safety and efficacy in the treatment of moderate-to-severe psoriasis in clinical studies.

What this study adds?

This is the first study demonstrating clinical outcomes and safety profile of secukinumab in Thai moderate-severe psoriasis patients in real life settings.

The results from this study will complement the results from RCTs and can be used to compare with real world findings from others country.

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Conflicts of interest

Dr. Bensachee Pattamadilok, Dr. Pravit Asawanonda, Dr. Charoen Choonhakarn, Dr. Chanidapa Wongtada, Dr. Ploysyne Rattanakaemakorn, and Dr. Natta Rajatanavin have received honoraria or fees for serving on advisory boards and as a speaker from Novartis, Eli Lilly, Janssen, Pfizer, and grants as an investigator from Novartis.

References

1. Griffiths CEM, van der Walt JM, Ashcroft DM, Flohr C, Naldi L, Nijsten T, et al. The global state of psoriasis disease epidemiology: a workshop report. Br J Dermatol 2017;177:e4-7.
2. Di Meglio P, Villanova F, Nestle FO. Psoriasis. Cold Spring Harb Perspect Med 2014;4:a015354.
3. Rendon A, Schäkel K. Psoriasis pathogenesis and treatment. Int J Mol Sci 2019;20:e4-7.
4. Bai F, Li GG, Liu Q, Niu X, Li R, Ma H. Short-term efficacy and safety of IL-17, IL-12/23, and IL-23 inhibitors brodalumab, secukinumab, ixekizumab, ustekinumab, guselkumab, tildrakizumab, and risankizumab for the treatment of moderate to severe plaque psoriasis: A systematic review and network meta-analysis of randomized controlled trials. J Immunol Res 2019;2019:2546161.
5. Griffiths CE, Barker JN. Pathogenesis and clinical features of psoriasis. Lancet 2007;370:263-71.
6. de Korte J, Sprangers MA, Mombers FM, Bos JD. Quality of life in patients with psoriasis: a systematic literature review. J Investig Dermatol Symp Proc 2004;9:140-7.
7. Langley RG, Elewski BE, Lebwohl M, Reich K, Griffiths CE, Papp K, et al. Secukinumab in plaque psoriasis--results of two phase 3 trials. N Engl J Med 2014;371:326-38.
8. Karle A, Spindeldreher S, Kolbinger F. Secukinumab, a novel anti-IL-17A antibody, shows low immunogenicity potential in human in vitro assays comparable to other marketed biotherapeutics with low clinical immunogenicity. MAbs 2016;8:536-50.
9. Martin DA, Towne JE, Kricorian G, Klekotka P, Gudjonsson JE, Krueger JG, et al. The emerging role of IL-17 in the pathogenesis of psoriasis: preclinical and clinical findings. J Invest Dermatol 2013;133:17-26.
10. Harper EG, Guo C, Rizzo H, Lillis JV, Kurtz SE, Skorcheva I, et al. Th17 cytokines stimulate CCL20 expression in keratinocytes in vitro and in vivo: implications for psoriasis pathogenesis. J Invest Dermatol 2009;129:2175-83.
11. Brembilla NC, Senra L, Boehncke WH. The IL-17 family of cytokines in psoriasis: IL-17A and beyond. Front Immunol 2018;9:1682.
12. Krueger JG, Wharton KA Jr, Schlitt T, Suprun M, Torene RI, Jiang X, et al. IL-17A inhibition by secukinumab induces early clinical, histopathologic, and molecular resolution of psoriasis. J Allergy Clin Immunol 2019;144:750-63.
13. Armstrong AW, Papp K, Kircik L. Secukinumab: Review of clinical evidence from the pivotal studies ERASURE, FIXTURE, and CLEAR. J Clin Aesthet Dermatol 2016;9(6 Suppl 1):S7-12.
14. Megna M, Di Costanzo L, Argenziano G, Balato A, Colasanti P, Cusano F, et al. Effectiveness and safety

of secukinumab in Italian patients with psoriasis: an 84 week, multicenter, retrospective real-world study. Expert Opin Biol Ther 2019;19:855-61.
15. Raimondo A, Balato A, Megna M, Balato N. Limitations of current monoclonal antibodies for plaque-type psoriasis and an outlook for the future. Expert Opin Biol Ther 2018;18:605-7.
16. Sanford M, McKeage K. Secukinumab: first global approval. Drugs 2015;75:329-38.
17. Frieder J, Kivelevitch D, Menter A. Secukinumab: a review of the anti-IL-17A biologic for the treatment of psoriasis. Ther Adv Chronic Dis 2018;9:5-21.
18. Thaçi D, Blauvelt A, Reich K, Tsai TF, Vanaclocha F, Kingo K, et al. Secukinumab is superior to ustekinumab in clearing skin of subjects with moderate to severe plaque psoriasis: CLEAR, a randomized controlled trial. J Am Acad Dermatol 2015;73:400-9.
19. Galluzzo M, D'Adamio S, Silvaggio D, Lombardo P, Bianchi L, Talamonti M. In which patients the best efficacy of secukinumab? Update of a real-life analysis after 136 weeks of treatment with secukinumab in moderate-to-severe plaque psoriasis. Expert Opin Biol Ther 2020;20:173-82.
20. Augustin M, Jullien D, Martin A, Peralta C. Real-world evidence of secukinumab in psoriasis treatment - a meta-analysis of 43 studies. J Eur Acad Dermatol Venereol 2020;34:1174-85.
21. Chiricozzi A, Balato A, Conrad C, Conti A, Dapavo P, Ferreira P, et al. Secukinumab demonstrates improvements in absolute and relative psoriasis area severity indices in moderate-to-severe plaque psoriasis: results from a European, multicentric, retrospective, real-world study. J Dermatolog Treat 2020;31:476-83.
22. Galluzzo M, Talamonti M, De Simone C, D'Adamio S, Moretta G, Tambone S, et al. Secukinumab in moderate-to-severe plaque psoriasis: a multi-center, retrospective, real-life study up to 52 weeks observation. Expert Opin Biol Ther 2018;18:727-35.
23. Notario J, Deza G, Vilarrasa E, Valentí F, Muñoz C, Mollet J, et al. Treatment of patients with plaque psoriasis with secukinumab in a real-life setting: a 52-week, multicenter, retrospective study in Spain. J Dermatolog Treat 2019;30:424-9.
24. Warren RB, Gooderham M, Burge R, Zhu B, Amato D, Liu KH, et al. Comparison of cumulative clinical benefits of biologics for the treatment of psoriasis over 16 weeks: Results from a network meta-analysis. J Am Acad Dermatol 2020;82:1138-49.
25. Roman M, Madkan VK, Chiu MW. Profile of secukinumab in the treatment of psoriasis: current perspectives. Ther Clin Risk Manag 2015;11:1767-77.
26. Papp KA, Lebwohl MG. Onset of action of biologics in patients with moderate-to-severe psoriasis. J Drugs Dermatol 2017;17:247-50.
27. Tiberio R, Graziola F, Miglino B, Veronese F, Annali G, Savoia P. Secukinumab for psoriasis in obese patients: Minireview and clinical experience. Case Rep Dermatol 2019;11:29-36.
28. Armstrong AW, Vender R, Kircik L. Secukinumab in the Treatment of Palmoplantar, Nail, Scalp, and Pustular Psoriasis. J Clin Aesthet Dermatol 2016;9(6 Suppl 1):S12-6.
29. Yang EJ, Beck KM, Liao W. Secukinumab in the treatment of psoriasis: patient selection and perspectives. Psoriasis (Auckl) 2018;8:75-82.