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Chronic plaque psoriasis is an inflammatory skin disease characterized by red thick, raised, silvery scaly patches. It is the most common type of psoriasis, often appearing on the knees, postauricular area, elbows, scalp, and lower back. Chronic plaque psoriasis was the most prevalent (73.7%) among children with psoriasis and was found to increase with age in a study at Olmsted County, Minnesota (Tollefson et al., 2010). Chronic plaque psoriasis is a life-changing condition that significantly impacts the overall health and well-being (emotional, physical, social, and psychological) as well as quality of life in pediatric patients. As a result of data paucity from clinical studies and limited treatment approval for pediatric population, treatment of chronic plaque psoriasis in pediatric patients is challenging. Managing chronic plaque psoriasis in children can be complicated, especially when use of systematic drugs is ineffective and non-approval of most of the biologics for use in pediatric patients.

Where conventional treatments such as phototherapy, oral systemic treatments and steroid injection are ineffective for chronic pediatric psoriasis treatment, biologics can be used as a treatment option. Effective and safe treatments are crucial in pediatric population for treatment of chronic plaque psoriasis. Biologics are safe for treatment of common chronic inflammatory diseases including psoriasis in children and adolescents (Niehues & Özgür, 2019). The use of biologics has recently been expanded to pediatric patients in the treatment of plaque psoriasis in USA, Canada, and Europe.

Biologics are considered to be a more targeted, safe, and effective treatment options for chronic plaque psoriasis in pediatric patients to improve symptoms and reduce the escalation of other related health co-morbidities. Since chronic plaque psoriasis is a lifelong condition,

effective treatments aim to reduce the frequency of recurrence, severity, and duration of occurrence. The efficacy of biologics for treating chronic plaque psoriasis in pediatric patients was assessed using information and data from studies, clinical trials, and medical articles. The conclusions from this literature review can contribute to recommendations for better outcomes for pediatric patients with chronic plaque psoriasis.

Background and Significance

Chronic plaque psoriasis is a skin condition which can be distressing and defy some of the available treatment options. Although the cause of psoriasis is unclear, treatment with topical ointments, phototherapy, steroid injections, and oral systemic treatment sometimes may not provide adequate relief or improve symptoms which can be devastating and frustrating especially with pediatric patients. The frequent use of biologics for treatment of psoriasis has shown positive outcomes with regards to safety and efficacy. The introduction of biologic therapies over the last decade targeting specific main immune pathways in management of moderate-to-severe disease in patients has revolutionized with newer drugs for psoriasis treatment and have demonstrated favorable safety and high efficacy with no evidence of increased specific organ toxicity (Mansouri & Goldenberg, 2015). There has been an increasing use of biologics for psoriasis treatment with improved results in adult population. However, there is limited medical literature and clinical studies on the use of biologics for treatment of pediatric plaque-type psoriasis.

The increased use of biologics for the treatment of psoriasis in pediatrics and adults has gained approval from regulatory authorities in some countries. There are a few biologics that have been approved for use in pediatric patients with plaque psoriasis: Etanercept and Ustekinumab received Food and Drug Administration (FDA) approval and Adalimumab

received European Medicines Agency (EMA) approval in treatment of moderate-to-severe pediatric psoriasis and are first-line systemic therapies (Cline et al., 2019). The Food and Drug Administration recently approved Ixekizumab for moderate-to-severe paediatric psoriasis (Paller et al., 2020b).

Due to the severity of pediatric plaque-type psoriasis and its devastating effects, effective treatment is crucial. Chronic plaque-type psoriasis in pediatrics if not managed adequately could lead to mental health crisis, stigmatization, social anxieties, emotional stress, low self esteem, and even suicidal thoughts. In selecting the appropriate biologic therapy for treatment of psoriasis in pediatric population, these key factors should be considered: Safety profile, dosing schedule and regulatory approval for pediatric population (Cline et al., 2019). Hence, the importance of the need for assessment in the determination of effective, more targeted, and safe treatment options with the use of biologics to improve chronic plaque-type psoriasis symptoms. With the emergence of biologics, studies have shown it is a viable treatment option for pediatric psoriasis. In this paper, the use of biologics for psoriasis treatment is focused on the pediatric population with chronic plaque psoriasis hence the question "What is the Efficacy of Biologics for Chronic Plaque-type Psoriasis Among Pediatric Patients?"

Methods

The databases and number of articles returned in each search that was used for this review include PubMed (117), ProQuest (215), Academic Search Complete (12), CINAHL Complete (32) and additional source: Clinical Trials.gov (108). Articles covering the use of biologics for treatment of psoriasis in pediatric population were screened and references listed of the selected articles were scrutinized to identify other relevant articles that had not been found in the initial search. The selected studies were conducted in the United States, Canada, and Europe.

The research methods in the studies include clinical trails and quantitative research. A total of 484 articles were screened and finally 11 studies were selected for the meta-analysis. The PRISMA diagram is shown in Figure 1.

Search Strategy

In this literature review, a combination of the following search words were used: 'Biologics', 'efficacy', 'chronic', 'psoriasis', 'pediatric patients', "pediatrics", 'plaque type', 'plaque', "psoriasis AND biologics AND chronic plaque AND pediatrics", "biologics AND chronic psoriasis AND pediatrics", "biologics efficacy pediatrics AND Psoriasis", "psoriasis AND biologics AND chronic plaque", "psoriasis AND biologics AND chronic plaque AND pediatrics patients", "psoriasis AND biologics AND chronic plaque", "biologics efficacy AND chronic psoriasis AND pediatrics", "chronic plaque psoriasis AND pediatrics", and "pediatrics AND chronic plaque type psoriasis".

Inclusion Criteria

Data from clinical studies including the following were recorded: Pediatric patients diagnosed with moderate-to-severe plaque psoriasis, psoriasis area-and-severity index (PASI) score of at least ≥10 (combination of the severity: redness, scaling, and thickness and the percentage of affected areas), Physician's Global Assessment (PGA) of at least 3 (where 0 indicates clear with no symptoms of psoriasis and 5 severe symptoms of psoriasis), Body Surface Area (BSA) of at least ≥10% (total body area affected by psoriasis), patients ages 0 < 18, duration of diseases ≥ 6 months, and record experience of inadequate result from use of previous or current treatment with systemic therapy or phototherapy or topical therapy. Only the medical articles and clinical research studies using FDA and EMA approved biologics (Adalimumab, Etanercept, Ustekinumab, and Ixekizumab) for treatment of pediatric plaque psoriasis were

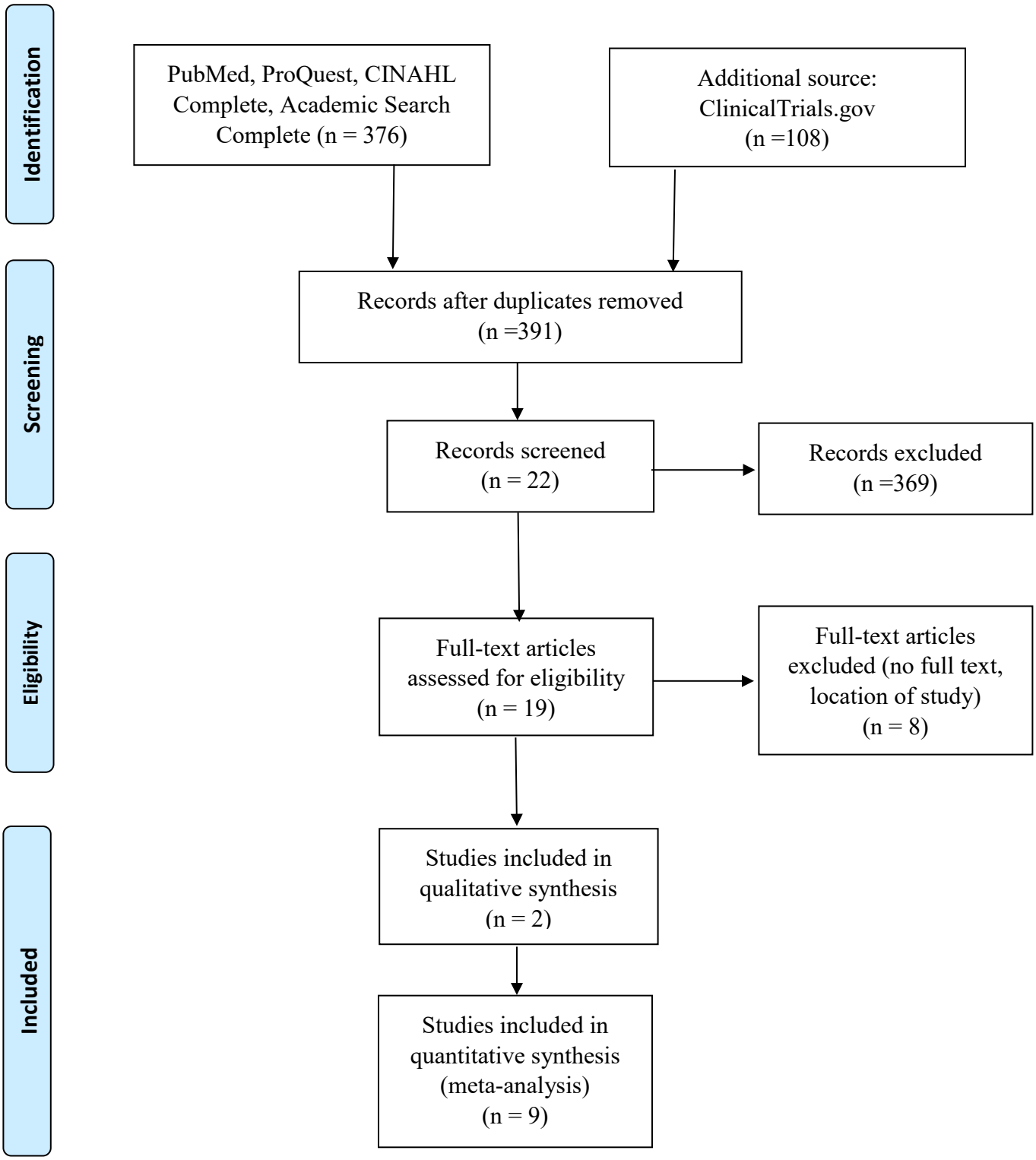
included. Peer-reviewed articles, clinical trial studies, and selected articles of relevant literature published from 2010 to June 2020 obtained from various search databases were screened and selected articles were included in this study.

Exclusion Criteria

The use of biologics in other types of psoriasis (pustular, inverse, guttate, or erythrodermic, psoriasis arthritis), Crohn's disease, cancer, and other diseases were excluded. Articles with specific information about biologics (e.g. its mechanism of action, pharmacokinetics, and adverse effects) were also excluded. Also, studies carried out in counties other than the United States, Canada, and Europe were excluded. Similarly, medical literature, clinical trials, reviews, and meta-analysis on the use of biologics in adult psoriasis and those with unapproved biologics for treatment of pediatric psoriasis were excluded.

Figure 1

PRISMA diagram



Results

This literature review examined the efficacy of biologics in treatment of chronic plaque psoriasis among pediatric patients. The results of these studies on the use of biologics in treating pediatric patients were evaluated based on clinical responses using the Physician's Global Assessment (PGA), Psoriasis Area-and-Severity Index (PASI), and Children's Dermatology Life Quality Index (CDLQI).

Physician's Global Assessment (PGA)

The studies reviewed in these articles included the PGA results upon assessment of the efficacy of biologics in pediatric patients with plaque psoriasis. The Physician's Global Assessment (PGA) is a reliable and valid instrument in evaluation of diseases severity of psoriasis in clinical studies (Duffin et al., 2019). A PGA score of 0 or 1 (where 0 is clear and 1 is almost clear) is required upon assessment by the physician after patients use of biologics for efficacy assessment. Results of a 12-week study with Ustekinumab treatment in patients age 12 to 17 showed significant proportion of patients achieved PGA 0/1 in standard dose (69.4%) and half-standard dose (67.6%) groups versus the placebo (5.4%; P \ .001) for both dose groups (Landells et. al., 2015). Also, a study conducted with treatment using Etanercept, 53% of study participants with pediatric psoriasis got a PGA result of clear or almost clear compared to 13% of participants in placebo group (Sanclemente et al., 2015). However, in a double-blind, multiperiod, randomised phase 3 trial study by Papp et al. (2017), the results showed treatment with Adalimumab (0·8 mg/kg) in children and adolescents with severe plaque psoriasis for 16 weeks revealed "a non-significant increase in the proportion of patients who achieved clear or minimal PGA compared with methotrexate" (p.48).

In an open-label, long-term extension study of Etanercept in children and adolescent with plaque psoriasis efficacy was confirmed and maintained with PGA status of clear/almost clear in approximately 40%–50% of patients enrolled (Paller et al., 2016). The results of a study carried out six years earlier reported 47% of patients achieved PGA score of clear or almost clear through week 96 with Etanercept treatment (Paller et al., 2010a). According to Paller et. al (2020b) in their study, results of treatment with Ixekizumab showed 81% of patients achieved PGA (0,1) and 57% of patients achieved PGA (0).

In a clinical study, improvement of a PGA score of 0/1 was achieved by all the efficacy groups following commencement of the long-term extension (52 weeks) treatment with Adalimumab with higher results compared to the initial 16-week of treatment in the study (Thaçi et al., 2019). Efficacy was achieved in a switch from systemic treatment to biologics therapy. Eighty percent of the pediatric patients with severe plaque psoriasis who switched from Methotrexate to Adalimumab (due to no response to efficacy) at 16 weeks, as early as the 4th week achieved a PGA score of 0/1 with no identified new safety risk (Thaçi et al., 2019).

Psoriasis Area and Severity Index (PASI)

The articles reviewed in studies with attaining efficacy of PASI 75, 90 and 100 with biologic treatment of pediatric plaque psoriasis were included. PASI is a valid tool in assessment of severity of psoriasis in patients and is important in clinical trials (Robinson et al., 2012). PASI score measures three aspects of psoriasis: Redness, thickness, and scale based on percentage of body surface area (BSA) affected. The intensity score of redness, thickness, and scale for each is assessed in the range of 0 to 4 (where 0 is none and 4 is very severe). There are four anatomical areas: Head and neck, upper extremities, trunk, and lower extremities with psoriasis involvement

score ranging from 0 to 6 (where 0 = none and 6 = 90% -100%). PASI score index range from 0 -72 (where 0 is none and 72 is maximum based on very severe in all anatomical areas).

The results of the studies showed attained efficacy of PASI 75, PASI 90, and PASI 100 with biologic treatment of pediatric plaque psoriasis. Two studies showed favourable results of achieving PASI 75 with use of biologics (Sanclemente, 2015; Siegfried et al., 2010). The results from the first study which involved participants (13 years median age) investigating Etanercept with dosage ranging from 0.8 to 50 mg per kilogram of body weight showed 57% of the participants achieved PASI 75 versus 11% who received placebo at week 12. The results from the second study with use of Etanercept showed a maintained PASI 75 over a 12-week duration.

Higher PASI score ≥75 was seen in studies with use of biologics. A remarkable improved efficacy outcome of PASI 75, PASI 90, and PASI 100 was achieved in the first randomized, double blinded, phase III trial study that evaluated long-term treatment (52 weeks) of children (4–18 years) with Adalimumab with results PASI 75, 90 and 100, 68·5%, 48·1% and 29·6% respectively in all groups compared to result at 16 weeks (Thaçi et al., 2019). PASI 75 and PASI 90 was achieved in other studies. Results of an open-label 5-year extension study of Etanercept revealed its efficacy of improved rate of PASI 75% in approximately 60%–70% patients and PASI 90% in approximately 30%–40% patients, maintained at 96 weeks in children and adolescents with plaque psoriasis and through the long-term (5 years) treatment (Paller et al., 2016).

The results of a 16-week study by Burness & McKeage (2015), showed paediatric patients who received treatment with Adalimumab 0.8 mg/kg up to maximum of 40 mg biweekly achieved improvement of ≥75% from baseline in PASI compared to patients who received Methotrexate. The results of a short-term, phase 3 CADMUS study conducted in Europe and

Canada at 36 sites evaluating Ustekinumab treatment in moderate-to-severe psoriasis in patients age 12 to 17 showed significant results with "PASI 75 (HSD, 78.4%; SD, 80.6%; placebo, 10.8%) or PASI 90 (HSD, 54.1%; SD, 61.1%; placebo, 5.4%) at week 12 ($P < .001$)" (Landells et. al., p. 597, 2015). Other studies reviewed (Aslam et al, 2020; Langley et al, 2011) reported similar results of great efficacy following Etanercept treatment with improved PASI 75 and PASI 90 were achieved as reported by Paller et al. (2016). The results of a study of patients aged 6 to < 18 years with moderate-to-severe plaque psoriasis with Ixekizumab treatment showed responses of the following percentages of patients at week 48: PASI 50 (92%), PASI 75 (90%), PASI 90 (83%), PASI 100 (55%) indicating superior improvement (Paller et al., 2020).

Children's Dermatology Life Quality Index (CDLQI)

The studies reviewed in this article included assessment of the efficacy of biologics treatment in pediatric patients as it relates to Children's Dermatology Life Quality Index. CDLQI assesses the impact skin diseases have on the quality of life of the children. Higher CDLQI score indicates patient is experiencing low quality of life while lower CDLQI indicates better quality of life. In a study to evaluate the efficacy of treatment with Adalimumab every other week versus treatment with methotrexate once a week, results at week 16 showed CDLQI change from baseline improved, higher in patients in the 0·8 mg/kg Adalimumab group than those in Methotrexate group (Papp et al., 2017). However, treatment of children (aged ≥ 4 and < 18) with severe plaque psoriasis using Adalimumab (0·8 mg kg−1) showed improvement of quality of life scores measured by CDLQI and Pediatric Quality of Life Inventory with patients at the end of the initial treatment (16 weeks) and over the 52 weeks long term extension (Thaçi et al., 2019).

Two studies (Sanclemente, 2015; Langley et al., 2011) reported similar results following 12 weeks Etanercept treatment for pediatric psoriasis showed CDLQI improvement score from

baseline compared with placebo. A study by Bruins et al. (2020) showed greatest improvements in quality of life was observed in PASI 90 or greater with significant change in CDLQI score. CDLQI score of 0/1 (where 0 = clear and 1 = almost clear) indicates higher health quality of life. Results of a study with use of Ustekinumab in moderate to severe pediatric psoriasis revealed CDLQI mean changes from baseline was greater in standard dose (SD) and half-standard dose (HSD) groups compared with placebo and at week 52, CDLQI score of 0/1 was achieved by 50.0% of patients in HSD group and 58.6% of patients in the SD group (Landells et al., 2015). Significant improvement in quality of life of patients was reported following Ixekizumab treatment as early as week 4 with further improvement through week 48 of study (Paller et al., 2020).

Discussion

This literature review of 11 studies examines available evidence of efficacy of biologics treatment of chronic plaque psoriasis in pediatric patients. The three measures used for interpretations of clinical response results were PASI, PGA and CDLQI scores in pediatric patients with plaque psoriasis. Biologics are immunomodulators widely considered for use in moderate to severe psoriasis and they do not manifest the toxicity/serious adverse effects as seen with other conventional systemic therapies (Aslam et al., 2020). Two studies stated biologics provide a viable option for children and adolescent as it provides a more favorable dosing routine requiring infrequent laboratory monitoring compared to conventional systematic therapies (Bronckers et al., 2015; Napolitana, 2016).

Psoriasis Area and Severity Index (PASI)

The interpretation of nine of the studies results showed significant clinical response in the PASI score of pediatric patients with moderate to severe psoriasis with regards to the efficacy of biologics treatment. With the limited available clinical studies of efficacy of biologics in treatment of pediatric psoriasis, the results of use of biologics has yielded a more targeted and effective treatment option and patients' efficacy achievement of PASI 75, 90, or 100. Physicians often refer to levels of efficacy as PASI 75, PASI 90, and PASI 100. This indicates the percentage that have achieved 75%, 90%, and 100% respectively reduction of their baseline PASI score, with PASI 100 indicating patients have achieved complete disease clearance. Results of the studies showed patients who received biologic treatment experienced significant improvement of the symptoms that lead to improved condition and in some cases complete clearance of disease was seen in patients who achieved PASI 100.

With the goal of achieving a clear or almost clear skin in psoriasis treatment, current treatment options are moving towards the achievement of PASI 90 or greater in line with increasing efficacy of newer treatment options. PASI 50 was initially considered as meaningful clinical response; however, with introduction of biologic therapies resulted in achievement of PASI 75 by a remarkable number of patients and have led to transformation in management of moderate-to-severe psoriasis (Hellen & Raghallaigh, 2019). Thaçi et al. (2019) in their study reported 29.6% of patients following long-term treatment with Adalimumab achieved PASI 100. According to Burness & McKeage (2015) in their study, patients treated with Adalimumab biweekly attained ≥75% improvement from PASI baseline compared to patients with Methotrexate treatment. The results of these studies suggest short-term treatment with Adalimumab achieved efficacy of PASI 75 compared with long-term treatment of higher

efficacy improvement up to PASI 100. The first study of long-term treatment of Adalimumab for severe plaque psoriasis showed efficacious outcomes in patients with maintained or improved achievement of PASI 75, PASI 90 and PASI 100 (Thaçi et al., 2019). The results support long-term treatment with use of biologics in treatment of pediatric patients with plaque psoriasis.

The efficacy of biologic treatment in pediatric patients with plaque psoriasis was seen in the achievement of PASI 75 and PASI 90 from results of four of the studies (Aslam et al., 2020; Paller et al., 2016; Langley et al., 2011; Landells et al., 2015). The efficacy outcome of PASI 75 was achieved in > 50% of patients with Etanercept treatment compared to placebo group in two studies (Sanclemente, 2015; Siegfried et al., 2010). The results suggest efficacy of PASI 75 can be maintained in patients who were previously treated with Etanercept and may have withdrawn treatment, upon retreatment with Etanercept efficacy can still be achieved. The results of these studies show biologics are efficacious in treating pediatric psoriasis. Where conventional systemic treatments have shown to be ineffective, switching to biologics has been proven to show desired outcomes. A switch from Methotrexate to Adalimumab in pediatrics suggest adalimumab is safe and efficacious (Thaçi et al., 2019). Among the studies reviewed, highest proportion of patients' achieving PASI 100 was seen with Ixekizumab treatment based on report by Paller et al. (2020).

In this author's experience working over the last two months in a dermatology clinic, Ustekinumab, Adalimumab, and Etanercept used in treatment of pediatric plaque psoriasis has shown significant improvements. Higher efficacy has been observed with treatment Ustekinumab, about 30% of patients have achieved PASI 100 and 40% have achieved PASI 90. About 24% of Patients treated with Adalimumab have achieved PASI 100 and 30% have achieved PASI 90. Lower number of patients has been observed in achieving PASI 100 (about

10%) and PASI 90 (about 20%) with Etanercept treatment. This finding aligns with that of Thaçi et al. (2019). A greater portion of patients achieved PASI 100 with Ustekinumab treatment.

Physician's Global Assessment (PGA)

This literature review examined the evidence of efficacy of biologics in pediatric patients with plaque psoriasis as seen in PGA score from results of the reviewed studies. The overall goal of psoriasis treatment is to achieve a clear or almost clear outcome. The efficacy of biologics in the treatment of pediatric plaque psoriasis can be shown in achievement of PGA score 0/1. PGA is essentially an overall assessment of patient's psoriasis. An indication of the response/outcome following biologic treatment from the baseline. Six of the 11 articles reviewed showed the efficacy of using biologics to treatment of pediatric psoriasis. Study participants experienced remarkable improvement in their psoriasis condition and achieved a PGA score of 0/1. The British Association of Dermatologists (BAD) in their 2017 guidelines suggest the minimum biologic therapy response of a Physician Global Assessment (PGA) of nearly clear or clear (Hellen & Raghallaigh, 2019).

The results of PGA score across the studies varied following short-term and long-term treatment with biologics. The results of a short-term study with Ustekinumab treatment showed beneficial outcomes of reduced psoriasis symptoms and 69.4% patients who received standard dose achieved PGA 0/1 (Landells et al., 2015). In one of the studies reviewed, an insignificant portion of patients that received Adalimumab following short-term treatment achieved PGA score of clear or almost clear compared to those that received Methotrexate treatment (Papp et al., 2017). This aligned with the findings reported by Thaçi et al. (2019) following short-term (16 weeks) treatment with Adalimumab. However, with improved symptoms of psoriasis, efficacy results were seen in patients with their achievement of PGA score of 0/1 following

commencement of 52 weeks long-term treatment with Adalimumab (Thaçi et al., 2019). These studies suggest a greater proportion of patients achieved PGA score of 0/1 following long-term biologic treatment. On the contrary, following long term studies with Etanercept treatment, a lesser proportion of children and adolescent achieved PGA status of clear/almost clear as reported in two studies (Paller et al., 2010a; Paller et al., 2016).

Significant PGA outcomes was seen in patients that switched to biologics treatment and a remarkable number of patients achieved complete clearance of psoriasis. According to Thaçi et al. (2019), a PGA score of 0/1 was achieved among 80% of pediatric patients with severe plaque psoriasis that switched treatment from Methotrexate to Adalimumab. This finding suggests treatment with biologics is effective and improvement in PGA status can be achieved when patients switch from systemic treatment to biologics. In cases where other drugs cannot be used or have failed, Etanercept has shown to be effective and well tolerated in children and adolescents with moderate to severe plaque psoriasis (Jayakar & Parimalam, 2016). A greater number of patients who achieved complete clearance of the disease among the studies was seen in Ixekizumab treatment. Treatment with Ixekizumab showed a significant number of patients (57%) achieved complete clearance of the skin (PGA score of 0) compared to patients in placebo group (Paller et al., 2020b).

In this author's experience working in a dermatology clinic, it is observed that PGA score 0/1 has been achieved in pediatric patients with biologics treatment for plaque psoriasis. The most efficacious outcomes of PGA 0/1 are seen in patients receiving Ustekinumab treatment. This finding aligns with that of Landells et al. (2015). Also, this author observed patients who switched from systemic treatments to biologics treatment have shown significant improvement in PGA score from baseline. This finding aligns with that of Thaçi et al. (2019).

Children's Dermatology Life Quality Index (CDLQI)

Seven of the studies examined in this literature revealed evidence of efficacy of biologics treatment of pediatric psoriasis as seen in measurement of patients' quality of life. Children Dermatology Life Quality Index is used in clinical practice in measuring and planning treatments of pediatric patients with skin diseases. The CDLQI is a questionnaire consisting of ten question that measures the impact on how the skin disease has affected the quality of life of the patients over the last week. A study suggested clinically meaningful treatment goals with PASI 90 or greater would assist patients with pediatric psoriasis to attain optimal quality of life (Bruins et al., 2020).

The CDLQI score results from the studies indicated the higher the PASI score, the higher the quality of life seen in pediatric psoriasis patients. The findings from a study revealed the quality of life of patients with psoriasis was seen to show significant improvement in CDLQI score in PASI 90 or greater (Bruins et al., 2020). Results of treatment with Etanercept therapy showed a substantial improvement in CDLQI score with larger percentage increase in patients with PASI 90 in week 12 when compared to those with PASI 75 (Langley et al., 2011). This suggests there may be a correlation between PASI score and CDLQL score. However, according to Bruins et al. (2020) investigation is yet to be done whether there exit a treatment association with quality of life independent of degree of improvement of psoriasis.

The results of the studies reviewed showed patients who received biologics treatment observed significant improvement in their quality of life. In a long-term study, 58% of pediatric patients with moderate to severe following Ustekinumab treatment showed CDLQI result of clear or almost clear (Landells et al., 2015). This indicates their psoriasis condition did not have a negative impact on their quality of life. In a short-term study, over 50% of patients treated with

Etanercept showed improvement from baseline in the CDLQI scores versus placebo group in two studies (Langley et al., 2011; Sanclemente, 2015). Children with severe plaque psoriasis that received treatment with Adalimumab showed improvement in quality-of-life results measured by CDLQI and Pediatric Quality of Life Inventory at the end of both the initial short-term treatment and long-term extension treatment (Thaçi et al., 2019).

The efficacy of biologics treatment as seen in CDLQI score compared with a systemic treatment was seen in one of the studies. The results of a study evaluating the efficacy and safety of Adalimumab versus Methotrexate showed CDLQI improvement from baseline was higher in Adalimumab group than Methotrexate group (Papp et al., 2017). Also, results of a study showed early significant improvement was seen in the health-related quality of life and further improved through week 48 in pediatric patients with moderate to severe plaque psoriasis treated with Ixekizumab (Paller et al., 2020b). The results of these studies support improvements in CDLQI score following treatment with biologics thereby leading to improvement in quality of life of pediatric patients with plaque psoriasis.

In this author's recent experience, a lower CDLQI score 0/1 has been achieved in pediatric patients with psoriasis receiving biologic treatment. About 50-60% of patients receiving Ustekinumab treatment have achieved CDLQI 0/1. This finding aligns with that of Landells et al. (2015). A lower number of patients achieve CDLQI 0/1 following treatment with Adalimumab (40-50%) and Etanercept (20-30%). However, it is unclear the reason(s) for a lower percentage of patients treated with Etanercept achieving CDLQI 0/1 in this clinic compared to the results reported by Sanclemente (2015) and Langley et al (2011). This author also observed patients with underlying ailments that are receiving biologic treatment may not have lower CDLQI even

though there is significant improvement in their psoriasis condition. Also, since some of the questions may not be applicable to some patients, the CDLQI score may be misleading.

Conclusion

The use of biologics has been shown to be effective in the treatment of pediatric chronic plaque psoriasis. The results of the clinical studies included in this review further revealed the efficacy of biologics in pediatric patients for the treatment of psoriasis. The proportion of patients that experience significant improvement with use of the approved biologics for pediatric psoriasis varied, as seen in the results of the PASI, PGA and CDLQI scores. The clinical trial data showing the comparative effectiveness of these biologics (Etanercept, Adalimumab, and Ustekinumab) is lacking (Warren et al., 2015). Based on the studies in this literature and the author's experience working in the dermatology clinic, PASI 100, PGA clear or almost clear, and CDLQI 0/1 can be achieved with treatment of plaque psoriasis with the use of biologics in pediatric patients. Higher efficacy outcomes are achieved with PASI 90 or greater. Results of the studies have shown high efficacy is achieved when patients switch from systemic treatment to biologics.

It is important to take into consideration the duration of the biologic treatment. While the highest biologic efficacy outcomes were seen following long term treatment, efficacy can also be achieved in short term treatment. The use of biologics in clinical practice in psoriasis patients have shown overall good survival rate, however there is a decrease overtime mainly due to loss of response (Warren et al., 2015). Due to the limited studies on use of biologics for psoriasis treatment in pediatric population, more studies should be conducted. Also, more clinical trials for the newer biologics (Ixekizumab, Risankizumab-rzaa, and Guselkumab) in pediatric population

should be carried out. Only the EMA and FDA approved biologics for pediatric population should be used for treatment of pediatric psoriasis. The results of the studies in this literature have shown biologics is a feasible option and is effective in treatment of pediatric chronic plaque psoriasis.

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