Efficacy and Safety of Vedolizumab in Management of Moderate to Severe Ulcerative Colitis: A Systematic Review

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Abstract

Ulcerative colitis (UC) is an inflammatory bowel disease and causes inflammation and ulcer of the colon. Vedolizumab is a newer biological agent with an inhibitory effect on α4β7 integrin approved for moderate to severe UC patients. Our study reviewed the clinical response, clinical remission, and mucosal healing of vedolizumab in moderate to severe UC management. Using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, we conducted a literature search in PubMed, Google Scholar, and Science Direct, and nine studies were included in the systematic review. At week six, vedolizumab showed a significant clinical response. At week 52, vedolizumab showed significant mucosal healing and clinical remission. The most commonly associated adverse effects are nasopharyngitis, oropharyngeal infection, and gastrointestinal infection. However, additional clinical trials and observational studies with longer follow-ups are required to study the efficacy and safety of the drug.

Categories: Internal Medicine, Allergy/Immunology, Gastroenterology
Keywords: ulcerative colitis (uc), vedolizumab, inflammatory bowel disease, management, biological agent

Introduction And Background

Ulcerative colitis (UC) is a chronic disease that causes diffuse inflammation of the rectal and colonic mucosa [1]. Incidences of UC were reported in Northern Europe (24.3 per 100,000), Canada (19.2 per 100,000), and Australia (17.4 per 100,000) [2]. The prevalence in Asian populations ranges from 5.3 to 63.6 per 100,000 people, whereas in North America, it ranges from 37.5 to 238 per 100,000 people [1]. UC patients usually present with increased frequency of bowel movements, mucus discharge, nocturnal defecation, abdominal pain, diarrhea, tenesmus, slimy stool, and hematochezia [2, 3]. In addition, UC is associated with family history, the Jewish population, genetic factors, environmental factors, former smoking history, and drugs like oral contraceptive pills (OCPs) and non-steroidal anti-inflammatory drugs (NSAIDs) [2]. Figure 1 demonstrates the risk factors associated with UC. Endoscopy, colonoscopy, or proctosigmoidoscopy with biopsy is the preferred choice for diagnosis of UC along with clinical signs and symptoms [2, 4].

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For mild to moderate UC, the first-line treatment is azathioprine, and the patients who do not achieve response are managed with corticosteroid therapy [5]. Moderate to severe cases are treated with thiopurines or biological drugs, or anti-tumor necrosis factor-alpha (TNF-α) medications, such as infliximab, adalimumab, and golimumab [6]. The Food and Drug Administration (FDA) has approved biological therapy like vedolizumab and TNF-α for the treatment of refractory cases in UC [7]. Among biological drugs, infliximab remains the most widely used for ulcerative colitis [7]. A newer biological drug, vedolizumab, was approved for moderate to severe UC cases refractory to standard medications by FDA [2]. In the treatment of failure cases with medical management, colectomy is the preferred method. Patients have experienced many side effects with medications like corticosteroids and TNF-α inhibitors [8]. A study performed by Herrlinger et al. showed about 58% of patients treated with infliximab underwent colectomy [9]. TNF-α inhibitors are associated with severe infections and tuberculosis [10,11]. Similarly, patients with prolonged steroid use experience various systemic side effects [10,11]. Vedolizumab and adalimumab are the humanized monoclonal antibody (HMA) with an inhibitory effect on α4β7 integrin [12]. The α4β7 integrin mediates lymphocyte migration from the circulation across the vascular endothelial barrier into gut-associated secondary lymphoid tissue or the intestinal lamina propria through interaction selectively expressed on the intestine and the interaction blocked by vedolizumab [11]. Figure 2 illustrates the mechanism of action of vedolizumab. Therefore, it has an early clinical response, clinical healing, and endoscopic wound healing in moderate to severe ulcerative colitis due to gut-specific receptor activity and fewer systemic side effects [13].
Vedolizumab blocks the interaction of the lymphocyte with the ligand MAdCAM-1 present in the vascular endothelial lining of the gut.

MAdCAM-1, mucosal addressin cell adhesion molecule-1.

The complications of UC were toxic megacolon, intestinal perforation, intestinal infarction, myocardial infarction secondary to anemia, and end-stage liver disease due to primary sclerosing cholangitis [1]. In addition, long-standing UC is associated with anxiety, depression, and the development of colorectal carcinoma [14].

This systematic review aims to study the efficacy and safety of vedolizumab in moderate to severe UC patients in early clinical remission, mucosal wound healing, and adverse effect of the medication.

**Review Methods**

**Sources of Data and Search Strategy**

We used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. We searched articles by using the databases PubMed, Google Scholar, and Science Direct. The keywords are as follows: ulcerative colitis, inflammatory bowel disease, drug therapy, and treatment. The Medical Subject Headings (MeSH) is the National Library Of Medicine (NLM) control vocabulary thesaurus, specifically used to search articles in PubMed databases. The final search strategy was as follows: ("Colitis, Ulcerative/drug therapy" [majr] OR "Colitis, Ulcerative/mortality" [majr] OR "Colitis, Ulcerative/surgery" [majr] OR "Colitis, Ulcerative/therapy" [majr]) AND "drug therapy" [subheading]. Table 1 illustrates the search strategy.

| Database       | Keywords                                                                 | Search result |
|---------------|--------------------------------------------------------------------------|---------------|
| PubMed        | As stated above                                                          | 1,323         |
| Science Direct| (Ulcerative colitis OR inflammatory bowel disease) AND (drug therapy OR treatment) | 885           |
| Google Scholar| Ulcerative colitis AND vedolizumab                                       | 94            |

**TABLE 1: Databases and search result**
Inclusion and Exclusion Criteria

We included and selected articles published in the English language, and clinical trials, human studies, adult population, availability of free full text, and articles published between 2017 and May 2021. Studies published in a non-English language, animal studies, review articles, and non-full-text articles were excluded.

Data Extraction and Risk of Bias Assessment

Screening of abstracts and titles was done initially using the Rayyan software (Rayyan Systems Inc., Cambridge, Massachusetts). Then, two authors (Renu and Opemipo) assessed the data independently and screened for all identified studies. A total of 2,302 articles were identified after applying the search criteria, and 2,265 articles remained after removing duplicates. A total of 2,265 articles were screened based on the inclusion and exclusion criteria, and nine papers were selected after the screening process. We used nine randomized clinical trials (RCTs) in our study and assessed the risk of bias using the Cochrane Risk of Bias 2.0 tool.

Results

A total of 2,302 articles were selected from January 2017 to May 2021 using the above search strategy criteria listed in the methods section. The articles were screened based on the title and abstract related to ulcerative colitis (UC) and vedolizumab. After a detailed assessment, we applied inclusion and exclusion criteria and included nine studies, and a complete PRISMA flow diagram was created [15]. Each clinical trial had a similar study design, intervention, and outcome. Figure 3 shows the PRISMA flowchart with the results of this systematic review.

Study Characteristics

Our review includes patients from nine RCT studies. Table 2 shows the characteristics and outcomes of the
| Authors             | Study design | Disease severity and the total number of participants (N) | Intervention                                | Follow-up | Outcome                                                                 |
|---------------------|--------------|----------------------------------------------------------|---------------------------------------------|-----------|--------------------------------------------------------------------------|
| Feagan et al. (2017) [16] | RCT phase 3  | Moderate to severe UC regardless of TNF-α inhibitors (N: 831) | Vedolizumab and placebo                     | 52 weeks  | At week six, vedolizumab-treated patients had a higher clinical response in both TNF-α failure and TNF-α naive patients. At week 52, mucosal healing, clinical remission, and corticosteroid had higher clinical significance in both groups than placebo. |
TABLE 2: A tabulated summary of the characteristics of included clinical trials

| Study (Year) | Study Design | Number of Patients | Disease severity | Treatment | Duration | Outcome |
|--------------|--------------|--------------------|-----------------|-----------|----------|---------|
| Feagan et al. (2019) | RCT placebo-controlled trial | Moderate to severe UC (N: 769) | Vedolizumab and placebo | SC | 52 weeks | At week 14, clinical remission was higher in patients with vedolizumab as compared to the placebo group. At week 52, patients who obtained clinical remission at week 14 in the vedolizumab group achieved sustained clinical remission. |
| Feagan et al. (2019) | RDBCT | Moderate to severe UC (N: 216) | and intravenous formulation and placebo | SC | 52 weeks | Therapeutic Benefits of Vedolizumab in Moderate to Severe Ulcerative Colitis |
| Sanders et al. (2019) | RCT placebo-controlled trial | Moderate to severe UC (N: 245) | Vedolizumab and placebo | SC | 52 weeks | Sandborn et al. studied deep remission with vedolizumab in 375 patients with moderate to severely active UC colitis [18]. At six weeks, vedolizumab responders were re-randomized to four-weekly therapy and eight-weekly therapy [18]. At week 52, deep remission was achieved in 8.7% of the placebo group and 28% and 27% of the vedolizumab group with four-weekly and eight-weekly therapy, respectively [18]. Similarly, endoscopic healing in the treatment group was 50.6% and 45.5% at four-weekly and eight-weekly therapy, respectively [18]. Thus, with a higher drug concentration in the blood with four-weekly therapy, |

Discussion

**Therapeutic Benefits of Vedolizumab in Moderate to Severe Ulcerative Colitis**

Clinical response is defined as a decrease in Mayo score (MS) from baseline of 30% or more and three or more points, along with either a rectal bleeding subscore of 0 or 1 or a decrease in the rectal bleeding subscore of one point or more [24]. The MS is a combined endoscopic and clinical scale classified into four categories: 0: normal or inactive disease; 1: a mild disease with erythema, decreased vascular patterns, and mild friability; 2: a moderate disease with marked erythema, absence of vascular patterns, friability, and erosions; and 3: a severe disease with spontaneous bleeding and ulceration [25]. Mucosal healing is an absence of friability, blood, erosions, and ulcers in all visualized segments of the gut mucosa [26]. Clinical remission in UC is the disappearance of clinical symptoms, endoscopic appearance, and histologic features; several clinical trials use Mayo score indexing or other indexing methods for the clinical remission of the disease [27].

Feagan et al. conducted a randomized trial (RCT) to study the efficacy of vedolizumab in moderate to severe UC patients irrespective of tumor necrosis factor-α (TNF-α) therapy [16]. The study included 464 patients in TNF-α naïve and 367 patients with inadequate response to TNF-α therapy and followed for 52 weeks [16]. At six weeks, 53.1% of patients naïve to TNF-α and 39% of patients in treatment-resistant to TNF-α therapy achieved clinical response. At 52 weeks, clinical remission was achieved in 46.9% of patients naïve to TNF-α therapy and 56.1% of patients in treatment failure to TNF-α therapy [16].

Similarly, in a study by Scribano et al., in open-label RCT with 800 patients at six weeks, 47.1% of patients in the vedolizumab group and 25.5% in the placebo group achieved clinical remission [17]. At 52 weeks, 24% of patients in vedolizumab achieved clinical remission after administering the drug at four weeks intervals. At eight weeks intervals, 20.5% of patients in the vedolizumab group achieved clinical remission [17]. In addition, the vedolizumab group showed higher mucosal healing and higher rates of corticosteroid-free remission [17].

The study by Yajnik et al. included 895 patients in the UC group and conducted a comparative analysis of vedolizumab’s efficacy and safety in different age groups less than 35 years, 35 to 55 years, and greater than 55 years [13]. The effectiveness of vedolizumab in achieving clinical response at week six was 51% (<35 years), 47% (35-55 years), and 38% (>55 years) [13]. In addition, at 52 weeks, clinical remission, mucosal healing, and corticosteroid-free remission were similar in all age groups treated with vedolizumab [13].

The study by Sanders et al. conducted RCT in 245 centers in 34 different countries [21]. It included a total of 769 patients to study the difference between vedolizumab and adalimumab for the management of moderate to severe UC patients [21]. At 14 weeks, 31.5% of the vedolizumab group and 22.5% of the adalimumab group achieved clinical remission [21]. At week 52, 39.7% of the vedolizumab group and 27.7% of the adalimumab group achieved endoscopic improvement [21]. However, at the same time, it failed to attain corticosteroid-free remission in the vedolizumab group [21].

Sandborn et al. studied deep remission with vedolizumab in 375 patients with moderate to severely active UC colitis [18]. At six weeks, vedolizumab responders were re-randomized to four-weekly therapy and eight-weekly therapy [18]. At week 52, deep remission was achieved in 8.7% of the placebo group and 28% and 27% of the vedolizumab group with four-weekly and eight-weekly therapy, respectively [18]. Similarly, endoscopic healing in the treatment group was 50.6% and 45.5% at four-weekly and eight-weekly therapy, respectively [18]. Thus, with a higher drug concentration in the blood with four-weekly therapy,
vedolizumab achieved a higher rate of deep remission [18].

Feagan et al. conducted post hoc analysis of phase three RCT, placebo-controlled trial to study the sustained clinical remission using MS of less than 2 with no subscore of greater than 1 or rectal bleeding of subscore (RBS) 0 in moderate to severe UC patients [23]. In the study at week 14, a higher proportion of patients treated with vedolizumab obtained clinical remission than the placebo group [23]. Based on MS, 32.7% and 20.1% achieved clinical remission in the vedolizumab and placebo groups, respectively. Similarly, 47.5% and 28.9% achieved clinical remission based on RBS in the vedolizumab and placebo groups, respectively [23]. Sustained clinical remission was higher in the vedolizumab group, who achieved clinical remission at 14 weeks, than in the placebo group [23].

The above-mentioned studies concluded that vedolizumab has a significant clinical response, clinical remission, and mucosal wound healing in moderate to severe UC patients.

In contrast, Motoya et al. conducted RCT double-blinded study in the Japanese population [20]. At week 10, clinical response achieved in the vedolizumab and placebo groups was 39.6% and 32.9%, respectively (p = 0.2722) but there was no statistical significance [20]. At week 60, 56.1% and 51% achieved significant clinical remission in the vedolizumab and the placebo groups, respectively (p = 0.0210) [20]. Therefore, the author concluded that a longer duration of treatment with the drug is required for the response.

**Route of Administration of Vedolizumab**

Sandborn et al. studied the efficacy and safety of vedolizumab subcutaneous (SC) formulation with UC patients [22]. They conducted a double-blinded RCT in 141 sites in 29 countries and included 216 patients [22]. At 52 weeks, clinical remission was achieved in 46.2%, 42.6%, and 14.3% of patients in SC vedolizumab, intravenous (IV) vedolizumab, and placebo groups, respectively [22]. In addition, SC vedolizumab achieved more remarkable endoscopic improvement than the placebo group [23]. Hence, the author concluded that the SC formulation is better than the IV formulation of vedolizumab because it showed higher clinical remission and can be self-administered [22].

While other included studies used IV formulation, no comparative study was done between SC and IV formulation.

**Adverse Effect of Vedolizumab**

Cohen et al. studied the safety profile of vedolizumab in UC and Crohn’s diseases in four years of the post-marketing survey [19]. Approximately 208,050 patients with UC and Crohn’s disease were included in the study [19]. Overall, the risk of serious infection was noted in 10.0% of UC patients, and a gastrointestinal infection was observed in about 17% of UC patients [19]. In both Crohn’s and UC patients, less than 1% malignancy, less than 1% hepatobiliary events, 19% serious infection rate, and 5% opportunistic infection rate were observed [19].

Sands et al. conducted a comparative study between vedolizumab and adalimumab in 245 centers in 34 different countries [21]. The overall infection rate in the vedolizumab was comparatively less than in the adalimumab group [21]. The rate of adverse events in the vedolizumab group and the adalimumab group was 62.7% and 69.2%, respectively [21]. Similarly, the rate of serious adverse events was 11% in the vedolizumab group and 13.7% in the adalimumab group [21].

Sandborn et al. conducted a double-blinded RCT in 141 sites in 29 countries, including 216 patients, to study the efficacy and safety of vedolizumab SC formulation with moderate to severe UC patients [22]. The incidence of injection site reaction was 1.9% and 0% in the vedolizumab group and the placebo group, respectively [22]. The gastrointestinal disorders were observed in 14.2% of the SC group, 11.1% of the IV group, and 32.1% of the placebo group [22]. The overall infection rate was 19.8% in the SC group, 27.8% in the IV group, and 25% in the placebo group [22]. And the rate of serious adverse events was 9.4% in the SC group, 13.0% in the IV group, and 10.7% in the placebo group [22].

Motoya et al. conducted a double-blinded RCT study in the Japanese population and included 292 patients [20]. Adverse events in the vedolizumab group were mild to moderate in intensity, and there was no death recorded during the treatment [20].

The study by Yajnik et al. included 895 patients in the UC group and conducted a comparative analysis of vedolizumab’s efficacy and safety in different age groups of less than 35 years, 35 to 55 years, and greater than 55 years [13]. The risk of severe infection was lower in the patient population with age greater than 55 years [13]. However, the author believes the difference may be due to the lesser number of patients in that age group [13].
We found few adverse reactions like nasopharyngitis, gastrointestinal infection, and injection site reactions, and no significant side effects like malignancy, leukoencephalopathy, and tuberculosis with the drug from our analysis. Few side effects reported may be due to the gut specificity of the drug. Hence, vedolizumab is well-tolerated and safe in patients with moderate to severe UC.

**Limitations**

Our article has some limitations; only the articles published in the English language, with the availability of free full text and clinical trials were included. In addition to this, patients in these included studies were only followed for 52 weeks and did not look for the relapse of the disease. Therefore, more RCTs with longer follow-ups are required to study more about the efficacy and safety profile of the drug.

**Conclusions**

The main objective of this article is to study the efficacy and safety of vedolizumab in the management of moderate to severe UC patients. Most of the included studies showed a significant clinical response and clinical remission of the disease. Additionally, vedolizumab is well-tolerated with fewer side effects and is safe to use in UC patients. In comparison to IV formulation, the SC formulation of vedolizumab was more effective, and the four-weekly therapy was better compared to the eight-weekly therapy. Comparative studies of vedolizumab with other biological agents will be beneficial and worth exploring as this drug is gut selective and efficient with lesser side effects.

**Additional Information**

**Disclosures**

**Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

**References**

1. da Silva BC, Lyra AC, Rocha R, Santana GO: Epidemiology, demographic characteristics and prognostic predictors of ulcerative colitis. World J Gastroenterol. 2014, 20:9458-67. 10.3748/wjg.v20.i28.9458
2. Ungaro R, Mehandru S, Allen PB, Peyrin-Biroulet L, Colombel JF: Ulcerative colitis. Lancet. 2017, 389:1756-70. 10.1016/S0140-6736(16)32126-2
3. Rosario M, French JL, Dirks NL, et al.: Exposure-efficacy relationships for vedolizumab induction therapy in patients with ulcerative colitis or Crohn’s disease. J Crohns Colitis. 2017, 11:921-9. 10.1093/ecto-jcc/jsx021
4. Collins P, Rhodes J: Ulcerative colitis: diagnosis and management. BMJ. 2006, 333:540-3. 10.1136/bmj.333.7565.540
5. Dignaas A, Lindsay JO, Sturm A, et al.: Second European evidence-based consensus on the diagnosis and management of ulcerative colitis part 2: current management. J Crohns Colitis. 2012, 6:991-1030. 10.1016/j.jcrough.2012.09.002
6. Wang Y, MacDonald JK, Vandermeer B, Griffiths AM, El-Matary W: Methylxatrexate for maintenance of remission in ulcerative colitis. Cochrane Database Syst Rev. 2015, 2015:CD007560.
7. Rutgeerts P, Sandborn WJ, Feagan BG, et al.: Infliximab for induction and maintenance therapy for ulcerative colitis. N Engl J Med. 2005, 353:2462-76. 10.1056/NEJMoa050516
8. Buchman AL: Side effects of corticosteroid therapy. J Clin Gastroenterol. 2001, 35:289-94. 10.1097/00004836-200110000-00006
9. Herrlinger KB, Barthel DN, Schmidt KJ, et al.: Infliximab as rescue medication for patients with severe ulcerative/indeterminate colitis refractory to tacrolimus. Aliment Pharmacol Ther. 2010, 31:1036-41. 10.1111/j.1365-2036.2010.04267.x
10. Singh JA, Wells GA, Christensen R, et al.: Adverse effects of biologics: a network meta-analysis and Cochrane overview. Cochrane Database Syst Rev. 2011, 2011:CD008794. 10.1002/14651858.CD008794.pub2
11. Waldron NH, Jones CA, Gan TJ, Allen TK, Habib AS: Impact of perioperative dexamethasone on postoperative analgesia and side-effects: systematic review and meta-analysis. Br J Anaesth. 2013, 110:191-200. 10.1093/bja/aet431
12. Singh H, Grewal N, Arora E, Kumar H, Kakkar AK: Vedolizumab: a novel anti-integrin drug for treatment of inflammatory bowel disease. J Nat Sci Biol Med. 2016, 7:4-9. 10.4103/0976-9668.172016
13. Yajnik V, Khan N, Dubinsky M, Adler J, James A, Abhyankar B, Lasch K: Efficacy and safety of vedolizumab
in ulcerative colitis and Crohn’s disease patients stratified by age. Adv Ther. 2017, 34:542-59. 10.1007/s12265-016-0467-6
14. Bopanna S, Ananthakrishnan AN, Kedia S, Yajnik V, Ahuja V: Risk of colorectal cancer in Asian patients with ulcerative colitis: a systematic review and meta-analysis. Lancet Gastroenterol Hepatol. 2017, 2:269-76. 10.1016/s2468-1253(17)30034-3
15. Page MJ, Moher D, Bossuyt PM, et al.: PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews. BMJ. 2021, 372:n160. 10.1136/bmj.n160
16. Feagan BG, Rubin DT, Danese S, et al.: Efficacy of vedolizumab induction and maintenance therapy in patients with ulcerative colitis, regardless of prior exposure to tumor necrosis factor antagonists. Clin Gastroenterol Hepatol. 2017, 15:229-39. 10.1016/j.cgh.2016.08.044
17. Scribano ML: Vedolizumab for inflammatory bowel disease: from randomized controlled trials to real-life evidence. World J Gastroenterol. 2018, 24:2457-67. 10.3748/wjv.v24.i23.2457
18. Sandborn WJ, Colombel JF, Panaccione R, et al.: Deep remission with vedolizumab in patients with moderately to severely active ulcerative colitis: a GEMINI 1 post hoc analysis. J Crohns Colitis. 2019, 13:172-81. 10.1093/ectj/ctx009
19. Cohen RD, Bhayat F, Blake A, Travis S: The safety profile of vedolizumab in ulcerative colitis and Crohn’s disease: 4 years of global post-marketing data. J Crohns Colitis. 2020, 14:192-204. 10.1093/ectj/ctx137
20. Motoya S, Watanabe K, Ogata H, et al.: Vedolizumab in Japanese patients with ulcerative colitis: a phase 3, randomized, double-blind, placebo-controlled study. PLoS One. 2019, 14:e0212989. 10.1371/journal.pone.0212989
21. Sands BE, Peyrin-Biroulet L, Loftus EV Jr, et al.: Vedolizumab versus adalimumab for moderate-to-severe ulcerative colitis. N Engl J Med. 2019, 381:1215-26. 10.1056/NEJMoa1905725
22. Sandborn WJ, Baert F, Danese S, et al.: Efficacy and safety of vedolizumab subcutaneous formulation in a randomized trial of patients with ulcerative colitis. Gastroenterology. 2020, 158:562-72. 10.1053/j.gastro.2019.08.027
23. Feagan BG, Schreiber S, Wolf DC, et al.: Sustained clinical remission with vedolizumab in patients with moderate-to-severe ulcerative colitis. Inflamm Bowel Dis. 2019, 25:1028-35. 10.1093/ibd/izy523
24. Achieving clinical response and remission in moderate-to-severe ulcerative colitis with golimumab. Gastroenterol Hepatol (N Y). 2014, 10:452-4.
25. Belya K, Hanai H, Sugimoto K, et al.: The ulcerative colitis endoscopic index of severity more accurately reflects clinical outcomes and long-term prognosis than the Mayo endoscopic score. J Crohns Colitis. 2016, 10:286-95. 10.1093/ectj/ctw047
26. Dave M, Loftus EV Jr: Mucosal healing in inflammatory bowel disease—a true paradigm of success? Gastroenterol Hepatol (N Y). 2012, 8:29-38.
27. Noman M, Ferrante M, Bischofs R, et al.: Vedolizumab induces long-term mucosal healing in patients with Crohn’s disease and ulcerative colitis. J Crohns Colitis. 2017, 11:1083-9. 10.1093/ectj/jwx048