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Rapid infusion of infliximab biosimilars and the incidence and severity of infusion-related reactions in patients with inflammatory bowel disease

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Abstract

What Is Known and Objective: Infliximab is an anti-tumour necrosis factor agent used in the treatment of inflammatory bowel disease (IBD), which includes Crohn's disease and ulcerative colitis. While the use of infliximab is well established in the treatment of IBD, there are now four recently FDA-approved infliximab biosimilars that are increasingly used due to their cost-benefit for patients, institutions and payors. In addition, shortening the length of infliximab infusions from 120 min (standard infusion) to 60 min or less (rapid infusion) has been shown to safely provide further cost-benefit while also improving patient convenience. The safety of rapid infusions has been well-established for the infliximab reference product, however, there are limited data available regarding the safety of rapid infusions for infliximab biosimilars. The purpose of this study was to compare the incidence and severity of infusion reactions among patients with IBD receiving rapid infusion of infliximab reference product compared with infliximab biosimilar.

Methods: This was a retrospective analysis of electronic health record data of patients with a diagnosis of IBD receiving an infliximab reference product or infliximab biosimilar infusion between December 2020 and December 2021. Patient-level variables included demographics, immunomodulator use, IBD-related hospitalization and infliximab trough concentration and antibody levels. Infusion-related variables of interest included total number of infusions, drug, dose, dosing interval, infusion time and use of pre-medications. Infusion-related reactions were defined as safety concerns documented by the administering nurse (anaphylaxis, shortness of breath, hypotension, swelling, rash, pruritus, hives, flushing, chest pain, muscle pain, joint pain, fevers, chills, headache or hypertension) or administration of emergency medications. Fisher's exact test was used to compare reaction rates.

Results and Discussion: A total of 188 patients met inclusion criteria for analysis, and a total of 1124 infusions were administered during the study period. There were no

statistically significant differences among any of the pre-specified outcomes. There were no differences in the incidence of infusion reactions among rapid infusion (60 min) infliximab and infliximab biosimilars ($p = 0.863$). Additionally, there were no differences in the incidence of infusion reactions among standard infusion (120 min) infliximab and infliximab biosimilars ($p = 0.993$). Finally, there were no differences among the rate of infusion reactions between rapid infusion of infliximab biosimilars and standard infusion of infliximab biosimilars ($p = 0.536$). Eight patients experienced safety issues, with three patients requiring emergency medications (1.6% of 188 patients).

What Is New and Conclusions: Rapid infusions of infliximab biosimilars were not associated with an increase in the incidence of infusion reactions compared with: rapid infusion of infliximab reference product, standard infusion of infliximab biosimilars, or standard infusion of infliximab reference product. This should reassure clinicians that rapid infusions of infliximab biosimilars are safe in clinical practice.

KEYWORDS
biosimilar, Crohn's disease, inflammatory bowel disease, infliximab, ulcerative colitis

1 | WHAT IS KNOWN AND OBJECTIVE

Infliximab is an intravenously administered anti-tumour necrosis factor (TNF) biological product approved for use in patients with inflammatory bowel disease (IBD), including Crohn's disease and ulcerative colitis.[1] While infliximab is a commonly used and guideline-recommended treatment for patients with IBD, there are several risks associated with its use.[2,3] The risk of an infusion reaction is among the most common of such risks, and initial studies report that up to 18% of patients experience an infusion reaction when defined as any adverse event occurring during an infusion or within 1 h after completing the infusion.[1] Furthermore, immunogenicity with development of anti-drug antibodies is another associated risk of infliximab that is often under-recognized and associated with a two- to threefold increase in the risk of an infusion reaction. Interestingly, concomitant immunomodulator use (i.e., azathioprine, mercaptopurine or methotrexate) may reduce the development of both infliximab infusion reactions and anti-drug antibodies.[1]

Infliximab and other biological products are composed of large, complex molecules that are inherent to variations that can occur during the manufacturing process. The U.S. Food and Drug Administration (FDA) defines biosimilars as, "biological products that are highly similar to, with no clinically meaningful differences from, an existing FDA-approved reference product." Under the Biologics Price Competition and Innovation Act (BPCI Act) of 2009, the FDA must vigorously conduct analytical studies, animal studies, pharmacokinetic and pharmacodynamic studies and clinical studies demonstrating that the biological product is highly similar to the reference product with the same safety, purity, potency and clinical result for the approved treatment indication.[4] There are currently four FDA-approved infliximab biosimilars in the United States: infliximab-dyyb, infliximab-abda, infliximab-qbtx and infliximab-axxq.

Due to safety considerations, both the infliximab reference product and infliximab biosimilars are approved for infusion over a 120 min interval. A number of studies have demonstrated that rapid infusions (≤ 60 min) of reference infliximab are not associated with an increased risk of infusion reactions.[5–7] Shorter infusion administration times provide cost-saving opportunities for centres by increasing the number of available appointments, and may improve patient experience by reducing the amount of time spent at the facility.[8] Increased use of biosimilar infliximab provides potential cost-savings for institutions as well.[9] The safety of rapid infusions for infliximab biosimilar agents is largely unknown, and further assessment of rapid infliximab biosimilar infusions is needed to determine the safety of this practice.[5,10]

The purpose of this study was to evaluate the incidence and severity of infusion reactions among patients with IBD receiving rapid infusion of infliximab reference product compared with infliximab biosimilar. Secondarily, we sought to further evaluate the incidence and severity of infusion reactions in patients receiving standard infusion infliximab and infliximab biosimilars, as well as rapid and standard infusion of infliximab biosimilars.

2 | METHODS

The University of Vermont Medical Center (UVMMC) outpatient gastroenterology clinic implemented a new protocol in February 2021 to permit rapid infusions (60 min) of infliximab biosimilars in addition to allowing rapid infusions of infliximab reference product at the institution's onsite infusion centre. Per this protocol, a patient newly starting on treatment must receive and tolerate four infusions of infliximab or infliximab biosimilar at the standard infusion length of 120 min before being eligible to receive a rapid infusion. If patients were switched from one infliximab product to another, this protocol additionally

requires the first infusion of the new product to be administered over 120 min before reducing the infusion time to 60 min for future infusions. Currently, UVMMC has infliximab, infliximab-dyyb and infliximab-abda on hospital formulary.

This was a retrospective cohort study of electronic health record data (Epic). Eligible patients were defined as adults 18 years or older with a diagnosis of IBD, including ulcerative colitis (UC), Crohn's Disease (CD), or indeterminate colitis who received at least 1 infusion of infliximab, infliximab-dyyb or infliximab-abda between December 2020 and December 2021. There were no exclusions.

Patient-level data included age, gender identity, race, insurance, smoking status, IBD duration, immunomodulator use, hospitalizations for IBD flares, and infliximab trough and antibody levels. Infusion-related variables included total infusions, drug, dose, dosing interval, infusion time, and use of pre-medications. Infusion-related reactions were defined as anaphylaxis, shortness of breath, hypotension, swelling, rash, pruritus, hives, flushing, chest pain, muscle pain, joint pain, fevers, chills, headache, or hypertension recorded by the infliximab-administering nurse in the electronic medical record or documentation of administration of emergency medications. Data were collected by manual chart review and managed using REDCap electronic data capture tools hosted at the University of Vermont.[11,12] This study was approved as exempt research by the University of Vermont Committee on Human Research.

The primary outcome was the incidence of infusion reactions between rapid infusion of infliximab biosimilars compared with infliximab reference product. This was assessed by reviewing the chart infusion encounter for nurse documentation for presence of infusion-related reactions and also the medication administration record (MAR) for use of emergency medications. Secondary outcomes included the severity of infusion reactions between rapid infusion of infliximab biosimilars and infliximab reference product, and comparison of the incidence and severity of infusion reactions between rapid infusion of infliximab biosimilars and standard infusion of infliximab biosimilars. Baseline characteristics of categorical and continuous variables were analysed descriptively. Analysis of primary and secondary outcomes were conducted using Fisher's Exact Test. Analyses were conducted using STATA 16.1 (Stata Corporation, College Station, TX), with $p < 0.05$ required for statistical significance.

TABLE 1 Patient demographics and disease characteristics

Characteristic	N	(%)
Total patients	188	(100)
Mean age (SD)	33.4	(16.3)
Gender Identity (% male or identify as male)	87	(46.3)
Caucasian	180	(95.7)
Insurance		
Commercial	123	(65.4)
Medicaid	38	(20.2)
Medicare, dual eligible, no insurance, other	27	(14.4)
Smoking status[a]		
Current	23	(12.4)
Former	45	(24.2)
Never	118	(63.4)
Inflammatory bowel disease (IBD) diagnoses		
Crohn's disease	129	(68.6)
Ulcerative colitis	53	(28.2)
Indeterminate colitis	6	(3.2)
Years since diagnosis (from 2021), median (IQR)	5	(0–28)
Hospitalization for flare during study interval, # (%)	38	(20.2)
Concomitant IBD medication use		
Azathioprine	7	(3.7)
Prednisone	6	(3.2)
Mesalamine—oral	4	(2.1)
Mercaptopurine	3	(1.6)
Methotrexate	2	(1.1)
Other[b]	5	(2.7)
Labs, if available		
Infliximab trough level (mcg/ml), median (IQR); $N = 105$	11	(5.2–17)
Infliximab antibody level (U/ml), median (IQR); $N = 29$	0	(0–32.5)
CRP (mg/L), median (IQR); $N = 92$	7.4	(0–157.1)
Faecal calprotectin (mcg/g), median (IQR); $N = 25$	463	(57.2–1000)

[a]$N = 186$, as two people were missing smoking status from their electronic health record.
[b]Budesonide, mesalamine suppositories, sulfasalazine.

3 | RESULTS

A total of 188 patients were included in analysis who received a total of 1124 infusions. The majority of patients were white males, with a

TABLE 2 Treatment characteristics for patients with switches in their infliximab therapy ($n = 188$)

Switches in infliximab therapy (%)	N	(%)
No switches		
Infliximab	148	(78.7)
Infliximab-dyyb	13	(6.9)
Infliximab-abda	16	(8.5)
1 Switch		
Infliximab to Infliximab-dyyb	9	(4.8)
Infliximab to Infliximab-abda	1	(0.5)
2 Switches		
Infliximab to Infliximab-dyyb to Infliximab	1	(0.5)

TABLE 3 Infusion characteristics

Characteristic	All infusions		Infliximab		Infliximab-abda		Infliximab-dyyb	
	N	(%)	*N*	(%)	*N*	(%)	*N*	(%)
Total infusions	1124	(100)	935	(83.2)	100	(8.9)	89	(7.9)
Dose, (mg), mean ± SD (range)	579.8 ± 238.2	(300–2200)	588.8 ± 247.5	(300–2200)	541.0 ± 153.1	(300–1000)	528.1 ± 205.0	(300–1100)
Mean administration time, (minutes), mean ± SD (range)	82.8 ± 30.3	(7–285)	79.0 ± 28.8	(50–285)	97.0 ± 32.8	(7–213)	106.5 ± 27.3	(60–180)
Infusions ordered as 60 min	763	(67.9)	695	(91.1)	44	(5.8)	24	(3.2)
Infusions ordered as 120 min	360	(32.1)	240	(66.7)	55	(15.3)	65	(18.1)
Pre-infusion medications								
Acetaminophen	675	(60.1)	551	(58.9)	60	(60.0)	64	(71.9)
Diphenhydramine	521	(46.4)	421	(45.0)	57	(57.0)	43	(48.3)
Methylprednisolone	76	(6.8)	65	(7.0)	0	(0.0)	11	(12.4)
Loratadine	12	(1.1)	8	(0.9)	0	(0.0)	4	(4.5)
Prednisone	2	(0.2)	2	(0.2)	2	(0.0)	2	(0.0)
None	382	(34.0)	321	(34.3)	38	(38.0)	23	(25.8)
Emergency Medications Used[a]	3	(0.3)	2	(0.2)	1	(1.0)	0	(0.0)
Infusion Reactions Present[b]	8	(0.7)	5	(0.5)	2	(2.0)	1	(1.1)

[a]Emergency medications included epinephrine, diphenhydramine, methylprednisolone, famotidine or prednisone.
[b]Infusion reactions included anaphylaxis, shortness of breath, rash, flushing, chest pain, hypertension, hypotension, fever.

mean age of 33.4 years with a diagnosis of Crohn's Disease (Table 1). Few patients were treated with an immunomodulator in combination with infliximab, with azathioprine as the most common concomitant IBD medication (3.7%).

The majority of patients received only infliximab reference product (78.7%, Table 2). Most patients (94.1%) did not undergo a switch in their infliximab therapy (e.g., reference product to biosimilar) during the study time frame and only one patient had multiple switches among infliximab products.

Infusion-level characteristics are reported in Table 3. The mean administration time across all infusions was 82.8 ± 30.3 min and the majority of orders were placed as 60-min infusions (67.9%) versus 120 minutes (32.1%). The mean dose across all infusions was 579.8 ± 238.2 mg. The majority of patients received pre-medications across all infusions, with acetaminophen (60.1%) and diphenhydramine (46.4%) being the most frequently administered.

There were no statistically significant differences among any of the pre-specified outcomes comparing the incidence or severity of infusion safety issues between rapid or standard infusions of infliximab products. There were no differences in the incidence of infusion reactions among rapid infusion infliximab, and infliximab biosimilars ($p = 0.863$). Additionally, there were no differences in the incidence of infusion reactions among standard infusion infliximab, and infliximab biosimilars ($p = 0.993$). Finally, there were no differences among the rate of infusion reactions between rapid infusion of infliximab biosimilars and standard infusion of infliximab biosimilars ($p = 0.536$). There were eight patients who experienced safety issues, defined as events documented in nursing notes or requiring emergency medicine administration (Table 4). Five safety issues occurred in patients receiving infliximab, two in patients receiving infliximab-abda, and one in a patient receiving infliximab-dyyb. The safety issues included anaphylaxis (one patient), chest pain, hyper/hypotension, shortness of breath, and rash. Half of the safety issues occurred during the first two infusions of infliximab or biosimilar, therefore patients received these infusion over 120 min per our clinic's protocol. Emergency medications were required in three patients (1.6% of all 188 patients).

4 | DISCUSSION

This study found no differences in the incidence or severity of infusion reactions between rapid infusion of infliximab biosimilars and infliximab reference product. The results of this study further demonstrate the safety of infliximab biosimilar products by confirming a low number of infusion reactions and safety issues under real-world clinical conditions in our patient population. Of the infusion safety concerns captured during our study period, five of the eight safety issues were unlikely caused by the infliximab or biosimilar infusion, and were caused instead by other factors such as anxiety regarding the infusion process, stress or dehydration. The three infusion safety issues that

TABLE 4 Infusion safety concerns

Product	Infusion time (min)	Pre-medications administered[a]	Reaction(s)	Emergency medications administered	Description
Infliximab	60	APAP, diphenhydramine	Chest pain	Famotidine	Infusion paused due to patient's report of pain below the sternum, radiating to the back and with breathing. Patient was administered famotidine and infusion was restarted and completed. Infliximab was continued without further noted reactions.
Infliximab	60	APAP, diphenhydramine	Chest pain	None	30 min after infusion started, patient reported chest heaviness. Nurse assessed and vital signs were stable. Infusion held for 10 min, patient's symptoms resolved and then infusion was restarted and completed. Infliximab subsequently discontinued due to presence of anti-drug antibodies.
Infliximab	120	APAP, diphenhydramine	Shortness of breath, rash, flushing, fever	Diphenhydramine, methylprednisolone	Nurse noted patient was anxious, feverish, shaking with ears red, reported chest pressure and shortness of breath. Infliximab restarted at slower rate after administration of emergency medications, which patient tolerated with no further reactions. Infliximab infusions continued with no noted reactions with other infusions.
Infliximab	120	APAP, diphenhydramine	Chest pain	None	23 min after infusion started, patient reported chest pressure, tightness in throat and difficulty breathing. Infusion stopped and was not resumed. Subsequently discontinued due to presence of anti-drug antibodies. Patient had previously received infliximab in 2018.
Infliximab	120	Methylprednisolone	Rash	None	Patient reported rash after infliximab infusions were given during hospitalization for UC flare. Infliximab was not continued due to concerns for rash as well as lack of insurance coverage.
Infliximab-abda	120	APAP, diphenhydramine	Anaphylaxis, flushing, chest pain, hypertension	Epinephrine, prednisone, famotidine	7 min after infusion started, patient experienced flushing, chest pressure, and swelling of her throat. Patient was transported to the ED for further evaluation and assessed to have an allergic reaction to infliximab-abda, which was subsequently discontinued.
Infliximab-abda	120	APAP, diphenhydramine,	Hypotension	None	Hypotension (80/51 mmHg) noted after completion of infusion. Per nurse notes, patient was asymptomatic and has history of low blood pressure and reported possible dehydration.
Infliximab-dyyb	120	None	Hypertension	None	Nurse noted blood pressure was elevated at end of infusion (184/78 mmHg). Patient felt asymptomatic and hypertension may have been related to stress rather than infusion. Infliximab continued.

[a]APAP = acetaminophen.

were likely related to infusion of the infliximab or biosimilar product, an overall very low number of total infusions, all resulted in subsequent discontinuation of the medication.

There are multiple clinical considerations that may impact the likelihood of an infusion reaction to infliximab. The majority of patients utilized pre-medications, which are given to reduce the risk of infusion reactions. The infliximab reference product group experienced the majority of infusion-related reactions, however, the premedication use was similar between infliximab reference and infliximab biosimilar patients. This suggests that premedication may not have had an impact on whether a patient developed an infusion-related reaction. This is supported by previous literature that has also shown no impact of premedication use on infusion reactions with reference product infliximab.[7,13]

An additional clinical consideration that may impact a patient's risk of infusion reactions is use of immunomodulators in addition to infliximab. There was low utilization of immunomodulator use in our patient population. This is a key difference from other literature evaluating rapid infusions of infliximab biosimilars, in which 21% and 19% of patients were on mercaptopurine and methotrexate, respectively.[10] There are data to suggest that combination therapy with an immunomodulator and anti-TNF therapy reduces the risk of antibody formation, also known as immunogenicity.[14] Therefore, our results support the safety and tolerability of infliximab reference and biosimilar at rapid infusion intervals, even in the absence of concurrent treatment with immunomodulators.

Another unique parameter, compared with similar literature, that was collected in this study was infliximab trough and antibody levels.[10] Therapeutic drug monitoring can be used to assess response and efficacy of infliximab, as well as immunogenicity.[15] Although there is no universally agreed upon therapeutic range for infliximab trough levels for the treatment of IBD, the median trough for patients included in this analysis was 11 mcg/ml (range 5.35–17 mcg/ml, Mayo Clinic Laboratories). This suggests that patients achieved therapeutic levels based on recommendations from the AGA for therapeutic drug monitoring for infliximab.[16] Additionally, 29 patients had infliximab antibody levels in our analysis, with an interquartile range of 0 to 32.5 U/ml. Although more data are needed to identify optimal cutoffs for high- versus low-titre antibodies and standardization is lacking between assays used by different laboratories, our laboratory assay reports the presence of antibodies to infliximab as positive when concentrations are ≥50 U/ml.[17] This suggests that most patients did not experience the development of high-titre antibody levels over the course of our study interval.

There are several limitations to note. This was a single centre, retrospective study, limited by a small sample size. Our chart review may have omitted some infusions of infliximab or biosimilar that were administered during inpatient admissions, and may be missing documentation of infusion reactions if they occurred during a patient's hospitalization. Additionally, the primary and secondary outcomes were reliant on the accuracy of documentation in the medication administration record and nursing notes, which may be subject to documentation or omission errors. Due to formulary restrictions at our institution, we were not able to evaluate all commercially available infliximab biosimilars. Lastly, this paper lacks a causality assessment, which would provide additional insight on whether the infusion related reactions reported in our study could be more confidently attributed to the infliximab product administered, versus other factors.

Overall, our findings support the safety and tolerability of rapid infusion of infliximab biosimilars (infliximab-abda and infliximab-dyyb). These findings may contribute to infliximab biosimilar infusion interval policy development, and help to conserve clinic time and resources, while increasing patient satisfaction and quality of life.

5 | WHAT IS NEW AND CONCLUSIONS

Rapid infusions of infliximab biosimilars were not associated with an increase in the incidence of infusion reactions compared with: rapid infusion of infliximab reference product, standard infusion of infliximab biosimilars or standard infusion of infliximab reference product. The overall incidence of infusion reactions between all infliximab products was low. This study adds to growing evidence that rapid infusions (≤ 60 min) of infliximab biosimilars are safe and well-tolerated.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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REFERENCES

1. Infliximab. *Package Insert*. Centocor Ortho Biotech Inc.; 2011.
2. Feuerstein JD, Ho EY, Shmidt E, et al. American Gastroenterological Association Institute clinical guidelines committee. AGA clinical practice guidelines on the medical management of moderate to severe luminal and perianal Fistulizing Crohn's disease. *Gastroenterology*. 2021;160(7):2496-2508.
3. Feuerstein JD, Isaacs KL, Schneider Y, et al. AGA clinical practice guidelines on the management of moderate to severe ulcerative colitis. *Gastroenterology*. 2020;158(5):1450-1461.
4. Biological Product Definitions, U.S. Food and Drug Administration. Accessed September 4, 2021. https://www.fda.gov/files/drugs/published/Biological-Product-Definitions.pdf
5. Buch MH, Bryer D, Lindsay S, Rees-Evans B, Fairclough A, Emery P. Shortening infusion times for infliximab administration. *Rheumatology (Oxford)*. 2006;45(4):485-486.
6. Neef HC, Riebschleger MP, Adler J. Meta-analysis: rapid infliximab infusions are safe. *Aliment Pharmacol Ther*. 2013;38(4):365-376.
7. Lee TW, Singh R, Fedorak RN. A one-hour infusion of infliximab during maintenance therapy is safe and well tolerated: a prospective cohort study. *Aliment Pharmacol Ther*. 2011;34(2):181-187.
8. Viola A, Costantino G, Privitera AC, et al. Clinical and economic impact of infliximab one-hour infusion protocol in patients with inflammatory bowel diseases: a multicenter study. *World J Gastrointest Pharmacol Ther*. 2017;8(2):131-136.

9. Gulacsi L, Pentek M, Rencz F, et al. Biosimilars for the management of inflammatory bowel diseases: economic considerations. *Curr Med Chem*. 2019;26(2):259-269.
10. Kim JY, Bhat S. Safety of rapid infliximab biosimilar infusions in patients with inflammatory bowel disease. *Ann Pharmacother*. 2022;56(3):280-284.
11. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;42(2):377-381.
12. Harris PA, Taylor R, Minor BL, et al. REDCap consortium the REDCap consortium: building an international community of software platform partners. *J Biomed Inform*. 2019;95:103208.
13. Picoraro J, Winberry G, Siegel CA, et al. Premedication use before infliximab administration: a cross-sectional analysis. *Inflamm Bowel Dis*. 2017;23(1):174-180.
14. Garcês S, Demengeot J, Benito-Garcia E. The immunogenicity of anti-TNF therapy in immune-mediated inflammatory diseases: a systematic review of the literature with a meta-analysis. *Ann Rheum Dis*. 2013;72(12):1947-1955.
15. Syversen SW, Goll GL, Jørgensen KK, et al. Therapeutic drug monitoring of infliximab compared to standard clinical treatment with infliximab: study protocol for a randomised, controlled, open, parallel-group, phase IV study (the NOR-DRUM study). *Trials*. 2020;21(1):13.
16. Feuerstein JD, Nguyen GC, Kupfer SS, Falck-Ytter Y, Singh S. American Gastroenterological Association Institute clinical guidelines committee. American Gastroenterological Association Institute guideline on therapeutic drug monitoring in inflammatory bowel disease. *Gastroenterology*. 2017;153(3):827-834.
17. Mayo Clinic Laboratories Rochester. Accessed July 15, 2022. https://testcatalog.org/show/INFXR.

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