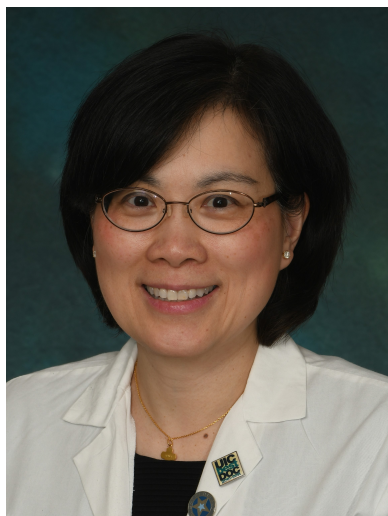


7/29/2023 12:00 am

Diabetic Retinopathy Symposium 1**Detection of Early Diabetic Retinopathy Using OCTA Bloodflow Analysis**

- Jennifer Lim, MD, FARVO, FASRS
- Albert Dadzie, OD
- David Le, BS
- Mansour Abtahi, PhD
- Behrouz Ebrahimi
- Taeyoon Son, PhD
- Xincheng Yao, PhD

Objective: Does the quantitative evaluation of bloodflow on OCTA imaging allow for early detection of diabetic retinopathy?

Purpose: To determine whether quantitative analysis of bloodflow based on OCTA images can detect early diabetic retinopathy (DR).

Methods: We performed a retrospective, IRB approved, OCTA imaging study to compare the bloodflow parameters of diabetic patients without diabetic retinopathy (NoDR), diabetic patients with mild nonproliferative DR (mild NPDR) and healthy controls. Inclusion criteria included good image quality, 6 mm x 6 mm scans and foveal centration. A thresholding algorithm was used to remove noise from OCTA images. Enface projections of the superficial vascular plexus (SVP) and the deep capillary plexus (DCP) were used to determine blood flow index (BFI) values for SVP and for DCP. Normalized BFI (NBFI) was calculated by dividing BFI by the standard deviation of the noise removed. NBFI thus compensated for noise from variable pigmentation and illumination irradiance that could affect quantification of BFI. BFI and NBFI of the SVP and DCP were compared for all three groups (control, NoDR, mild NPDR). Multiple group comparisons were performed using one-way ANOVA or Kruskal–Wallis one-way ANOVA. Corresponding individual comparisons were performed using Student's t-test or Mann-Whitney's t-test.

Results: A total of 77 eyes, 47 diabetic eyes (21 eyes from 15 diabetic patients with NoDR and 26 eyes from 22 patients with mild NPDR) and 30 control eyes (20 healthy subjects), underwent OCTA BFI and NBFI analyses. BFI of the DCP could differentiate between control vs mild NPDR ($p=0.0002$) and between NoDR vs mild NPDR ($p=0.0140$). NBFI of the SVP could differentiate all three groups from each other (ANOVA, $p<0.0001$) and between control vs mild NPDR ($p<0.0001$), NoDR vs mild NPDR ($p=0.0002$). NBFI of the DCP could differentiate all three groups from each other (ANOVA, $p<0.0001$) and between control versus NoDR ($p=0.0416$), control vs mild NPDR ($p=0.0093$) and NoDR vs mild NPDR ($p<0.0001$).

Conclusion: Quantitative OCTA analysis using NBFI of the SVP and the DCP is a useful OCTA biomarker that can detect early DR. NBFI of the DCP is the most sensitive bloodflow parameter to distinguish NoDR, mild NPDR and control eyes from one another.

IRB APPROVAL Yes

7/29/2023 12:00 am

Diabetic Retinopathy Symposium 1**Retinal Nonperfusion on Widefield OCTA in Determining Diabetic Retinopathy Severity**

- Kiyoun Kim, MD, PhD
- Seung-Young Yu, MD
- Jong Beom Park

Objective: To generate prediction model for the five severity stages of diabetic retinopathy (DR) based on retinal neurodegeneration and microvascular changes detected by OCT and OCT-Angiography.

Purpose: Whether anti-VEGF could aggravate retinal ischemia remains controversial. Some studies reported the worsening of the macular perfusion index, represented as the increase of FAZ area and the decrease of blood flow density after injection. However, an increasing number of studies reported that anti-VEGF treatment does not aggravate retinal ischemia, and even promote reperfusion.

Methods: A cross-sectional study involved 155 diabetic patients. Macular ganglion cell/inner plexiform layer (mGCIPL) thickness in 6 macular regions was measured using OCT. A custom, semiautomatic software algorithm was used to calculate capillary nonperfusion area (NPA) from 3x3mm and 12x12mm field SS-OCTA images. Region of interests was selected as circular area of 3mm and 12mm diameter centered at the fovea and divided into six sub-sections. The classification and regression tree (CART) analysis was used to identify the best predictors to discriminate five stages of DR severity.

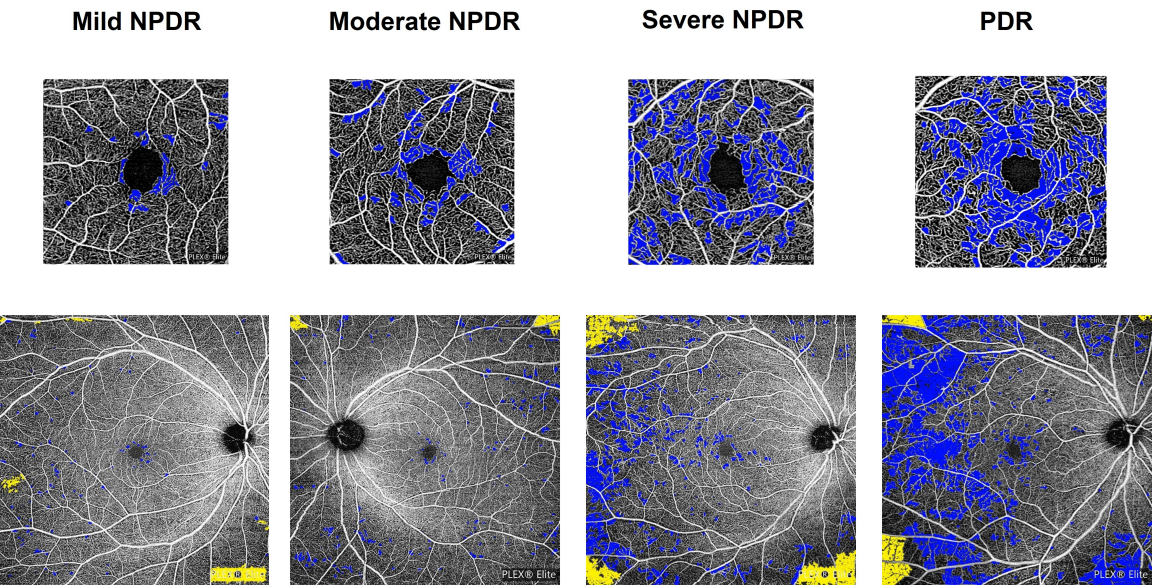
To evaluate effect of anti-VEGF on midperipheral retina, we studied 31 patients with DME who received 3 monthly anti-VEGF injection followed by PRN regimen. Our Imaging modality was SS-OCTA of 12x12 field scan. We divided subjects into 3 groups: aggravation, stable, or improvement group, according to the changes of NPA after 3-loading injection.

Results: All eyes were classified into five stages based on ETDRS severity grading. Mean NPA was the largest in inferotemporal sector and NPA from inferior hemispheric field was significantly larger than superior hemispheric 12 x 12mm field. Mean mGCIPL thickness were significantly correlated with NPA from 12x12mm field in subjects with early stage of DR. The CART method identified that inferior hemispheric NPA from 12x12mm field and average mGCIPL thickness are two variables to discriminate No DR vs mild NPDR (Accuracy: 88.8%) and mild vs moderate NPDR (Accuracy: 93.5%). With the optimal combination of average NPA from 12x12mm and 3x3mm field, moderate vs severe NPDR (Accuracy: 91.8%) and severe NPDR vs PDR (Accuracy: 94.1%) are determined.

In the result, about 30% patients showed worsening of NPA after injection. Interestingly, visual acuity at 2 years was not different between three groups. However, the total number of injection for 2 years was significantly greater in aggravation groups compared to others.

Conclusion: Capillary nonperfusion may initially occurs in mid-peripheral area in conjunction with macular neurodegeneration and progressed posteriorly with an increase in DR severity. Optimal combination of NPA from OCTA and mGCIPL thickness could be a novel strategy for determining DR severity. We can also conclude that a worsening of midperipheral NPA after anti-VEGF injection is associated with more frequent further injections in DME.

IRB APPROVAL Yes



Representative images of different stages of DR with NPA marking



Aggravation and improvement of NPA after anti-VEGF injection

7/29/2023 12:00 am

Diabetic Retinopathy Symposium 1**National Cohort Study on New Oral Hypoglycemic Agents in Diabetic Retinopathy Progression**

- Ehsan Rahimy, MD
- Karen Wai, MD
- Cassie Ludwig, MD, MS
- Aneesha Ahluwalia
- Ravi Parikh, MD
- Euna Koo, MD
- Prithvi Mruthyunjaya, MD, MHS

Objective: Within a large real-world database population, diabetic patients on GLP-1 agonists were found to have increased conversion rates to proliferative diabetic retinopathy, but similar rates of surgical vitrectomy compared to patients on SGLT-2 inhibitors.

Purpose: Newer oral hypoglycemic agents such as glucagon-like peptide-1 receptor (GLP-1) agonists and sodium-glucose cotransporter-2 (SGLT-2) inhibitors have been increasingly utilized in management of glycemic control in diabetes. However, little is known on the effects of these novel hypoglycemic agents on diabetic retinopathy (DR). Our study aims to assess the relationship between usage of next generation oral hypoglycemic agents and effect on DR.

Methods: We conducted a retrospective cohort study using the TriNetX research network (Cambridge, MA, USA), which is a federated electronic records research network that aggregates data from large health organizations within the United States. Patients with non-proliferative DR (NPDR) were identified by ICD 9 or 10 codes and stratified by monotherapy with GLP-1 agonist use or SGLT-2 inhibitor use. Patients with use of other oral hypoglycemics such as metformin or dipeptidyl peptidase-4 inhibitors within three months prior to initiation or within the study period were excluded. Cohorts were matched for age, gender, race, and baseline HbA1c level. The primary outcome was conversion to proliferative diabetic retinopathy (PDR) and need for pars plana vitrectomy (PPV). Outcomes were examined at one and five years after initiation of the hypoglycemic agent and were compared after propensity score matching.

Results: A total of 8850 patients were included in the analysis with 4425 patients in each of the GLP-1 and SGLT-2 cohorts after propensity matching. The average age was 64.0 years vs. 63.8 years and average HbA1c was 8.5% vs 8.5% in the GLP-1 and SGLT-2 groups after matching, respectively. At one and five years after initiation of the oral hypoglycemic agent, the GLP-1 group had higher rates of conversion to PDR relative to the SGLT-2 group (4.0% vs. 3.0%, $p<0.01$ for one year; 6.2% vs 4.0%, $p<0.01$ for five years). The GLP-1 agonist group had similar rates of vitrectomy surgery relative to the SGLT-2 inhibitor group (0.7% vs. 0.7%, $p=0.90$ for one year; 1.1% vs 0.9%, $p=0.28$ for five years). The average HbA1c decreased in both the GLP-1 and SGLT-2 groups from baseline (7.9% vs 8.1%, $p<0.01$ at one year; 7.9% vs 8.1%, $p<0.01$ for five years).

Conclusion: Within a large real-world database, patients on GLP-1 agonists were found to have increased conversion rates to PDR, but similar rates of PPV compared to patients on SGLT-2 inhibitors. The transient worsening of retinopathy may be related to rapid control of glucose levels. Clinicians should be aware of these effects when initiating treatment with hypoglycemic agents to ensure appropriate monitoring for DR.

IRB APPROVAL No - no IRB

7/29/2023 12:00 am

Diabetic Retinopathy Symposium 1**Systemic Adverse Events in Patients With Diabetes Treated With Intravitreal Antivascular Endothelial Growth Factor Injections**

- Roomasa Channa, MD

Objective: Explore the systemic safety of intravitreal anti-vascular endothelial growth factor (VEGF) agents among patients with diabetes mellitus (DM).

Purpose: Antivascular endothelial growth factor (VEGF) agents are currently the mainstay of treatment for diabetes related retinal disease. Although effective, data on their systemic safety remains inconclusive, particularly in high-risk patient groups.

Methods: Design: Retrospective, longitudinal analysis of the Corporate Data Warehouse, a large-scale database of patients within the Veteran Health Affairs.

Setting: Population-based.

Participants: All patients aged ≥ 18 years with type 2 diabetes mellitus (DM) who were seen at any VA health-care facility in the United States between January 1st, 2011-December 31st, 2012, were identified. We then extracted data on incident systemic adverse events (AEs) among this patient cohort from January 1st, 2013-December 31st, 2017. All individuals with (DM) who did and did not receive anti-VEGF injections were included. Patients with history of prior systemic AEs and those who received an intravitreal injection between January 1, 2011 to December 31, 2012 were excluded.

Exposure(s): Anti-VEGF injection administration.

Main Outcome(s) and Measure(s): Proportion of patients with any incident SAE, acute MI, CVD and KD at 1-, 3- and 5-year of follow-up.

Results: A total of 1,731,782 patients with Type 2 DM were included. DR was present in 27.5% of veterans and 14,022 (0.8%) received anti-VEGF injections. Of the total number of patients with T2DM, 321,940 (18.6%) developed systemic AEs between 2013-2017. The 5-year cumulative incidence of any SAE was 37.0% ($n=5,187/14,022$) in the injection group versus 18.4% ($n=316,753/1,717,760$) in the non-injection group ($p<0.0001$). Anti-VEGF injections were independently associated with a higher likelihood of developing any systemic AE (OR and 95% CI: 1.9 (1.8-2.0) while controlling for age, race, gender, ethnicity, tobacco use, severity of DR, DCCI score, mean A1c, total number of injections and statin use.

Conclusion: Intravitreal anti-VEGF injections were independently associated with a higher likelihood of systmic AEs among this group of patients with diabetes.

IRB APPROVAL Yes

7/29/2023 12:00 am

Diabetic Retinopathy Symposium 1

Aflibercept 8 mg for Diabetic Macular Edema: 48-Week Results of the Phase 2/3 PHOTON Trial



- Diana Do, MD, FASRS

Objective: To evaluate the efficacy and safety of aflibercept 8 mg vs 2 mg in patients with diabetic macular edema (DME).

Purpose: To determine whether aflibercept 8 mg demonstrates comparable efficacy and safety to aflibercept 2 mg.

Methods: PHOTON (NCT04429503) is an ongoing, double-masked, 96-week, non-inferiority trial that randomized patients with DME to receive aflibercept 8 mg every 12 or 16 weeks after 3 monthly doses (8q12 [n=328] or 8q16 [n=163]) or aflibercept 2 mg every 8 weeks after 5 monthly doses (2q8; n=167). Beginning at Week 16, patients in the 8q12 or 8q16 groups received aflibercept 8 mg in shorter intervals if they met prespecified dose regimen modification criteria denoting disease activity. The primary endpoint was the mean change from baseline in BCVA at Week 48; the key secondary endpoint was the proportion of patients with ≥ 2 -step improvement in DRSS score at Week 48. The mean change from baseline in total fluorescein leakage area at Week 48 per reading center was evaluated as an exploratory endpoint.

Results: Mean BCVA change from baseline at Week 48 was +9.2, +8.8, and +7.9 letters with 2q8, 8q12, and 8q16, respectively (95% CI for 8q12 vs 2q8: -2.26, 1.13; 95% CI for 8q16 vs 2q8: -3.27, 0.39). The proportion of patients with ≥ 2 -step improvement from baseline in DRSS score was 27%, 29%, and 20% with 2q8, 8q12, and 8q16, respectively (95% CI for 8q12 vs 2q8: -6.61, 10.57; 95% CI for 8q16 vs 2q8: -16.88, 1.84). Through Week 48, 91% (8q12) and 89% (8q16) of patients maintained their original randomized dosing interval with no shortening, and in the 8 mg-combined group, 93% of patients maintained a dosing interval ≥ 12 weeks. The mean change from baseline in total fluorescein leakage area at Week 48 was -9.2, -13.9, and -9.4 mm² with 2q8, 8q12, and 8q16, respectively. Safety outcomes for aflibercept 8 mg and 2 mg were similar through Week 48.

Conclusion: Aflibercept 8 mg met the primary efficacy endpoint, demonstrating non-inferiority in BCVA vs aflibercept 2 mg, with no new safety signals through 48 weeks. The vast majority of patients maintained extended ≥ 12 -week dosing (93% in 8 mg-combined) and 16-week dosing (89% in 8q16). Overall, aflibercept 8 mg provides greater therapeutic benefit, an expanded injection interval, and equivalent safety vs aflibercept 2 mg.

IRB APPROVAL Yes

7/29/2023 12:00 am

Diabetic Retinopathy Symposium 1**Intravitreal Aflibercept 8 mg for Diabetic Macular Edema: Week 48 Efficacy Outcomes by Baseline Demographics in the Phase 2/3 PHOTON Trial**

Andres Emanuelli, MD

Objective: To evaluate the treatment effects of aflibercept 8 mg versus 2 mg at Week 48 in patients with diabetic macular edema (DME) by baseline demographics.

Purpose: To determine whether visual improvements achieved with aflibercept 8 mg versus 2 mg were comparable across several patient subgroups in the PHOTON trial.

Methods: PHOTON (NCT04429503) is an ongoing, double-masked, 96-week, non-inferiority trial that randomized patients with DME to receive aflibercept 8 mg every 12 or 16 weeks after 3 monthly doses (8q12 [n=328] or 8q16 [n=163]) or aflibercept 2 mg every 8 weeks after 5 monthly doses (2q8 [n=167]). The treatment effects of 8q12 and 8q16 versus 2q8 on the primary endpoint, the mean change from baseline in best-corrected visual acuity (BCVA) at Week 48, were evaluated by baseline demographics (sex, age, race, and ethnicity).

Results: Mean BCVA change from baseline at Week 48 with 2q8, 8q12, and 8q16, respectively, was +8.7, +8.4, and +8.3 letters in male patients (n=401); +9.8,

+9.6, and +7.2 letters in female patients (n=257); +13.0, +10.2, and +11.1 letters in patients aged <55 years (n=144); +10.3, +8.0, and +7.1 letters in patients aged ≥55-<65 years (n=225); +6.9, +9.2, and +7.0 letters in patients aged ≥65-<75 years (n=218). The results were generally comparable by race (White [n=471]: +9.3, +9.5, and +8.3 letters; Asian [n=101]: +7.3, +5.9, and +6.6 letters) and ethnicity (Hispanic or Latino [n=119]: +8.9, +8.3, and +7.6 letters; non-Hispanic or Latino [n=525]: +9.4, +8.8, and +7.9 letters). Select subgroups (≥75 years and Black or African American) could not be evaluated due to small sample size.

Conclusion: Aflibercept 8 mg achieved meaningful BCVA gains from baseline at Week 48 in patients with DME across evaluable subgroups of sex, age, race, and ethnicity.

IRB APPROVAL Yes

7/29/2023 12:00 am

Diabetic Retinopathy Symposium 1

Impact of Initial Monthly Doses of Aflibercept on Visual Outcomes in Eyes With Diabetic Macular Edema in Routine Clinical Practice in the US



- Ferhina Ali, MD, MPH
- Nitish Mehta, MD
- Rishi Singh, MD
- Nick Boucher
- Fabiana Silva, MD
- Rutvi Desai, OD
- Steven Sherman, MPH

Objective: To evaluate the factors associated with initial monthly dosing of intravitreal aflibercept injections (IAI) and the impact on visual outcomes in patients with diabetic macular edema (DME).

Purpose: In routine clinical practice, patients treated with IAI may not receive the recommended prescribed initial dosing. Understanding the factors associated with initial monthly dosing of IAI and the impact on outcomes may inform clinical decision making.

Methods: This retrospective analysis assessed electronic medical records from a large US database (Vestrum Health) for eyes newly diagnosed with DME from January 2015 to June 2021 who received IAI as first-line anti-VEGF therapy and had ≥ 18 weeks of follow-up (initial monthly dosing period [IMDP]). Eyes that switched to another drug during the IMDP were excluded. Logistic regression was used to evaluate baseline (BL) factors predictive of receiving ≥ 4 injections in the IMDP, as well as of ≥ 5 -, ≥ 10 - or ≥ 15 -letter best-corrected visual acuity (BCVA) gains at 12 months. IAI doses received during the IMDP were analyzed by tertiles (T1: 1-2; T2: 3; T3: ≥ 4 injections).

Results: A total of 23,962 eyes were included (T1, n=7781; T2, n=6922; T3, n=9259). BL factors predictive of receiving ≥ 4 injections (all $P < 0.05$) during the IMDP included: type 2 diabetes vs type 1 diabetes, BL BCVA $< 20/40$ vs $\geq 20/40$, CST ≥ 300 μm vs < 300 μm , presence of intraretinal fluid or subretinal fluid, DME and diabetic retinopathy (DR) diagnosed simultaneously at BL vs < 1 year from DR diagnosis, and severe nonproliferative DR (NPDR) vs moderate NPDR (Table 1). Among a subset of 9457 eyes with BCVA data at 12 months (T1, n=2637; T2, n=2615; T3, n=4205), the proportions of eyes gaining ≥ 5 -, ≥ 10 -, and ≥ 15 letters increased from T1 to T3. Predictors of ≥ 15 -letter gains at 12 months (all $P < 0.05$) included age < 65 vs 75-79 years, BCVA $< 20/40$ vs $\geq 20/40$, receiving ≥ 4 vs 1-2 injections during the IMDP, post-IMDP injection count, and severe vs moderate NPDR (Table 2). Results for ≥ 5 - and ≥ 10 -letter gains were similar.

Conclusion: Several clinical and demographic factors were associated with receiving ≥ 4 IAI doses in the IMDP. In particular, eyes with baseline BCVA of $< 20/40$ vs $\geq 20/40$ were more likely to receive ≥ 4 injections. Among other factors, eyes receiving ≥ 4 vs 1-2 initial monthly doses were more likely to gain ≥ 5 -, ≥ 10 -, and ≥ 15 letters at 12 months, suggesting more frequent IAI treatment during IMDP may be beneficial.

IRB APPROVAL Yes

7/29/2023 12:00 am

Diabetic Retinopathy Symposium 1**Cost-Effectiveness of Aflibercept Monotherapy vs Bevacizumab-First Followed by Switching to Aflibercept if Needed for Diabetic Macular Edema**

- Mathew MacCumber, MD, PhD

Objective: To evaluate the cost and cost-effectiveness of aflibercept monotherapy versus bevacizumab-first strategies for treating eyes with moderate or more severe vision loss from diabetic macular edema (DME) over 2 years

Purpose: In DRCR Retina Network Protocol AC, 70% of eyes in the bevacizumab first group switched to aflibercept and no clinically meaningful difference in visual acuity outcomes was observed between the two treatment groups over two years. Understanding the estimated cost and cost-effectiveness of these management strategies is important.

Methods: We performed a preplanned economic analysis of a randomized clinical trial (Protocol AC) for eyes with center-involved DME and best corrected visual acuity of 20/50-20/320. Incremental Cost-Effectiveness Ratio (ICER) in cost per quality-adjusted life-year (QALY) over 2 years was derived based on efficacy and resource utilization data in this trial with health utility mapping from the literature and Medicare unit costs.

Results: This analysis included 228 participants with one study eye: 116 in the aflibercept monotherapy group and 112 in the bevacizumab-first group. Over 2 years, the average cost was \$26,594 for the aflibercept monotherapy group and \$13,929 for the bevacizumab-first group. The estimated difference was \$12,575 (95% CI, \$9,987 - \$15,163). Compared with bevacizumab-first, based on the better-seeing eye, aflibercept monotherapy gained 0.015 QALYs with an ICER of \$837,077. Considering a threshold for ICER of \$100,000 per QALY, aflibercept could be cost-effective if the price per dose decreases to \$305 or lower, or if the price of bevacizumab per dose increases to \$1,307 or more.

Conclusion: For eyes with vision loss from center-involved DME, aflibercept monotherapy is not a cost-effective treatment strategy compared with bevacizumab first. Compared with aflibercept monotherapy, the bevacizumab-first strategy used in this study for managing center-involved DME is likely to confer substantial cost savings on a societal level without sacrificing visual acuity gains over 2 years

IRB APPROVAL Yes

Baseline factor	Odds ratio (95% CI)	P value
Age <65 (vs ≥75 to ≤79 years)	0.79 (0.70, 0.89)	<0.001
Female (vs male)	0.91 (0.86, 0.96)	0.001
Smoking history (vs never)		
Active smoker	0.80 (0.72, 0.89)	<0.001
Former smoker	0.91 (0.85, 0.97)	0.004
Type 2 diabetes (vs type 1)	1.21 (1.13, 1.29)	<0.001
Hypertension (vs none)	0.92 (0.87, 0.97)	0.003
Baseline BCVA (vs ≥20/40)		
<20/40 to ≥20/100	1.24 (1.16, 1.33)	<0.001
<20/100 to ≥20/200	1.51 (1.36, 1.68)	<0.001
<20/200 to ≥20/400	1.46 (1.25, 1.70)	<0.001
Baseline CST (vs <300 μm)		
300-400 μm	1.30 (1.16, 1.47)	<0.001
>400 μm	1.83 (1.63, 2.06)	<0.001
DME and DR diagnosed simultaneously at baseline (vs <1 year)	1.68 (1.49, 1.90)	<0.001
DR severity (vs moderate NPDR)		
PDR	0.79 (0.74, 0.85)	<0.001
Severe NPDR	1.12 (1.04, 1.21)	0.005
IRF present (vs not present)	1.35 (1.20, 1.52)	<0.001
SRF present (vs not present)	1.30 (1.19, 1.41)	<0.001

BCVA, best-corrected visual acuity; CI, confidence interval; CST, central subfield thickness; DME, diabetic macular edema; DR, diabetic retinopathy; IMDP, initial monthly dosing period; IRF, intraretinal fluid; NPDR, nonproliferative diabetic retinopathy; PDR, proliferative diabetic retinopathy; SRF, subretinal fluid.

Table 1. Baseline factors associated with receiving ≥4 IAI in the IMDP

Factor	Odds ratio (95% CI)	P value
Age <65 (vs ≥75 to ≤79 years)	1.39 (1.08, 1.80)	0.012
Baseline BCVA (vs ≥20/40)		
<20/40 to ≥20/100	23.22 (17.33, 31.93)	<0.001
<20/100 to ≥20/200	115.49 (84.05, 162.36)	<0.001
<20/200 to ≥20/400	170.81 (118.32, 251.44)	<0.001
<20/400	278.14 (185.25, 426.21)	<0.001
Receiving ≥4 vs 1-2 injections during the IMDP	1.49 (1.25, 1.77)	<0.001
Post-IMDP injection count	1.07 (1.04, 1.10)	<0.001
Severe NPDR (vs moderate NPDR)	1.24 (1.04, 1.48)	0.014

BCVA, best-corrected visual acuity; CI, confidence interval; IMDP, initial monthly dosing period; NPDR, nonproliferative diabetic retinopathy.

Table 2. Factors associated with ≥15-letter gain at Month 12