

Efficacy of Avastin in Improving Visual Acuity and Reducing Retinal Swelling in Patients with Diabetic Retinopathy at a Hospital in Gauteng (SA)

Motbang Theodora Mosala , Thokozile Ingrid Metsing 

Department of Optometry, Faculty of Health Sciences, University of Johannesburg, Johannesburg, South Africa

Correspondence: Thokozile Ingrid Metsing, Department of Optometry, University of Johannesburg, P.O. Box 524, Auckland Park, Johannesburg, 2006, South Africa, Tel +27828755475, Email ingrim@uj.ac.za

Background: Globally, diabetic retinopathy (DR) has been identified as the cause of blindness among adults with both Type 1 diabetes (T1DM) and Type 2 diabetes (T2DM).

Purpose: The study aimed to investigate the efficacy of Avastin in improving visual acuity (VA) and reducing central foveal (CFT) and parafoveal thicknesses (PFT) in participants with DR.

Patients and Methods: A cross-sectional observational study was conducted at a tertiary hospital in the Gauteng Province (South Africa). A total of 55 participants were included in the study, with VA's that were less than 0.5 LogMAR units and CFT's greater than 300 microns (μm). Measurements of VA's, CFT (μm), and PFT (μm) were conducted at baseline, after three and six months of receiving Avastin treatment. Numerical data were collected and analysed using IBM SPSS Version 28, and non-parametric tests were used to compare the means of the variables.

Results: The mean VA improved from 1.00 ± 0.71 LogMAR at baseline to 0.66 ± 0.51 and 0.57 ± 0.48 LogMAR at 3 and 6 months, respectively ($p < 0.001$). The mean CFT improved from $441.22 \pm 142.35 \mu\text{m}$ at baseline to $355.58 \pm 129.38 \mu\text{m}$ and $308.40 \pm 137.60 \mu\text{m}$ at 3 and 6 months, respectively ($p < 0.001$). The superior parafoveal thickness (SPFT) showed the highest decrease from a mean baseline of $379.04 \mu\text{m}$ to a mean baseline of $317.36 \mu\text{m}$ at 3 months. At 6 months, the decrease in the NPFT was statistically significant ($p < 0.025$) in improving VA.

Conclusion: Early administration of Avastin treatment in diabetic patients is effective in reducing the mean CFT, NPFT, and improving the mean VA.

Keywords: diabetic retinopathy, macula oedema, diabetes mellitus

Introduction

The World Health Organisation (WHO) has noted in its 2026 report that globally, at least 2.2 billion people have a vision impairment that affects their ability to see, and almost half of these people have visual problems that could be prevented or treated.¹ The report also noted that diabetic retinopathy (DR) was among the leading causes of vision impairment. The report further recommends strategies to prevent visual loss, one of which is early detection and treatment of DR to prevent permanent loss of vision. The results of a cross-sectional study by Sun et al (2021), which assessed the correlation between DR and metabolic syndrome, demonstrated that controlling blood glucose levels as well as hypertension contributed towards preventing vision loss.^{2,3} Several studies have postulated that retinal hypoxia has been shown to increase the production of vascular endothelial growth factor (VEGF), which increases vascular permeability, resulting in the accumulation of fluid in the macula.^{4,5}

A review by Lee et al (2024) has described how hypoxia-inducible factors (HIF) play a critical role in the oxygen homeostasis of the retina.^{6,7} This review noted that, in retinopathy, hypoxia damages microvessels and endothelial cells, which, in turn, induces VEGF production. A review by Gnanasambandam et al (2024) also postulated that retinal arteries,

which are surrounded by pericytes and play a role in regulating vascular flow in the retina and choroid, also protect against hypoxia.⁷ Earlier studies have shown that treatment modalities for DR have included Argon laser photocoagulation, pars plana vitrectomy, and anti-VEGF intravitreal injections.^{8,9} Studies have also demonstrated that following the identification of vascular endothelial growth factor in participants with DR, there has been an increase in the use of the anti-VEGF Avastin in the treatment of diabetic macular oedema (DMO), resulting in improved visual outcomes as well as a reduction in DMO.^{10–13} The objectives of the study were to determine VA, CFTs, and PFTs of participants with DR after treatment with Avastin. Very few studies, if any, have been conducted locally to investigate the treatment of DR in primary healthcare centres (PHCs), and consequently, the prevalence of the disease and its management have not been documented.

Material and Methods

This study used a descriptive cross-sectional design. A total of 55 eyes from 49 participants aged 24 to 86 years were included in the study. The participants in this study were purposively selected from patients with DM who were referred to the Ophthalmology department from the Diabetic, Podiatry, and medical outpatients department. All purposively selected participants were given an information document about the study, which was explained to the hospital, and were required to provide consent before participating. Retrospective data were collected from the record cards of 37 participants who had received at least 3 cycles of Avastin injections, and prospective data were collected from 18 participants who had been diagnosed with diabetic retinopathy and were scheduled to receive Avastin injections. For both the retrospective and the prospective data collected from record cards, ethical clearance was obtained from the Gauteng Hospital, where the study was conducted.

Demographic and clinical data from the retrospective and prospective phases were captured in an Excel spreadsheet and exported to IBM SPSS version 28 for analysis. Prospective data were collected from the records of participants receiving Avastin injections during the study. Participants who had been diagnosed with DR received monthly intravitreal injections of 0.025mg of Avastin. Each cycle consisted of 3 monthly injections, and participants received a total of 6. Participants in the study had visual acuities of less than 0.5 LogMAR units and CFTs greater than 300 microns. Excluded from the study were patients who had the following ocular conditions that could also result in an increase in CFT, such as proliferative diabetic retinopathy (PDR), recent cataract surgery that had resulted in Irvin Gass syndrome, vein occlusion or branch occlusion, wet macular degeneration, vitreous macular adhesion or vitreous macular traction, retinal detachment, and lamellar macular hole. Clinical data were collected at baseline and at 3 and 6 months post-injection. VA measurements were done at 6 meters using a Snellen Chart and then converted to LogMAR units. The CFT and PFT measurements were taken using the Copernicus Revo Optical Coherence Tomography (OCT) to monitor the presence of DMO. Three measurements were taken, and one with a quality index above 5 was recorded.

For this study, the demographic characteristics of the participants, as well as VA, CFT, and PFT measurements, were described using means, medians, and standard deviation (SD) for continuous variables with percentages for categorical variables. Descriptive statistics were used to analyse the data with IBM SPSS version 28, and the data for VA at baseline, 3, and 6 months post-injection were presented as frequencies and percentages. The data for the CFT and PFT were presented as means, including measures of spread. In this study, the Wilcoxon Signed-Rank nonparametric test was used to investigate the relationship between VA, the dependent variable, and the independent variables (CFT, SPFT, IPFT, NPFT, and TPFT). A p-value of less than 0.05 was considered statistically significant. Spearman's rho (ρ) correlation was used to measure monotonic association. A multiple linear regression model was used to assess whether there were statistically significant differences in VA, CFT, and PFT outcomes at 3 and 6 months post-injection. Ethical approval for this study was received from the University of Johannesburg, Faculty of Health Sciences Research Ethics (REC-979-2021) and Higher Degrees Committees (HDC01-17 2021). Ethical clearance was also obtained from the tertiary hospital (GP202104-049). The study adhered to the tenets of the Declaration of Helsinki.

Results

This study aimed to investigate the efficacy of Avastin in improving VA and reducing CFT and PFT in participants who had been diagnosed with DMO. Of the 55 participants, 37 were of African descent, 9 were Caucasian, 4 were mixed-race, and 5 were Asian. The participants' ages ranged from 24 to 86 years, with a mean of 61.2 years (Table S1). Thirty-one participants were female, 24 were male, 42 had T2DM, and 13 had T1DM. Most participants (60%; N=33) had a baseline HbA1c $\leq 7.7\%$ (9.68 mmol/L).

After 3 months, the mean VA had improved from 1.00 ± 0.71 LogMAR at baseline to 0.66 ± 0.51 LogMAR and had improved further after 6 months to 0.57 ± 0.48 LogMAR ($p < 0.001$) (Figure S1). After 3 months of Avastin treatment, the mean CFT decreased to $355.58 \pm 129.4 \mu\text{m}$, compared with the baseline mean of $441.22 \pm 142.35 \mu\text{m}$ ($p < 0.001$), indicating a statistically significant difference. Similarly, after 6 months of Avastin treatment, the mean CFT was found to have decreased even further to $308.40 \pm 137.60 \mu\text{m}$, compared to the mean CFT of $355.58 \pm 129.38 \mu\text{m}$ at 3 months ($p < 0.001$) (Figure S2). After 3 months, the mean SPFT had decreased to $331.55 \pm 89.72 \mu\text{m}$ from a baseline of $379.04 \pm 99.20 \mu\text{m}$ ($p < 0.001$). Furthermore, it was noted that after 6 months of Avastin treatment, the mean SPFT had decreased further to a mean of $317.36 \pm 84.93 \mu\text{m}$ ($p < 0.001$) (Figure S3).

The multiple linear regression model showed that after 3 months (0.661) and 6 months (0.405), the CFT was statistically significant in improving VA ($p < 0.001$, 0.026, respectively (Table S2). The coefficients of the other independent variables (SPFT, IPFT, NPFT, and TPFT) were not statistically significant in improving VA at 3 months (0.663, 0.666, 0.291, and 0.084), respectively (Table S2). At 6 months, the CFT was also statistically significant in improving VA ($p < 0.026$), while the SPFT, IPFT, and TPFT were not statistically significant, 0.192, 0.232 and 0.832, respectively. The NPFT, however, was statistically significant at 6 Months in improving VA, $p < 0.025$.

Discussion

The study aimed to investigate the efficacy of Avastin in improving VA and reducing CFT and PFT in participants with DR. It is estimated that the global prevalence of DR will reach 103.12 million by 2030 and 160.50 million by 2045.¹⁴ Teo et al (2021)¹⁴ also found that Africa had the highest (35.90%) prevalence of DR, attributed to poor or a lack of screening protocols, including poorly resourced healthcare facilities. In South Africa, DR is the fourth leading cause of blindness, after cataracts, glaucoma, and age-related macular degeneration.¹⁵ The participants for this study were patients from within the catchment area of Johannesburg who were referred to the tertiary hospital from various primary healthcare (PHC) centres where their blood glucose levels were poorly controlled. This was an adult population, the majority of which were of African descent. Most participants were between the ages of 46 and 75 years old and were mostly diagnosed with T2DM, indicating that this was an aging population with comorbidities. Even though most participants had T2DM, our results showed that their blood glucose levels were well controlled, as evidenced by a mean HbA1c of 7.53 ± 1.62 .

After 3 months of Avastin treatment, the mean VA had decreased to 0.66 ± 0.51 LogMAR from a mean of 1.00 ± 0.71 LogMAR at baseline, and the mean VA further decreased to $0.57 \pm 0.48 \mu\text{m}$ at 6 months, $p < 0.001$. A comparison of mean VAs at baseline, 3 months, and 6 months demonstrated that VA improved during the treatment period. The results of our study showed that mean CFT decreased from $441.22 \pm 142.35 \mu\text{m}$ at baseline to $355.58 \pm 129.38 \mu\text{m}$ after 3 months and further decreased to $308.40 \pm 137.60 \mu\text{m}$ after 6 months, $p < 0.001$.

The results of our study were similar to those of Kyei et al (2023), who also found improvements in VA and decreases in CFT among participants who had received Avastin 6 weeks post-injection.¹⁶ Similar results showing a decrease in CFT and an improvement in VA after three (3) and six (6) months with Avastin treatment were found.¹⁷ Similarly, the results of a study by Castro & Loy (2014) showed a trend toward improvement from a mean baseline VA of 0.62 LogMAR to a mean BCVA of 0.26 LogMAR at the 12th month following Avastin treatment.¹⁸ Likewise, a study by the Diabetic Retinopathy Clinical Research Network (DCRC.net) compared improvements in VA and CFT between a group that received two injections of Avastin and a group that received laser treatment. The findings from the DCRC.net group showed significant improvements in VA and the CFT.¹⁹ Although the DCRC network protocol differed from ours, their

results for the Avastin group were comparable. Additionally, our study found that Avastin effectively reduces CFT, and the longer the treatment duration, the greater the decrease in CFT.

The mean SPFT was the only dependent variable with the largest decrease at 3 months ($p < 0.001$), while the decreases in the other three quadrants were lower but significant ($p < 0.001$). The mean SPFT decreased from $379.04 \pm 99.20 \mu\text{m}$ at baseline to $331.55 \pm 89.72 \mu\text{m}$ at 3 months ($p < 0.001$). Thus, this finding is inconsistent with those of the study conducted by Haritoglou et al (2016), who reported the reduction in CFT without differentiating the macular from the parafoveal area.^{20,21} The results of the multiple linear regression also confirmed the efficacy of Avastin in improving VA and reducing CFT in our study. Our results showed improved VAs with reduced CFT at 3 months ($F=11.17$; $p < 0.001$) and at 6 months ($F=16.51$; $p < 0.001$). A decrease in the mean of three parafoveal quadrants (superior, inferior, and temporal) was found to be statistically insignificant ($p > 0.05$) in improving VA after 3 months and 6 months. However, our results further demonstrated that a decrease in NPFT at 6 months was statistically significant in predicting an improvement in VA ($p = 0.025$).

Our study findings demonstrate the efficacy of Avastin in improving VA and reducing DMO. Further studies are recommended to investigate the effect of Avastin on a larger sample size.

Conclusion

Avastin was found to effectively improve VA by reducing CFT at 3 and 6 months ($p < 0.001$), while a decrease in NPFT at 6 months was statistically significant in predicting VA improvement ($p < 0.025$). The findings of this study suggest that there is a need to recognise the debilitating effects of DR, which could be prevented through the treatment and management of DR with Avastin. The decrease in NPFT observed after 6 months suggests that future research should investigate the association between improvements in VA and decreases in PFT, rather than focusing solely on CFT. Based on this result, we could therefore argue that PFT may have a role to play in improving VA in participants with DR who are treated with Avastin. There is also a need to develop and implement screening protocols at the PHC level to enable early diagnosis of DR and subsequent referral for management. The results thereof would inform resource allocation and treatment modalities. Nevertheless, the results of this study can be used to motivate the training of healthcare workers (HCW) on screening for diabetic retinopathy at PHC level. Upskilling of HCW at PHC level would facilitate timely diagnosis and treatment of DR. In addition, there should be a strengthening of health education on DM and DR for patients, particularly at PHCs. Future studies should focus on larger sample sizes, particularly at the PCH level to have a better understanding of the burden of disease and its management.

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Disclosure

The authors report no conflicts of interest in this work.

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