Predictors of response to intravitreal bevacizumab in diabetic macular edema: A prospective study at a National Hospital in Tanzania

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ABSTRACT

Objective: To assess the clinical outcomes and predictors of response to Intravitreal Bevacizumab Injections (IVB) in patients with diabetic macular edema at Muhimbili National Hospital (MNH).

Methodology: A prospective longitudinal study was conducted at MNH over a 6-month period. Patients received monthly IVB (1.25mg/0.05mL) for three consecutive months. Baseline and post-treatment assessments included ocular examination, spectral-domain Optical Coherence Tomography (OCT), and laboratory investigations. Main outcome measures were changes in Best-Corrected Visual Acuity (BCVA, logMAR) and Central Macular Thickness (CMT, µm) at 12 weeks. Data were analysed using SPSS v25 with paired t-test and linear regression, and $p < 0.05$ was considered statistically significant.

Results: Of the 60 patients analysed, 58.3% were male, with a median age of 60.5 years (IQR, 44 years). More than half (56.7%) had been living with diabetes for 11–20 years, and 83.3% had an HbA1c level >7%. Baseline mean BCVA was 0.876 ± 0.592 logMAR, and mean CMT was 453.02 ± 71.94µm. At 12 weeks, mean BCVA improved by 0.216 ± 0.523 logMAR ($p = 0.002$), equivalent to a >10-letter gain, and mean CMT decreased by 95.78 ± 57.65 µm ($p < 0.001$). Longer diabetes duration was significantly associated with less CMT reduction, with each additional year corresponding to a 0.434µm increase in CMT ($p = 0.003$). Elevated HbA1c also predicted poor anatomical response, with each 1% increase associated with a 0.434µm increase in CMT ($p = 0.003$).

Conclusion: Three intravitreal bevacizumab injections resulted in a significant reduction in diabetic macular edema, marked by a decrease in central macular thickness and accompanied by a significant improvement in mean best-corrected visual acuity. Longer diabetes duration and poor glycemic control are associated with a poorer anatomical response, highlighting the importance of integrated diabetes management and structured treatment protocols in resource-limited settings.

Key words: Bevacizumab, Intravitreal injection, Diabetic macular edema, Diabetic retinopathy

INTRODUCTION

Diabetic Macular Edema (DME) is a leading cause of central visual impairment among patients with diabetic retinopathy, with a reported global prevalence of approximately 6.8%[1]. In sub-Saharan Africa, prevalence estimates vary, ranging from 3.2% in South Africa and 4.1% in Kenya to 15.4% in Tanzania[1,2]. These figures are expected to rise in parallel with the increasing burden of diabetes mellitus and improved life expectancy among affected individuals. It is estimated that approximately 25–30% of patients with diabetes will develop DME during their lifetime[3]. If left untreated, DME progressively impairs central vision, leading to visual deterioration ranging from mild visual impairment to blindness. This loss of visual function significantly affects personal independence, economic productivity, and overall quality of life[3].

Given its substantial clinical and socioeconomic impact, timely diagnosis and effective management of DME remain critical priorities, particularly in low-resource settings. Diagnosis is based on clinical history and detailed ophthalmic examination, with Optical Coherence Tomography (OCT) playing a crucial role in confirming the diagnosis, assessing disease severity, and monitoring treatment response. The mainstay of treatment is intravitreal injection of anti–Vascular Endothelial Growth Factor (anti-VEGF) agents. However, other treatment modalities, including laser photocoagulation, corticosteroids, and vitreoretinal surgery, may also be considered depending on the clinical context[4].

Bevacizumab is a recombinant humanised monoclonal immunoglobulin G1 antibody that inhibits Vascular Endothelial Growth Factor (VEGF), thereby reducing vascular permeability and macular edema[5]. Due to its relatively low cost, bevacizumab is widely used as a

first-line anti-VEGF agent in many clinical settings, often administered with fewer injections than those recommended in Randomised Controlled Trials (RCTs)[5]. Previous studies have shown that visual outcomes following Intravitreal Bevacizumab (IVB) injections are influenced by baseline visual acuity, with poorer baseline vision associated with reduced visual gains[6]. Additionally, reductions in Central Macular Thickness (CMT) following IVB treatment have been associated with significant improvements in visual acuity[5].

However, treatment response to IVB remains variable, with a subset of patients demonstrating persistent DME despite repeated injections[7]. This heterogeneity in response is influenced by several systemic factors, including diabetes duration, glycemic control, blood pressure, renal function, and lipid profile. These factors play important roles not only in the pathogenesis and progression of DME but also in determining both anatomical and functional responses to anti-VEGF therapy[6].

At Muhimbili National Hospital (MNH), a significant number of patients with DME are routinely managed, with IVB injections serving as the primary treatment modality for over a decade. Despite its widespread use, there is limited local evidence on treatment outcomes and predictors of response in this setting. Therefore, this study aims to evaluate clinical outcomes-both functional (Best-Corrected Visual Acuity, BCVA) and anatomical (Central Macular Thickness, CMT)-and predictors of response to IVB treatment among patients with DME at MNH. Understanding these factors will help individualized treatment, improve clinical decision-making, and better manage patient expectations regarding visual recovery.

MATERIALS AND METHODS

Study design and duration: An observational prospective longitudinal study was conducted from June to December 2022.

Study setting: This study was conducted at Muhimbili National Hospital (MNH), which has a well-established eye department providing tertiary eye care to paediatric and adult patients. Data collection took place at the retina clinic, which sees approximately 40–50 patients per day. The clinic is conducted twice weekly, with an average of one to three new cases of Diabetic Macular Edema (DME) seen per week. Each clinic session is managed by two retina specialists.

Study population: All newly diagnosed patients with diabetic macular edema during the study period.

Inclusion criteria: The study included all newly diagnosed patients with diabetic macular oedema who had Best-Corrected Visual Acuity (BCVA) < 6/9 and CMT > 250μm, and who were planned for intravitreal bevacizumab injection[7].

Exclusion criteria: Patients with coexisting visually significant cataracts, advanced glaucoma, optic atrophy and other retinal diseases.

Data collection procedure: All patients underwent visual acuity (BCVA) assessment using the Snellen visual acuity chart and pinhole before pupil dilation with 0.5% tropicamide eye drops for fundus examination. For statistical analysis, Snellen visual acuity measurements were subsequently converted to logarithm of the Minimum Angle of Resolution (logMAR) values. A comprehensive anterior segment and fundus evaluation was performed by a retina specialist using a slit lamp biomicroscope with 78D and 90D Volk lenses. Patients with features suggestive of diabetic macular edema, i.e., macular thickening with or without hard exudates, were identified.

Newly diagnosed patients with clinical features of DME underwent Optical Coherence Tomography (OCT) using the 3D OCT Maestro1 (Topcon Medical Laser Systems) to quantify Central Macular Thickness (CMT). Patients with significant central macula edema defined as CMT > 250μm and VA < 6/9, who were planned for intravitreal bevacizumab injection, were considered eligible for the study. These patients were approached and informed about the study; those who provided written consent were consecutively recruited.

All enrolled patients underwent blood pressure measurement and baseline laboratory investigations, including glycated haemoglobin (HbA1c), lipid profile (total cholesterol, High-Density Lipoprotein [HDL], Low-Density Lipoprotein [LDL]), and renal function tests (serum creatinine and blood urea nitrogen), prior to intravitreal bevacizumab injection. Patients received counselling on the management of diabetic retinopathy, emphasizing strict glycemic control and lifestyle modifications. In addition, detailed counselling regarding the intravitreal bevacizumab injection procedure was provided.

Under aseptic conditions, all patients received intravitreal bevacizumab injections (1.25 mg/0.05mL). Each patient received three consecutive monthly injections. One month after the third dose, re-assessments were performed, including visual acuity and IOP measurement, dilated fundus examination, OCT, and repeat laboratory tests (HbA1c, lipid profile, and renal function tests).

The decision for additional bevacizumab injections beyond the third dose was based on clinical judgment and OCT findings. However, outcomes following the fourth and subsequent injections were outside the scope of this study.

Data analysis: Data were analysed using the Statistical Package for the Social Sciences (SPSS) software, version 25.0 (IBM Corp., Armonk, NY, USA). A paired t-test was applied to compare mean Central Macular Thickness (CMT) and Best-Corrected Visual Acuity (BCVA) at baseline and three months after Intravitreal Bevacizumab (IVB) treatment. Linear regression analysis was performed to determine factors associated with visual and anatomical outcomes. Statistical significance was defined as a p-value <0.05.

Ethical considerations: Ethical approval for this study was obtained from the Institutional Review Board of Muhimbili University of Health and Allied Sciences (MUHAS). Permission to conduct the study was also granted by the Executive Director of Muhimbili National Hospital. Written informed consent was obtained from all participants prior to enrollment. Participants were informed of their right to withdraw from the study at any time without affecting their standard of care. No financial incentives were provided, and participation posed no additional risk beyond routine treatment. All patients continued their treatment program as clinically indicated, including those who required more than three bevacizumab injections. The study adhered to the principles of the Declaration of Helsinki (1964) and its subsequent amendments.

RESULTS

A total of 69 newly diagnosed patients with diabetic macular edema were initially recruited for the study. Of these, nine patients were excluded from the final analysis due to predefined exclusion criteria: two had advanced glaucoma, two were scheduled for focal laser therapy, four were lost to follow-up, and one voluntarily withdrew from the study. In total, 63 of the 120 eyes were included in the final analysis.

More than half of the patients (35, 58.3%) were male. Half of the participants (30, 50%) were older than 60 years, 29 (48.3%) were aged between 40 and 60 years, and 1 (1.7%) was younger than 40 years. The median age of participants was 60 years (IQR:44). Many 28 (46.7%) participants had attained college or higher education, 19 (31.7%) had secondary education, 9 (15%) primary education, 4 (6.7%) had no formal education. All patients had type 2 diabetes mellitus.

More than half (34, 56.7%) of patients had a diabetes duration of 11-20 years. Baseline Visual Acuity (VA) was worse than 1.0 LogMAR in 23 (38%) patients. Nearly two-thirds (39, 62%) of participants had a baseline central macular thickness of 400-499µm. The majority (50, 83.3%) of patients had elevated HbA1c (Table 1).

Table 1: Clinical characteristics of study participants (N=60)

Characteristic	Frequency	
	No.	(%)
Duration of DM (years)		
5-10	21.0	35.0
11-20	34.0	56.7
>20	5.0	8.3
Best corrected VA (logMAR)		
0.00-0.2	4.0	6.3
0.3-0.5	18.0	28.6
0.6-0.9	18.0	28.6
1.0-1.3	13.0	20.6
>1.3	10.0	15.9
Central macular thickness (µm)		
200-299	0.0	0.0
300-399	11.0	17.5
400-499	39.0	61.9
500-599	8.0	12.7
600-699	3.0	4.8
>700	2.0	3.1

Glycated haemoglobin (HbA1c)		
Normal	10.0	16.7
Elevated	50.0	83.3
Systolic Blood Pressure (SBP) (mmHg)		
≤ 130	24.0	40.0
>130	36.0	60.0
Diastolic Blood Pressure (DBP) (mmHg)		
≤80	36.0	60.0
>80	24.0	40.0
Total cholesterol (mmol/L)		
0-5.17	44.0	73.3
>5.17	16.0	26.7
High density lipoprotein (mmol/L)		
≤1.55	44.0	73.3
>1.55	16.0	26.7
Low density lipoprotein (mmol/L)		
≤3.34	39.0	65.0
>3.34	21.0	35.0
Urea (mmol/L)		
2.5-6.7	52.0	86.7
>6.7	08.0	13.3
Creatinine (µmol/L)		
50.4-98.1	41.0	68.3
>98.1	19.0	31.7

There was a significant improvement in mean logMAR BCVA from 0.876 ± 0.592 at baseline to 0.660 ± 0.589 one month post the 3rd injection ($p < 0.002$).

Similarly, CMT demonstrated a significant reduction from 453.02 ± 71.94µm at baseline to 357.23 ± 65.19µm post-treatment ($p < 0.001$) (Table 2).

Table 2: Mean BCVA and mean CMT at baseline and after three IVB injections (N = 63 eyes)

	Mean (±SD)	Paired t-test	P -value
Mean BCVA at baseline	0.876 (±0.592)	3.199	<0.002
Mean BCVA after 3 IVB injections	0.660 (±0.589)		
Mean change in BCVA	0.216 (±0.523)		
Mean CMT at baseline	453.02 (±71.944)	12.87	<0.001
Mean CMT after 3 IVB injections	357.23 (±65.192)		
Mean change in CMT	95.783 (±57.645)		

P-value generated using the two-tailed t-test; BCVA = Best Corrected Visual Acuity in logMA; IVB = Intra-vitreal Bevacizumab; CMT = Central Macular Thickness

Among patients with normal HbA1c levels, the mean BCVA was 0.553 logMAR, compared to 0.767 logMAR in those with elevated HbA1c levels. Although the BCVA appeared better in patients with tighter glycemic control, the difference was not statistically significant. Similarly, CMT was lower in patients with normal HbA1c (342.53µm) than in those with elevated HbA1c (371.93µm). In contrast, elevated serum creatinine levels (>98.1 µmol/L) were significantly associated with increased CMT. Patients with higher creatinine levels had a mean CMT of 398.65µm, compared with 340.86µm in those with lower creatinine levels (p = 0.019) (Table 3).

Table 3: Factors associated with mean BCVA and mean CMT change after IVB injection (N = 60)

Factor	No. (%)	Mean BCVA (logMAR)	Two- tailed t-test P-value	Mean CMT (microns)	Two- tailed t-test P-value
Duration of DM (years)					
≤10	21 (35.0)	0.695		359.38	0.372
>10	39 (65.0)	0.650	0.163	345.18	
Glycated haemoglobin (HbA1c)					
Normal	30 (50.0)	0.553		342.53	
Elevated	30 (50.0)	0.767	0.163	371.93	0.081
Systolic Blood Pressure (SBP)					
≤130 mmHg	23 (38.3)	0.726		358.48	
>130 mmHg	37 (61.7)	0.619	0.498	356.46	0.908
Diastolic Blood Pressure (DBP)					
≤80 mmHg	45 (75.0)	0.649		353.27	
>80 mmHg	15 (25.0)	0.693	0.803	369.13	0.419
Total cholesterol					
≤5.17 mmol/L	52 (86.7)	0.644		352.69	
>5.17 mmol/L	08 (13.3)	0.763	0.602	386.75	0.171
Low Density Lipoprotein (LDL)					
≤3.34 mmol/L	47 (78.3)	0.638		352.15	
>3.34 mmol/L	13 (21.7)	0.739	0.100	374.62	0.254
High Density Lipoprotein (HDL)					
≤1.55 mmol/L	49 (81.6)	0.627		353.84	
>1.55 mmol/L	11 (18.3)	0.809	0.358	372.36	0.399
Urea					
≤6.7 mmol/L	55 (91.7)	0.636		351.51	
>6.7 mmol/L	05 (08.3)	0.920	0.307	420.20	0.295
Creatinine					
≤98.1 µmol/L	43 (71.7)	0.579		340.86	0.019
>98.1 µmol/L	17 (28.3)	0.864	0.091	398.65	

P-value generated using the two-tailed t-test, CMT = Central Macular Thickness in *µm*; BCVA = Best Corrected Visual Acuity in logMAR

Linear regression analysis following three intravitreal bevacizumab injections revealed that a 1% increase in glycated haemoglobin (HbA1c) was associated with a 0.247 logMAR increase in BCVA, indicating a trend toward poor visual outcomes with higher HbA1c levels. However, this association did not reach statistical significance.

In contrast, a statistically significant relationship was observed between DM duration and CMT. Each additional year of DM duration was associated with a 0.434µm increase in CMT. Similarly, HbA1c levels were significantly associated with CMT changes, where a 1% increase in HbA1c corresponded to a 0.434µm increase in CMT (Table 4).

Table 4: Linear regression analysis of factors associated with change in CMT and BCVA after three IVB injections (N = 60)

	CMT		BCVA	
Factor	Coefficient Beta	P-value	Coefficient Beta	P-value
Duration of DM	0.434	<0.003	-0.054	0.703
HbA1c	0.434	<0.003	0.247	0.108
Systolic BP	-0.035	<0.835	-0.112	0.548
Diastolic BP	0.155	<0.294	0.116	0.471
Total cholesterol	0.199	<0.34	0.236	0.302
HDL	-0.335	<0.094	-0.061	0.778
LDL	-0.125	0.489	-0.25	0.21
Creatinine	-0.382	0.42	-0.43	0.408
Urea	0.704	0.145	0.534	0.311

DISCUSSION

This study aimed to evaluate the functional and anatomical outcomes of Intravitreal Bevacizumab Injection (IVBI) in patients with Diabetic Macular Edema (DME) at Muhimbili National Hospital (MNH) and to identify clinical factors associated with treatment response. DME is a significant vision-threatening condition that commonly affects patients with diabetes and is a leading cause of visual impairment among working-age individuals globally[5]. Due to poor vision, the overall quality of life, productivity, and independence of these patients are affected[5]. IVB injection has demonstrated good visual and structural outcomes in the treatment of DME. Quantitative central macular thickness data from OCT have become commonly used as indicators for decision-making and monitoring disease progression in clinical practice[8].

The results of this study showed a significant improvement in BCVA after three bevacizumab injections. The mean BCVA change was 0.21 LogMAR; this is similar to other studies[2,8,9]. The results differ from those of the study done by Lam *et al.*[10] in Hong Kong. This difference may be explained by variations in baseline visual acuity between the study populations. Patients with poorer baseline visual acuity generally have greater potential for visual gain because they have more room for improvement, whereas patients with relatively better baseline visual acuity may demonstrate smaller gains despite successful treatment.

There was a significant decrease in macular edema at 12 weeks after bevacizumab injections. The mean decrease in central macular thickness in our patients was 95.783µm (±57.645), indicating a favourable anatomical response to treatment. These findings are similar to those of the study by Kabuga *et a.l*[5] in Uganda, which also reported a similar reduction in CMT. The similarity may be explained by comparable baseline characteristics of the study participants, including similar follow-up time, baseline CMT values, mean age, and duration of diabetic mellitus. Different results were reported in a study by Bafaraj *et al.*[9], which showed marked improvement in CMT. The difference in this study is due to a longer follow-up period for participants after three IVB injections. Over time, anti-VEGF continues to bind soluble VEGF, restoring the integrity of the blood-retinal barrier and resulting in a progressive decrease in CMT.

Our study showed that glycemic control is associated with improved BCVA after three IVB injections, whereas a 1-unit increase in HbA1c was associated with a 10-letter decrease in BCVA on the LogMar chart, though this association was not statistically significant. The

finding was consistent with other studies[11-13]. There was a statistically significant association between glycemic control and CMT change, such that a 1% increase in HbA1c was associated with a 0.434 micron increase in CMT. This means that poor blood glucose control leads to reduced CMT. This was consistent with the results of other studies[11,13,14]. Good glycemic control helps slow the progression of DME, thereby improving BCVA and reducing CMT. Chronic hyperglycemia is associated with the accumulation of advanced glycation end products, which disrupt the blood-retinal barrier and break down endothelial cell junctions, resulting in macular oedema.

The macular oedema decreased more in patients with DBP of 80mmHg or lower than in those with DBP above 80mmHg. Linear regression analysis shows that a 1-unit increase in DBP is associated with a 0.116 LogMar-unit decrease in BCVA, but this difference was not statistically significant. There was no statistically significant difference in the mean change in CMT and DBP. Systolic blood pressure was not found to have any statistically significant association with the change in CMT and BCVA after IVB injections. These findings contrast with the study by Janeite *et al.*[6]. High blood pressure decreases retinal perfusion, thereby increasing VEGF production, which leads to DME progression through increased vascular permeability.

Our study showed that patients with shorter diabetes duration experienced a greater reduction in macular edema following three intravitreal bevacizumab injections than those with longer diabetes duration. Linear regression analysis demonstrated a significant association between longer diabetes duration and poorer anatomical response, as reflected by less reduction in central macular thickness. However, there was no statistically significant association between diabetes duration and change in best-corrected visual acuity. These findings are similar to those of the study by Wong *et al.*[14]. The long duration of diabetes results in continuous microvascular damage, which, in turn, increases vascular permeability, thereby facilitating the progression of DME. Minimal improvement in BCVA may reflect damage to ganglion cells resulting from macular oedema.

This study shows an association between hyperlipidemia and visual acuity and structural outcomes: participants with normal total cholesterol levels showed improvements in BCVA and CMT after IVB injection, though the association was not statistically significant. The results also show that no statistically significant association was found between high- and low-density lipoprotein and BCVA or CMT change among study participants. Similar findings were reported in the study by Chew *et al.*[15] in the ETDRS report 22 and in Das *et al*.[16]. This can be attributed to the normalization of lipid levels, which reduces retinal leakage and exudate deposition, thereby decreasing CMT.

There was a statistically significant decrease in mean central macular thickness among participants with normal creatinine levels compared with those with high creatinine levels. There was no statistically significant association between changes in BCVA and creatinine levels. This finding differs from that reported in a study by Wong *et al*.[14]. Participants with high urea levels showed less improvement in BCVA post-IVB injections, with a 1-unit increase in urea level resulting in a 0.534 logMAR worsening in BCVA. On the other hand, patients with high urea levels showed less improvement in CMT than those with normal urea levels, although this difference was not statistically significant. These findings differed from those of Woodward *et al*.[17]. Impaired renal function disrupts the osmotic balance in the kidney, promoting Blood-Retinal Barrier (BRB) vascular damage and increasing macular oedema, leading to a poor treatment response.

Strengths and limitations of the study

The strength of the study is its prospective follow-up of each participant to assess the outcome of a single-agent injection. The limitation of the study is that patients were followed for only three months; further prospective studies with longer follow-up are needed.

CONCLUSION

Three intravitreal bevacizumab injections resulted in a significant reduction in diabetic macular oedema, as evidenced by decreased central macular thickness and a significant improvement in mean best-corrected visual acuity. Longer diabetes duration and poor glycemic control are associated with a poorer anatomical response, highlighting the importance of integrated diabetes management and structured treatment protocols in resource-limited settings.

Funding: The research was not funded.

Consent for publication: All the authors provided consent for the submission of this manuscript for publication.

Availability of data and materials: The original full article is available with the author and at Muhimbili University Library. Any additional data or information required may be obtained by contacting the corresponding author.

Competing interests: The authors declare no conflict of interest.

Authors' contributions: Masuki H and Haji Z participated in conception, research design, data collection, data analysis and interpretation as well as drafting of this manuscript.

ACKNOWLEDGMENT

We acknowledge the support we got from all members of Eye Department from Muhimbili University and Muhimbili National Hospital for making this work possible.

REFERENCES

1. Yau JWY, Rogers SL, Kawasaki R, Lamoureux EL, Kowalski JW, Bek T, *et al.* Global prevalence and major risk factors of diabetic retinopathy. *Diabetes Care.* 2012; **35**(3):556–564.
2. Kanji S, Dhalla K, Makupa W. Outcomes of intravitreal bevacizumab in patients with diabetic macular edema at a tertiary hospital in northern Tanzania. *East Afr Health Res J*. 2020; **12**(4):27–34.
3. Salvetat ML, Pellegrini F, Spadea L, Salati C, Musa M, Gagliano C, *et al*. The treatment of diabetic retinal edema with intravitreal steroids: how and when. *Curr Drug Targets*. 2019; **20**(13):1223–37.
4. American Academy of Ophthalmology Retina/ Vitreous Panel. Retina and vitreous. San Francisco: American Academy of Ophthalmology; 2016. p. 1–23.
5. Kabunga RR, Onyango J, Ruvuma S, Arunga S. Outcome of intravitreal Avastin® injections in patients with macular oedema in Uganda: a cohort study. *Afr Health Sci.* 2022; **22**(1):235–242.
6. Choovuthayakorn J, Tantraworasin A, Phinyo P, Patumanond J, Kunavisarut P, Srisomboon T, *et al.* Factors associated with 1-year visual response following intravitreal bevacizumab treatment for diabetic macular edema: a retrospective single-center study. *Int J Retina Vitreous.* 2021; **7**(1):17.
7. Wells JA, Glassman AR, Jampol LM, Aiello LP, Antoszyk AN, Baker CW, *et al***.** Diabetic Retinopathy Clinical Research Network. Association of baseline visual acuity and retinal thickness with 1-year efficacy of aflibercept, bevacizumab, and ranibizumab for diabetic macular edema. *JAMA Ophthalmol.* 2016; **134**(2):127-134.
8. Arevalo J, Garcia-Amaris R. Intravitreal bevacizumab for diabetic retinopathy. *Curr Diabetes Rev*. 2009; **5**(1):39–46.
9. Bafaraj AG, Alshammari NS, Alshammari HS, Alshammari FS, Alibrahim AK, Masaud JS. Visual and anatomical outcomes after single injection of intravitreal bevacizumab (Avastin) in patients with diabetic macular edema. *Ann Int Med Dent Res*. 2017; **3**(4):7–10.
10. Lam DSC, Lai TYY, Lee VYW, Chan CKM, Liu DTL, Mohamed S, *et al*. Efficacy of 1.25 mg versus 2.5 mg intravitreal bevacizumab for diabetic macular edema: Six-month results of a randomized controlled trial. *Retina*. 2009; **29**(3):292–299.
11. Matsuda S, Tam T, Singh RP, Kaiser PK, Petkovsek D, Carneiro G, *et al*. The impact of metabolic parameters on clinical response to VEGF inhibitors for diabetic macular edema. *J Diabetes Complications*. 2014; **28**(2):166–170.
12. Bressler SB, Odia I, Maguire MG, Dhoot DS, Glassman AR, Jampol LM, *et al*. Factors associated with visual acuity and central subfield thickness changes when treating diabetic macular edema with anti-vascular endothelial growth factor therapy: an exploratory analysis of the Protocol T randomized clinical trial. *JAMA Ophthalmol*. 2019; **137**(4):382–389.
13. Sharma S, Joshi SN, Karki P. HbA1c as a predictor for response of bevacizumab in diabetic macular oedema. *BMJ Open Ophthalmol.* 2020; **5**: e000449.
14. Wong WM, Chee C, Bhargava M, Chai C, Lin H, Zhao P, *et al*. Macular edema. *Dis Mon*. 2020; **66**(8):101041.
15. Das R, Kerr R, Chakravarthy U, Hogg RE. Dyslipidemia and diabetic macular edema: a systematic review and meta-analysis. *Ophthalmology*. 2015; **122**(9):1820–27.
16. Idiculla J, Nithyanandam S, Joseph M, Mohan VA, Vasu U, Sadiq M. Serum lipids and diabetic retinopathy: a cross-sectional study. *Indian J Endocrinol Metab*. 2012; **16**(8):492–494.
17. Woodward R, Mgaya E, Mwanansao C, Peck RN, Wu A, Sun G. Retinopathy in adults with hypertension and diabetes mellitus in western Tanzania: a cross-sectional study. *Trop Med Int Health.* 2020; **25**(10):1214–25.