

Evaluation of Best Corrected Visual Acuity Before and After the Use of Suprachoroidal Triamcinolone Acetonide

Gul Zaman¹, Kazma Kulsoom², Abid Hussain Shah³, Muhammad Dawood⁴, Muhammad Noman Tariq⁵, Ayesha Altaf⁶

1. Department of Eye and Vision Sciences, the University of Lahore, Lahore, Pakistan.
2. University Institute of Public Health, the University of Lahore, Lahore, Pakistan.
3. University Institute of Public Health, the University of Lahore, Lahore, Pakistan
4. Department of Eye and Vision Sciences, the University of Lahore, Pakistan
5. University Institute of Public Health, the University of Lahore, Pakistan
6. Department of Eye and Vision Sciences. the University of Lahore, Pakistan

Correspondence: Kazma Kulsoom, University Institute of Public Health, the University of Lahore, Lahore, Pakistan

ABSTRACT

Background: Macular edema severely reduces Best Corrected Visual Acuity. So, there is a need to reduce the macular thickness for the sake of overcoming the severity of macular edema and improving the visual acuity. For this purpose, Suprachoroidal triamcinolone acetonide is used for reducing the macular thickness.

Objective: The objective of this research is the evaluation of best corrected visual acuity before and after the use of Suprachoroidal triamcinolone acetonide.

Methods: Sixty-two patients were enrolled from the University of Lahore Teaching hospital, Mayo Hospital and Jinnah Hospital Lahore who were suffering with macular edema. The visual acuity of the people were assessed before and after the use of Suprachoroidal triamcinolone acetonide. The comparison is made for highlighting the impact of Suprachoroidal triamcinolone acetonide on the improvement of visual acuity.

Results: 24 (38.7%), 12 (19.4%), and 17 (27.4%) of the respondents visual acuity reduced up to 6/36, 6/24, and 6/18 because of reducing the macular thickness. Meanwhile, 43 (69.4%) and 19 (30.6%) of the people improve their visual acuity up to 6/6 and 6/9 respectively after the use of Suprachoroidal triamcinolone acetonide. The results showed that the use of Suprachoroidal triamcinolone acetonide produced positive consequences for the improvement of visual acuity and

reducing the macular thickness.

Conclusion: It is concluded that there is significant improvement in best corrected visual acuity after the use of suprachoroidal triamcinolone acetonide injection that's why this injection is effective and safer for the treatment of macular edema and for improving visual acuity.

Keywords: Macular edema, Suprachoroidal, Triamcinolone acetonide, Visual acuity, Best corrected visual acuity.

Introduction:

Macular edema is the inflammation of macula in which there is buildup of fluid in the macula. The vision of the people is directly associated with the retinal inflammation. The entire parts of the retina should be healthy for the sake of normal vision. This fact needs to be kept in mind that the problem in any part of the retina leads to creating a problem for the vision.¹ When it comes to the macula, it directly associates with the central vision of the people. So, the macular portion should be clear for the sake of best visual acuity. In short, the normal functioning of the macula is compulsory for visual acuity. It was observed that the macula is affected because of several associated diseases that have a direct impact on decreasing the visual acuity of common people.² Mostly, macular edema is occurred because of diabetic retinopathy, age-related macular degeneration, inflammatory diseases of the retina, blockage of retinal blood vessels, and complications of eye surgeries. These are the conditions that become the reason for macular inflammations due to which the physiology of macula is disturbed. In short, the normal functioning and anatomy of edema are essential for the best-corrected visual acuity. Firstly, there is a need to discuss the association of diabetic retinopathy with macular edema.³ The use of Suprachoroidal triamcinolone acetonide overcomes the inflammation that is beneficial for the recovery of visual acuity. The decreasing of inflammation is also beneficial for the recovery of central vision. Several associated treatments are also used by healthcare professionals for the management of macular edema. It was observed that the use of Suprachoroidal triamcinolone acetonide is a convenient way to treat macular edema.⁴ As macular edema is a sudden condition, there is also a need for a sudden procedure for the treatment of macular edema that can be possible with the help of Suprachoroidal triamcinolone acetonide. In this context, there is a need to focus on the efficacy of this injection for the treatment of macular degeneration. The efficacy of Suprachoroidal triamcinolone acetonide can easily be highlighted by assessing the improvement in visual acuity of people before and after.⁵ When it comes to diabetic retinopathy,

it is the process according to which the small blood vessels and neurons of the retina are damaged that becomes the reason for secreting bloody fluid on the retina. The damage to blood vessels also leads to the inflammation of the retina.⁶ It was observed that diabetes directly affect the macular region. When the macular region of the retina is disturbed it directly affects the central vision of the people. The loss of central vision highly influences the visual acuity of people. So, macular edema has a direct impact on reducing the visual acuity of the patients. The immediate management of macular edema is compulsory for the sake of recovering the visual acuity.⁷ The macular edema has occurred suddenly and their side effects are also sudden. Firstly, sudden vision loss and a decrease in visual acuity are the primary effects of macular edema. Meanwhile, the health of the retina is also decreased because of macular edema. So, rapid management is required for overcoming the effects of macular edema.⁸ The rapidity of the treatment is directly associated with overcoming the effects of macular edema. Nevertheless, the Suprachoroidal triamcinolone acetonide is used for the management of macular edema but it doesn't fully recover the damages of macular edema. The use of Suprachoroidal triamcinolone acetonide in the early stages of macular edema is beneficial for recovery.⁹ Later on, more inflammation leads to a decrease in the effects of Suprachoroidal triamcinolone acetonide. The visual acuity of the patients is not fully recovered. Thus, the effective use of Suprachoroidal triamcinolone acetonide is essential for the management of macular edema. This fact needs to be kept in mind that the use of Suprachoroidal triamcinolone acetonide is also associated with several risks. Therefore, healthcare professionals have to follow a complete framework for the use of Suprachoroidal triamcinolone acetonide.¹⁰ The macular edema can be managed by secondary and tertiary intervention. When it comes to tertiary intervention, it is the surgical procedure for the management of macular edema. It is comparatively a complex procedure for the management of macular edema. So, healthcare professionals are not going for surgical treatment on an immediate basis.¹¹ The use of Suprachoroidal triamcinolone acetonide injection is also beneficial for overcoming the effects of retinal complications. In such conditions, the efficacy of Suprachoroidal triamcinolone acetonide injection is dependent on the complete recovery of overall complications. This fact needs to be kept in mind that the Suprachoroidal triamcinolone acetonide is beneficial for the recovery of macular edema. Still, the improvement of the best-corrected visual acuity can be improved by the complete recovery of macular edema.¹² Suprachoroidal triamcinolone acetonide is a well-known procedure for the management

of macular edema. It is the process according to which the intraocular drugs are injected through the Suprachoroidal route. Macular edema is the inflammation of the macula that may occur because of the fluid.¹³ In such conditions, intraocular drugs are considered to be beneficial to overcome the inflammation of the macula. For this purpose, Suprachoroidal triamcinolone acetonide is considered to be beneficial for the management of macular edema. The process of Suprachoroidal is widely used in the healthcare department for the management of macular edema.¹⁴ observed that the Suprachoroidal triamcinolone acetonide is effective based on the severity of macular edema. Sometimes, the inflammation of the macular is very slight due to which the minor dose of Suprachoroidal triamcinolone acetonide is enough for the management of macular edema.¹⁵ Meanwhile, a high dose of Suprachoroidal triamcinolone acetonide is required for the management of macular edema. In short, the use of Suprachoroidal triamcinolone acetonide is beneficial for the management of macular edema but the severity of the disease should be focused on by the healthcare professionals during the management of macular edema.¹⁶ In such conditions, intraocular drugs are considered to be beneficial to overcome the Inflammation of the macula. For this purpose, Suprachoroidal triamcinolone acetonide is considered to be beneficial for the management of macular edema. The process of Suprachoroidal is widely used in the healthcare department for the management of macular edema.¹⁷ It was observed that the Suprachoroidal triamcinolone acetonide is effective based on the severity of Macular edema. Sometimes, the inflammation of the macular is very slight due to which the minor dose of Suprachoroidal triamcinolone acetonide is enough for the management of macular edema.¹⁸ Meanwhile, a high dose of Suprachoroidal triamcinolone acetonide is required for the management of macular edema. In short, the use of Suprachoroidal triamcinolone acetonide is beneficial for the management of macular edema but the severity of the disease should be focused on by the healthcare professionals during the management of macular edema.¹⁹ The people have to follow a particular protocol in post-operative intervals according to the recommendations of healthcare professionals. When the people are not following the recommendations of healthcare professionals then it becomes the reason for retinal surgery's complications. These complications become the reason for macular edema.²⁰ The macular edema directly affects the visual acuity of the people. The management of macular edema is compulsory for the improvement of visual acuity. For this purpose, Suprachoroidal triamcinolone acetonide is beneficial for the management of macular edema. There is a need to

focus on the management of macular edema with the use of Suprachoroidal triamcinolone acetonide. Meanwhile, there is also a need to justify the importance of Suprachoroidal triamcinolone acetonide for the improvement of visual acuity. Therefore, the research is conducted for highlighting the efficacy of Suprachoroidal triamcinolone acetonide for the improvement of visual acuity.

Methods:

The study was approved by the Institutional Review Board and Ethics committee of University of Lahore. Informed written consent was signed by all the patients. This comparative study was conducted in University of Lahore Teaching Hospital and was completed in a duration of four months. The sample size was calculated through Epi info WHO calculator. A total number of 62 patients participated in this clinical trial. Through non probability sampling technique data was collected, according to which the samples which are conveniently available to the researcher were collected. The whole data was collected based on inclusion and exclusion criteria. The inclusion criteria consisted of patients of different age groups both male and female having medical conditions like Diabetic Retinopathy, Age-related macular edema and Central retinal vein occlusion. The patients having medical conditions like media opacity, having diseases other than diabetes and pregnant women were excluded from this clinical trial. The collected data was analysed statistically by using SPSS version 26. Quantitative variable like macular thickness and quantitative variable like best corrected visual acuity were recorded on proforma at different intervals i.e at one week, one month and three months.

The self made proforma was made for the collection of data. The self made proforma include "Demographic data, Ocular and systemic history and Visual Acuity. The data collection in our Research include Macular thickness. We collected data by performing Visual acuity of patients who already diagnosed with macular edema by the ophthalmologist. After the treatment (Suprachoroidal trimcenolone acetonide) by the ophthalmologist a follow-up was arranged and we again performed the Visual acuity and obtained the BCVA.

The Statistical Package for the Social Sciences 21.0 was used for the analysis of data. Firstly, the data was arranged with the use of an excel sheet. After this, the data was entered into the Statistical Package for the Social Sciences 21.0 for the sake of quantitative results. Initially, the frequency of the demographics including age and gender was made for the sake of highlighting the percentage

of respondents.

The percentage and proportion technique was beneficial for producing quantitative results. It was observed that the research was based on the comparison, so the comparison between the BCVA before and after the Suprachoroidal injection was considered to be beneficial for producing the results of the research.

Results

The results are based on the primary data collected for the research. The research was critically focused on the improvement in visual acuity after Suprachoroidal triamcinolone acetamide.

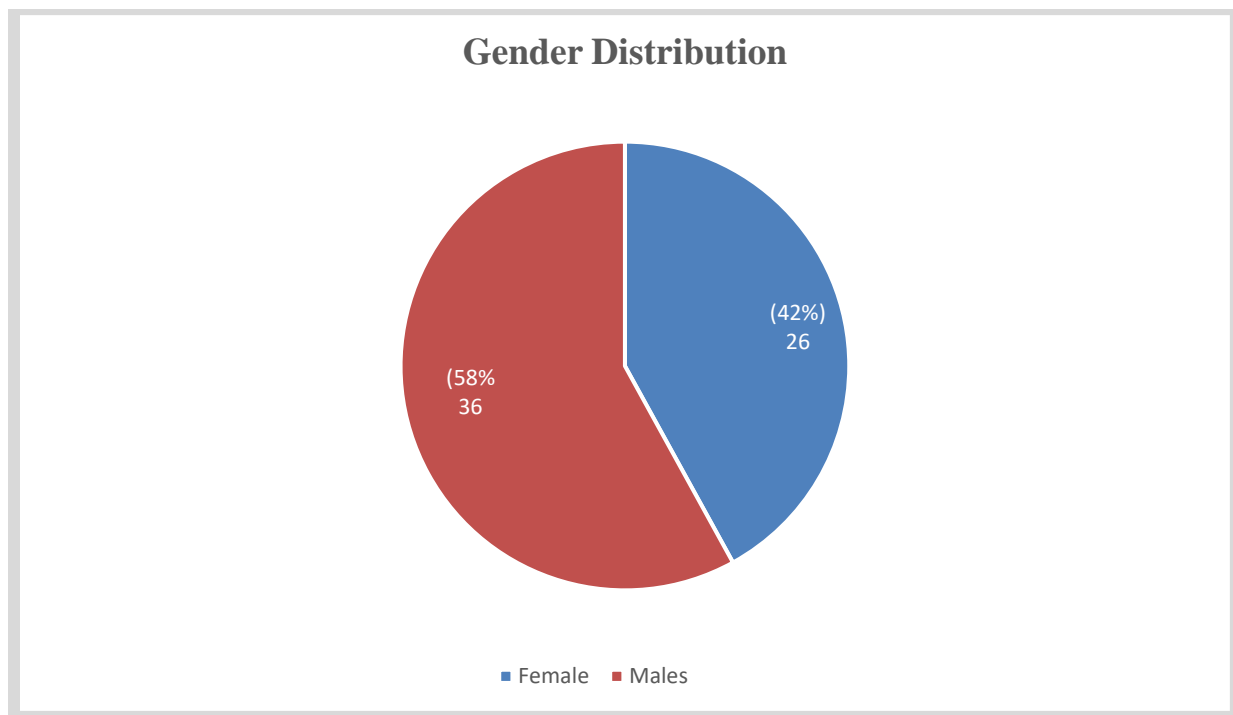


CHART 1: GENDER DISTRIBUTION

Description:

Chart 1 is representing the gender distribution of the research. Out of 62 people, 36 (58%) respondents are male and 26 (42%) respondents are female.

FREQUENCY OF RESPONDENTS BASED ON AGE				
Frequency	40-50 years	51- 60 years	61-70 years	Total
	27	22	13	62
Percentage (%)	43.5%	35.5%	21%	100

TABLE 1: FREQUENCY OF RESPONDENTS BASED ON AGE

Description:

Table 1 is representing the age range of the respondents. Three groups of people become the respondents of the research including the age range of 40-50, 51-60, and 61-70.

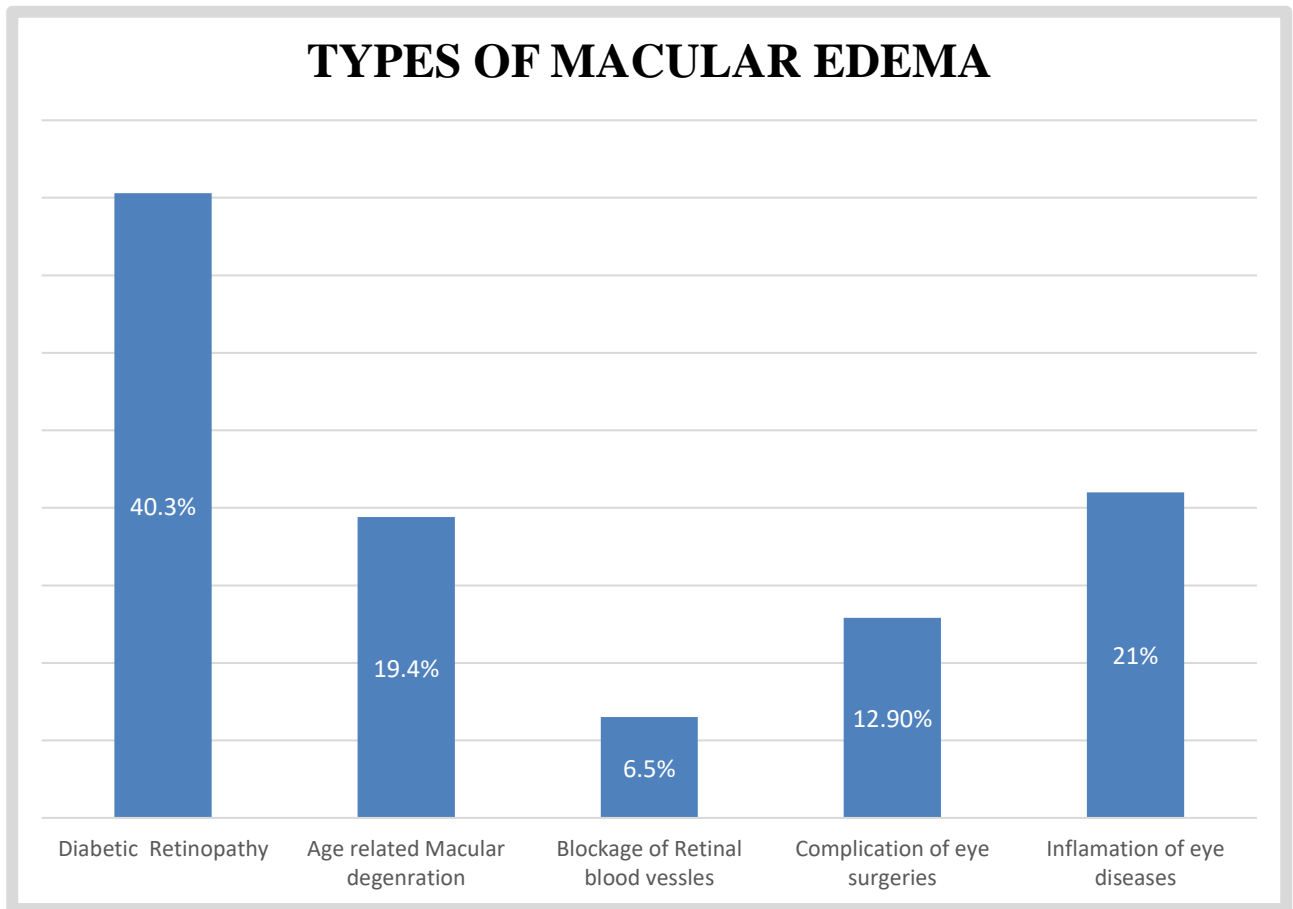


CHART 2: TYPES OF MACULAR EDEMA

Description:

Chart 2 is representing the types of diseases due to which macular edema occurred in the respondents. It was observed that macular edema is occurred because of five fundamental reasons including diabetic retinopathy, age-related macular degeneration, blockage of retinal blood vessels, the complication of eye surgeries, and inflammation of eye diseases.

CAUSES OF MACULAR EDEMA						
Age	Diabetic Age related retinopathy	Age related Macular degeneration	Blockage of Retinal blood vessels	Complication of eye surgeries	Inflammatory eye disease	Total
<u>40-50 years</u>						
Count	17	6	2	2	0	27
% within age	63.0%	22%	7.4%	7.4%	0.0%	100.0%
% with in causes of macular edema	68.00%	50.00%	50.00%	25%	0.00%	43.5%
<u>51-60 years</u>						
Count	6	1	2	6	7	22
% within age	27.3%	4.5%	9.1%	27.3%	31.8%	100.0%
% with in causes of macular edema	24.0%	8.3%	50.0%	75.0%	53.8%	35.5%
<u>61-70 years</u>						
Count	2	5	0	0	6	13
% within age	15.4%	38.5%	0.0%	0.0%	46.2%	100.0%
% with in causes of macular edema	8.0%	41.7%	0.0%	0.0%	46.2%	21.0%
Total						
Count	25	12	4	8	13	62
% within age	40.3%	19.4%	6.5%	12.9%	21.0%	100.0%
% with in causes of macular edema	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

TABLE 2: CAUSES OF MACULAR EDEMA

Description:

Table 2 is representing the causes of macular edema based on respondents' age. It was also found that the causes of macular edema are directly associated with the age of the respondents. The old aged people are considered to be the primary suspect of age-related macular degeneration which becomes the reason for macular edema. Therefore, the old aged people are suffering from macular edema because of age-related macular degeneration. Meanwhile, the people from 51-to 60 have done their cataract or retinal-related surgeries. Thus, they are the suspects of macular edema because of eye surgeries complication.

SIGNIFICANT VALUE FOR THE ASSOCIATION BETWEEN AGE FACTOR AND CAUSES OF MACULA EDEMA			
	Value	df	Asymp.Sig (2 sided)
Chi-Square Pearson	29.200 ^a	8	.000
Likelihood Ratio	36.224	8	.000
Linear -By-Linear	12.496	1	.000
Association N of Valid Cases	62		

TABLE 3: SIGNIFICANT VALUE FOR THE ASSOCIATION BETWEEN AGE FACTOR AND CAUSES OF MACULA EDEMA

Description:

Table 3 is representing the significant value for the association between age factor and causes of macular edema. The significant value for the association between causes of macular edema and age factor is 29.20 which is higher than the table value. In this context, people have to critically focus on the adoption of associated precautions for the management of macular edema based on their age.

PAIRED SAMPLE T-TEST			
Variable	Mean	Std.Deviation	Sig. (2-tailed)
Visual acuity of patients before injection- Visual acuity of patients after injection	1.46774	1.25081	.000

TABLE 4: COMPARISON BETWEEN VISUAL ACUITY OF THE PATIENTS BEFORE AND AFTER INJECTING THE SUPRACHOROIDAL TRIAMCINOLONE ACETONIDE

Description:

Table 4 represents the mean value for the comparison between visual acuity of the people before and after injecting the Suprachoroidal triamcinolone acetonide is 1.46 + 1.25. There is a significant relation occurred between visual acuity of the people before and after injecting the Suprachoroidal triamcinolone acetonide ($p = 0.001$).

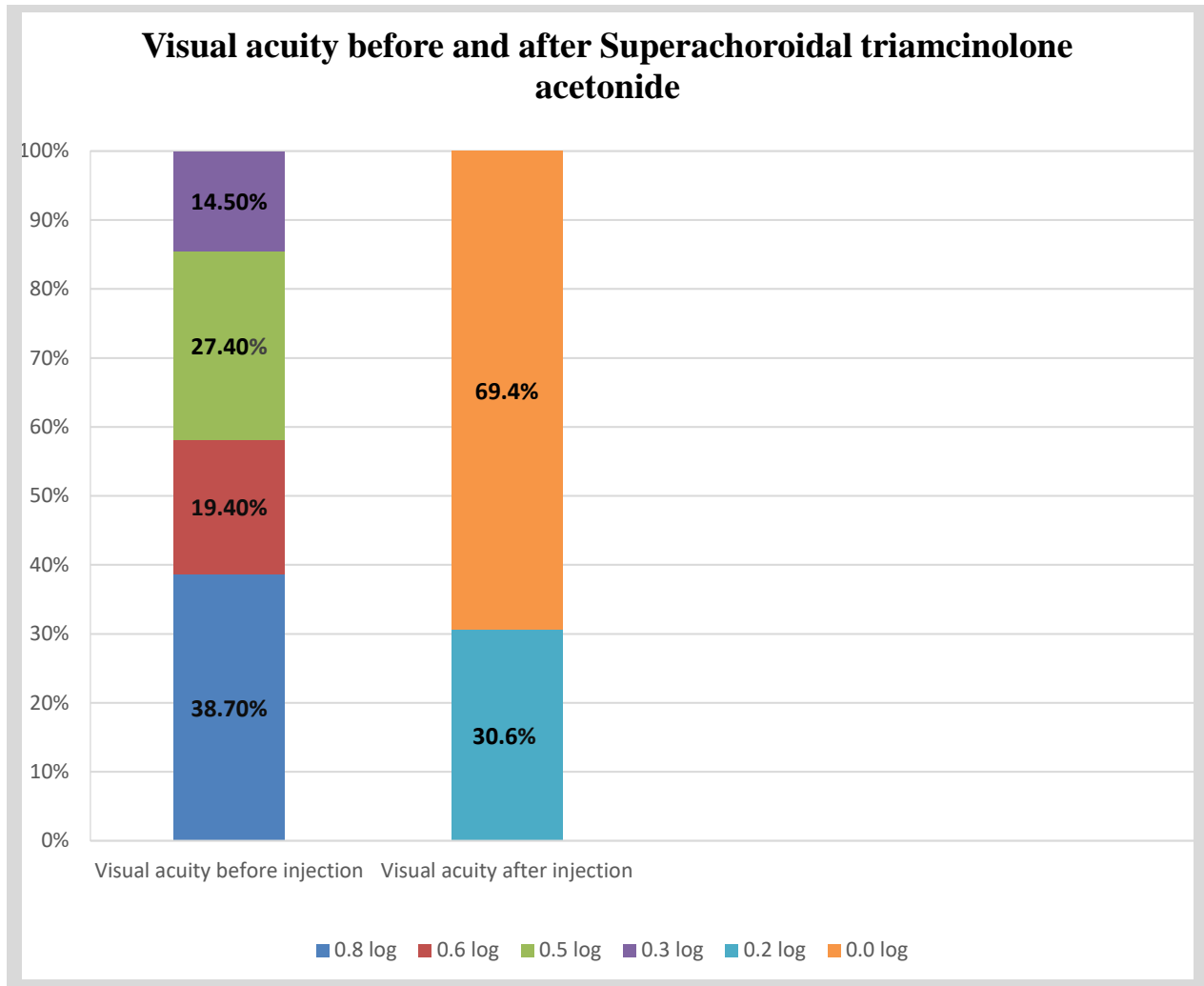


CHART 3: VISUAL ACUITY BEFORE AND AFTER SUPRACHOROIDAL TRIAMCINOLONE ACETONIDE

Description:

Chart 3 is representing the Visual acuity before and after Suprachoroidal triamcinolone acetate. For this purpose, the comparison between the frequencies of visual acuity before and after the injection of Suprachoroidal triamcinolone acetate is beneficial for highlighting the efficacy of Suprachoroidal triamcinolone acetate for the improvement of visual acuity. When it comes to the visual acuity of the respondents before Suprachoroidal triamcinolone acetate, 14.5% of the respondents have the visual acuity 0.3 log, 27.4% of the respondents have the visual acuity 0.5 log, 19.4% of the respondents have the visual acuity 0.6 log, and 38.7% of the respondents have the visual acuity 0.8 log. All of these respondents are suffering from macular edema. It was found that most people lose their visual acuity up to 0.8 log which is considered to

be an alarming situation for healthcare professionals. There is a comprehensive improvement occurred in the visual acuity of the people with the use of Suprachoroidal triamcinolone acetonide. After the use of Suprachoroidal triamcinolone acetonide, out of 62 patients, 43 (69.4%) patients improve their visual acuity up to 0 log. 19 (30.6%) of the patients improve their visual acuity up to 0.2log. Overall, results show that the use of Suprachoroidal triamcinolone acetonide is produced positive consequences for the treatment of macular edema.

Meanwhile, the use of Suprachoroidal triamcinolone acetonide has a direct impact on the improvement of visual acuity. The complication rate of Suprachoroidal triamcinolone acetonide is very low. This fact needs to be kept in mind that healthcare professionals have to follow a particular procedure for Suprachoroidal injections. Meanwhile, healthcare professionals have to use drug doses according to the severity of macular edema.

VISUAL ACUITY OF THE PATIENTS BEFORE INJECTION		
Visual acuity in logMar	Frequency	Percent (%)
0.5 log	17	27.4%
0.6 log	12	19.4%
0.8 log	24	38.7%
0.3 log	9	14.5%
Total	62	100%

TABLE 5: VISUAL ACUITY OF PATIENTS BEFORE SUPRACHOROIDAL TRIAMCINOLONE ACETONIDE INJECTION

VISUAL ACUITY OF PATIENTS AFTER INJECTION		
Visual acuity in logMar	Frequency	Percent (%)
0.0 log	43	69.4%
0.2 log	19	30.6%
Total	62	100%

TABLE 6: VISUAL ACUITY OF PATIENTS AFTER TREATED WITH SUPRACHOROIDAL TRIAMCINOLONE ACETONIDE INJECTION

Discussion

The use of Suprachoroidal triamcinolone acetonide is considered to be an effective method for the treatment of macular edema. Meanwhile, the use of Suprachoroidal triamcinolone acetonide is also beneficial for the recovery of visual acuity that reduces particularly because of macular edema. When it comes to macular edema, it produces severe negative consequences for the retina and visual acuity. Macular edema is an inflammatory condition but the fundamental focus of the treatment is the improvement of visual acuity and retinal health. The use of suprachoroidal triamcinolone acetonide is a beneficial to treat macular edema and to improve visual acuity. Thus, this drug is most safest to treat macular edema. We found that the best corrected visual was improved after the instillation of this injection. This treatment has limited side effects. The dose of Suprachoroidal triamcinolone acetonide also treated the associated infections and problems in macular region. In previous researches, we observed that the results that we have achieved are almost similar to them. The best corrected visual acuity that we get after the treatment with Suprachoroidal triamcinolone acetonide was improved in majority of cases. In most of the patients the visual acuity was even 6/60 before the treatment and improved to 6/6 after macular edema is treated. We observed a few cases where the visual acuity following medication instillation did not achieve Snellen 6/6, which was attributed to the patients' age. Apart from DME, suprachoroidal triamcinolone injection has been tested in Retinal Vascular Occlusion (RVO) and posterior uveitis. In the TANZANITE research, the efficacy of SCTA was

compared with intravitreal aflibercept in instances of RVO. The TANZANITE research showed that combination injections resulted in persistent edoema clearance and improved visual outcomes with a lower number of doses. SCTA was utilised for non-infectious posterior uveitis in a comparable research (DOGWOOD), and the authors found positive results in terms of BCVA improvement and persistent reduction in CST. Similar investigations (PEACHTREE Phase III study). Similar studies (PEACHTREE Phase III study) have been done to evaluate the safety and efficacy of SCTA. Preclinical data demonstrate that using suprachoroidal space for drug delivery, particularly TA, results in a more posterior distribution with higher concentrations of medicines available for the retina, choroid, and retinal pigment epithelium; and less exposure to the anterior section. The suprachoroidal route of Triamcinolone administration has also been employed in cases of macular edoema caused by Retinal Vascular Occlusion (RVO) and posterior uveitis. In the TANZANITE research, intravitreal Aflibercept efficacy was compared to that of SCTA in patients of macular edoema caused by retinal venous blockage. The results have been very encouraging in terms of improved visual outcomes with fewer injections and thus maintained edoema resolution. Haroon et al. conducted a local trial with positive visual OCT outcomes. The fundamental advantage of employing the suprachoroidal region for drug delivery is that it results in a more posterior distribution with larger concentrations available for the retina, choroid, and retinal pigment epithelium while exposing the anterior segment tissues less. This, in turn, minimises the adverse effects of triamcinolone in the anterior segment, such as cataract formation and increased IOP. This has been demonstrated in previous research such as the HULK, DOGWOOD, and TANZANITE studies.

Conclusions

It is concluded that there is significant improvement in best corrected visual acuity after using Suprachoroidal triamcinolone acetonide injection. That's why Suprachoroidal triamcinolone acetonide is considered to be beneficial for the management of macular edema. This injection is affective and safer for the treatment of macular edema.

Recommendations

It is recommended that

- The management of associated diseases is considered to be beneficial for overcoming the severity of macular edema.

- Ophthalmologist should prefer Suprachoroidal triamcinolone acetonide for the treatment of macula edema as it improves visual acuity in patients.

Limitations

The sample size of this study was small and study was limited to one research center.

Ethical Approval

The research was conducted after the approval of the Ethical Committee of University of Lahore and data was collected after approval of ethical review committee of University teaching hospital on May 21th, 2022.

Acknowledgement

The authors are thankful to Mrs, Faiza Akhtar her helpful comments on the manuscript. Additional thanks also for Dr. Anwar ul Haq for his encouragement and support to collect patient data from University teaching hospital Lahore.

Conflict of Interest:

There is no conflict of interest for any author related to this study.

Source of Funding:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. All the information was retrieve from the patients file and test reports which was done on routine basis.

Authors contributions:

1. Gul Zaman: Concept development; Manuscript writing
2. Kazma Kulsoom: Study design; Manuscript writing
3. Abid Hussain Shah: Proof reading, final approval
4. Muhammad Dawood: Statistical analysis
5. Muhammad Noman Tariq: Data Collection
6. Ayesha Altaf: Review

References:

1. Daruich A, Matet A, Moulin A, Kowalczyk L, Nicolas M, Sellam A, Rothschild PR,

- Omri S, Gélizé E, Jonet L, Delaunay K. Mechanisms of macular edema: beyond the surface. *Progress in retinal and eye research*. 2018 Mar 1;63:20-68.
2. Iijima H. Mechanisms of vision loss in eyes with macular edema associated with retinal vein occlusion. *Japanese Journal of Ophthalmology*. 2018 May;62(3):265-73.
 3. Gundogan FC, Yolcu U, Akay F, Ilhan A, Ozge G, Uzun S. Diabetic macular edema. *Pakistan journal of medical sciences*. 2016 Mar;32(2):505.
 4. Campochiaro PA, Wykoff CC, Brown DM, Boyer DS, Barakat M, Taraborelli D, Noronha G, Tanzanite Study Group. Suprachoroidal triamcinolone acetonide for retinal vein occlusion: results of the Tanzanite Study. *Ophthalmology Retina*. 2018 Apr 1;2(4):320-8.
 5. Chen M, Li X, Liu J, Han Y, Cheng L. Safety and pharmacodynamics of suprachoroidal injection of triamcinolone acetonide as a controlled ocular drug release model. *Journal of Controlled Release*. 2015 Apr 10;203:109-17.
 6. Wang W, Lo AC. Diabetic retinopathy: pathophysiology and treatments. *International journal of molecular sciences*. 2018 Jun;19(6):1816.
 7. Stitt AW, Curtis TM, Chen M, Medina RJ, McKay GJ, Jenkins A, Gardiner TA, Lyons TJ, Hammes HP, Simo R, Lois N. The progress in understanding and treatment of diabetic retinopathy. *Progress in retinal and eye research*. 2016 Mar 1;51:156-86.
 8. Kauppinen A, Paterno JJ, Blasiak J, Salminen A, Kaarniranta K. Inflammation and its role in age-related macular degeneration. *Cellular and Molecular Life Sciences*. 2016 May;73(9):1765-86.
 9. Chung YR, Kim YH, Ha SJ, Byeon HE, Cho CH, Kim JH, Lee K. Role of inflammation in classification of diabetic macular edema by optical coherence tomography. *Journal of Diabetes Research*. 2019 Oct;2019.
 10. Lampen SI, Khurana RN, Noronha G, Brown DM, Wykoff CC. Suprachoroidal space alterations following delivery of triamcinolone acetonide: Post-hoc analysis of the phase 1/2 HULK study of patients with diabetic macular edema. *Ophthalmic Surgery, Lasers and Imaging Retina*. 2018 Sep 1;49(9):692-7.
 11. Mathew C, Yunirakasiwi A, Sanjay S. Updates in the management of diabetic macular edema. *Journal of diabetes research*. 2015 Apr 23;2015.
 12. Coscas G, Cunha-Vaz J, Soubrane G. Macular edema: definition and basic concepts. *Macular Edema*. 2017;58:1-0.

13. Barakat MR, Wykoff CC, Gonzalez V, Hu A, Marcus D, Zavaleta E, Ciulla TA. Suprachoroidal CLS-TA plus intravitreal aflibercept for diabetic macular edema: a randomized, double-masked, parallel-design, controlled study. *Ophthalmology Retina*. 2021 Jan 1;5(1):60-70.
14. Xia JP, Wang S, Zhang JS. The anti-inflammatory and anti-oxidative effects of conbercept in treatment of macular edema secondary to retinal vein occlusion. *Biochemical and biophysical research communications*. 2019 Jan 22;508(4):1264-70.
15. Holekamp NM. Review of neovascular age-related macular degeneration treatment options. *Am. J. Manag. Care*. 2019 Jul 1;25(10).
16. Kim EJ, Lin WV, Rodriguez SM, Chen A, Loya A, Weng CY. Treatment of diabetic macular edema. *Current diabetes reports*. 2019 Sep;19(9):1-0.
17. Xia JP, Wang S, Zhang JS. The anti-inflammatory and anti-oxidative effects of conbercept in treatment of macular edema secondary to retinal vein occlusion. *Biochemical and biophysical research communications*. 2019 Jan 22;508(4):1264-70.
18. Holekamp NM. Review of neovascular age-related macular degeneration treatment options. *Am. J. Manag. Care*. 2019 Jul 1;25(10).
19. Kim EJ, Lin WV, Rodriguez SM, Chen A, Loya A, Weng CY. Treatment of diabetic macular edema. *Current diabetes reports*. 2019 Sep;19(9):1-0.
20. Jampol LM, Glassman AR, Sun J. Evaluation and care of patients with diabetic retinopathy. *New England Journal of Medicine*. 2020 Apr 23;382(17):1629-37