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Original Research Article

Comparison of Different Treatment Modalities for Age-related Macular Degeneration

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Abstract

Background: Age-related Macular Degeneration (AMD) is a significant cause of visual impairment in the elderly. As there are several treatment methods, it is essential to compare their efficacy and enhance patient outcomes and clinical decision-making.

Methods: It is a hospital-based prospective comparative study that will be carried out at JNKT Medical College & Hospital, Madhepura, from August 2023 to December 2025. There were 105 patients aged ≥50 years with AMD. Patients were grouped into three categories Group A (anti-VEGF treatment, n=45), Group B (laser/photodynamic therapy, n=30), and Group C (nutritional/conservative management, n=30). Snellen chart was used to determine visual acuity at baseline and follow-up. Data were done on SPSS with statistical significance being entertained at $p < 0.05$.

Results: Among the 105 patients, 58 were males and 47 were females, with a mean age of years. There was also improvement in visual acuity in 32 patients in Group A, 18 patients in Group B and 10 patients in Group C. No change in vision was noted in 10, 8, and 12 patients in Groups A, B, and C respectively, while worsening of vision occurred in 3, 4, and 8 patients, respectively. The statistical significance of the difference in the results between the groups was significant ($p < 0.05$). There were some minor complications and mild adverse effects as seen in 7 in Group A, 6 in Group B, and 2 in Group C.

Conclusion: Anti-VEGF treatment proved to be the most efficient in terms of visual acuity and stabilization of AMD among other modalities. It is also the most efficient treatment option, and it has significant implications for clinical practice, especially in tertiary care.

Keywords: Age-related macular degeneration, Anti-VEGF therapy, Photodynamic therapy, Visual acuity, Wet AMD.

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Introduction

AMD is a progressive degenerative disease of the central retina and one of the major causes of permanent loss in vision of the elderly demographic in the global population [1]. It mainly attacks the macula, the centre of the retina that helps with fine and acute vision, thus severely limiting activities that involve reading, driving, and face recognition. The two common types of AMD are dry (non-neovascular) AMD and wet (neovascular) AMD.

The more common is dry AMD which has almost 80% to 90% of the cases and it is associated with the formation of drusen (yellow deposits) and progressive thinning of the retinal pigment epithelium [2]. Wet AMD is less prevalent but more severe and causes most cases of the quick loss of vision as it develops abnormal blood vessels under the retina, causing leakage, hemorrhage, and scarring [3]. AMD is an affliction of millions of people around the globe, and its rates are likely to increase due to the growing life expectancy and aging [4,5]. The number of people infected by AMD is estimated to be more than 190 million all over the world and it is estimated that by 2040, the figure will be almost 288 million [6].

AMD is becoming a major health issue in India especially among those whose age is over 50 years. According to different epidemiological research, the rate of AMD in India would be between 1.4% and 3.1% with an increase in the older age groups and in urban populations [7]. The increasing weight of AMD in the developing world indicates the

necessity of early diagnosis and proper treatment measures.

Pathophysiology of AMD is multifactorial and complex, and involves genetic predisposition, environmental factors, oxidative stress, and inflammatory mechanisms [8]. In dry AMD, progressive degeneration of photoreceptors occurs as a result of the build-up of drusen between the retinal pigment epithelium and Bruch's membrane [9,10]. In wet AMD, an increase in Vascular Endothelial Growth Factor (VEGF) stimulates the development of abnormal choroidal neovascularization that destroys retinal architecture and leads to a rapid visual loss.

Various modalities of treatment have been evolved in order to treat AMD, especially the neovascular type. The gold standard treatment of wet AMD at present is the anti-VEGF injections, including ranibizumab and bevacizumab, which prevent the growth of abnormal blood vessels and decrease fluid leakage [11]. Laser photocoagulation therapy is less popular nowadays, but it may be effective in some cases, as it seals leaking blood vessels. Photodynamic therapy (PDT) using verteporfin, is a treatment that uses a photosensitizing agent that is caused by laser to destroy abnormal vessels and avoids damaging surrounding tissues [12]. Also, the Age-Related Eye Disease Study (AREDS) formulation of nutritional supplementation (antioxidants and zinc) has been demonstrated to retard the development of intermediate to advanced dry AMD.

Although several treatment modalities are available, no comprehensive comparative hospital-based studies have been done to assess the effectiveness of the modalities in a real-world clinical setting, especially in resource-constrained areas. The majority of the available literature concentrates on individual therapies and does not have direct comparisons available, leaving a knowledge gap that can inform clinicians to choose the most suitable treatment method. Thus, the objective of the study is to compare various interventions in the management of AMD and find out how effectively they can work and what clinical results they can achieve in the tertiary care hospital.

Objectives

- To compare the efficacy of the various treatment modalities (anti-VEGF therapy, laser/photodynamic therapy and nutritional management) in patients with age-related macular degeneration.
- To measure the change in visual acuity and disease progression in patients who are treated with various treatments.
- To measure and compare safety, complications of each treatment modality.

Materials and Methods

Study Design: The study was carried out as a prospective comparative study that was done at a hospital to measure and compare the efficacy of various treatment modalities in patients with AMD. To enable a systematic follow-up of patients over time and to accurately evaluate the outcome of treatment including changes in visual acuity and progression of the disease among various intervention groups, a prospective design was used.

Study Setting: The research was conducted in JNKT Medical College & Hospital, Madhepura, a tertiary care facility that offers specialized ophthalmological services to a high number of people in the area. A variety of patients were facilitated by the hospital environment.

Study Duration: This study was conducted for 29 months, from August 2023 to December 2025. This duration was to give sufficient time to recruit the patients, administer the treatment and visit the patients after the treatment to determine the efficacy of the different treatment modalities.

Sample Size: The study included 105 patients who had age-related macular degeneration. The number of samples was calculated depending on the number of eligible patients during the study period and was considered adequate to carry out comparative statistical analysis across the various treatment groups.

Inclusion Criteria: The study involved patients based on the following criteria individual aged 50 years and over, a confirmed clinical diagnosis of age-related macular degeneration via ophthalmological examination, and patients who had been under treatment of AMD in the study center. Patients who agreed to take part and were willing to undergo a follow-up assessment were enrolled only.

Exclusion Criteria: The study was not inclusive of patients who had other co-existing retinal conditions like diabetic retinopathy or retinal detachment, incomplete medical records or those who had undergone other ocular surgeries that had the potential to affect the outcome of visual criterion. These were the criteria used in order to reduce confounding factors and in order to make the results reliable.

Grouping of Patients: The registered patients were grouped into three categories according to the type of treatment they received. Group A involved patients who had undergone anti -VEGF therapy. Group B included patients who received either laser therapy or photodynamic therapy. Group C consisted of patients who were treated with nutritional supplementation and non-pharmacological methods, including the AREDS

formulation. This categorization allowed comparative analysis of the results of the treatments in various modalities.

Data Collection: The structured proforma was used to collect data per patient. Visual acuity was evaluated on the Snellen chart both at baseline and follow-up visits. Optical Coherence Tomography (OCT) was done to analyze the morphology of the retina and to track down the disease. Fundus examination was performed to determine the structural alterations in the retina. The patients were periodically followed to document response to treatment and any change in clinical status.

Outcome Measures: The primary study outcome measure was the enhancement of visual acuity after the treatment. The secondary outcome measures were the disease progression, which was observed based on clinical and imaging observations and also the incidence of any complication or adverse event during treatment.

Statistical Analysis: Data gathered was entered in Microsoft Excel and analyzed on the SPSS software. Demographic and clinical data were summarized using descriptive statistics. Statistical tests were used to compare the results of the groups using inferential statistics, such as the Chi-square test and analysis of variance (ANOVA). The p-value was less than 0.05 which was regarded as significant.

Ethical Considerations: The research was carried out in compliance with the principles of ethics and was accepted by the Institutional Ethics Committee of the hospital. All subjects were informed by giving them consent before being included in the study. The confidentiality of patients and their data privacy were considered during the research process.

Results

Demographic Data: The study included a total of 105 patients diagnosed with AMD. Most of the patients were aged and thus the disease was a reflection of their age. The majority of the respondents belonged to the 60-69 years of age group, then 70-79 years of age group. The average age of the research group was around 66.5 years. Regarding gender inequality, there was a minor difference between males and females but not significant.

Table 1: Age and Gender Distribution of Patients

Age Group (years)	Male	Female	Total
50–59	10	8	18
60–69	20	15	35
70–79	16	14	30
≥80	12	10	22
Total	**58**	**47**	**105**

Treatment Distribution: The patients were divided into three groups according to the type of treatment they received. Most patients underwent anti-VEGF therapy, which was followed by laser/photodynamic therapy and nutritional/conservative management.

Table 2 Distribution of Patients by Treatment Modality

Treatment Group	Number of Patients	Percentage (%)
Group A (Anti-VEGF)	45	42.9%
Group B (Laser/PDT)	30	28.6%
Group C (Nutritional/Conservative)	30	28.6%
Total	**105**	**100%**

Visual Outcomes: The Snellen chart helped in determining the visual acuity before and after the treatment. Anti-VEGF therapy was found to have a great enhancement in visual acuity among the patients as compared to other groups. The laser/photodynamic therapy patients reported moderate improvement and minimally the nutritional/conservative group reported improvement.

Table 3: Pre- and Post-Treatment Visual Acuity Improvement

Treatment Group	Improved	No Change	Worsened
Group A (Anti-VEGF)	32	10	3
Group B (Laser/PDT)	18	8	4
Group C (Nutritional)	10	12	8

Comparative Analysis

The anti-VEGF modality was the most effective in visual acuity improvement, as shown in the comparative analysis of treatment outcomes.

The statistical analysis with ANOVA revealed that the difference in results among the groups was significant ($p < 0.05$) in Group A, with a rate of improvement in about 71.1% of patients. These results show that anti-VEGF treatment has better

clinical effects in the treatment of AMD than other modalities.

Complications

Problems related to the treatment were also documented and compared in groups. The use of anti-VEGF therapy was generally tolerated and few patients reported minor side effects like eye discomfort and short-term redness.

There was minor retinal damage and visual disturbances in a few patients in the laser/photodynamic therapy group. The nutritional/conservative group had minimal side effects, as anticipated.

Table 4: Complications Observed Across Treatment Groups

Treatment Group	No Complications	Mild	Moderate
Group A (Anti-VEGF)	38	7	0
Group B (Laser/PDT)	22	6	2
Group C (Nutritional)	28	2	0

Overall, the findings suggest that although the anti-VEGF treatment demonstrated the most effective effect in enhancing the visual outcomes, it also has a positive safety profile. Laser and photodynamic treatments were moderately effective with a slightly increased incidence of complications, but nutritional treatment alone did not have much effect on visual improvement.

Discussion

The aim of the present study was to compare the efficacy of various treatment modalities used in AMD in a hospital setting. The results revealed that the anti-VEGF therapy produced the greatest effect in improving the visual acuity among the patients, then laser/photodynamic therapy, and the nutritional/conservative management gave relatively few advantages. Most of the patients injected with anti-VEGF reported stability or improvement in their vision, which is a demonstration of the effectiveness of the treatment in terms of neovascular alterations with AMD. Conversely, the results of the nutritional group indicate that these interventions might be more supportive than a primary treatment modality.

Comparison with Previous Studies: The results of this study are consistent with some of the earlier published studies that have established anti-VEGF therapy as the gold standard in the treatment of neovascular AMD [13]. Clinical studies as MARINA and ANCHOR have shown huge improvements in visual acuity of patients undergoing ranibizumab therapy.

In the same vein, bevacizumab studies have shown the same efficacy in real-world. The photodynamic therapy research is moderately beneficial, especially prior to the popularity of anti-VEGF agents, with the most recent literature demonstrating its application as a secondary treatment only [14]. The low efficacy of nutritional supplementation found in this study is also in line with the results of the AREDS trials, which highlights the efficacy of such supplementation in slowing down but not enhancing vision [15].

Strengths of the Study: The prospective nature of this study is one of its main strengths as it provided an opportunity to conduct systematic data collection and track patients throughout the years. The combination of several treatment modalities in one study gives a detailed comparison of the modalities effectiveness in a real clinical set-up. Also, the standardized assessment tools, including the Snellen chart and OCT, increase the credibility of the results.

Limitations of the Study: The study has some limitations although it has its strengths. The findings can be generalized because of the relatively small sample size (105 patients). Moreover, the study being a single-center investigation that was carried out in a single tertiary care hospital, the findings might not be applicable to general populations or other healthcare facilities.

Patient compliance and follow-up time also might have been variable and could have contributed to the results. It is suggested that further multicenter research involving bigger sample sizes be conducted in the future to confirm these results, and offer stronger evidence to guide clinical decisions.

Conclusion

This research showed that in comparison with alternative treatments of AMD, anti-VEGF therapy was the most effective in terms of getting better visual acuity and stabilizing the disease. Anti-VEGF injections were demonstrated to be significantly effective in comparison with laser/photodynamic therapy, nutritional or conservative management which demonstrated moderate and limited efficacy respectively. This results, the use of anti-VEGF therapy as the primary mode of treatment in clinical practice of patients with neovascular AMD should be regarded as the first-line option. Nevertheless, the choice of treatment must be personal, considering the individual patient factors like the severity of the disease and its availability, cost and compliance. Alternative modalities can be applied as supplements, or in those instances when anti-VEGF

therapy cannot be applied. The future study needs to consider a large-scale, multicenter study with longer follow-ups to confirm these results and consider combination therapies, newer pharmacological agents, and cost-effective treatment options to enhance patient outcomes, especially in resource-constrained environments.

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