# CLINICAL STUDY ON THE SAFETY AND EFFICACY OF INTRAVITREAL TRIAMCINOLONE FOR RECALCITRANT MACULAR EDEMA IN SOUTH INDIAN POPULATION

Submitted in partial fulfillment for

**M.S. OPHTHALMOLOGY**

**BRANCH - III**

**Regional Institute of Ophthalmology**

**Madras Medical College & Research Institute,**

**Chennai – 600 003**


**THE TAMILNADU Dr.M.G.R. MEDICAL UNIVERSITY**

**CHENNAI – 600 003**

**TAMIL NADU**

**MARCH 2010**

# CERTIFICATE

Certified that this dissertation entitled" **CLINICAL STUDY ON THE SAFETY AND EFFICACY OF INTRAVITREAL TRIAMCINOLONE FOR RECALCITRANT MACULAR EDEMA IN SOUTH INDIAN POPULATION**" is the bona fide work by Dr. CHINMAY NAKHWA, post graduate student, done under my guidance and supervision during the period from June 2008 to November 2008 in partial fulfillment for the award of M.S. Degree (Ophthalmology) of the Tamil Nadu Dr. M.G.R. Medical University, Chennai.

**Prof. Dr.B.Jayasuganthi M.S.,D.O.**
Chief, Vitreo- Retina services
RIO - GOH,
Chennai - 8.

**Prof. Dr. M.Radhakrishnan M.S,D.O**
Director & Superintendent,
RIO - GOH,
Chennai - 8.

**Prof. Dr.J Mohanasundaram.M.D., Ph.D, D.N.B.,**
Dean,
Madras Medical College
Chennai

# ACKNOWLEDGEMENTS

My sincere thanks and gratitude to **Prof. Dr J Mohanasundaram, M.D., Ph.D, D.N.B.,** Dean, Madras Medical College for permitting me to utilize the clinical materials of this hospital.

I have immense pleasure in thanking **Prof. Dr. M. Radhakrishnan M.S., D.O.,** Director and Superintendent, Regional Institute of Ophthalmology and Govt. Ophthalmic Hospital for his guidance and suggestions during this study.

I have great pleasure in thanking my unit chiefs, my guide **Prof. B. Jayasuganthi M.S., D.O** and **Prof. R. Ravikumar M.S., D.O** for their continuous guidance, valuable advice and constant support at every stage of my dissertation.

I take immense pleasure in thanking my unit Assistant Professors, **Dr.Zaibunissa M.S., D.O., Dr. Padmapriya M.S., and Dr. A.Palaniraj M.S.,** for their valuable suggestion, guidance and help during the study.

I am thankful to all the professors and assistant professors of this institute who have guided me in this study.

I am grateful to all the patients without whose cooperation this study would not have been possible.

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# INTRODUCTION

Edema of the retina is an extremely common condition occurring to some degree in most circulatory disturbances and all inflammatory conditions. Broadly defined macular edema is an abnormal thickening of the macula with accumulation of excess fluid in the extracellular space of the neurosensory retina.

The term cystoids macular edema applies when there is accumulation of fluid in cyst like spaces within the macula as evidenced by clinical examination, flourescien angiography or OCT.

Macular edema in its various forms can be considered the leading cause of central vision loss in the world and is therefore of enormous medical and socio-economic importance.

# ANATOMY OF THE MACULA

Macula is the optical, functional and organic focal point of the eye. It is concerned with precise visual functions of acuity, form sense, color differentiation and stereopsis.

According to Wolff, the macula is an oval zone of yellow coloration within the central retina approximately 5 mm in diameter. The yellow color of the macula is probably from the presence of the carotenoid pigment Xanthophyll in the ganglion calls and the bipolar cells in this area.

The side walls of the macula is the clivus which slopes gently towards the fovea centralis. Fovea is the center of the area centralis and is located 4 mm temporal to the center of the optic disc and 0.8 mm below the horizontal meridian. Its thickness is 0.25 mm, diameter is 1.85 mm and it corresponds to 5 degrees of visual field. Foveola is at the center of the fovea where the retinal layers are thinner. It is of 0.13 mm thickness, 0.35 mm in diameter and corresponds to 1 degree of visual field. It is the area of highest visual acuity because of the sole presence of cone photoreceptors and its avascularity. It appears deeper red than the adjacent retina because of the rich choroidal circulation and abundant choriocapillaris. Parafovea

is a 0.5 mm wide zone around the fovea. Perifovea is a 1.5 mm band beyond the parafovea.

## HISTOPATHOLOGY

The retina as such has 10 layers which are as follows-

1. Retinal pigment epithelium
2. Photoreceptor layer of rods and cones
3. External limiting membrane
4. Outer nuclear layer
5. Outer plexiform layer
6. Inner nuclear layer
7. Inner plexiform layer
8. Ganglion cell layer

9. Nerve fiber layer.

10. Internal limiting membrane

At the fovea, the only layers present are the

1. Retinal pigment epithelium

2. Photoreceptors ( only cones)

3. External limiting membrane

4. Outer nuclear layer

5. Inner fibers of photoreceptors ( Henle's layer)

6. Internal limiting membrane

Thus the fovea has no inner nuclear layer, inner plexiform layer or ganglion cell layer and practically no nerve fiber layer.

At the macula the ganglion cells are much more numerous than elsewhere in the retina, being arranged in several layers. The OPL is made up of arborisation of

axons of rods and cones with bipolar cell dendrites. it also includes Muller's fibers and the horizontal cell processes. This layer has a reticular structure but as the macula is approached it takes a fibrous structure called the 'Henle's fiber layer'. The fibers run at first vertically, then obliquely near the macula and finally parallel to the surface. This layer is thickest at the macula but almost absent at the fovea. There is also a progressive disappearance of rods.[i] The RPE and choriocapillaris are thicker than at the macula. This is important since the macula has no retinal blood vessels. At the fovea the layers of the retina are spread aside so that light may fall directly on the cones. Each cone is connected to only one ganglion cell ( in other area each ganglion cells connects up to 100 rods). At the center of the fovea cone cells are located in a 50μ diameter area and are separated from each other by relatively wide spaces of watery cytoplasm belonging to Muller's fibres. The thinness of the basal lamina and the watery cytoplasm allow light to pass through[ii].

# ANATOMIC PECULARITIES OF THE MACULA CAUSING AN EXAGGERATED RESPONSE TO PATHOLOGICAL PROCESSES.

The peculiar susceptibility of the macula to a number of different pathological processes both local and generalized is called the 'exaggerated response of the macula'[iii]. The causes for this are listed below-

## 1. VASCULAR SUPPLY:

The arcade arrangement of the capillaries which arise as terminal parts of an end artery system, together with the central avascular zone make the fovea a 'watershed'. Local impairment of metabolism , whether from disturbances in perfusion and accumulation of metabolites or from the effects of capillary damage, lead to extra cellular fluid accumulation at a quicker rate than what can be absorbed.

## 2. TISSUE ARCHITECTURE:

The processes of Muller's cells run horizontally in the OPL, hence the retina loses its compact nature and this laxity enables large quantities of extra

cellular fluid or exudates to be accommodated in the macular region leading to the characteristic cystiod macular edema.

**3. CELLULAR CONSTITUENTS:**

The ganglion cells have a high metabolic rate and their dysfunction due to any cause leads to rapid accumulation of tissue metabolites here. Most metabolites have a vasodilator effect and this along with the underlying hypoxia can lead to CME

4. **INTERNAL LIMITING MEMBRANE:**

The vitreous is an excellent diffusing medium and the ILM provides little additional interference to the progress of toxic substances arising from the iris, peripheral choroid and pars plana. These substances may traverse the vitreous and because of the thinness and adherence of the ILM in the foveal region, may preferentially disturb the function of the cells which are highly concentrated around the foveal rim, and also affect the macular capillary permeability.

**5. CHOROID AND RPE:**

The macular choroid and the RPE are also the preferential sites for degenerative changes which may be hereditary, toxic or arteriosclerotic. There

is a predisposition for choroidal vascular diseases with decompensation and hemorrhage in the central area which is thought to be because RPE in the fovea is very active metabolically and this hyperactivity along with the special homodynamic effects of the narrow choroidal capillaries may lead to increased susceptibity.

## MACULAR EDEMA

The extra cellular space of the retina normally constitutes a small proportion of its total volume. Active transport of electrolytes and larger molecules from the retina across the retinal pigment epithelium to the blood maintains this situation. Disruption of either the outer or the inner blood retinal barrier leads to leakage of plasma proteins and fluid into the extra cellular space. This is often accompanied by accumulation of fluid in the macular are usually in the area of outer plexiform layer and inner nuclear layer. Retinal edema localized to the macula is called macular edema. More generalized leakage leads to diffuse thickening of the posterior pole. Accumulation of fluid in cystic spaces leads to cystoids macular edema.

# CYSTOID MACULAR EDEMA

Causes for cystoids degeneration of the macula have been classified by Duke – Elder as[iv]

- Senile degeneration
- Vascular disorders- arteriosclerosis, CRVO,CRAO,BRVO, retinal periphlebitis, hypertensive retinopathy, diabetic retinopathy.
- Inflammatory disorders- chorioretinitis, iridocyclitis
- Degenerative conditions affecting the macula- RD, macular dystrophies, retinitis pigmentosa.
- Trauma
- Glaucoma
- Hereditary macular cystoid dystrophy

Other conditions mentioned by Stephen J Ryan are[v]-

- Choroidal melanoma, choroidal hemangioma
- Retinal detachment
- Epinephrine maculopathy
- Nicotinic acid maculopathy
- After intraocular surgeries- cataract extraction, vitrectomy, PKP,glaucoma filtering procedures.
- Tractional maculopathies- vitromacular traction syndrome, epiretinal membrane, myopic traction maculopathy.
- Optic nerve head abnormalities- optic disc pit, coloboma, diabetic pappilopathy, neuroretinitis.

# DIABETIC CYSTOID MACULAR EDEMA

It is the most frequent cause of moderate visual impairment in patients with NPDR.This is best detected by Slit lamp with +60D, +78D, +90D or Macular contact lens. Its incidence increases with type of DM (its occurrence is more common in type 2 DM) , duration of DM, age of onset, use of insulin, uncontrolled DM, associated risk factors like Hypertension, Hyper lipedemia, anemia, nephropathy.

Hyper glycemia is the main inciting factor which causes Blood Retinal Barrier breakdown by 3 mechanisms:

1. Increased paracellular transport due to disruption of cell junction

2. Loss of endothelial cell integrity

3. Increased transcellular transport through damaged endothelium

**CLINICAL FEATURES:**

Diabetic Macular Edema has following features:

1. Thickening of macula

2. Blurring of underlying choroidal vascular pattern.

3. Loss of foveolar light reflex if foveola is involved.

4. Cystoid spaces

5. Lipid exudation from leaking Microaneurysms forming circinate retinopathy

**CLASSIFICATION:**

**Focal Edema :**

Areas of focal leakage from micro aneurysms and dilated capillary segments. These focal areas of thickening are delineated from adjacent healthy retina by complete or partial ring of Hard Exudates.

**Diffuse Edema**

Breakdown of Blood Retinal Barrier with leakage from Micro aneurysms and dilated capillary bed throughout posterior retina causes diffuse edema. It differs from focal edema by:

1. Diffuse edema usually not associated with Hard exudates. Even when edema resolves spontaneously it does not leave hard exudates.
2. Cystoid spaces develop more commonly in DME. It is visible clinically, but seen better in late phase of FFA & on OCT as hyper reflective spaces with hyper reflective septa.
3. Mostly bilaterally symmetrical.
4. May disappear spontaneously at same time in both eyes even without laser only to reappear spontaneously.
5. Certain systemic features may be associated with exacerbation & amelioration of DME & include CVS, renal, Hypertension, Pre eclampsia

**Ischemic edema**

Ischemic type of lesion has the following features :

- Enlargement of Foveal Avascular Zone(FAZ)
- Irregularities of FAZ

- Capillary budding into FAZ
- Widening of intercapillary space and capillary dropout in perifoveal area

**CSME (Clinically Significant Macular Edema)**

1. Thickening of the retina < 500 microns from the center of the macula.

2. Hard exudates with thickening of the adjacent retina located 500 microns from the center of macula

3. A zone of retinal thickening, 1 disc area or larger in size located 1 disc diameter from center of macula.

**FFA:**

Focal macular edema shows areas of leakage mainly micro aneurysms that show leakage in late phase. Diffuse macular edema shows dilated capillary network & areas of Capillary Non Perfusion areas with extravasations of dye in late phase. Dye may pool in cystoids spaces if present

**International Clinical DME Severity Scale:**

1. DME absent: No thickening or hard exudates in posterior pole.

2. DME present :

Some retinal thickening or hard exudates in posterior pole. It can be mild, moderate or severe.

## CYSTOID MACULAR EDEMA IN POST INTRAOCULAR SURGERIES

Theories explaining aphakic and pseudo phakic CME

**Vitreous traction theory-**

Constant constriction and dilatation of the pupil created pulling on the anterior vitreous strands which is transmitted to the vitreous base and to the macula by presumed connections between the posterior hyaloid and the surface of the macula

**Inflammation theory-**

CME following cataract extraction ( Irvine –Gass) syndrome can be seen in approximately 20% of uncomplicated cases[vi]. Prostaglandins most likely synthesized by the anterior uveal tissues, have been implicated in causing macular capillary hyperpermeability in these cases. Since the eye does not contain the

enzyme 15-PG dehydrogenase to deactivate prostaglandins, their removal is dependent on an active transport pump called Bito's pump present in the ciliary epithelium. This pump is inoperable for at least 3 weeks after ocular trauma.

CME remains the most common cause of vision loss after cataract surgery. A higher incidence is seen when surgery is complicated by vitreous loss, vitreous adhesions to the cataract wound or other anterior segment structures, iris damage or retained lens material.

The risk of developing CME is substantially higher in patients with pre existing conditions known to produce vasoactive stimuli such as diabetic retinopathy and uveitis.

## CYSTOID MACULAR EDEMA IN RETINAL VENOUS OCCLUSIONS.

An immediate consequence of retinal venous thrombosis is elevation of the intravascular pressure in the retinal veins distal to the occlusion site. Due to this there is an increased transmural hydrostatic pressure in the retinal capillaries .This leads to greater transudation of fluid into the extra cellular space.

Breakdown of the blood retinal barrier, mediated by cytokines such as VEGF that are upregulated in the hypoxic retina, greatly facilitates the extravasation of fluids as well as large protein molecules.[vii]

In this manner both central and branch retinal vein occlusions commonly result in macular edema which tends to be chronic, difficult to treat and visually disabling. In many eyes vision loss is exacerbated by macular hemorrhage, macular ischemia, submacular fluid with secondary RPE changes or traction from ERM or vitreomacular adhesions.

## CLINICAL EVALUATION OF CYSTOID MACULAR EDEMA-

**1. Visual Acuity**

Loss of vision mainly depends on the involvement of the macula.

**2. Color Perimetry**

Field charting by perimetry bay reveal scotomas corresponding to areas of involvement in the fundus

**3. Color Vision**

The most common defect observed is blue yellow. In diabetes the sensitivity of blue cones are depressed. These defects are best detected by Farnsworth Munsell 100 hue test.

**4. Stereoscopic indirect ophthalmoscope**

This technique is of special importance because it allows the examiner to integrate the view of the entire retina. This allows the examiner to form a clearer understanding of the cause &forces involved in the various pathological features involving the retina.

**5. Slit lamp Biomicroscope**

Since the bio microscope is focused about 95mm, the retina is not visible unless any of the below optical methods are used:

1. Goldmann contact lens- 3 mirror
2. Hruby lens
3. 90 D, 78 D condensing lens.

By combining these maneuvers, it is possible to see virtually the entire retina.

**6. Direct Ophthalmoscope**

Though the area of field observed is smaller, increased magnification obtained with this method allows detailed examination of the various details of the fundus.

**7. Threshold Amsler Grid Testing**

This rapid, sensitive and high yield means of assessing the central fields in patients with diabetic retinopathy.

**8. Photo Stress Test**

After images and central scotomas persist after a long time. This explained the prolonged re-adaptation times in photo stress test in the affected eye.

**9. Electrophysiology**

- **Electro Retinography**:

Early stages of diabetic retinopathy may reveal abnormalities of oscillatory potential in the ascending limit of the b wave. Delay in implicit time occurs as the macular edema progresses

- **Electro Oculography:**

This test may reveal abnormal light to dark ratio(Arden's ratio)

- **Visually Evoked Responses:**

The macular disease with edema, the VER shows amplitude reduction depending on the reduced visual acuity with no change in latency.

**10. Fluorescein Angiography**

This is one of the mandatory investigations needed in macular edema for:

1. Confirmation of the diagnosis
2. Documentation of the various lesion
3. Deciding about the management
4. Follow up

**11. OCT :**

This investigative modality can also be used for diagnosis and follow-up. It has the added advantage of being non invasive. In addition parameters like the macular thickness can be quantified on subsequent visits. The macular edema patterns seen on OCT are as follows-

**1. Sponge like retina** :

It is mostly confined to outer retinal layers due to backscattering from intraretinal fluid.

**2. Cystoid macular edema** :

Cystoid spaces confined to outer retina mostly. In long standing cases they fuse to form large cyst.

**3. Serous retinal detachment** :

Hypo reflective space under fovea. It may disappear following laser.

**4. Tractional macular edema** :

Foveo vitreal traction causes detachment of fovea. Its an indication for Pars Plana Vitrectomy to release traction. Laser will worsen macular edema in these cases.

**5. Taut Posterior Hyaloid Membrane**:

Cystoid spaces confined to outer retina mostly. In long standing cases they fuse to form large cyst.

# EVOLVING THERAPIES FOR MACULAR EDEMA

## Laser photocoagulation:

ME secondary to retinovascular disease, especially that caused by diabetic retinopathy and BRVO, responds well to focal or grid laser photocoagulation. Focal laser treatment is used to close micro aneurysms, while grid laser treatment reduces leakage from damaged, permeable, macular capillaries. The highest success rates with laser treatment are achieved when the leakage is localized.

The Early Treatment for Diabetic Retinopathy Study (ETDRS) established the indications and guidelines for laser treatment in diabetic ME.[viii] Laser treatment is indicated for clinically-significant ME (CSME), which is defined by at least one of the following:

- Retinal thickening involving or within 500μm of the foveal avascular zone
- Hard exudates at or within 500μm of the foveal avascular zone, if associated with thickening of the adjacent retina
- Retinal thickening >1 disc area within 1 disc diameter of the center of the foveal avascular zone.

Moderate visual loss was reduced by 50% in patients who received laser therapy in the ETDRS. Grid photocoagulation has also proven to be of benefit for

BRVO, but not for central retinal vein occlusion (CRVO). In the Branch Vein Occlusion Study, 65% of grid laser-treated eyes gained at least 2 lines of vision, compared with 37% of untreated eyes[ix]. Laser treatment also reduced the risk of vision loss. In the Central Vein Occlusion Study (CVOS), grid laser did not have a statistically significant effect on vision, although there was a trend towards better vision in patients aged <60 years who underwent laser treatment.

**Topical therapy:**

Several studies have documented the utility of topical nonsteroidal anti-inflammatory drugs (NSAIDs) for the prevention and treatment of ME after cataract surgery.[x] A double-masked, randomized, placebo-controlled trial to evaluate the effect of Ketorolac 0.5% ophthalmic solution on chronic aphakic and pseudophakic CME determined that this drug was beneficial for the primary outcome measure (ie, Snellen acuity)[xi]. The efficacy of topical Flurbiprofen 0.03% and Indomethacin 1% in preventing pseudophakic ME was examined in a randomized, double-masked study that revealed a reduced incidence of clinical and angiographic CME in the early postoperative period. Recently, two new topical NSAIDs – Bromfenac 0.09% and Nepafenac 0.1% – have been Food and Drug Administration (FDA)-approved for post-cataract surgery inflammation and pain. There have been reports, particularly for Nepafenac, of their potential for

preventing pseudophakic ME.[xii] Nepafenac is a pro-drug that is converted after corneal penetration to Amfenac, a potent NSAID. In one animal model, Nepafenac was shown to inhibit prostaglandin in the vitreous humor to a much greater extent than other traditional NSAIDs. Whether this efficacy will translate into improved prevention or treatment of pseudophakic CME is currently under investigation. Corticosteroid drops, alone or in combination with NSAID drops, have been studied for the treatment of pseudophakic CME. Treatment with topical NSAIDs appears to be more effective than topical steroids alone. However, combination therapy with topical NSAID and prednisolone acetate was superior to either one alone in treating CME. Consensus for topical NSAID use has not been formally established; however, the standard of care for many cataract surgeons is to use both NSAIDs and topical steroids for at least 1 to 2 days preoperatively and for several weeks postoperatively. In higher risk patients, such as those with pre-existing ocular inflammation or diabetes, extended preoperative and postoperative use is typically employed. Patients must be monitored for the side effects of both NSAIDs (corneal toxicity) and corticosteroid use (increased intraocular pressure).

## Systemic therapy:

Systemic NSAIDs have been examined as a treatment of uveitic ME. A recent study of oral naproxen or rofecoxib revealed that these medications had no

effect on CME. However, these patients also had active, intraocular inflammation. NSAIDs may have some role in the prevention of a recurrence of CME after inflammation is controlled, although this scenario is still under investigation.[xiii] The potential for NSAIDs to cause gastrointestinal ulceration or liver toxicity must be addressed with patients before initiating this class of therapy. Carbonic anhydrase inhibitors (CAIs) reduce ME that can occur in association with retinitis pigmentosa (RP). A randomized crossover study demonstrated improvement in visual acuity in >80% of all RP patients who received acetazolamide.[xiv] The usual starting dose in these patients is 500 mg/day. Sometimes, CAIs are used to treat uveitis-associated ME, although the potential benefits have not been substantiated by clinical research. In fact, there is conflicting evidence for CAI use in this situation, with one study demonstrating a statistically significant improvement in visual acuity in the treated group, while another failed to show an improvement despite a reduction in the amount of edema evident on FA.[xv] The evidence for the usefulness of CAIs in the treatment of pseudophakic ME is even less robust. Systemic corticosteroids have a long history of successful use in the treatment of uveitis-associated ME. In severe cases, intravenous steroids are recommended during induction therapy. More typically, treatment is initiated with a high oral dose, approximately 1 mg/kg, followed by a standard slow taper over several weeks to months. Tapering the medication dose too rapidly is associated with a higher chance of recurrence. The

short-term side effects of steroids, including mood alterations, difficulty sleeping, increased appetite, and the potential for sudden worsening of a diabetic state, must be discussed with the patient. There are a few reports on the successful use of systemic steroids in the treatment of recalcitrant cases of pseudophakic CME, but this indication has not been well established. Steroid-sparing immunomodulators have been shown to be effective in the treatment of uveitis, but their utility in ME is less clear.

## Periocular and intravitreal corticosteroids:

The rationale for the use of corticosteroids in the treatment of ME stems from the observation that steroids influence by multiple pathways that contribute to breakdown of the blood-retinal barrier and edema. Corticosteroids inhibit VEGF and other cytokines and growth factors that regulate endothelial tight cell junctions. They also reduce the synthesis of prostaglandins and leukotriene, two local potent inflammatory mediators. Periocular steroids may be given with equivalent benefit either as an injection into sub-Tenon's space or a peribulbar (usually inferior) location. Either type of depot administration achieves a more sustained treatment effect than topical corticosteroid drops alone. At the least, peribulbar steroids provide a short-term benefit in some cases of ME associated with diabetes mellitus, BRVO, CRVO, or pseudophakia. Periocular steroids are

particularly useful in cases of anterior uveitis that are not responsive to topical therapy. In such cases, periocular steroids can both quell the inflammation and diminish the retinal thickening produced by the ME.

## Role of intravitreal steroids in macular edema

The rationale for the use of coticosteroids in the treatment of diabetic macular edema follows from the observation that the breakdown of the blood retinal barrier leads to the edema[xvi] and is in part mediated by Vascular endothelial growth factor (VEGF). Corticosteroids have been shown to inhibit VEGF and other cytokines and growth factors, thereby regulating endothelial cell tight junctions. In addition, they inhibit prostaglandin and leukotriene synthesis, which results in a local reduction of inflammatory mediators. The resultant anti-inflammatory effect contributes to the reduction of edema.[xvii] Increased diffusion by modulation of calcium channels[xviii] could also account for the efficacy of the corticosteroids in reducing macular edema. In the last 5 years, intravitreal steroids – and triamcinolone in particular – have gained widespread use as a treatment of all forms of ME. Intravitreal triamcinolone (IVTA), alone or in combination with laser therapy, has been the subject of multiple investigations of therapy for DME. In general, IVTA reduces retinal thickening on OCT and improves vision in a substantial number of patients. Patients with a cystoid component to their ME

respond better. However, the duration of the effect varies and ME recurrence and visual decline are often observed 4 to 6 months after injection. Repeated therapy is often limited by side effects. Intraocular pressure elevation occurs in about one third of patients, which can (rarely) require glaucoma surgery. Acceleration of cataract formation, endophthalmitis, and retinal detachment are the other adverse events that should be considered and discussed with the patient as part of informed consent. IVTA has also been used for treatment of vein occlusion-associated ME. It has been employed more extensively for CRVO because laser therapy is not an option in this disease. A recently published 1-year study revealed a short-term visual benefit in some patients with CRVO-associated ME who were treated with IVTA, although their vision generally returned to pretreatment levels at 1 year despite repeated injections.[xix] It has also been observed that the rate of intraocular pressure rise and need for glaucoma surgery appears to be higher in this subset of patients than in those with DME. The SCORE (Standard Care vs. Corticosteroid for Retinal Vein Occlusion) Study, a National Eye Institute-sponsored randomized clinical trial of intravitreal steroid for BRVO- and CRVO-associated ME, is currently underway and should provide more definitive answers regarding the safety and efficacy of treatment with IVTA for cases of vein occlusion-associated ME.

Finally, IVTA has been used in uveitic ME. A retrospective review of 16 patients with chronic, refractory uveitic CME who received at least 1 injection of IVTA had results that mirrored those seen when this medication was used as a treatment for ME caused by other diseases.[xx] At a mean follow-up of 34 weeks, there was a sustained improvement in visual acuity in 55% of patients, although there was a relapse or persistence of CME in half of all patients receiving this treatment. One of the 20 eyes required glaucoma implant surgery for increased pressure. There are several alternative intravitreal steroid delivery devices currently under investigation for ME. A non biodegradable intravitreal implant containing fluocinolone acetonide which isinserted via a pars plana incision, has been approved by the FDA for the treatment of severe uveitis. In a clinical trial of 278 patients with refractory posterior uveitis, vision stabilized or improved in 87% of subjects in the treatment group, generally due to reductions in CME, over the 34-week follow-up period.[xxi] About half the eyes required topical ocular antihypertensive medications and 6% required glaucoma surgery. This implant is currently undergoing clinical trials for diabetic and uveitic ME. Preliminary results from a DME study of 197 patients showed a significantly better rate of 3-line improvement in vision and resolution of ME at 2 years for patients who received the implants.[xxii] This advantage was lost by 3 years presumably because the effect of the implant, which provides about 30 months of constant release, had dissipated.

However, about 30% of implant recipients developed sustained elevation of intraocular pressure that ultimately required glaucoma surgery and 95% of phakic patients required cataract extraction.

## **Intravitreal anti-VEGF compounds*:***

Anti-VEGF agents work to restore the normal permeability of the blood-retinal barrier. Pegaptanib sodium an anti-VEGF pegylated aptamer, has been studied in a Phase II randomized, double-blind, controlled trial of DME in 172 subjects.[xxiii] Patients received at least 3 injections at 6-week intervals and were followed for 36 weeks. The patients assigned to pegaptanib were more likely to gain at least 10 letters (34% vs. 10%, p = 0.003), were more likely to show a reduction in central retinal thickness (42% vs., 16%, p=0.02) and, at follow-up examinations, were deemed less likely to need additional photocoagulation therapy (25% vs. 48%, p = 0.04). Ranibizumab (Lucentis®), another intravitreal anti-VEGF agent that has been FDA-approved for treatment of wet age-related macular degeneration, was studied in a small series of 10 patients with DME and found to significantly reduce foveal thickness and improve vision.[xxiv] Larger, randomized trials are necessary to assess the significance of this preliminary finding. Bevacizumab is a recombinant, humanized, monoclonal antibody directed against VEGF. Avastin has received

FDA approval as an intravenous drug for treatment of metastatic colon cancer. An intravitreal formulation was first used off-label for the treatment of age-related macular degeneration. Subsequently, there have been a number of case series examining bevacizumab for the treatment of ME. In cases of diffuse DME that failed other treatments, intravitreal injection of bevacizumab was associated with improved vision and decreased retinal thickness 12 weeks after the first injection.[xxv] Most of the patients received >1 bevacizumab injection during follow-up. A recent study of intravitreal bevacizumab treatment for ME in patients with CRVO revealed a significant decrease in mean central retinal thickness (887 to 372 μm, $p < 0.001$), and improved visual acuity (defined as halving the visual angle) in 14 of 16 eyes.[xxvi] Patients had received an average of 2.8 injections and were followed for a mean of 3 months. No adverse outcomes occurred. These encouraging short-term results need to be validated in prospective studies. Bevacizumab has been tried in patients with ME secondary to uveitis. In one case series, in which patients were followed for at least 2 months after a single intravitreal injection, about 70% of treated patients had a decrease in foveal thickness, but only 40% had improved visual acuity by ≥2 lines.[xxvii] All patients had failed other treatments for their ME, though their inflammation was quiescent. Thus, for patients with difficult-to-control ME, bevacizumab may be a therapeutic option with reasonably good outcomes.

# ESTABLISHED AND EXPERIMENTAL TREATMENTS FOR MACULAR EDEMA OF DIFFERENT ETIOLOGIES.

| | |
|---|---|
| Diabetic macular edema | Treatments with established efficacy by large RCTs<br>Grid or focal laser photocoagulation<br>Treatments with potential efficacy,limited or no RCT data<br>Periocular triamcinolone, intravitreal triamcinolone, intravitreal pegaptanib sodium, intravitreal ranibizumab, intravitreal bevacizumab, |
| CRVO | Treatments with established efficacy by large RCTs – None<br>Treatments with potential efficacy, but limited or no RCT data<br>Periocular triamcinolone, intravitreal triamcinolone, intravitreal bevacizumab, intravitreal ranibizumab, vitrectomy with or without radial optic neurotomy |
| Post operative CME | Treatments with established efficacy<br>Topical steroids and NSAIDs; vitrectomy if vitreous wick to surgical wound<br>Treatments with potential efficacy,but limited or no RCT data<br>Periocular triamcinolone, intravitreal triamcinolone |

# AIM OF THE STUDY

I. To study the visual acuity response of intravitreal triamcinolone in cases of:

1. Diffuse DME not responding to laser therapy.
2. CME after intraocular surgeries not responding to topical anti inflammatory drugs
3. CME after retinal venous occlusion.

II. To evaluate the change in macular thickness by OCT following injection in above said conditions.

III. To evaluate the safety and efficacy of intravitreal injection of Triamcinolone

## INCLUSION CRITERIA

1. Refractory diffuse DME unresponsive to focal laser photocoagulation
2. CME after intraocular surgeries not responding to topical anti inflammatory drugs
3. CME after retinal venous occlusion.
4. Central subfield macular thickness greater than 200 μm

## EXCLUSION CRITERIA

1. History of glaucoma or ocular hypertension
2. Loss of vision as a result of other causes
3. Systemic corticosteroid therapy
4. Severe systemic disease
5. Any condition affecting follow-up or documentation
6. Uncontrolled diabetes, uncontrolled hypertension.
7. History or evidence of ongoing uveitis.

# MATERIALS AND METHODS

This study was carried out in the department of vitreo-retina services of RIOGOH, Chennai from May to November 2009. Patients who were referred to Retina clinic with provisional diagnosis of DME, post op CME, BRVO and CRVO were screened and selected for the study.

All the patients were taken a brief history, and subjected to detailed systemic and ophthalmic evaluation.

Anterior segment examination with Slit lamp biomicroscope and posterior segment examination using 90D, binocular indirect ophthalmoscope and a detailed fundus drawings were done and Fundus photograph was also taken for documentation. Fundus fluorescein angiography and Optical coherence tomography were done for all the patients.

A commercially available Triamcinolone (4mg/0.1ml) was prepared for each patient and placed in a tuberculin syringe using aseptic techniques. After the eye had been prepared in a standard fashion using 5% povidone iodine and topical antibiotics, 4 mg (0.1 ml) Triamcinolone was injected intravitreally via the pars plana. After the injection, intraocular pressure and retinal artery perfusion were

checked, and patients were instructed to administer topical antibiotics for 3 days. Patients were called 2 to 3 days after injection and were re examined within 1 week.

**Intravitreal injections–procedure guidelines:**

Injection procedure guidelines include consideration of pre existing conditions such as active external infection, eyelid abnormalities, povidone iodine, lid scrubs, pre injection topical antibiotics, lid speculum, drape, gloves, and anaesthesia and post injection topical antibiotics.

In general the risk of endophthalmitis following intra vitreal injection is estimated to be approximately < 0.1%.

## Guidelines for intra vitreal injection:

1. Povidone iodine for ocular surface, eyelid and eye lashes
2. Use of speculum and avoid contamination of the needle with eye lid margin
3. Avoid extensive massage of the eye lids either pre or post injection
4. Dilate pupil
5. Adequate use of anaesthetic (topical drops/ sub conjunctival injection)

6. Avoid prophylactic or post injection paracentesis

7. IOP to be checked following injection

8. Dilated fundoscopic examination should be performed following injection to confirm central retinal artery perfusion and intra ocular location of the drug.

## Guidelines for follow up:

Patients were followed up on the immediate day following intra vitreal injection. They were followed up every week for 1 month, then every 2 weeks subsequently. The results published are for a period extending to six months of followup. However patients were instructed to contact ophthalmologist if there if increased ocular redness or discomfort or decreased vision compared to that present right after the injection procedure.

**Main outcome measures:**

- Best corrected visual acuity (Snellen's chart)
- Macular thickness by OCT
- Intraocular pressure by Goldmann's applanation tonometry.

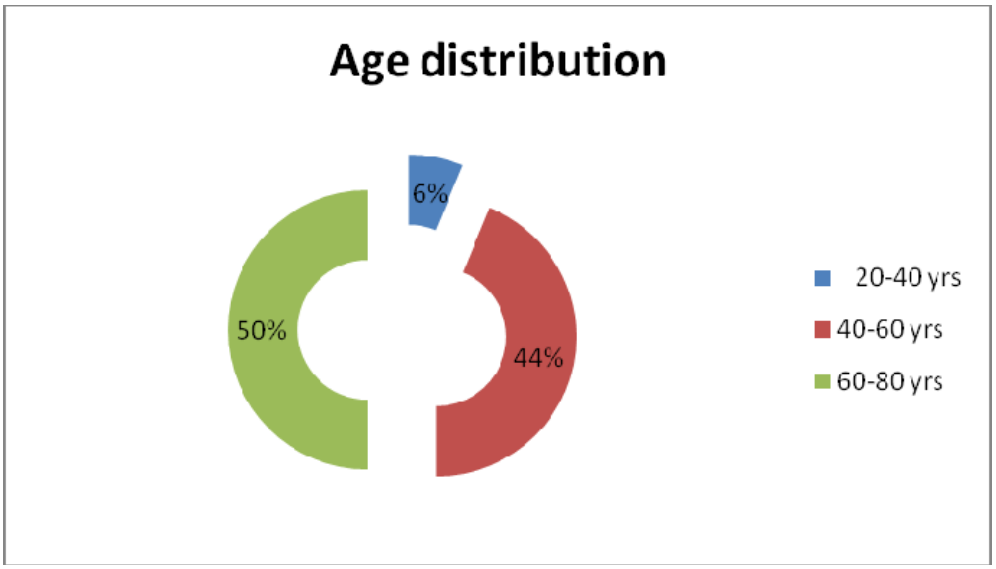
# OBSERVATIONS AND RESULTS

**Age distribution.**

Total no. of patients- 32

**Table - 1**

| Age distribution | No of patients | Percentage |
|---|---|---|
| 20-40 yrs | 2 | 6 |
| 40-60 yrs | 14 | 44 |
| 60-80 yrs | 16 | 50 |

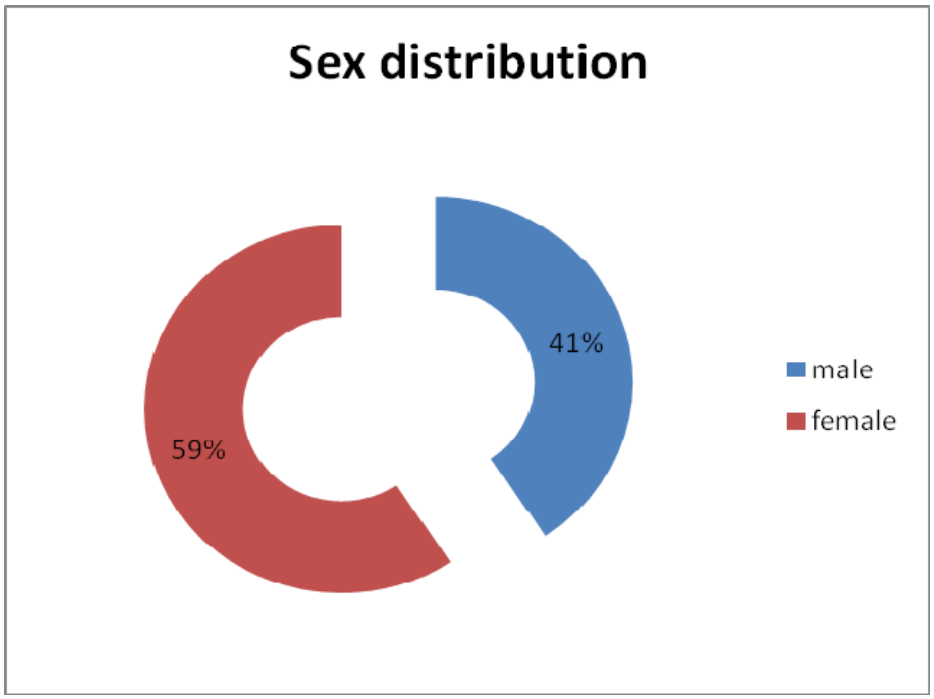



Most of the patients in our study were in the age group of 60-80 yrs(50%). The oldest patient was 74 years of age while the youngest was 25 years.

## Sex distribution

## Table - 2

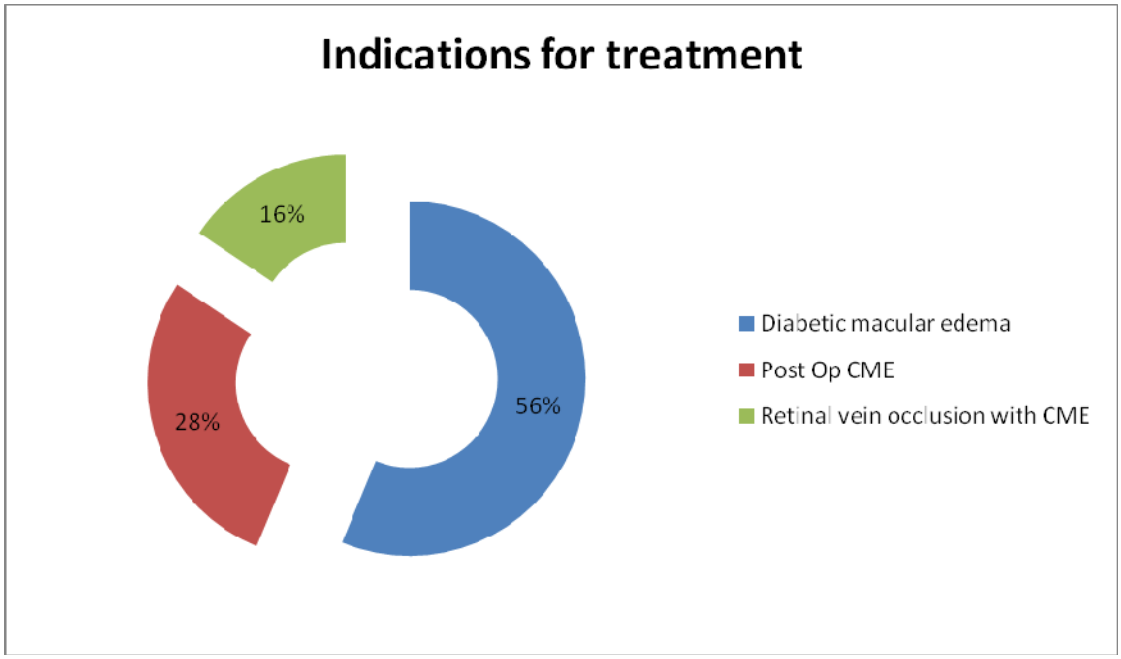
| Sex | No of patients | percentage |
|---|---|---|
| Male | 13 | 41 |
| Female | 19 | 59 |



## Indications for treatment

## Table - 3:

| Indications | No of patients | Percentage(%) |
|---|---|---|
| Diabetic macular edema | 18 | 56 |
| Post Op CME | 9 | 28 |
| Retinal vein occlusion with CME | 5 | 16 |




Out of the many causes for macular edema three of the most common causes were included in this study , namely diabetic macular edema (56 % patients) , post

surgery macular edema( 28% patients) and post retinal venous occlusion macular edema ( 16 % patients).

## Results of intravitreal triamcinolone in diabetic CME

### Pre treatment visual acuity

**Table - 4**

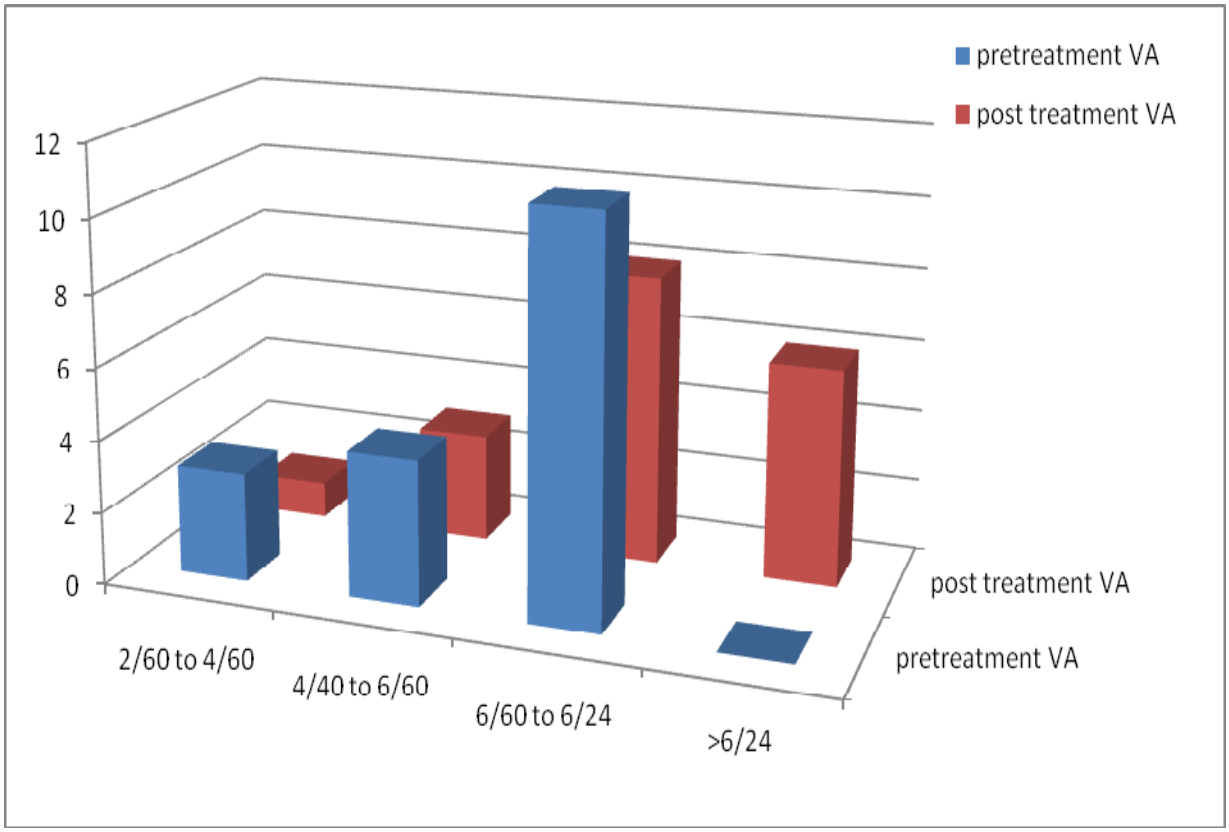
| Visual acuity | No.of patients | Percentage |
|---|---|---|
| 2/60 – 4/60 | 3 | 17 |
| 4/60 – 6/60 | 4 | 22 |
| 6/60 – 6/24 | 11 | 61 |

### Post treatment visual acuity

**Table - 5**

| Visual acuity | No.of patients | Percentage |
|---|---|---|
| 2/60 – 4/60 | 1 | 6 |
| 4/60 – 6/60 | 3 | 17 |
| 6/60 – 6/24 | 8 | 33 |
| >6/24 | 6 | 44 |

## Comparison between Pre and Post treatment Visual acuity in DME




There was a distinct improvement in visual acuity post injection. The pre treatment VA ranged from 2/60 to 6/24 ( least being 6/24). After treatment the VA for 6 patients (44%) improved to >6/24.

## Pre treatment macular thickness

### Table - 6

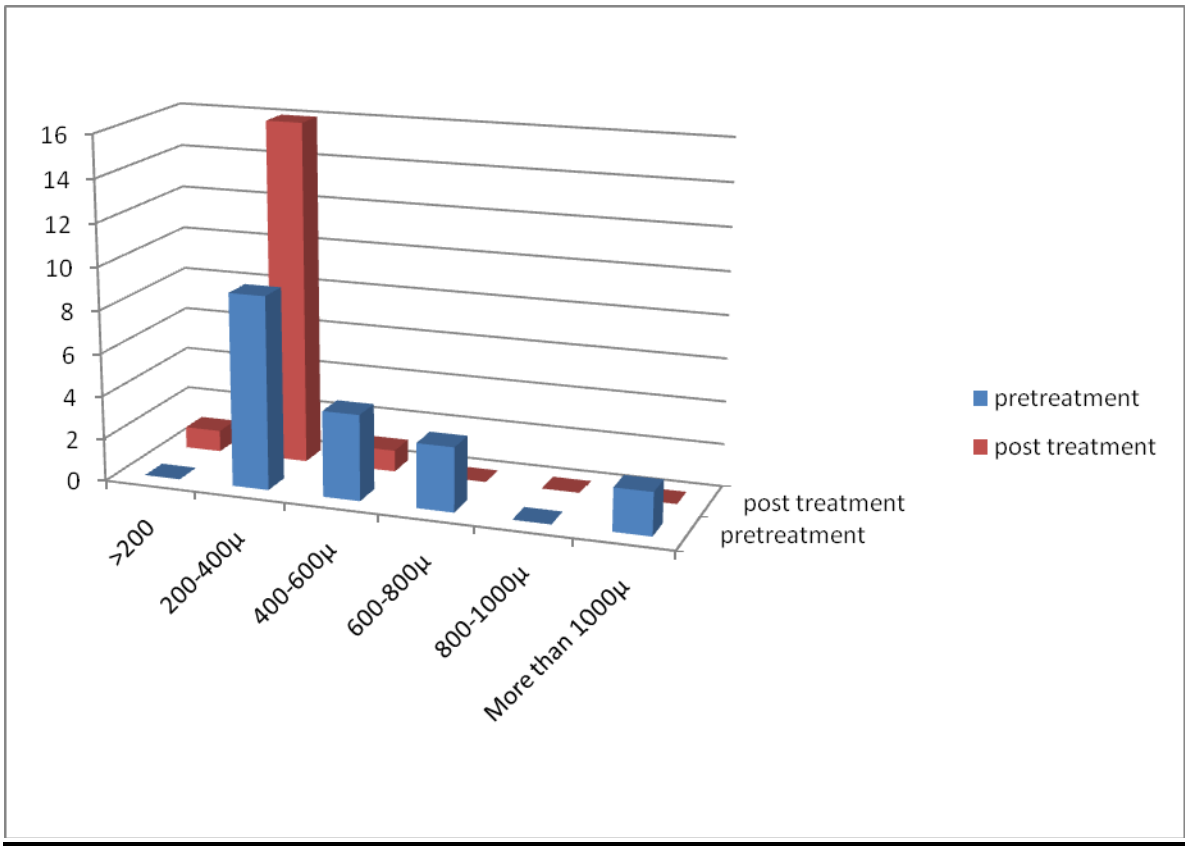
| Macular thickness | No.of cases | Percentage |
|---|---|---|
| 200-400μ | 9 | 50 |
| 400-600μ | 4 | 22 |
| 600-800μ | 3 | 17 |
| 800-1000μ | -- | - |
| More than 1000μ | 2 | 11 |

## Post treatment macular thickness

### Table - 7

| Macular thickness | No.of cases | Percentage |
|---|---|---|
| <200 | 1 | 5 |
| 200-400μ | 16 | 89 |
| 400-600μ | 1 | 6 |
| >600μ | 0 | 0 |

## Comparison between pre treatment and post treatment macular thickness




The patients had a pre treatment macular thickness that ranged from 200 to 1200µ with about 50% having thickness >400µ. After treatment only 1 patient (6%) had persistent macular thickness > 400µ. Most of the patients had reduction in their macular thickness to levels between 200-400µ with one patient achieving thickness <200µ.

## Pre treatment intraocular pressure

### Table - 8

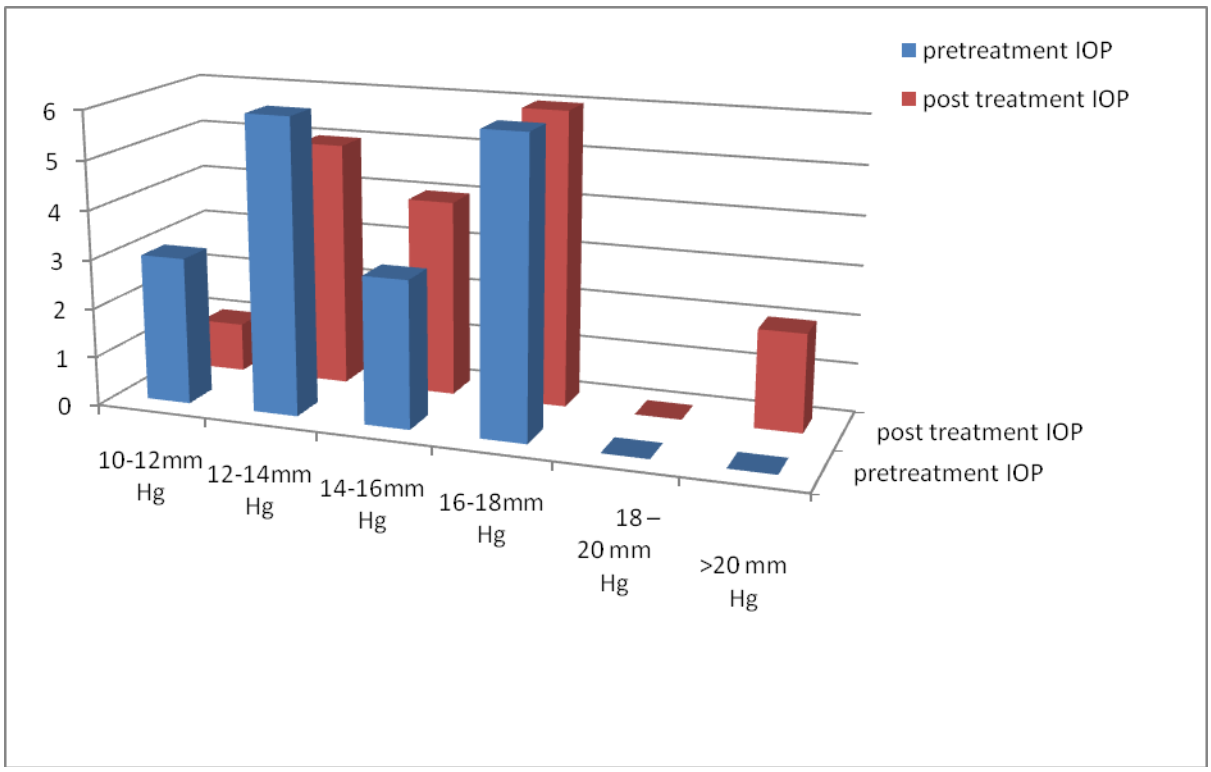
| Intraocular pressure | No.of cases | Percentage |
|---|---|---|
| 10-12mm Hg | 3 | 17 |
| 12-14mm Hg | 6 | 33 |
| 14-16mm Hg | 3 | 17 |
| 16-18mm Hg | 6 | 33 |
| 18 – 20 mm Hg | 0 | - |
| >20 mm Hg | 0 | - |

## Post treatment IOP

### Table - 9

| Intraocular pressure | No.of cases | Percentage |
|---|---|---|
| 10-12mm Hg | 1 | 6 |
| 12-14mm Hg | 5 | 28 |
| 14-16mm Hg | 4 | 22 |
| 16-18mm Hg | 6 | 33 |
| 18 – 20 mm Hg | 0 | - |
| >20 mm Hg | 2 | 11 |

## Comparison of pre and post treatment IOP in DME




Most patients maintained their IOP within the normal range with <2mm difference between pre and post treatment IOP. However 2 patients had an IOP of 22 mm Hg and 24 mm Hg starting at 10 weeks. These patients were treated with topical β- blocker (0.5% timolol maleate) and reviewed. They were maintaining their IOP at 18 mm Hg at the end of 12 weeks.

# Results of intravitreal Triamcinolone in post op macular edema

## Pre treatment Visual acuity

### Table - 10

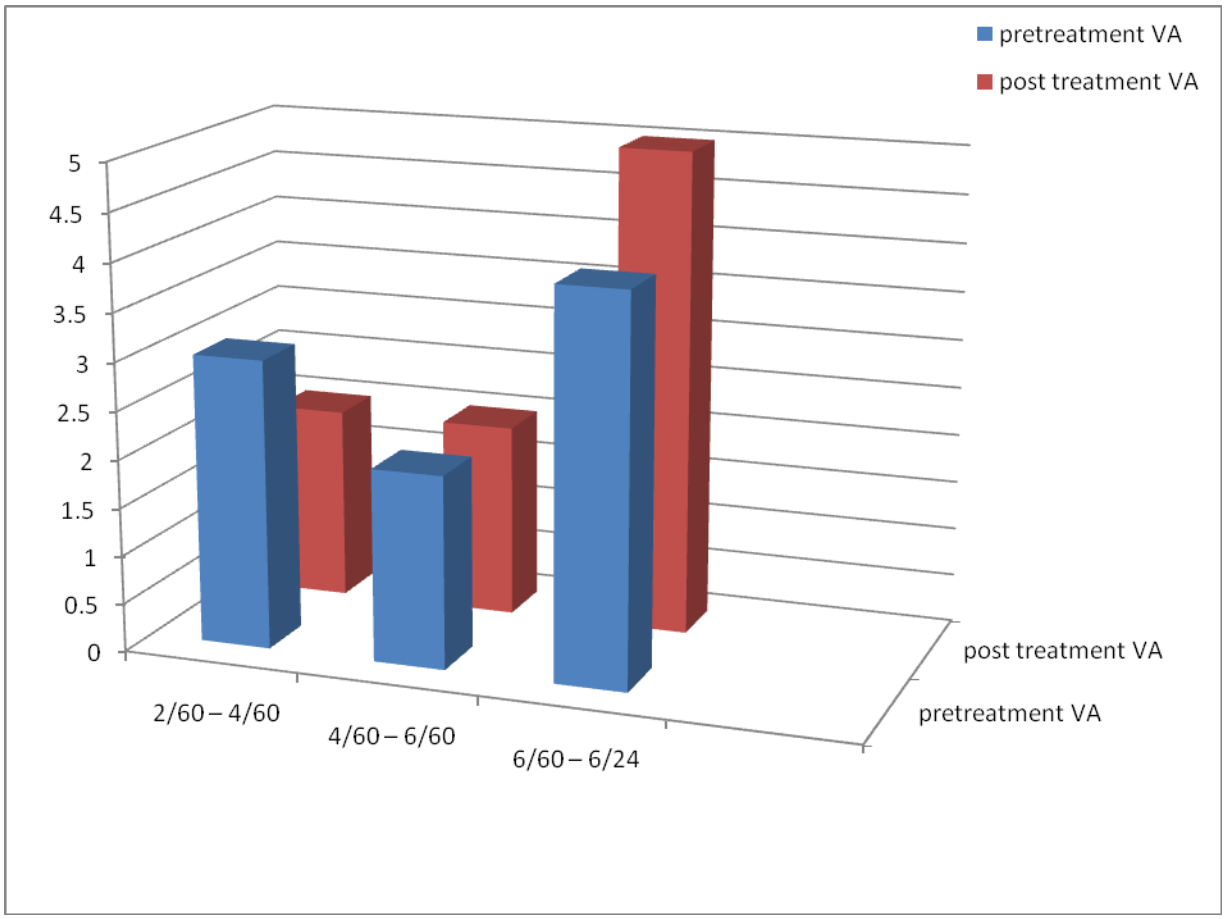
| Visual acuity | No.of patients | Percentage |
|---|---|---|
| 2/60 – 4/60 | 3 | 33 |
| 4/60 – 6/60 | 2 | 22 |
| 6/60 – 6/24 | 4 | 45 |

## Post treatment Visual Acuity

### Table - 11

| Visual acuity | No.of patients | Percentage |
|---|---|---|
| 2/60 – 4/60 | 2 | 22 |
| 4/60 – 6/60 | 2 | 22 |
| 6/60 – 6/24 | 5 | 56 |

## Pre and post treatment VA comparison in post Surgical CME




The post treatment visual acuity showed a modest increase with 56% patients having a VA of 6/60 to 6/24 compared to 45% in the same range before treatment.

## Pre treatment macular thickness

### Table - 12

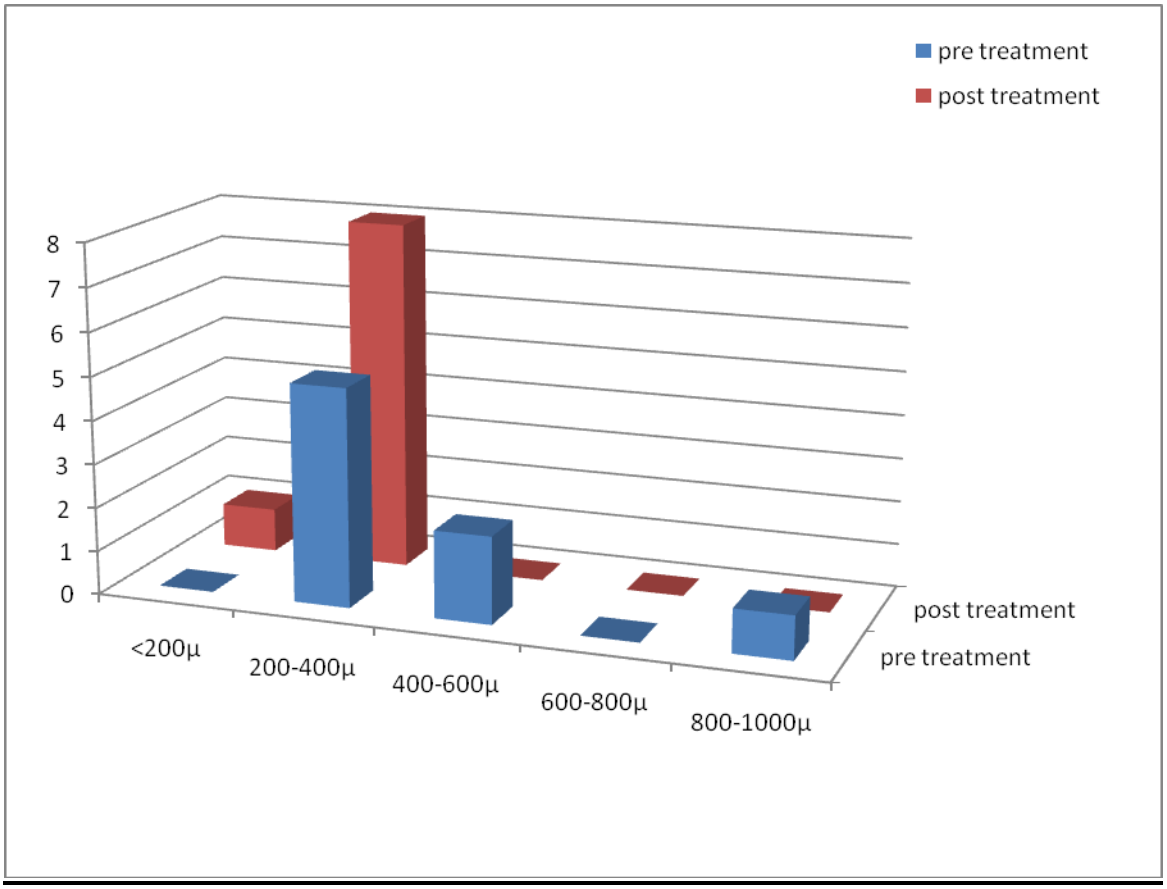
| Macular thickness | No. of cases | Percentage |
|---|---|---|
| 200-400μ | 5 | 62 |
| 400-600μ | 2 | 25 |
| 600-800μ | 0 | 0 |
| 800-1000μ | 1 | 13 |
| More than 1000μ | 0 | 0 |

## Post treatment macular thickness

### Table - 13

| Macular thickness | No. of cases | Percentage |
|---|---|---|
| <200 | 1 | 11 |
| 200-400μ | 8 | 89 |
| 400-600μ | 0 | 0 |
| >600μ | 0 | 0 |

**Comparison between pre and post treatment macular thickness in post surgical macular edema**




The macular thickness was between 200 to 1100 µ pre treatment. 62% had thickness between 200 to 400µ. 38% had between 400 to 1100µ. Post treatment all patients had macular thickness less than 400µ with one patient having reduced thickness < 200µ. However this marked reduction in macular thickness did not correspond to an equivalent increase in visual acuity. This could be due to the long standing macular edema which could lead to photoreceptor loss.

## Pre treatment IOP

## Table - 14

| Intraocular pressure | No. of cases | Percentage |
|---|---|---|
| 10-12mm Hg | 0 | 0 |
| 12-14mm Hg | 2 | 22 |
| 14-16mm Hg | 3 | 33 |
| 16-18mm Hg | 4 | 45 |
| 18 – 20 mm Hg | 0 | - |
| >20 mm Hg | 0 | - |

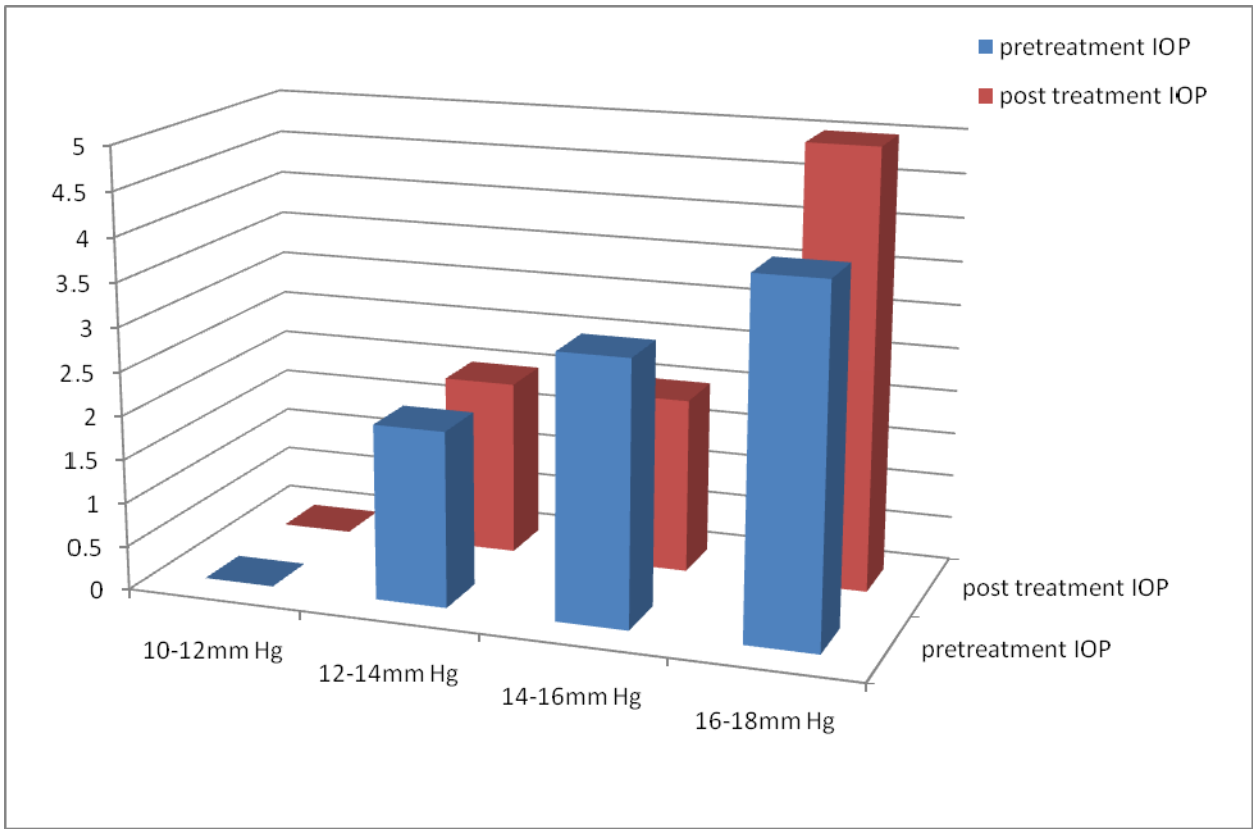
## Post treatment IOP

## Table - 15

| Intraocular pressure | No.of cases | Percentage |
|---|---|---|
| 10-12mm Hg | 0 | 0 |
| 12-14mm Hg | 2 | 22 |
| 14-16mm Hg | 2 | 22 |
| 16-18mm Hg | 5 | 56 |
| 18 – 20 mm Hg | 0 | - |

| | | |
|---|---|---|
| >20 mm Hg | 0 | - |

**Comparison between pre and post treatment IOP in post surgical macular edema**




Most of the patients maintained their IOP at their pre treatment levels except for one patient who had his IOP raised by 2mm Hg at 12 weeks. However this was within the physiologically accepted normal range.

## Results of intravitreal Triamcinolone in CME due to retinal venous occlusion.

### Pre treatment visual acuity

**Table 16:**

| Visual acuity | No. of patients | Percentage |
|---|---|---|
| 2/60 – 4/60 | 3 | 60 |
| 4/60 – 6/60 | 0 | 0 |
| 6/60 – 6/24 | 2 | 40 |

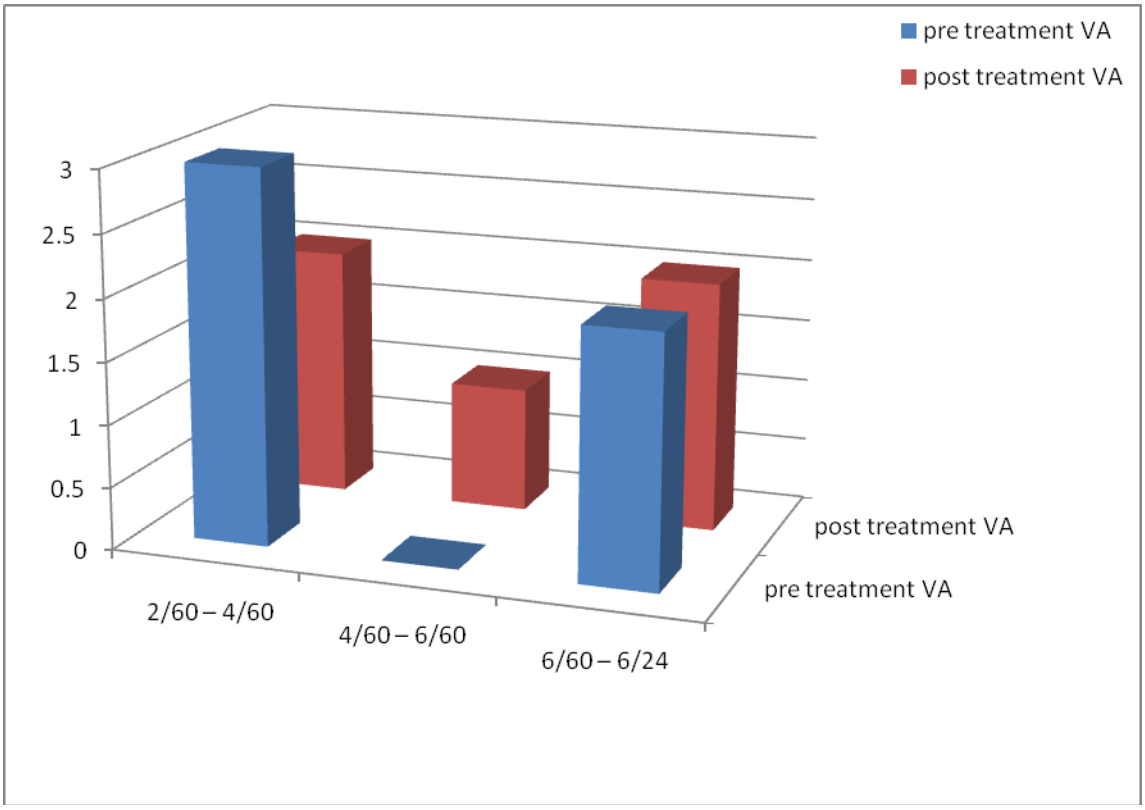
### Post treatment visual acuity

**Table 17:**

| Visual acuity | No. of patients | Percentage |
|---|---|---|
| 2/60 – 4/60 | 2 | 40 |
| 4/60 – 6/60 | 1 | 20 |

| | | |
|---|---|---|
| 6/60 – 6/24 | 2 | 40 |

**Comparison Between Pre And Post Treatment Visual Acuity In Retinal Venous Occlusion**




The visual acuity showed a marginal improvement with only 1 patient having an improvement by 3 meters ( 3/60 to 6/60) . Other patients had an improvement by one line on an average.

## Pre treatment macular thickness

## Table - 18

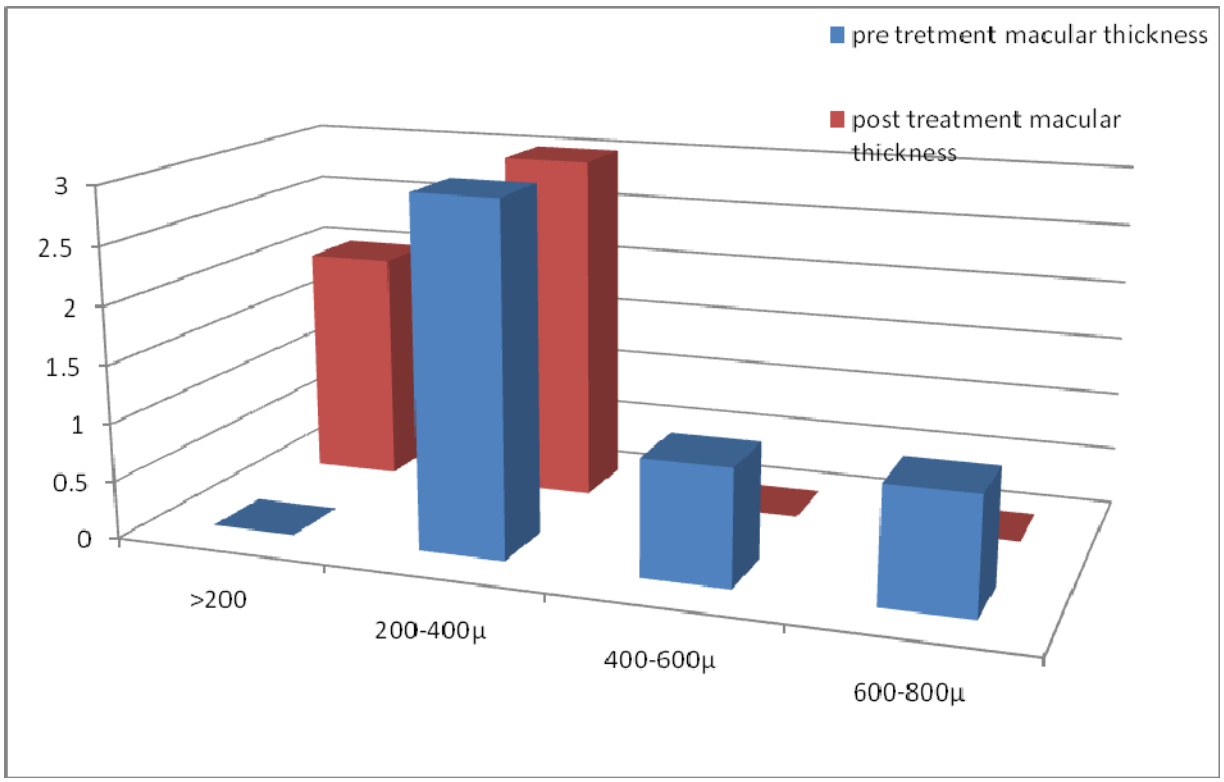
| Macular thickness | No. of cases | Percentage |
|---|---|---|
| >200 | 0 | 0 |
| 200-400μ | 3 | 60 |
| 400-600μ | 1 | 20 |
| 600-800μ | 1 | 20 |
| 800-1000μ | 0 | 0 |
| More than 1000μ | 0 | 0 |

## Post treatment macular thickness.

## Table - 19

| Macular thickness | No. of cases | Percentage |
|---|---|---|
| >200 | 2 | 20 |
| 200-400μ | 3 | 80 |
| 400-600μ | 0 | 0 |
| >600μ | 0 | 0 |

## Comparison between pre and post treatment macular thickness in retinal venous occlusions




The macular thickness showed a significant improvement. Prior to treatment 40% patients had thicknesses of > 400µ. After treatment all the patients had thickness within 400 µ, with 2 patients having reduction to < 200µ. However, again this drastic reduction did not correspond to improved visual acuity most likely due to long standing macular edema.

## IOP measurements

**Table 20:**

| Intraocular pressure | Pre treatment | Post treatment |
|---|---|---|
| 10-12mm Hg | 0 | 0 |
| 12-14mm Hg | 2 | 2 |
| 14-16mm Hg | 3 | 3 |
| >16mm Hg | 0 | 0 |

All the patients in this group maintained their IOP at their pre treatment levels. They were closely followed up and examined for the development of anterior segment neovascularisation. No patient was seen to develop this complication at 12 weeks.

# DISCUSSION

The administration of intravitreal triamcinolone is appealing for a number of reasons. In a country like India with a significant number of diabetics, visual morbidity due to diabetic macular edema is high. As of current practice, laser treatment as advocated by the ETDRS[xxviii] remains the standard therapy of DME. However refractory DME can be considered for treatment with pharmacological agents like intravitreal Triamcinolone or anti VEGF agents. There have been RCTs which have demonstrated that intravitreal triamcinolone alone can provide visual and anatomical benefits for upto 2 years ( Gillies et al, Ophthalmology 2006). Anti VEGF agents though a promising mode of therapy , remains a costly affair in a developing economy like India. Anti VEGF agents for macular edema await phase III clinical trials. In this scenario , therapy with intravitreal corticosteroids can be considered for individual patients after a risk-benefit evaluation .

In cases of macular edema due to venous occlusions, the recently concluded SCORE( Standard Care vs Corticosteroids for Retinal Vascular occlusions) study clearly mentions a benefit of intraocular triamcinolone as compared to standard therapy in CRVO ( SCORE-CRVO trial). In cases of macular edema due to BRVO

triamcinolone and grid lases show a comparable respone, however triamcinolone can be used for macular edema not responding to grid laser therapy.[xxix]

# SUMMARY


- This is a six month prospective , non randomized clinical study to evaluate the efficacy and safety of intravitreal triamcinolone in the treatment of macular edema due to causes like diabetes, post surgical and post venous obstruction, which was refractory to conventional treatment.

- The main aim was to evaluate the improvement in visual acuity and decrease in macular thickness in the above said conditions after intravitreal injection.

- The occurrence of adverse effects known to intraocular steroids like increase in the intraocular pressure and progression of cataract were also noted.

- Of the 32 patients who were enrolled for this study 19 were female (59%) and 13 were male (41%)

- The indications for treatment were diabetic macular edema (56%), post surgical macular edema (28%) and edema secondary to retinal venous occlusions(16%).

**Visual acuity:**

- The VA in diabetic maculopathy showed a definite increase with 44% patients showing an increase in VA better than 6/24. There was an increase by 3 lines in about 50% of the patients

- In post surgical macular edema 2 patients showed an improvement of 2 lines. 56% patients had a VA ranging from 6/60 to 6/24 whereas pre treatment 45% patients had VA in the same range.

- In the treatment of edema secondary to retinal venous occlusion , the visual acuity showed an improvement by one line(50%) on an average. 2 patients had about 3 lines of improvement.

- In summary, this study shows that the vast majority of patients demonstrated stability or improvement of the VA. Of those few patients with a visual decline, the change was felt to be due to disease progression rather than drug toxicity.

**Macular thickness:**

- The reduction in macular thickness in DME after administration of triamcinolone was substantial. Pre treatment the macular thickness varied from 200 to 1200µ. After treatment most of the patients (89%) had a reduction within the range of 180 to 300µ.Patients also had a corresponding increase in their visual acuity.

- In post surgery CME, the macular thickness was within the range of 200 to 1100 μ. The mean baseline macular thickness was 400μ. Post injection all the patients had macular thickness less than 400μ with 11 % having thickness less than 180μ.

- In cases of macular edema secondary to venous occlusion, the results were encouraging. Prior to treatment 40% patients had thicknesses of > 400μ. After treatment all the patients had thickness within 400 μ, with 2 patients having reduction to < 200μ. However, again this drastic reduction did not correspond to improved visual acuity most likely due to long standing macular edema with associated photoreceptor loss.

**Intra ocular pressure measurements:**

- The IOP for most patients remained within the normal physiological range. The mean IOP noted for all patients was 16±2mm Hg. However 2 patients showed a rise in IOP occurring around 10 weeks of followup. These patients were started on topical aqueous suppressants (0.5 % timolol maleate) and were seen to be maintaining their IOP within the physiological limits on subsequent visits. None of the patients with increased IOP needed multiple drugs or trabeculectomy.

# Conclusions

**Intravitreal Triamcinolone** (4 mg) treatment is well tolerated over 6 months with significant safety and efficacy.

Nevertheless, this is a small interventional study, with no comparison arm to quantify the actual magnitude of benefit of this treatment modality compared with other therapies.

This would have to be studied subsequently in larger studies and also needs to be compared with other VEGF inhibitiors regarding safety and efficacy.

# Comparison between pre and post treatment macular OCT scans

## CASE - 1

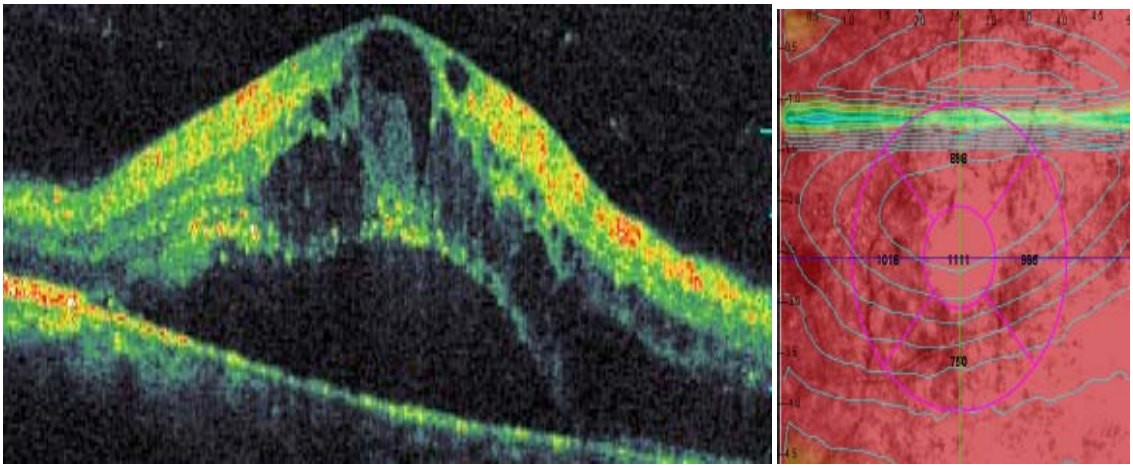



**FIGURE 1: Pre injection: OCT shows cystoid spaces intraretinally with serous macular detachment. Central macular thickness is 1111µ.**

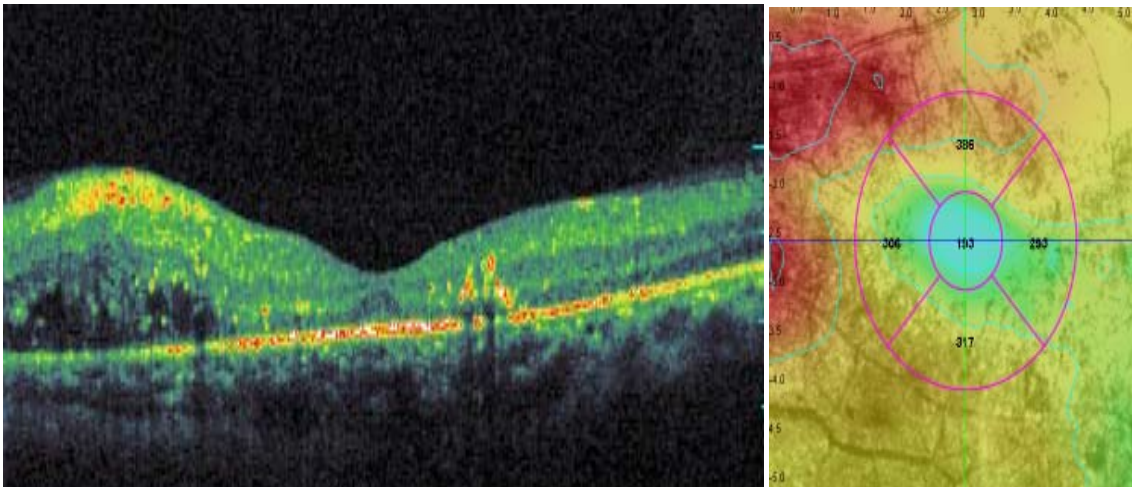



**FIGURE 1: 24 weeks post injection: Repeat OCT shows reduction in the cystoids spaces with macular thickness now being 183µ**

## CASE - 2

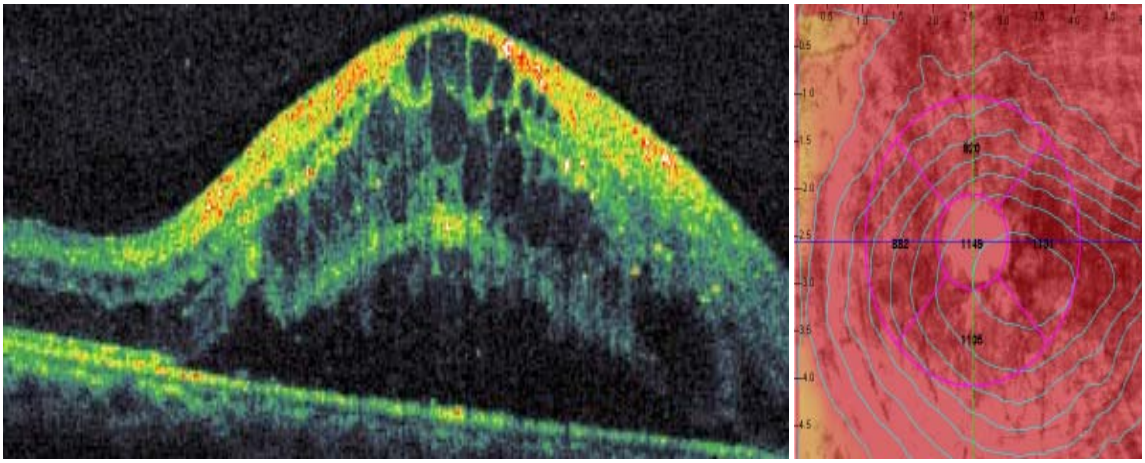


**FIGURE 1: Pre injection: multiple cystoid spaces with macular detachment**

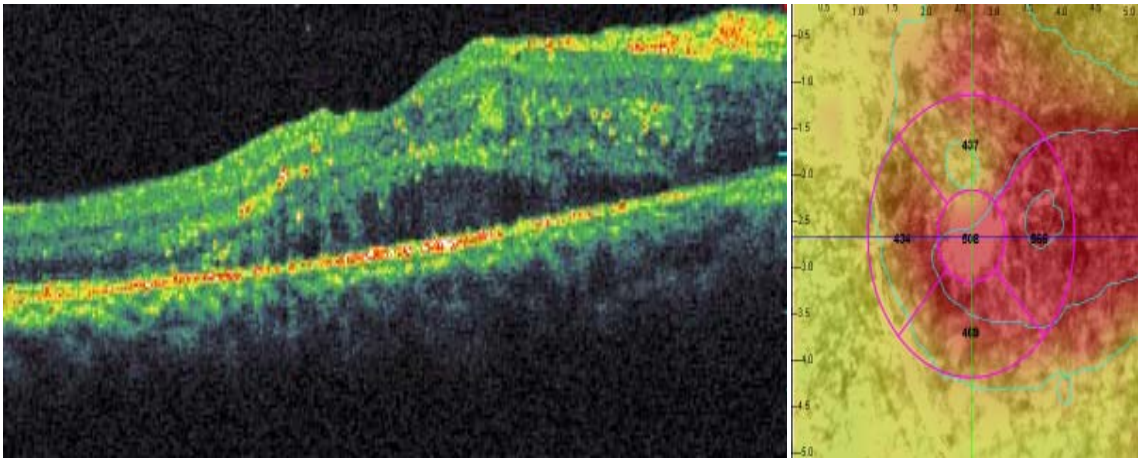


**FIGURE 2: 24 weeks post injection: 50% reduction in macular thickness. VA also showed comparable improvement.**

## CASE - 3

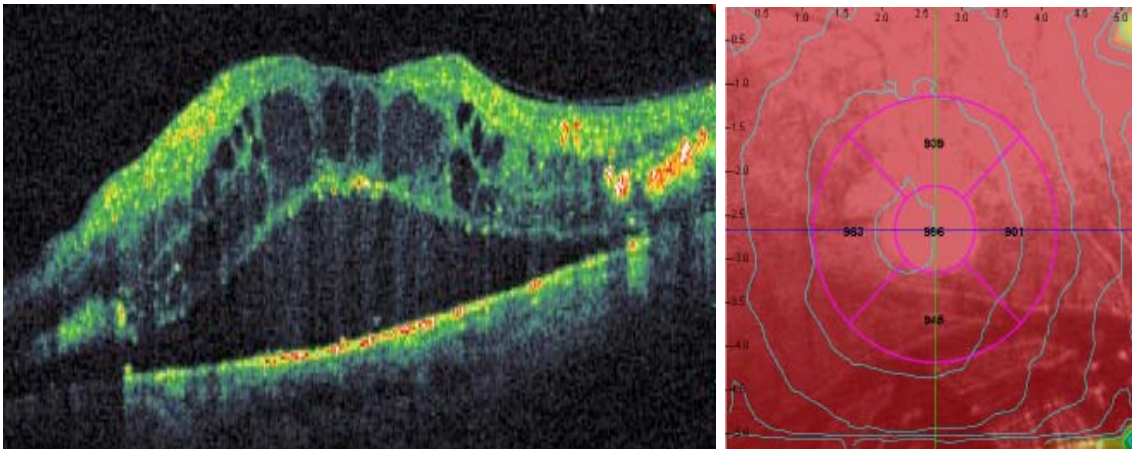



**FIGURE 1: Pre injection: cystoid change in the retina noted pre treatment.**

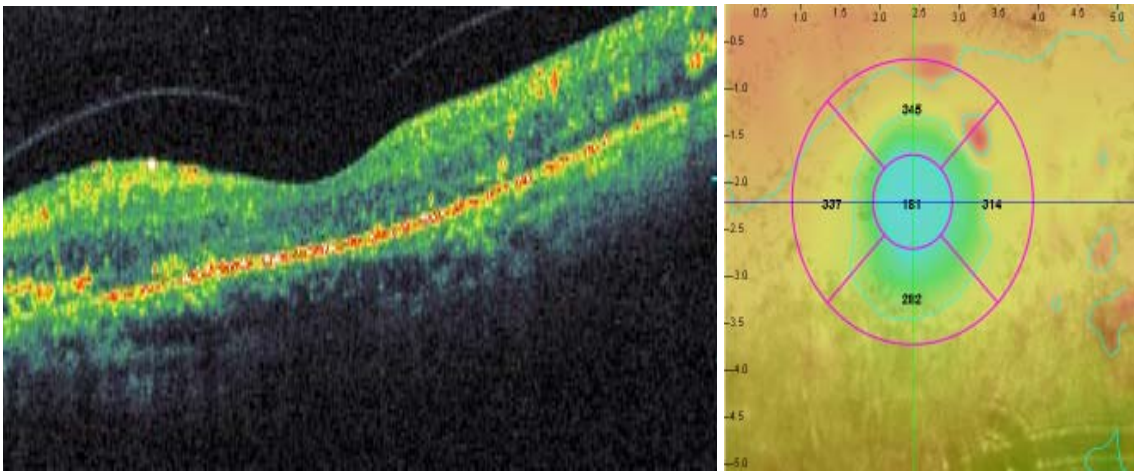



**FIGURE 2: 24 weeks post injection, the cystoid edema has completely resolved with reduction in macular thickness. However the VA showed a minimal improvement (by1 line). The patient had defective vision post venous occlusion for about 1 year.**

## CASE - 4

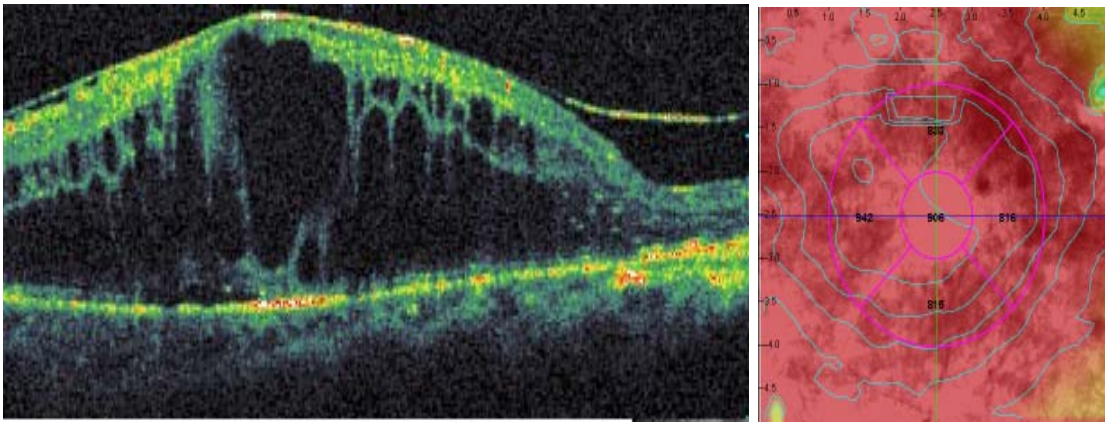


**FIGURE 1: Pre treatment**

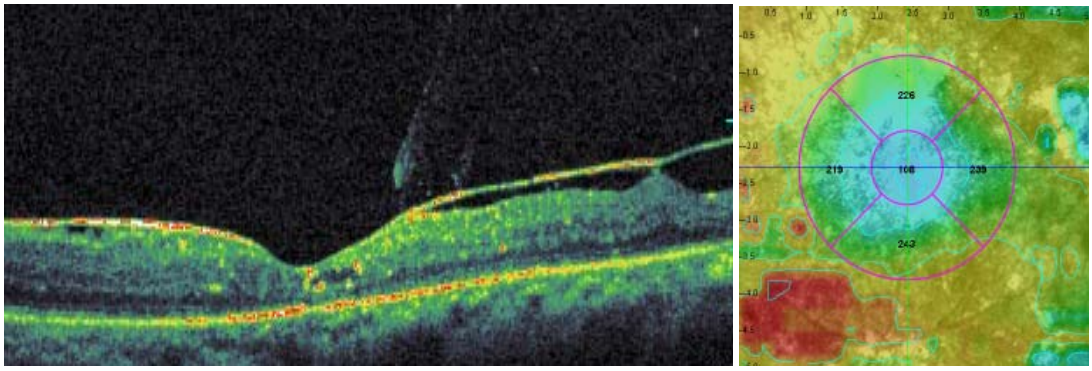


**FIGURE 2: 24 weeks post treatment**

## Case 5

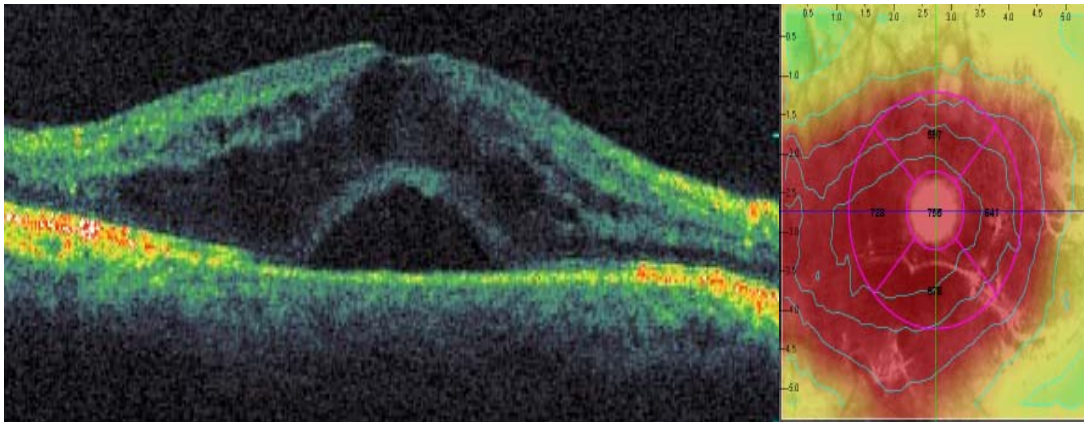


**FIGURE 1: Pre treatment**

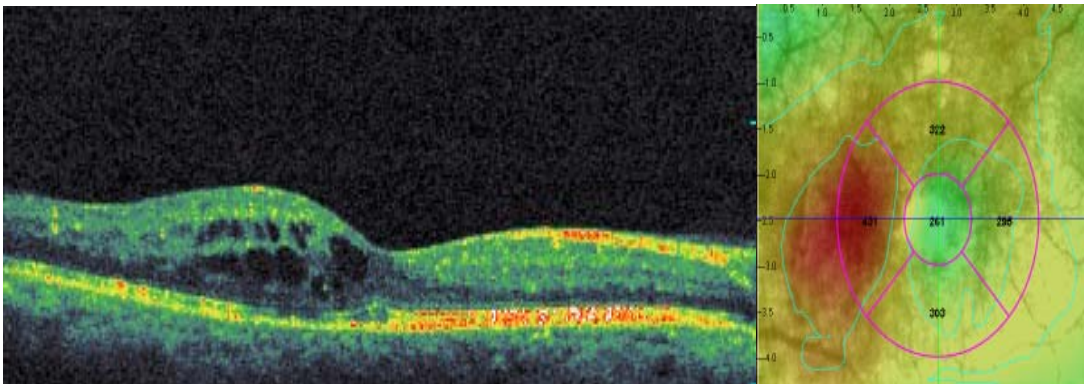


**FIGURE 2: Post treatment reduction in macular edema**

# PROFORMA

**Case-Information:**

Name :

Age :

Sex :

Occupation :

OP No. :

Address :

Phone No. :

**Chief complaints**

- Defective vision
- Distorted vision
- Pain in the eye

**Past history:**

- Diabetes - no of years
  - type I / II
  - On oral hypoglycemics / Insulin
  - Whether blood sugar under control
  - associated with NVG
  - PRP given / not

    If given – no of sittings
- Hypertension - No of years
  - On what medication

- Associated with ischemic heart disease/hyper lipidemia / cerebrovascular insult

- Ocular surgery - date of surgery
  - time since defective vision
  -type and duration of topical medications used

**On systemic examination:**

PR: BP:

RBS: Urine – alb & sugar:

**On ocular examination:**

| | **RE** | **LE** |
|---|---|---|
| Visual acuity | -- | |
| Tension (By NCT) | -- | |
| Conjunctiva | -- | |
| Cornea | -- | |
| Iris | -- | |
| Ant.chamber | -- | |
| Lens | -- | |
| Slit lamp Ex | -- | |
| Fields | -- | |
| Colour vision | -- | |
| Fundus by 90D | | |
| Fundus by IDO | | |

Fundus flourescein angiography : Type of leak

Optical coherence tomography : Macular thickness

Diagnosis:

**Treatment history:**

Under aseptic conditions, under topical anaesthesia, inj. Triamcinolone acetonide 4mg is injected intravitreally.

No.of sittings - Date

**Outcome of treatment:**

# KEY TO MASTER CHART

| | | |
|---|---|---|
| OCT | - | Optical coherence tomography |
| NPDR | - | Non proliferative Diabetic Retinopathy |
| CSME | - | Clinically Significant Macular Edema |
| BRVO | - | Branch Retinal Vein Occlusion |
| CRVO | - | Central retinal Vein Occlusion |
| V/A | - | Visual acuity |
| PH | - | Pinhole |
| NIP | - | Not Improving with pinhole |
| IOP | - | Intraocular pressure |
| IT/ST | - | Inferotemporal / Superotemporal |

# LIST OF SURGERIES PERFORMED

| S. No. | Name | Age | Sex | IP no. | Diagnosis | Surgeries |
|---|---|---|---|---|---|---|
| 1. | Kanniammal | 60 | F | 684392 | BE IMC | LE ECCE with PCIOL |
| 2. | Maragatham | 65 | F | 785391 | RE IMC/LE MC | LE ECCE with PCIOL |
| 3. | Elangovan | 76 | M | 790160 | RE IMC/LE MC | LE ECCE with PI |
| 4. | Perumal | 70 | M | 690437 | RE IMC/LE MC | LE ECCE with PCIOL |
| 5. | Jayagopal | 50 | M | 692899 | BE IMC | RE ECCE with PCIOL |
| 6. | Subramani | 57 | M | 793525 | RE IMC/LE MC | LE ECCE with PCIOL |
| 7. | Kaliammal | 68 | F | 783728 | BE Nuclear Cat. | RE ECCE with PCIOL |
| 8. | Annammal | 60 | F | 674267 | BE MC | LE ECCE with PCIOL |
| 9. | Krishnaveni | 50 | F | 725015 | BE IMC | LE SICS with PCIOL |
| 10. | Muniyammal | 65 | F | 816095 | BE IMC | LE SICS with PCIOL |
| 11. | Dhanalakshmi | 46 | F | 785885 | BE IMC | RE SICS with PCIOL |
| 12. | Ramasamy | 65 | M | 826095 | BE IMC | RE SICS with PCIOL |
| 13. | Vasantha | 38 | F | 656005 | RE PSEUDO/ LE IMC | LE ECCE with PCIOL |
| 14. | Gopal | 65 | M | 776441 | BE IMC | LE SICS with PCIOL |
| 15. | Chandra | 65 | F | 886336 | RE MC/ LE PSEUDO | RE SICS with PCIOL |
| 16. | Vellaiyan | 55 | M | 847637 | BE MC | LE ECCE with PCIOL |
| 17. | Dasappan | 35 | M | 87720 | LE EXP. KERATITIS | LE MEDIAL TARSORRAPHY |
| 18. | Etiappan | 58 | M | 891721 | LE-IMC | LE – SICS with PCIOL |
| 19. | Mariappan | 52 | M | 792726 | LE-IMC | LE – SICS with PCIOL |
| 20. | Shanthi | 48 | F | 811986 | BE IMC | RE SICS with PCIOL |
| 21. | Varadhan | 46 | M | 820826 | RE CDC | RE DCR |
| 22. | Sumathy | 54 | F | 762091 | LE CDC | LE DCT |
| 23. | Baskar | 52 | M | 83940 | RE-Matur Cataract | RE – SICS with PCIOL |
| 24 | Venkatesh | 56 | M | 78542 | LE-IMC | LE – SICS |
| 25. | Lakshmi | 72 | F | 84286 | RE CDC | RE - DCT |

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# Master Chart

| NAME | AGE | SEX | DIAGNOSIS | | VA ON PRESENTATION | | IOP | OCT MACULAR THICKNESS PRE INJ | | | | PROCEDURE | | | | POST PROCEDURE RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | RE | LE | RE | LE | RE | LE | RE | LE | 4 WEEK | | 8 WEEKS | | | | | 16 WKS | | |
| | | | | | | | | | | | | VA | IOP | OCT | VA | IOP | OCT | VA | IOP | OCT |
| meena | 60 | f | sev NPDR csme | sev NPDR csme | 6/24ph6/12 | 6/60ph 6/36 | 18 | 18 | 218 | 263 | LE IVTA | 6/60 P 6/36 | 18 | - | 6/24PH6/9 | 18 | 220 | 6/24 ph 6/9 | 18 | 210 |
| marimuthu | 65 | m | post op cme ,npdr | mod npdr | 6/36nip | 6/18 nip | 12 | 14 | 550 | 225 | RE ivta | 6/60 ph 6/36 | 12 | - | 6/18ph6/12 | 12 | 350 | 6/12nip | 12 | 259 |
| ramanathan | 68 | m | post op cme | mild npdr | 6/36ph6/18 | 6/36ph 6/9 | 16 | 16 | 329 | 233 | RE ivta | 6/36 ph 6/12 | 14 | - | 6/24ph 6/9 | 14 | 300 | 6/12ph6/9 | 14 | 250 |
| dakshinamoorty | 60 | m | sev. NPDR | sev. NPDR | 6/60 ph6/24 | 3/60ph6/60 | 14 | 14 | 1053 | 1112 | Le ivta | 5/60ph 6/60 | 14 | - | 6/24ph 6/18 | 16 | 345 | 6/12ph6/9 | 16 | 195 |
| george prakash | 25 | m | normal | post op cme | 6/6p | 1/60 nip | 12 | 12 | 620 | 173 | RE ivta | 1/60p | 14 | - | 1/60 nip | 14 | 450 | 3/60nip | 16 | 390 |
| sr.franklin | 74 | f | post op cme | normal | 6/60 ph6/36 | 6/18ph6/12 | 18 | 18 | 440 | 280 | RE ivta | 6/36 ph 6/18 | 18 | - | 6/12ph6/9 | 18 | 365 | 6/9nip | 18 | 315 |
| krisnaveni | 55 | f | sev. NPDR,csme | sev. NPDR,csme | 1/60 nip | 6/36 ph 6/24 | 18 | 18 | 248 | 236 | RE ivta | 1/60nip | 18 | - | 1/60 nip | 18 | 380 | 1/60nip | 18 | 514 |
| sekar | 50 | m | sev NPDR csme | sev NPDR | 6/60ph6/18 | 6/12ph6/9 | 14 | 14 | 334 | 227 | RE ivta | 6/60PH6/18 | 14 | - | 6/18ph6/9 | 14 | 290 | 6/12ph6/9 | 16 | 262 |
| usha | 60 | f | IT BRVO mac edem | normal | 2/60ph3/60 | 6/12ph6/9 | 16 | 16 | 394 | 177 | RE ivta | 3/60 nip | 16 | | 3/60nip | 18 | 267 | 3/60nip | 18 | 167 |
| rani | 60 | f | modNPDR csme | modnpdr | 6/36ph6/24 | 6/12ph6/9 | 12 | 12 | 771 | 190 | RE ivta | 6/36ph 6/24 | 12 | - | 6/24PH6/18 | 14 | 554 | 6/18ph6/12 | 16 | 345 |
| padmavathy | 55 | f | normal | post op cme | 6/36ph6/9 | 1/60nip | 14 | 14 | 272 | 180 | RE ivta | 2/60nip | 14 | - | 3/60 nip | 14 | 274 | 4/60 nip | 16 | 260 |
| lalitha | 50 | f | CNVM mac edema | armd | 1/60nip | 6/60nip | 18 | 18 | 256 | 137 | RE ivta | 1/60nip | 16 | - | 2/60nip | 16 | 225 | 2/60nip | 16 | 225 |
| murugavalli | 58 | f | normal | ST BRVOmac edem | 6/12ph6/9 | 6/60nip | 16 | 18 | 160 | 288 | Le ivta | 6/60nip | 16 | - | 6/36nip | 18 | 250 | 6/24ph6/18 | 18 | 200 |
| saroja | 60 | f | sev NPDR csme | sev NPDR Csme | 5/60ph6/60 | 3/60 ph 6/60 | 14 | 16 | 232 | 996 | Le ivta | 5/60NIP | 22 | - | 6/60nip | 20 | 180 | 6/24nip | 16 | 108 |
| govindraj | 50 | m | IT BRVO mac edem | sev NPDR csme | 6/36ph6/24 | 1/60ph 3/60 | 12 | 12 | 581 | 940 | Le ivta | 2/60nip | 14 | - | 2/60nip | 16 | 478 | 2/60nip | 14 | 330 |
| bhargavi | 64 | f | modNPDR csme | mod npdr csme | 6/18ph6/12 | 6/36nip | 16 | 16 | 285 | 370 | Le ivta | 6/36ph 6/24 | 16 | - | 6/36ph6/18 | 18 | 240 | 6/36ph6/18 | 18 | 210 |
| gunasundari | 70 | f | sev NPDR csme | sev NPDR csme | 6/24ph6/18 | 6/36ph6/24 | 12 | 12 | 200 | 280 | Le ivta | 6/36ph18 | 12 | - | 6/24ph6/12 | 16 | 246 | 6/12nip | 16 | 220 |
| ranjitham | 58 | f | sev NPDR csme | sev NPDR csme | 6/60 nip | 6/24nip | 16 | 16 | 396 | 183 | RE ivta | 6/60 ph24 | 16 | - | 6/60ph6/18 | 16 | 320 | 6/24nip | 16 | 270 |
| muthulaksmi | 65 | f | post op cme | normal | 6/60nip | 6/9ph 6/6 | 16 | 18 | 256 | 173 | RE ivta | 6/60ph24 | 16 | - | 6/24ph6/18 | 18 | 239 | 6/24ph6/18 | 18 | 219 |
| sarojini | 67 | f | post op cme | post op cme | 6/18 ph 6/12 | 2/60 nip | 16 | 16 | 412 | 996 | Le ivta | 3/60nip | 18 | - | 6/60nip | 18 | 291 | 6/36nip | 18 | 181 |
| sundarmurthy | 59 | m | sev NPDR csme | mod npdr | 5/60 nip | 6/24nip | 18 | 18 | 618 | 185 | RE ivta | 6/60nip | 18 | - | 6/60nip | 20 | 516 | 6/60nip | 18 | 406 |
| gangadaran | 57 | m | post op cme | normal | 6/60ph6/36 | 6/18ph6/9 | 18 | 18 | 607 | 238 | RE ivta | 6/36ph6/24 | 18 | - | 6/24PH6/18 | 18 | 450 | 6/24ph6/12 | 14 | 375 |
| gopinath | 39 | m | severe NPDR Csme | severe NPDR CSME | 3/60nip | 4/60nip | 18 | 18 | 1149 | 1025 | RE ivta | 3/60 nip | 18 | - | 6/24ph6/18 | 16 | 508 | 6/18ph6/9 | 18 | 235 |
| andal | 55 | f | modNPDR csme | mod npdr csme | 3/60 nip | 6/12p | 14 | 14 | 394 | 184 | RE ivta | 3/60p | 16 | - | 5/60nip | 14 | 270 | 6/60ph6/24 | 16 | 240 |
| ashokamma | 53 | f | modNPDR csme | modnpdr csme | 6/18nip | 6/24nip | 14 | 14 | 210 | 250 | LE IVTA | 6/36nip | 14 | - | 6/24ph6/18 | 14 | 220 | 6/24ph6/12 | 14 | 200 |
| kuppamal | 60 | f | ST BRVO | sevNPDR CSME | 3/60NIP | 6/18ph6/12 | 16 | 16 | 322 | 278 | RE ivta | 3/60 ph4/60 | 16 | - | 6/60 ph 6/36 | 16 | 290 | 6/36ph6/24 | 16 | 260 |
| rajendran | 62 | m | ST BRVO | gr3 htr | 4/60nip | 5/60ph6/36 | 10 | 10 | 745 | 372 | RE ivta | 3/60 ph 6/60 | 12 | - | 4/40 ph 6/60 | 12 | 540 | 5/60ph6/36 | 16 | 440 |
| sundarrajan | 69 | m | sev NPDR csme | mod NPDR | 6/60nip | 6/36ph6/12 | 14 | 14 | 665 | 300 | RE ivta | 6/60nip | 14 | - | 6/60ph6/24 | 14 | 520 | 6/24ph6/18 | 14 | 440 |
| malliga | 56 | f | modNPDR csme | mod npdr csme | 6/36nip | 6/24nip | 16 | 16 | 462 | 397 | RE ivta | 6/24nip | 16 | - | 6/18nip | 16 | 412 | 6/18ph6/12 | 16 | 312 |
| abdulkhader | 66 | m | stBrvo | normal | 3/60nip | 6/36ph6/18 | 14 | 14 | 785 | 289 | RE ivta | 3/60nip | 14 | - | 4/60ph5/60 | 14 | 512 | 5/60ph6/60 | 14 | 320 |
| janardan | 70 | m | sev NPDR csme | sev NPDR csme | 6/60nip | 6/60nip | 18 | 18 | 600 | 690 | Le ivta | 6/60ph6/36 | 18 | - | 6/60ph6/24 | 18 | 474 | 6/18nip | 18 | 320 |
| baby | 69 | f | itBrvo | normal | 6/60ph6/36 | 6/24nip | 16 | 16 | 489 | 306 | RE ivta | 6/36nip | 16 | - | 6/36ph6/24 | 18 | 320 | 6/24ph6/18 | 18 | 220 |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| kumari | 58 | f | post op cme | normal | 6/60nip | 6/12ph6/9 | 12 | 12 | 298 | 189 | RE ivta | 6/36ph6/24 | 12 | - | 6/36ph6/18 | 12 | 220 | 6/18ph6/12 | 12 | 194 |