Rhegmatogenous Retinal Detachment: Risk Factors, screening, Prophylaxis and Choice of Procedure for surgical management

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Since the introduction of ignipuncture in 1920's by Jules Gonin, father of retinal detachment surgery, retinal reattachment surgery has undergone tremendous evolution. Introduction of binocular indirect ophthalmoscopy by Charles Schepens in 1945, scleral buckling procedure by Custodis in 1949, photocoagulation by Mayer Schwickerath in 1956, cryotherapy by Lincoff in 1964, intravitreal silicone oil by Cibis 1962, vitrectomy (VISC) by Robert Machemer in 1971 and use of intraocular expansile gas by Edward Nortan in 1973 has expanded the options & extent to which rhegmatogenous retinal detachments can be approached effectively. For the past forty years vitreous surgery has evolved from 18G to 25G instrumentation, integrated microsurgical instruments, endoscopic surgical techniques, improvements in illumination, controlled cutting & suction, wide angle viewing systems, endophotocoagulation and perfluoro carbon liquids acting as third surgical hand have made retinal reattachment surgery more predictable and highly successful.

While at one end, vitreo-retinal surgery evolved as highly sophisticated surgery with predictable outcomes in terms of anatomical attachment rates (more than 95% (89 of 93 patients analyzed at LVPEI, operated by us), but the functional results are poor (only 61% (57/93) achieving better than 20/200 vision). We found that late detection by the patient or delayed approach the retinal surgeon as one of the major factor for non improvement of vision as 34.4% (32/93) of the patients presented to us with more than 1 month history of RD and another 24% (23/93) presented with more than 2 weeks history of RD. Patients with fresh RDs should ideally be treated within a week since it has been demonstrated that photoreceptor damage starts within 7 days of the onset of retinal detachment and retinal atrophy set in soon after. This is an important piece of information. This indicates that we need to improve the patients understanding of RD and importance of performing binocular indirect ophthalmoscopy by the general ophthalmologist as a routine. We also need to realise the importance of treating the lesions predisposing retinal detachment and quick referral of a patient with retinal detachment to a retina specialist. I would be discussing about the aspects I have mention in this review. I have kept my stress on the general ophthalmologists while writing most of this review, however given guidelines to retina specialist regarding decision making in surgical management of retinal detachment.

Self screening for Retinal Detachment by Patients:

It is the responsibility of general ophthalmologist to teach every high risk patient, how to perform a self screening for danger signs of retinal detachment. A patient can detect early occurrence of retinal detachment if he routinely does precautionary screen of vision by closing one eye and check how his visual acuity and field of vision in other eye. Self screening needs to be performed at least once in two weeks. Other signs one should look for are flashes of light and any sudden shower of black spots. The flashes indicate active traction on retina, could be either from partially detached vitreous or due to dynamic traction involving a retinal break. In either case it indicates a need for retina evaluation.

Risk Factors :

Some patients are more prone for retinal detachment, though it can occur in general population to a lesser extent (1 in 1000 population per year).1 Myopia is most common condition associated with retinal detachment. All myopia patients need to be screened for predisposing retinal lesions or retinal detachment. Moderate myopia (- 6 to 8.5 D) associated with higher risk of retinal detachment compared to high myopia (> - 14 D). Cataract surgery especially when it is complicated by posterior capsular rent and vitreous loss is associated with higher incidence of retinal detachment. Cataract surgery when complicated by vitreous loss is associated with 4.5 times higher incidence of retinal detachment.1 Uncomplicated Phacoemulsification surgery is associated with 0.4 to 3.6% incidence of retinal detachment, while ECCE associated with 0.3 to 7.5% incidence.2 Overall any patient undergoing cataract surgery associated with 5.5 times increased risk of retinal detachment over 10 year period.3 Partial posterior vitreous detachment either spontaneous due to aging or secondary to trauma can be associated with retinal detachment. Vitreous hemorrhage of varied causes can cause liquefaction of vitreous and secondarily lead to retinal detachment. Vitreo-retinal degenerative disorders are associated with higher incidence of retinal detachment in this subset of population.

Lesions predisposing to retinal detachment:

Lattice degeneration is the most common lesion of the retina that can predispose to retinal detachment (Figure: 1). Prevalence of lattice degeneration is 6 - 10.7% in non-selected patients.4 Bilateral occurrence of lattice is observed in 34-42%. Lattice degeneration is most common in vertical meridian and infero temporal quadrants. Retinal tears occur in 1.9% patients with lattice degeneration.4 The risk of retinal detachment in patients with lattice found to be 0.3 to 0.5%.4 The lattice degeneration is considered high risk lesion, especially when associated with retinal detachment in the fellow eye, positive family history for retinal detachment, symptomatic lattice, lattice with edge break (Figure: 2). All these lattice lesions should be treated by either laser photocoagulation or cryotherapy.

White without pressure areas (Figure: 3) are important lesions for two reasons. Primarily they need to be differentiated from RD and secondarily in rare occasion they predispose to giant retinal tear. Occasionally one may confuse an intervening normal retina in a white without pressure area for a round hole. White without pressure areas do not warranty any prophylactic treatment unless, there is a giant retinal tear in the fellow eye. In this case a 360° barrage laser is indicated in the eye with white without pressure areas.

Other lesions that need close follow-up include cystic retinal tags (Figure: 4). Retinal tears associated with cystic tufts have been accounted for 10% of the retinal detachments, therefore a prophylactic photocoagulation can be considered. Meridional fold and complexes (Figure: 5) are common development variations of ora serrata, occur as multiple lesions in 27% of the eyes. In cases of retinal detachment with meridional folds, the retinal break can occur at the posterior end of the meridional complex, though per say it does not seem to be increasing the incidence of retinal detachement. Enclosed oral bays (Figure: 6) are the lesions near the oraserrata may mimick a round retinal hole, good indentation can help in differentiating such lesions and avoid unnecessary treatment.

Paving stone degeneration (Figure: 7) appear as pale, flat and sharply demarcated lesions, is a common peripheral retinal degeneration observed in 17-20% patients. Bilateral involvement is about 35%. Paving stone degeneration do not predispose to development of primary retinal breaks or retinal detachment. Other peripheral retinal degenerative lesions observed are microcystoid degeneration, white with pressure and

zonular traction tufts are less important in terms of predisposition to development of retinal detachment.

Prophylactic treatment :

Prophylactic treatment in retinal detachment is in the form of photocoagulation or cryotherapy to the lesions that predispose to retinal detachment. As mentioned above, self screening by the patient will alert the patient at the earliest and will make them come to the ophthalmologist. A good indirect ophthalmoscopy by an ophthalmologist can help a long way, in identifying the predisposing lesions and in avoiding retinal detachment, by doing prophylactic treatment, I am now aware of several general practioners, who are taking extra training in lasers and medical retina, are proficient enough to handle the high risk lesions. One can prevent retinal detachment from occurring, if they can handle the high risk lesions.

Once the decision was taken regarding treatment of a lesion in question. Two or three contiguous rows of grade 3 intensity burns of 500 micron spot size with 200 milli seconds duration to be given around the lesion (Figure: 8). In case the anterior edge of the lesion can not be reached or lesion is too anterior, prophylactic cryotherapy can be attempted. These patients need to be followed after two weeks to assess the sufficiency of the photocoagulation or cryotherapy and there after they need to be followed up every 6 monthly intervals.

Choice of the surgical intervention :

Retinal detachment (RD) is a separation of the neurosensory retina from the retinal pigment epithelium (Figure: 9). Once the patient presents with retinal detachment, one should think of surgical intervention. If the facilities are not available, the patient should be reffered to a higher center for immediate attention. Whether pneumoretinopexy or simple scleral buckling would suffice in a given patient of retinal detachment or a vitreous surgery is needed, is largely depend on the type of retinal detachment, identification, location, number and extent of the retinal breaks, presence or absence and extent of proliferative vitreo-retinopathy, availability of the equipment and comfort & competence of a vitreo-retinal surgeon. For the same form of retinal detachment, each surgeon would think & adapt a surgical procedure differently & successfully. However certain clinical conditions associated with retinal detachment would make different surgeons to think in the same surgical lines. A number of procedures were described in the literature for retinal reattachment. In this chapter I would like to concentrate on the choice between vitrectomy, scleral buckling and pneumoretinopexy as currently these three procedures are in wide practice. Following are the indications where each procedure is exclusively practiced or form a definite indication.

Pneumoretinopexy: The term pneumatic retinopexy was used by Hilton and Grizzard as a designation for a non-incisional retinal reattachment operation consisting of an intravitreal injection of expandable gas with cryotherapy and/or photocoagulation of the retinal breaks (Figure: 10).5 The primary indications for pneumatic retinopexy include retinal detachments with proliferative vitreo retinopathy of not greater than PVR C1 with 1. single retinal break not larger than 1 clock hour, 2. multiple retinal breaks within 1 clock hour in superior quadrants and 3. residual retinal detachment with single open break after scleral buckling or vitrectomy.5 Other indications in which one may consider pneumatic retinopexy are optic pit with serous detachment, macular hole with retinal detachment. As the experience grows one may relax the indications to some extent.6 Pneumatic retinopexy scores over scleral buckling and vitrectomy in being simple & quick procedure, which can be performed as out patient basis (under aseptic precautions). However, it suffers from the drawbacks like 1. the air or gas stays there for short period, 2. Positioning of the patient is very essential there by can not be done in patients of detachment with inferior retinal breaks or patients who can not maintain a specific posture due to systemic problems, 3. gas stays

for shorter period & can not relive any traction element in patients with obvious vitreous traction and PVR changes without performing vitrectomy.

A multi center randomized controlled clinical trial compared pneumatic retinopexy and traditional scleral buckling procedure in eligible patients showed similar results in both the groups.7 However, pneumatic retinopexy group had higher frequency of new or missed retinal breaks.

Scleral buckling: Since its introduction in 1949, scleral buckling surgery has been most popular procedure performed for retinal reattachment. This procedure has produced successful and reliable results in patients of retinal detachment of varied forms.8, 9 Scleral buckling forms the procedure of choice with fresh retinal detachment with single or multiple peripheral retinal breaks especially when their location is in the inferior quadrants. Similarly scleral buckling procedure is associated with high success in patients of retinal dialysis of less than 3 clock hours.

Scleral buckling procedure with or without sub retinal fluid drainage aids in closure of the retina break and also helps in relieving the vitreous traction to an extent as there is reduction of circumferential diameter with application of encircling band (Figure:11 & 12). This factor scores over pneumoretinopexy in clinical conditions where there is vitreous traction over a peripheral retinal break.

Meta-analysis of published reports of pneumatic retinopexy showed overall retinal reattachment rate of 80% in eligible patients.10 Scleral buckling success rate ranges from 84-92%. Scleral buckling success rate is 96% in "pneumatic retinopexy eligible" patients.10 The retinal reattachment rates are similar in phakic eyes between pneumatic retinopexy and scleral buckle, However in non-phakic eyes single procedure retinal reattachment rates are higher with scleral buckling compared to pneumatic retinopexy.10

Though scleral buckle is associated with high success rate in uncomplicated retinal detachments, its associated with high failure rates in some clinical situations, where accurate placement of buckle is rendered impossible when breaks can not be identified due to poor media clarity eg. vitreous hemorrhage or where there is an unusually complex situations of retinal breaks like breaks posterior to the equator or multiple retinal beaks in more than one quadrant with different anterio-posterior locations or when there is vitreous traction that can not be relieved by external encirclage band like in severe PVR changes or traction/combined traction-rhegmatogenous retinal detachment, secondary to various vitreo-retinal pathologies like vascular occlusions or diabetic retinopathy. Scleral buckle is also found to be less successful in patients of retinal detachments associated with choroidal detachment and giant retinal tear or dialysis of more than 180°.11, 12 I prefer vitrectomy over scleral buckling in patients of aphakic or pseudophakic retinal detachments with unidentifiable retinal breaks.

Overall scleral buckle is preferred surgical technique for retinal reattachment in uncomplicated retinal detachments. In some patients with complex situations one may get away with scleral buckling as one gains experience but most need to opt for vitrectomy with additional procedures. The major advantage of scleral buckling is it is completely extraocular procedure. However if one thinks in correct perspective, scleral buckle attempts to attach the retina without directly dealing with the primary structure (retina) concerned. This thinking gives pretty insecure feeling, but I have seen perfect retinal reattachment with scleral buckle with over 10 year follow-up period with no associated complications.

Vitrectomy: Vitrectomy procedure per se has undergone tremendous improvement in technique over past 30 years since its introduction. Introduction of silicone oil, expendable gases, perfluo carbon liquids, wide angle viewing systems and endophotocoagulation has made vitrectomy, the procedure of choice in several

clinical situations in patients with retinal detachments.11, 13 The patients with retinal detachments associated with giant retinal tears, macular hole, choroid coloboma, secondary regmatogenous detachments associated with tractional retinal detachment of varied reasons and proliferative vitreoretinopathy of severe than PVRC2, vitrectomy has emerged as the procedure of choice.11-14 In uncomplicated retinal detachments with posterior retinal breaks and pseudophakic retinal detachments also vitrectomy forms preferred procedure. Several reports now started appearing in literature regarding vitrectomy as primary procedure in simple retinal detachment.15, 16

Parsplana vitrectomy is effective in PVR patients by removing the diseased vitreous with it's mitogenic and chemotactic stimuli there by disrupts the pathogenesis of PVR as well as yields higher retinal reattachment rate compared to scleral buckle or pneumatic retinopexy.

Use of heavier than water temporary substitutes such as perfluoro carbon liquids during vitrectomy has allowed manipulation of retina with patient in supine position. Perfluoro carbon liquids also act as a third surgical hand to gently pull the peripheral retina posteriorly and open the peripheral retinal folds. It also prevents the posterior flap of giant retinal tear from slippage (figure: 13).11 The preretinal fibrous membrane identification is easier with use of perfluoro carbon liquids, there by allows the surgeon to do more complete dissection. Introduction of wide angle viewing system, made it easier to maximise removal of vitreous gel and relieve vitreous traction from retinal breaks during vitrectomy.

Introduction & improvements in intraocular tamponading agents, wide angle viewing system and endophotocoagulation has revolutionized vitreous surgery and greatly improved the out comes in complex retinal detachments. Vitrectomy offers certain potential advantages over scleral buckling, it affords a direct approach to vitreous traction, allows internal drainage of subretinal fluid and avoids use of external buckling material. By principle vitreous surgery deals with the pathologic tissue directly. Vitrectomy is also advantageous over scleral buckling in terms of less distortion & disturbance of extraocular tissues. However vitrecotmy is not free of complications. The potential complications associated with parsplana vitrectomy are cataract, angle closure glaucoma, iatrogenic retinal break formation, vitreous hemorrhage, endophthalmitis and possible sympathetic ophthalmia.

In retinal detachments associated with PVR one should opt for either long acting gases (SF6 or C3 F8) or silicone oil as intraocular tamponading agent after vitrectomy. Silicone oil study group addresses this issue. Silicone oil study is a prospective randomized study conducted in patients with retinal detachment of grade severe than PVR C3, to address the effectiveness of long acting gases Vs silicone oil in reattachment of retina. The study observations suggest that silicone oil is superior to SF6 (60% Vs 40%) and as effective as C3 F8 (64% Vs 73%) in terms of retinal reattachment rate in patients with RD associated with PVR greater than C3.17, 18

Prognosis in patients with retinal detachment :

The features predicting poor retinal reattachment rate are

Proliferative vitreoretinopathy

Co-existing choroidal detachment

Post traumatic retinal detachments in the presence of vitreous hemorrhage.

Giant retinal tears.

Long standing retinal detachment.

The features predicting poor visual outcome even if the retina is reattached are:

Macula off RD

Long standing RD

Cystoid macular changes

Coexisting macular hole

Subclinical retinal detachments: Limited retinal detachments were defined by size criteria included width at least 2 times but not greater than the diameter of the largest break and less than 2 clock hours in size with posterior extent not beyond the equator (Figure: 14). Laser demarcation consisting of 3 rows of confluent laser photocoagulation around the subretinal fluid and photocoagulation of the retinal break with help of scleral depression has caused flattening of retina with chorioretinal scarring in 2-3 weeks in 85% of the eyes.19 Successful stabilization depends on selection and adequate laser treatment. Demarcation laser photocoagulation can also be considered in recurrent subclinical retinal detachments following scleral buckle or pneumatic retinopexy.

Pseudophakic retinal detachments: Viewing the peripheral retina is the major problem in the repair of pseudophakic retinal detachments. The difficulty evolves from refraction at the rim of the intraocular lens, opacification of the posterior and anterior capsule and remnants of cortical matter as well as resistant pupillary dilatation.16 This results in high rate of non-identification of retinal breaks, which makes difficulty in accurate placement of scleral buckle. Parsplana vitrectomy allows easy localization of retinal breaks, elimination of vitreoretinal traction and precise treatment of breaks by endophotocoagulation in these patients.

Giant retinal tear/dialysis: One of the more technically difficult problems in vitreous surgery is patients with giant retinal tear/dialysis with PVR.11 In these patients in addition to the contraction forces of epiretinal membranes, dissection is complicated by the free flap of the giant tear. Another problem that encountered in the management of these patients is slippage of the posterior flap of the giant retinal tear. Both these problems can be dealt well with the availability of perfluoro carbon liquids. As mentioned before, perfluoro carbon liquids facilitate complete dissection of the membranes, also helps in complete flattening of the retina and prevent slippage of posterior retinal flap of the giant retinal tear by doing a PFCL gas/silicone oil exchange towards the conclusion of the surgery.11, 13 Perfluoro carbon liquids also facilitate in good application of photocoagulation during surgery. In these patients scleral buckling/ encirclage band can only play a supportive role to vitrectomy.

Conclusions:

Management of retinal detachment will start at self screening by the patient, which brings the patients at an early stage to the ophthalmologist. Routine dilated indirect ophthalmoscopy by the general ophthalmologist helps a long way in identification of high risk lesions. Prophylactic treatment by photocoagulation and cryotherapy is an important medical retinal skill, reduce the incidence of retinal detachment. Once patient develop retinal detachment, one should not lose any time before getting it reattached to gain maximum anatomical and functional gain. Vitreo-retinal surgeons should use the choice of the procedure deligently to attain maximum outcome with minimum intervention and discomfort to patient. The choice of the procedure for rhegmatogenous retinal detachment largely depends on the type of detachment, number, location & extent of the retinal breaks and presence or absence of any associated factors like proliferative vitreoretinopathy and other complex situations. For simple retinal detachments with peripheral retinal breaks pneumatic retinopexy can be considered if the breaks are single or multiple but within one clock hour and are located in the superior quadrants.20 Other simple retinal detachments with peripheral retinal breaks scleral buckling is the procedure of choice. If the retinal detachment is associated with complex situations, vitrectomy with additional procedures should be considered. Vitrectomy is also considered in special situations like pseudophakic or aphakic retinal detachments with unidentifiable retinal breaks. Delimiting photocoagulation has a limited role in patients of subclinical retinal detachment of primary or recurrent nature.19 I

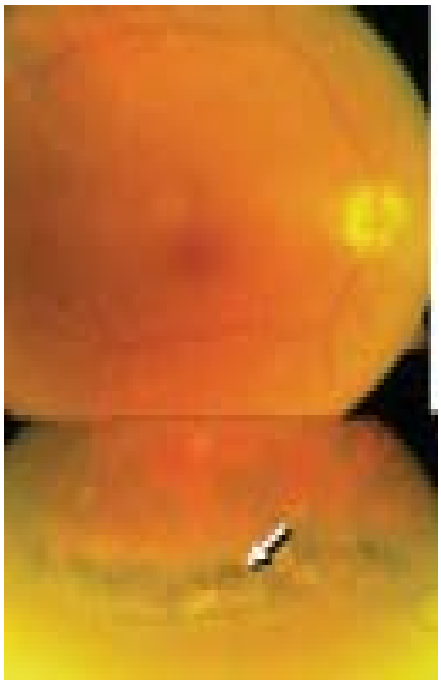

Figure 1: Areas of pigmented lattice degeneration in the inferior retinal periphery

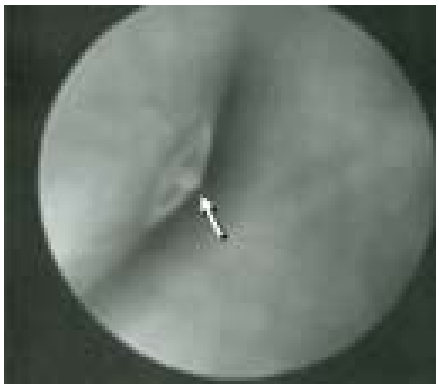

Figure 4: An area of Cystic retinal tuft with with scleral indentation. (adopted from text book of Retinal Detachment by Michels RG)

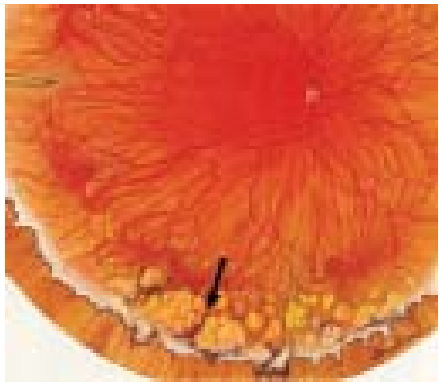

Figure 7: Cartoon showing an area of paving stone degeneration. (adopted from color atlas of peripheral retina by Bell FC)

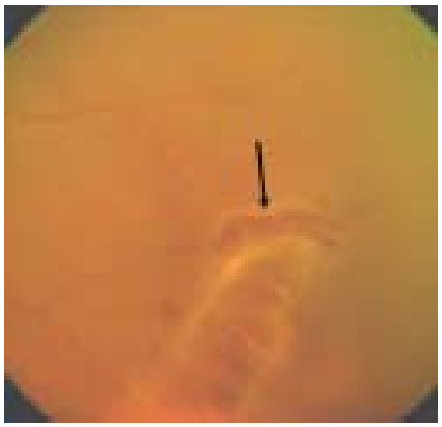

Figure 2: Lattice with edge break, a high risk lesion for the development of retinal detachment.

Figure 5: Cartoon showing an area of Meridional fold and meridional complex. (adopted from color atlas of peripheral retina by Bell FC)

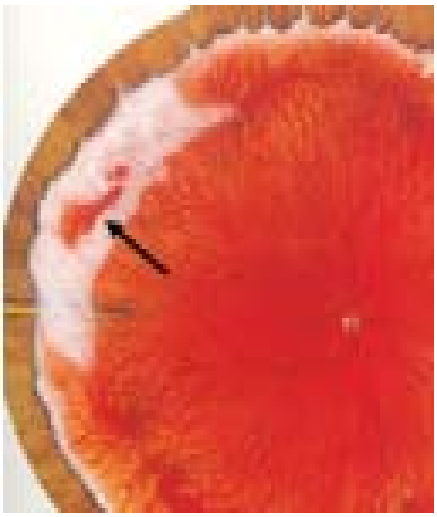

Figure 3: Cartoon showing an area of white without pressure area. (adopted from color atlas of peripheral retina by Bell FC)

Figure 6: Cadeveric eye showing an area of enclosed oral bay. (adopted from text book of Retinal Detachment by Michels RG)

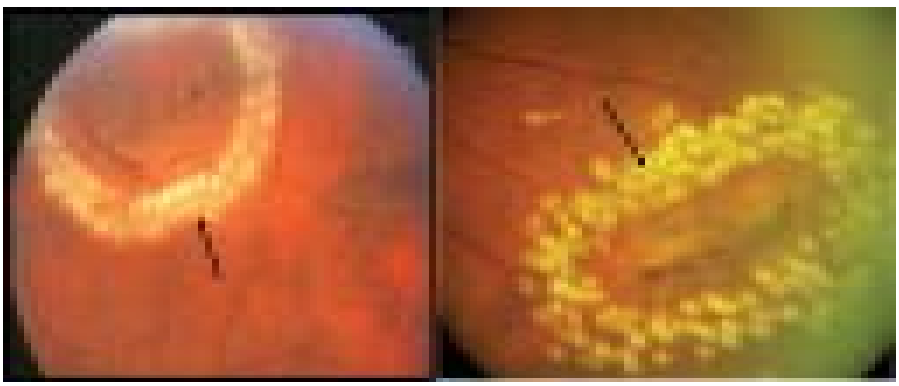

Figure 8: Prophylactic laser photocoagulation for retinal break (A) and lattice with multiple holes (B)

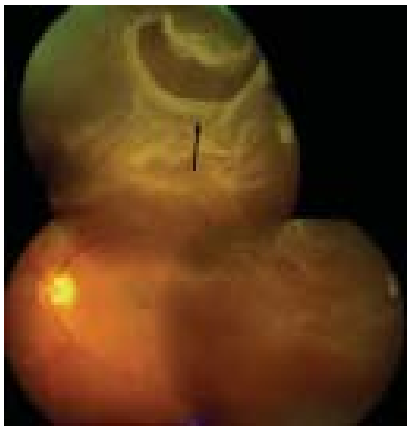

Figure 9: Large horse tear with Retinal detachment

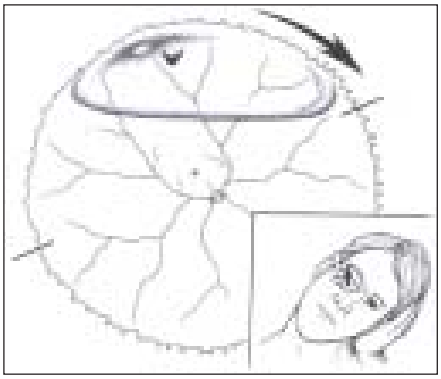

Figure 10: Patient positioning in pneumoretinopexy after injection of gas and cryopexy /laser photocoagulation (adopted from text book of Retinal Detachment by Michels RG)

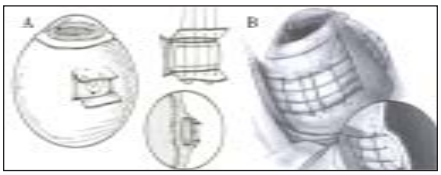

Figure 11: Cartoons showing the implant (A) and exoplant (B) technique of Scleral buckiling procedure (adopted from text book of Retinal Detachment by Michels RG)

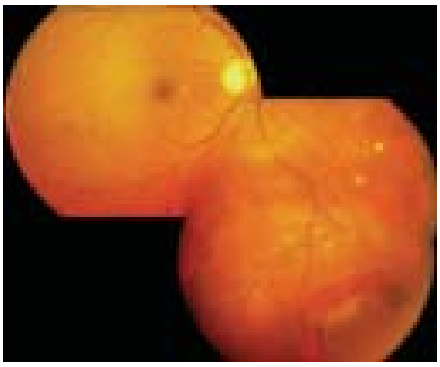

Figure 14 : Subclinical Retinal detachment (white arrow) with horse shoe tear (black arrow) in the inferonasal quadrant

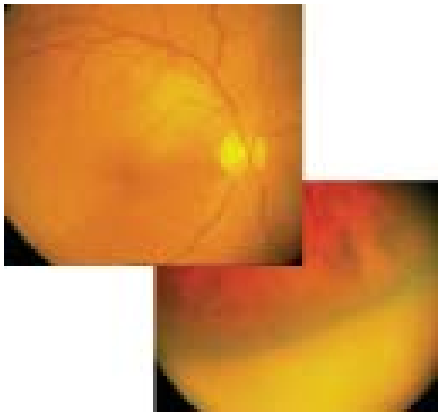

Figure 12: scleral buckle indentation seen from inside after surgery with well attached retina

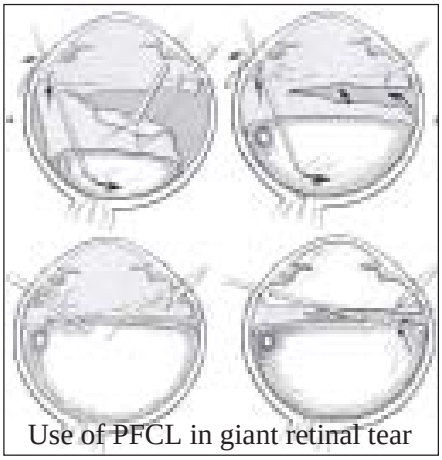

Figure 13: Steps of use of PFCL in giant retinal tear. A& B: relief of traction and flattening the flap of GRT under PFCL, C: Endophotocoagulation once flap flattens, D: Silicone oil PFCL exchange (adopted from text book of Retinal Detachment by Michels RG)

purposefully avoided the discussion on the use of 23 and 25 guage vitrectomy systems in retinal detachments, as they are under evolution. I see a signicant role for 23 guage system in management of retinal detachments in future. Though I tried to make the whole indications simple there are many grey zones where there is debate about one over the other procedure & also about the use of a particular intraocular tamponading agent over the other along with vitrectomy. These grey zones vary according to each surgeon's preference and experience.

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