HISTORICAL NOTES

History of Vitreo-Retinal Surgery

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Many posterior segment eye ralated problems including vitreous haemorrhage, retinal detachment, posterior segment trauma were virtually untouchable before the advent of vitreoretinal surgery. Herein we briefly present history of vitreo-retinal (VR) surgery and how it has revolutionized the approach and management of some of these disorders which before the advent of VR surgery were practically untreatable. Starting from 1920 through 1990s, we see that vitreo-retinal surgery and its evolution has been a major quantum jump in ophthalmology. In this revolution, of course, VR surgery has been helped and promoted by simultaneous developments in related ophthalmic and other medical fields.

Vitreo-retinal surgery has been the major area of exponential advances in ophthalmology in the twentieth century. This has helped patients who were untreatable before, including many of the ocular emergencies. The main ocular emergencies which are presently managed by VR surgery include.

Traumatic ocular emergencies

- Blunt trauma
- Penetrating trauma
- Penetrating trauma with intraocular foreign body
- Vitreous haemorrhage
- Retinal detachment with opaque media
- Endophthalmitis

Non-traumatic ocular emergencies

- Retinal detachment with "Macula on"
- Vitreous Haemorrhage (Bilateral)
- Giant retinal tears
- Metastatic endophthalmitis.

We will start from 1920s. It may seem like going a long way back but it is worth remembering that all of the above conditions were virtually untreatable before that and eyes so afflicted usually ended up with blindness. Before 1920, all retinal detachments were untreatable. Like for all untreatable disorders innumerable kinds of medical, surgical and many unclassified methods of treatment were used, all ended up in failure. The saga of retinal detachment (RD)surgery reflects man's ingenuity and how the advances in technology have built upon them an edifice of algorithms which can be used by all ophthalmologists to treat conditions, hence to untreatable, with high success rate. It was in 1920s that Gonin, a Swiss national, suggested that retinal detachments were caused by retinal breaks (tears, holes, dialysis) - and that if one could "seal" the break with the

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retinal pigment epithelium, retina would reattach. His surgical approach included locating the break, drainage of sub-retinal fluid (SRF) and applying thermocautery through sclera (2). The idea was to surround the tear with enough cautery burns thus producing inflammation which would seal the break by binding the retina surrounding the retinal tear to the pigment epithelium. To achieve this, postoperative bed rest with head immobilised in a certain posture with sand bags was advised, which often lasted months. This not withstanding, about 20 to 40 percent success was achieved in treating the retina (3). The method, as is known with new innovations, was much criticized but this limited but unprecedented success made the method popular and suddenly an untreatable disease became treatable.

Next major advance was the need felt to somehow bring retina in close approximation to RPE to bring rapid scaling of the break. It was realised that it could either be done by tamponading the retina internally or externally. Rosengren (4) used intravitreal air with post-operative positioning after SRF drainage and claimed better success rate. As we shall see later, this concept of intravitreal tamponade had such merit, which went unrecognised, that it is in extensive use in VR surgery presently, albeit in a modified form.

External tamponade was sought to be achieved by :–

1. Scleral resection not over break
2. Scleral resection over break
3. Partial polythene tube
4. Circling polythene tube
5. Circling tube with silicone implant
6. Circling silicone implant

The last, was recommended by Charles Schepens in 1947 and he has been called the "Father of modern RD surgery" (5). However, his contributions in this field were multifold. He introduced binocular indirect ophthalmoscope in place of monocular ophthalmoscope which was used till then. Schepens binocular indirect ophthalmoscope (6) was a boon for retinal surgeons. Suddenly you could see more retina in one go, illumination was better, retinal periphery could be seen more easily and combined with external scleral indentation (7) one could see right upto pars plana-breaks in the periphery which before would have remained hidden, could be easily seen and this combined with comfortable working distance at surgery, generally increased the popularity of the instrument. He introduced silicone rubber (8) as the buckling material as encircling or a local buckle of various sizes and contours to suit individual patient needs, these continue to be used till today. Replacement of thermocautery with diathermy by Heim (9) and Weve (10) and later the use of cryo-application to reduce chorioretinal reaction by Bietti (11) were important advancement during this period. Schepens improvisations dramatically revolutionised RD surgery and success rate rose upto 70-80%, which was unthinkable then. But Schepens approach had one problem, he advocated that buckle be placed intra-sclerally after lamellar seleral dissection. This step of lamellar scleral dissection often took a long time but Schepen's method was nevertheless universally adopted and he continued to use it right through the eighties. One of the biggest advantages of Schepen's technique was that retina was attached on the table and need for postoperative bed rest was eliminated, a no mean achievement.

Next jump in progress of RD surgery was brought in by Custodis (12), a German, in 1953. He used polyvinyl sponge to buckle the break but his breath taking

breakthrough was the realisation that drainage of SRF was not essential for reattachment of retina. He presented his paper in Boston, the hometown of Schepens. Nobody believed him and this included Schepens who was in the audience and did express total shock at this new revealation. Custodis non-drainage methods did not have many takers till Harvey Lincoff (13) of Comell, New York, who worked with Custodis and was convinced that this method works, returned to America and popularised the method. Lincoff preferred silicone sponge to silicone rubber, he replaced cryotherapy (14) for sealing retinal break in place of diathermy and lastly, he stated that buckle could be placed externally, thus eliminating the need for lamellar scleral dissection. This was in 1960. Suddenly RD surgery became easier to do. Success rates achieved were similar to that of Schepen's. Lincoff also preferred radial to circumferential buckles (15) and his method continues to be used till today though present day preference is for circumferential silicone rubber buckles. This is mainly because of advancement in vitreous surgery. And so it continued till 1970. RD surgery could be done with SRF drainage or non-drainage. Till today each method has its proponents and opponents.Now RD surgery success rates were 80-90 percent and commonest cause of failure of RD surgery was proliferative vitreoretinopathy (PVR) and this was untouchable and the eye doomed to blindness. Around this time microsurgery was finding its place in ophthalmology but vitreous was untouchable. Such was the vitreous sanctity that controversy raged in late 1960s and early 1970s that "can we touch the vitreous and go unpunished". Many believed that vitreous has computer like memory and once touched and lost from the eye, the eye is lost. This group of investigators believed the vitreous to be unviolable. Cibis (16) removed vitreous with scissors but results were equivocal. In 1969, the bubble of "inviolability" of vitreous was finally bursted by Kasner (17), who through cornea, after removing lens, cut and removed opaque vitreous in two patients with primary amyloidosis. These patients regained vision, this was a big step, for it proved that vitreous was expendable, so what do we do now. Kasner's technique was inapplicable in rest majority of cases of vitreous related blindness including PVR, traumatic vitreous haemorrhage and so on. Another quantum jump was soon made and this was by a colleague of Kasner, Robert Machemer (18). Machemer had great insight to realize that best area to approach vitreous for removal was pars plana, for here RPE and anterior continuation of retina that is, ciliary epithelium are so firmly adherent that an opening could be made here without causing retinal detachment. To achieve this end he succeeded in devising a motorised instrument with about 18 gauge tip size and working in his garage could remove egg albumin through a small opening in the egg shell. Soon the instrument was used in vitreous related blindness clinically. He called this instrument, vitreous infusion suction cutter. (VISC)

Machemer's technique of Trans Pars plana Vitrectomy (TPPV) included a single 18 gauge port made in Pars Plana and introduction of the instrument probe through this opening into the vitreous cavity. This probe would infuse fluid into the eye, cut the vitreous and aspirate it thus removing the vitreous, opaque or otherwise and leave the vitreous cavity filled with BSS or ringer lactate. He reported his results in American Journal of Ophthalmology in a series of seven papers starting from 1971. In many cases of untreatable ocular blindness accompanied by vitreous opacities (haemorrhage etc.) fairly good results were obtained. But his reported first 28 cases of PVR, all failed. Later Machemer added fiberoptic light to the probe to be able to see through

microscope and corneal lens system right upto the macula clearly by enhancing the illumination. Connor O'Malley (19) in 1974 proposed three port vitrectomy - all sized 20 gauge. In lower temporal quadrant was placed infusion cannula to continuously infuse the vitreous cavity with balanced salt solution during surgery and two ports were made close to recti muscles in superotemporal and superonasal quadrants. These two ports being equal sized, opening were interchangeable. Through one port endo-illuminator was introduced and through the second port vitrectomy probe was introduced. This probe would cut the vitreous and aspirate it. Thus VISC of Machemer which was 18 gauge or of larger size and limited the maneuverability inside the vitreous cavity was replaced by 20 gauge sized instruments which enhanced maneuverability and also permitted use of any instrument which was of 20 gauge size to be introduced into the vitreous cavity. This could be a scissors, foreign body forceps, epiretinal membrane removal instruments like Pics, scratchers. The list is endless. Thus multifunctional VISC was replaced by O'Malley's 3 port vitrectomy system which continues to be used. Initial vitreous suction system in 1970s were primitive - assistant hand controlled, surgeons hand controlled, solenoid peristaltic foot control system. In 1976, Steve Charles (20) introduced linear and delta suction controlled system by foot pressure suction pressure could be set to a present level from 0-400 mm Hg. This was a tremendous advance which permitted surgeons to work very near the retina without fear of causing iatrogenic unintentional retinal tear. Charles also introduced flute needle for internal drainage of SRF (21). Flute needle now has been replaced by silicone tipped extrusion needle and suction can be controlled from same foot switch which operates the vitrectomy probe.

In eighties, endolasers became available and better bipolar diathermy systems were introduced (22). For prolonged intraocular tamponade long acting gas (SF_6) was introduced in 1975 by Norton (23). Longer acting gas (C_3F_8) is in greater use now (24). Gas gives temporary tamponade varying from 1 to 3 weeks. For permanent tamponade silicone oils introduced by Cibis *et. al.* (25) are available in varying range of viscosity from 1000 Cs to 13000 Cs. Silicone oil is lighter than water (S.G.O.97). Heavier than water silicone oil which flatten the inferior retina is also available, the (flurosilicone).

Recently various perfluorcarbon (26) liquids which are heavier than water, have proven most valuable intraoperative tools in various vitreo-retinal conditions. These flatten the retina by their heavier specific gravity and have proved extremely valuable in the most feared condition of giant retinal tear.

Thus, we see that advance in VR surgery and its history reveals how invaluable these have become in many conditions including ocular emergencies. Presently better viewing systems, ophthalmic ultrasound, better instrumentation, laser systems, imaging (CT, NMR, SPECT etc.) and now endoscopic vitreo-retinal surgery through opaque media have enabled us to manage challenging vitreo-retinal conditions.

To conclude, today practically all detached retinae can be reattached and the march to perfection continues which will undoubtedly help in better management of ocular emergencies.

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