Retinopathy of Prematurity (ROP)\(^1\) is an important cause of childhood blindness in our country. With mushrooming of NICU’s saving the smallest of babies, a steep rise in number of ROP cases is occurring across the country. Lack of awareness among ophthalmologists and neonatologists is leading to a huge increase in ROP related blindness, which poses a huge socio-economic burden on the community.\(^2\)

As more ophthalmologists get trained in ROP care, they encounter complex situations which need expert advice. These Ophthalmic Deliberations share the opinions and views of the top ROP experts in the country on selected ROP case scenarios. Their experience in managing such cases will surely benefit the ROP beginner as well as the seasoned ROP specialist.

**Parijat Chandra** - Case 1: A preterm baby born at 29 wks gestational age (GA) and 865g birth weight (BW) presents at 33 weeks post conceptional age. The child has a history of sepsis, jaundice and assisted ventilation. The pupils dilate poorly and have dense tunica vasculosa lentis. Only the posterior pole was visualized with plus disease and was suggestive of zone I Aggressive Posterior ROP (APROP) in both eyes (Figure 1).

Q - What are the challenges to perform laser treatment in such cases and how to overcome them? Do you think fundus fluorescein angiography is of use here?

**Rajvardhan Azad** - The challenges to performing laser include - small pupils, hazy media, dense tunica vasculosa lentis and absence of clear demarcation line. As we can see the posterior pole, and since it is a Zone 1 disease - one should take up this case on an urgent basis. To delineate the demarcation between vascular and avascular retina, an ideal approach will be to do Retcam assisted fundus fluorescein angiography (FFA) as we need to perform laser urgently.\(^3\) While doing laser, all avascular areas should be knocked off preferably in one sitting in both eyes. However, if hazy media precludes the view of fundus, which is not in this case, one can inject AntiVEGF agents followed by laser after 2-3 days.

Q - Would you use intravitreal AntiVEGF drugs in this case or not, and why? How long will you follow up after Anti-VEGF drugs use?

**Mangat Dogra** - My first choice will be confluent laser photocoagulation with diode/532 laser delivered through laser indirect ophthalmoscope (LIO) delivery...
system. Both laser wavelengths work well in the presence of tunica vasculosa lentis without causing any lens opacities. Non dilating pupils mostly dilate well after scleral depression due to mechanical stretching during laser treatment.

In case laser treatment is not possible or inadequate due to media haze, I would inject intravitreal Bevacizumab (Avastin) and wait for media to improve. I always prefer to perform laser to the entire avascular retina after intravitreal injection of Avastin. This helps to prevent recurrence of ROP in long term follow up. FFA helps to delineate entire areas of avascular retina in the initial stage and later to monitor retinal changes induced by Avastin. However, all cases after intravitreal anti-VEGF require close and long term follow up as compared to eyes undergoing laser treatment.

Subhadrál Jalali - Laser is challenging but can be always done. Dilate with 1% Tropicamide and 2.5% Phenylephrine every 5-7 minutes, three times in a strict schedule and start laser after 25-30 minutes. Pupils dilate as soon as we put in 20-30 laser spots. It is important not to release and depress the globe hastily as that leads to pupils becoming small. More details further in our article on technique of laser for ROP under topical anaesthesia.4

FFA may be difficult to get in a ‘hot eye’ due to media haze and poor pupillary dilatation and also one may not be able to target the laser exactly in the area we see on FFA at that stage. Hence I would not consider FFA at first stage where a lot of avascular retina needs to be ablated quickly and targeted laser is not the approach at that point of time. If FFA is available, I may consider it in the next visit after 3-5 days to identify skip areas and posterior avascular pockets and treat them - FFA quality will be better and we can do targeted laser at that stage due to better pupillary dilatation and reduction in media haze. However, clinically also these areas can be diagnosed with some experience and so not having FFA does not preclude getting good laser outcomes of beyond 85% success in APROP.5

Anti-VEGF injection can be considered, though not mandatory – it will depend on how much laser was I able to achieve in the first sitting. I will use it only if it is really essential as adverse events are reported.6,7 If anti-VEGF is used, I will still add laser in few days especially to the peripheral retina. Follow-up will be at least for one year and will especially watch out for newly growing peripheral avascular retina and also any rebound recurrences both posteriorly and peripherally. May require couple of general anesthesia evaluations as child becomes big and heavy in follow-up.

Pramod Bhende - FFA is not necessary at this stage. Challenges due to small rigid pupils - difficulty in visualizing the retina to be lasered, risk of incomplete treatment, risk of iris burns and lens damage leading to localized/progressive cataract, risk of hyphema, rarely corneal burn, and laser treatment may take longer time - increasing risk of episodes of bradycardia and apneic spells.

Personally I would prefer to inject intravitreal Avastin (0.25 ml/0.625mg). Generally there is a response within 48 hours and plus disease subsides. Iris/retinal vessel congestion will be reduced and pupils will dilate allowing better fundus evaluation. Follow the patient at 5-7 days interval till normal vessels grow in zone three and there is no plus disease. If plus disease reappears (this may happens anytime 2-3 weeks post injection), I would prefer to go ahead with laser to avascular retina rather than reinjection. By this time generally the disease has reached to zone two anterior or zone three. This will reduce extensive treatment and laser near macular region and the need for prolonged follow up. The other option could be – to go ahead with laser to the maximum extent possible and plan second setting of laser after 3-4 days. This will help to take care of the initial crisis and generally pupil dilates better during the next laser sitting letting you complete the treatment.

Narendran V - Non dilating pupils is a big challenge for doing laser in such a scenario. This is partially overcome by putting dilating drops at least one hour before laser and addition of topical anesthetic drops also helps. However, even if the pupil is still small, laser can be started as with the constant indentation and de-indentation, the pupils start dilating in a very short time. Fluorescein angiography is of use to see the extent of capillary drop out areas. Thus it helps the surgeon to know the posterior extent of the laser.

In today’s scenario anti-VEGF’s do have a role in AP-ROP as a primary treatment. It will not only help in over-coming the non-dilating pupil, but will also give some time for the normal blood vessels to grow away in zone 2, which will avoid us in doing a very posterior laser which has the risk of destroying the fovea. Follow up should be weekly for a month followed by two weekly and then 3 to 4 weekly according to the retinal status. Longer and meticulous follow up is required till either the vessels mature fully or till new vessels re appear. Recurrences are known to happen even beyond 12 to 20 weeks after anti-VEGF injection. Thus follow up will be required till 80 weeks post conceptual age and in some cases even beyond that.

Summary (Parijat Chandra): APROP offers unique challenges for beginners as well as experts in ROP – there are difficulties in screening, diagnosis and treatment commonly caused by rigid non diluting pupils, unclear demarcation areas and an uncertain complicated course might lead to ROP progression and blindness despite best of efforts. AntiVEGF drugs serve as a useful tool in selected cases of APROP, but their safety profile still needs to be proved by larger studies, and risk of recurrence continues to be a challenge.

Parijat Chandra - Case 2: A preterm baby born at 30 wks gestational age and 1000g birth weight presented at 37 weeks post conceptional age. The child has a history of sepsis, apnea, intraventricular hemorrhage and assisted ventilation. Examination revealed advancing 4A ROP in Zone 1-2 in both eyes with dense preretinal hemorrhage in right eye (Figure 2).
Q - How will you manage this case? What are the current indications, challenges and outcomes of vitreoretinal surgery in such eyes? Would you use intravitreal AntiVEGF drug in this case or not, and why?

Rajivardhan Azad - As you have mentioned it is an advancing Stage 4A ROP. I would like to do lens sparing vitreoretinal surgery to remove the traction and scarring which is pulling the retina. The challenges include correct instrument entry, and removing the traction gently using high cut rate and moderate suction. With pre-retinal hemorrhage, one can inject antiVEGF drugs with a close watch on traction on the retina.

Mangat Dogra - My first choice again will be confluent laser with diode/532 delivered through laser indirect ophthalmoscope (LIO) delivery system. I would look for skipped or retracted areas of avascular retina in first week and supplement more laser treatment. This case needs close follow up to monitor for progression of proliferation and retinal detachment. Progressive retinal detachment or new fibrovascular proliferation will need early lens sparing vitrectomy (LSV). Most cases do well if LSV is performed early. I would not use intravitreal anti-VEGF in this case due to fear of crunch phenomenon in view of extensive fibrovascular proliferation. Crunch phenomenon would most likely result in an inoperable retinal detachment.

Subhadra Jalali - This is an emergency and depending on time of day the child presents, following will be the general sequence of our management: Counselling to parents about the emergency situation. Send blood samples for GA fitness and systemic evaluation. Do laser as much as possible on same day to both eyes while awaiting lab blood test results. Plan early surgery in next 2-3 days especially right eye (usually we do bilateral same day surgeries in such high risk cases). Main challenge is GA fitness and we expedite that as an emergency with a surgical counselor or fellow doctor put on task to get patient to the operating room safely and quickly. This right eye and of course the left eye is salvageable with good outcome if we do not delay surgical management. We admit the patient for pre-op preparation so that the child does not fall through in numerous cross-consults, especially as many of these are out station patients. We get GA fitness within 24 hours - get hemogram and if low, give transfusion quickly. Manage any respiratory problems/ cardiac issues by quick cross consultations; discuss risks of anesthesia with parents and importance of team work with us doctors. Work as a strong leader of the team, which should get the child operated as soon as possible as an emergency.

After getting GA clearance we often, but not always, do give anti-VEGF one day prior so as to reduce vascularity and intraoperative bleeding. I would give anti-VEGF drug (Avastin) 0.025 ml for right eye but not for left eye as in left eye it should be manageable without any anti-VEGF drug. Lens sparing vitrectomy will be the choice of procedure. However, I would ensure complete laser and if needed, peripheral cryotherapy intraoperatively to ablate all the avascular retina. I have seen NVG developing in an eye where incomplete laser was done following anti-VEGF assisted lens sparing vitrectomy. Outcomes are good at this stage with visual acuity ranging from 20/200 to 20/50 in most cases. Surgical vitrectomy procedure is short, usually 15-20 minutes in each eye. The youngest patient operated by us has been 1300 grams at time of surgery. Main challenge is to get the whole team together and I believe this can be got done by focusing, commitment and working as the team leader, taking all stakeholders along-with. With more than 500 surgeries, we faced a single mortality so far, that too in a 5 kg child and none so far in those less than 2 kgs at time of surgery. Results are truly gratifying.

Pramod Bhende - I would prefer intravitreal anti-VEGF and laser treatment (to available retina) at the same sitting or after 2-3 days in both the eyes. Both eyes can have gap of 3-4 days while injecting antiVEGF, but laser can be performed at same sitting. Eventually both the eyes will need ‘lens sparing vitrectomy’ and I would like to prepare the baby and parents for the same. With so many systemic issues,
the pediatrician and anesthetists will need time to stabilize the general condition and get the baby ready for general anesthesia. AntiVEGF and laser will help us buy time and at the same time will help to reduce the vascularity and risk of intra operative bleeding. So here, antiVEGF is being used as an adjunct to the surgery. There is a small risk of worsening of the traction. In the left eye, there is a remote chance that the fleshy vascular membrane may regress following antiVEGF injection and adequate laser. The most challenging part will be to get fitness for general anesthesia. I would prefer 23/ 25G MIVS (without cannula) for vitrectomy in these eyes. There is a risk of intra-operative bleeding even after antiVEGF injection. These eyes do not have PVD and it is almost impossible to induce PVD. As much vitreous debulking as possible can be performed. The preexisting blood clot will be partly at subhyaloid/ sub-membrane level with underlying tractional retinal detachment and partly mixed with vitreous.

Getting correct plane for dissection is very difficult, rather almost impossible in these eyes. Sometime tissue identification will also be difficult. Surgeon has to carefully shave the vitreous and clot layer by layer. Eventually some blood and residual proliferative tissues will always be left behind. In preterm infants, intraventricular and intraocular hemorrhage are bad prognostic signs. Post-surgery risk of reproliferation, recurrent vitreous hemorrhage and rubecosis is very high. Re-surgeries, generally, do not help much.

Narendran V - We would give extensive laser to both eyes immediately followed by lens sparing vitrectomy for RE after a week. The most common complications that may arise during surgery are bleeding from the new vessels, iatrogenic retinotomy and lens touch. The outcome is good if surgery is done immediately. We would refrain from using anti-VEGF in this case as it may cause contraction of the fibrous ridge and worsening of the disease.

Summary (Parijat Chandra): Advancing ROP poses a tough challenge for ROP surgeons. Laser is the gold standard and should always be performed - but in advancing ROP, early surgical intervention is key to get good outcomes. As these babies are very preterm and systemically unstable too - getting general anesthesia fitness is also a tough task. Moreover, many anesthetists are not experienced to manage such small babies, and post-operative NICU monitoring support might also be lacking. AntiVEGF drugs have emerged as a useful tool to reduce vascularity, improve intraoperative and postoperative outcomes; but their long term safety is still under trial and long term side effects unknown.

Narendran V - We would give extensive laser to both eyes immediately followed by lens sparing vitrectomy for RE after a week. The most common complications that may arise during surgery are bleeding from the new vessels, iatrogenic retinotomy and lens touch. The outcome is good if surgery is done immediately. We would refrain from using anti-VEGF in this case as it may cause contraction of the fibrous ridge and worsening of the disease.

Summary (Parijat Chandra): Advancing ROP poses a tough challenge for ROP surgeons. Laser is the gold standard and should always be performed - but in advancing ROP, early surgical intervention is key to get good outcomes. As these babies are very preterm and systemically unstable too - getting general anesthesia fitness is also a tough task. Moreover, many anesthetists are not experienced to manage such small babies, and post-operative NICU monitoring support might also be lacking. AntiVEGF drugs have emerged as a useful tool to reduce vascularity, improve intraoperative and postoperative outcomes; but their long term safety is still under trial and long term side effects unknown.

Parijat Chandra - Case 3: A preterm baby born at 30 wks gestational age and 1200g birth weight presents at postconceptional age of 56 wks. The child has a history of severe sepsis, pneumonia, and assisted ventilation. He had a NICU stay of 8 weeks, but no ROP screening was done or advised at discharge. The parent brought the child due to leukocoria and poor vision in both eyes. Examination was suggestive of stage 5 ROP in both eyes (Figure 3).

Q - What are the indications, challenges and outcomes of surgery in such cases? Will you operate both eyes? What investigations will you advise? Had this baby presented at 2 years of age – would you still take up for surgery?

Rajvardhan Azad - I will ask for a B Scan ultrasound for this baby to evaluate the retinal funnel configuration to decide about surgical options. An open funnel would encourage me to undertake surgery which is clinically evident in this case. Additional information can be had from the child’s response to light and a positive VER. I will do a lensectomy and vitreoretinal surgery for this baby, because to remove the scar tissue and peripheral traction, we need to approach the peripheral areas. I also do a surgical iridectomy to enlarge the pupil to prevent postoperative phimosis of the pupil and postop after cataract. If this child comes at 2 years age and the picture is same, I would still operate this child as I feel the surgery would definitely give some vision as I have seen in couple of my patients. The legal challenges are nil as long you do a good preoperative counseling and honestly explaining everything.
Mangat Dogra - Looks like a poor prognosis case of stage 5 ROP for vitreoretinal surgery in both the eyes. Needs pre anesthetic checkup and evaluation. Neonatologist should be consulted and kept in loop. Parents need thorough counseling before surgery regarding outcome. One third of such eyes after surgery show anatomical reattachment but visual prognosis is generally poor. Ambulatory vision is very rarely restored. Best results of vitreous surgery in infants can be achieved between 6 to 12 months of age. Presentation at two years would result in extremely poor prognosis after surgery. In most cases surgery at that stage may not be recommended.

This case has serious medico-legal implications. This preterm baby was never advised screening during stay of 8 weeks in NICU and at discharge. The neonatologist treating the baby had no idea or awareness about ROP. He did not follow the guidelines for screening and management of ROP. Parents can sue the neonatologist and hospital which would definitely result in a large claim.

Subhadra Jalali - Initially, I would operate only sort of ‘good prognostic’ stage 5 eyes - means open funnel ones and those with normal IOP and preferably well dilating pupils with no subretinal cholesterol echoes on ultrasound, like the one depicted above. However, with more and more experience, and refined techniques and dedicated surgical time, I am willing to take up all types of stage 5 eyes for surgery as long as some response to bright light is present. I have now started doing open sky vitrectomy also in patients that I thought were not amenable to standard surgical approach.

Investigations: I usually do not do VEP as it has not proved valuable to assess outcome, in my opinion. I often get an USG done to document extent of detachment and extent of subretinal cholesterol or blood, but not as much to decide about surgery. I always record IOP under anesthesia before surgery (and of course in follow up).

Over a period of time, one realizes that stage 5 ROP is a progressive condition with progressive involvement of AC, cornea, iris and trabecular meshwork, and not an ‘end stage static disease’. Surgery halts the progressive disease and provides a possibility of visual functional recovery. Usually I do both eyes together in a single sitting, or sequentially at a gap of 3-4 weeks depending on surgical time taken for the first eye. In three years of follow-up, one can certainly see the differences in visual and developmental behavior of operated versus un-operated patient cohorts. Most children are likely to get ability to perceive shadows, and few about 15% will get to read large fonts with low vision aids.

I was very inspired by Prof. Tatsuo Hirose, the father of ROP surgery from Boston when he said, ‘ROP stage 5 tractional retinal detachments are the most difficult detachments a retinal surgeon can operate’ - this sets one thinking that why we cannot find solutions to tackle these detachments when we as retina surgeons really tackle such difficult detachments in other situations. Dr. Micheal Trese, whose practice is almost exclusively ROP related surgeries, has shown the path to such surgeries and published acceptable results. Each surgical case unfolds differently in preop, intraop and postop period- I think dedicated and focused stage 5 ROP surgeries have vastly improved my surgical success and visual outcomes. There are no medicolegal implications for the ophthalmologist and retinal surgeon to best of my knowledge as we are informing the serious condition upfront to family. Of course there are huge implications for child care professionals under whose care the baby has been before being counseled and referred for ROP management as almost all these are cases of delayed or non-referral. For ophthalmic management, written informed consent, as for any other procedure, is of course mandatory. Frank and repeated communication with family is key to avoid any medico-legal issues if any at all arise during ophthalmic care.

Pramod Bhende - Fundus picture shows possibly anteriorly open funnel. I would like to ask for B scan ultrasonography to confirm the configuration of retinal detachment. Also would like to look for subretinal echoes. Posteriorly closed funnel configuration and subretinal echoes (usually suggestive of altered blood) indicates poor prognosis. Also in eyes with corneal haze, surgery may not benefit. If USG shows posteriorly open configuration, I would prefer combined lensectomy with vitrectomy in both the eyes at 1 week interval. 20/23G instruments can be used.

Vitrectomy for ROP is one of the most challenging procedures for VR surgeons. Sclerotomies should be anteriorly placed, almost through the iris root. I use AC maintainer for infusion. It helps me to maintain globe integrity and intraocular pressure throughout the surgery. Iris hooks can be used to dilate the pupil. Sectoral or complete iridectomy can be another option for better visualization and approach to peripheral retina. Differentiating retina from surrounding fibrovascular tissue is critical for better outcome of the surgery. There is high risk of dialysis while making sclerotomies or subsequently during movement / exchange of the instruments. There is always a risk of intraoperative bleeding and iatrogenic retinal breaks. In eyes with dialysis or retinal break/s, prognosis is poor. It is important to dissect and remove persistent hyaloid system to open the funnel for overall better prognosis. Unfortunately complete traction relief will never be possible in these eyes. There is high incidence of reproliferation. Overall anatomical outcome is poor in eye with success rate of 17- 25 %. Functional prognosis is much worse. Had this baby presented at 2 years of age, it would still not be preferable to take up for surgery.

Medico-legal implications - Few eyes may still progress to advanced stage of ROP even after regular screening examinations and laser treatment. But not arranging for eye examination or not creating ROP awareness among the parents having a preterm baby is a definite case of negligence on the part of neonatologist. I would probably call the treating neonatologist and emphasize the need for
timely screening, without directly criticizing him or making unnecessary comments in front of the parents. There is need to create ROP awareness among the parents and healthcare providers (pediatricians, neonatologists, obstetricians and even ophthalmologists).

Narendran V - Outcome of surgery in these cases are quite poor. The common complication seen here is creation of iatrogenic dialysis. We would do a pre-operative B-scan to see the configuration of the detachment. Yes, if the parents are motivated, we would operate on both the eyes. We would not operate if child presents at 2 years of age. Medico legally, the family can sue the pediatrician as it is their responsibility to initiate ROP screening.

Summary (Parijat Chandra): Stage 5 ROP is a disappointing situation for the parents and ophthalmologist alike. Experienced ROP surgeons operate such challenging eyes, with hope of restoring navigable vision to the child, but the surgical results are often poor. Delayed surgery after few years makes the prognosis even poorer. As there are well accepted international and national guidelines for screening and treatment of ROP - lack of awareness, nollected screening, late/tough treatment, delayed referral and poor counselling of parents by ophthalmologists and neonatologists may lead to huge medicolegal cases in future.

Parijat Chandra - Case 4: A preterm baby born at 34 wks gestational age and 1900g birth weight presented at postconceptional age of 44 wks. The child has a history of jaundice, and prolonged oxygen supplementation. The child was under regular follow up in a ROP screening program, but they delayed laser hoping for spontaneous regression in Zone 3. Examination revealed disc macular dragging with mild traction at ridge in Zone 3 in both eyes (Figure 4).

Q - Why did this larger baby develop ROP? What ROP screening criteria do you follow for these larger babies?
Q - Would it be better to laser such eyes earlier, despite being zone 3 with no plus (outside ETROP type I criteria)? How will you manage this case now and follow up?

Rajvardhan Azad - Larger babies do develop ROP in our part of the world and it is well known. I have always said that it is basically due to the third factor (i.e. sick babies with high risk to develop ROP), the first and second factor being gestational age and birth weight. This is very much prevalent in our situation. This includes all risk factors that this baby is having. As regards screening criteria, it would be wise to include all babies as per the new guidelines formulated by ROP National Task Force and National Neonatology Forum (NNF) - gestation age less than 34 weeks and birth weight less than 1750gms. I think laser would work in this case. This is a borderline case and one can watch for progression or do laser for the entire avascular area. But in any case, a good watch is desirable.

Mangat Dogra - Heavier babies often develop severe ROP in developing countries like India due to variable neonatal care and maternal factors. We follow National Neonatology Forum (NNF) Clinical Practice Guidelines 2010 for screening of ROP. All infants weighing < 1750 grams at birth or < 34 weeks of period of gestation are screened for ROP. Heavier (1750-2000g) or older babies (34-36 weeks) are screened depending upon the attending risk factors like mechanical ventilation, prolonged oxygen therapy, hemodynamic instability or adverse respiratory or cardiac disease profile. These eyes should be lasered early as per ETROP Study Recommendations. At this stage of presentation I would perform confluent laser to entire vascular retina and follow closely. Development and progression of fibrovascular proliferation or retinal detachment post laser would be indication for lens sparing vitrectomy.

Subhada Jalali - Large babies are known to get vision affecting ROP, especially in developing countries. This is multi-factorial and includes poor antenatal care including anaemia and poor weight gain, and possible absence of antenatal steroids to high risk mothers, sub-optimal post natal care especially with respect to oxygen monitoring, use...
of antibiotics and sepsis prevention, nutrition and blood transfusion strategies etc, besides possible genetic factors. In fact in the sixties and seventies, big babies also got ROP in the developed world, but this has been much controlled due to attention to above mentioned modifiable risk factors. We follow India NNF guidelines (available on nnfpublication.org) for ROP screening. This includes babies less than 34-35 weeks gestational age (provided GA is accurately available from LMP date), birth weight less than 2000 grams, all premature babies irrespective of birth weight or even GA who had any ‘sickness’ criteria during hospital care, any preterm baby where GA is not well known, any baby where pediatrician has concerns for ROP etc.

ETROP guidelines (and also Cryo ROP guidelines) were formulated with the goal to ‘prevent’ retinal detachment and not ‘preserve vision that child was born with’. The reason being that ROP was equated with stage 5 retinal detachment and complete blindness and so ‘favorable outcomes’ were considered to be anything better than 20/200 (6/60) visual acuity or if retina did not detach. Dragging of macula or disc, exotropia due to retinal distortion and vision affects of these anatomical derangements that occur when the retinopathy progresses to a vireo-retinopathy, were still considered as ‘treatment successes’ and ‘favorable outcomes’. This is analogous to the intracapsular cataract surgery era where patients came with total cataract and blindness, so visual acuity of 20/60 (6/18) or better was considered as ‘good outcomes’ because blindness was cured! Today in modern cataract surgery era we aim to get unaided 20/20 or better because that is the potential of the eye and aim is not to ‘cure blindness’ but to get the best vision possible.

Similarly, in the ROP scenario today where we now understand the disease progression from a retinopathy to a vireo-retinopathy, the premature newborn has potential of at least 20/50 or better visual acuity based on the macular structure and function at time of birth and so we need to change our benchmark of successful treatment outcomes for ROP as 20/50 or better and no vitreopathy as the anatomical benchmark. Based on these considerations, we do treat with laser zone III disease with plus and also without plus depending on clock hours, post menstrual age at evaluation, previous visit findings and sickness criteria etc, that have the potential of progression and causing dragging/ folds etc. Our aim of all ROP treatments is to preserve the anatomy and visual function the baby is born with and not merely prevent detachment and get 20/200 and better vision.

In this case lens sparing vitrectomy will be considered for either eye, based on examination under anesthesia findings of posterior and circumferential extent of vitreous traction. The condition at 44 weeks can still be progressive and lens sparing vitrectomy has excellent outcomes in halting progression and reversing some of the anatomical derangements. If surgery is not considered, then follow up would be at 2 weeks, one month, two months, four months and so on to monitor refraction, visual development, squint and anatomical status. Early surgeries have better outcomes than delayed surgeries, in general.

**Pramod Bhende** - Unsupervised high oxygen supply for prolonged duration can be one of the causes. Poor general condition can be the other reason. Over all poor standard of neonatal care is responsible for higher incidence of ROP in higher birth weight babies in our country. In our institute we screen all the babies with birth weight less than or equal to 2000g and gestational age less than 36 weeks. Babies with stormy post nasal course are screened even if birth weight is more than 2000 g. Eyes with no plus disease should be screened and followed up at regular interval till normal vascular growth is complete. In eyes with documented increase in vascular activity, they will need early laser treatment.

Scleral buckling is not much practiced nowadays. But it is still a useful option in select group of patients. Probably this is the ideal case for scleral buckling. The patient should be follow up at 2-3 moth intervals. Initially. The buckle should be removed / cut after 6-9 months following surgery.

**Narendran V** - This large baby could have developed ROP due to prolonged supplemental oxygenation. Pediatricians should be advised to give “blended” oxygen and avoid giving 100% oxygen. We usually follow the 2010 NNF guidelines, which includes larger babies upto 36 wks GA and 2000 g BW, having prolonged oxygenation. We would usually closely (2 weekly) follow up this child. Proper counseling to parents regarding strict follow up is required. Retcam images of RE actually shows fibrous NVE in anterior zone II. If around due date (40 wks post conceptional age), if mild straightening of posterior pole arcade vessels is seen then we would give laser. This case now, we would give laser to the avascular retina (to halt progression) and follow up 2 weekly. Some experts would also give 2 rows posterior to ridge in the vascularized retina.

**Summary (Parijat Chandra):** Larger babies commonly develop severe ROP in developing countries due exposure to multiple high risk factors for ROP, mostly due to poor NICU practices. Most centers in India are adopting higher screening criteria (as guided by the NNF guidelines) to bring all babies at high risk to develop ROP under the screening ambit. The American guidelines are no longer blindly applicable across the world, as ROP profile varies considerably. Finding of disc-macula dragging in a preterm baby should always raise suspicion of ROP activity and an urgent need to screen the retinal periphery, and treat if required. Always remember that ROP is not ‘over’ till it is ‘over’.

**Parijat Chandra** - Case 5: A preterm infant born at 32 wks gestational age and 1500g birth weight underwent first ROP screening at 36 wks. The child has a history of difficult caesarean section delivery, birth asphyxia, anemia, multiple blood transfusions and prolonged oxygen maintenance. Examination revealed dense vitreous hemorrhage (RE>LE) in both eyes. Fundus details were...
Q - Why did vitreous hemorrhage occur in this case – was it due to ROP? How will you investigate this case?

Q - How will you manage this case? Will you wait for the vitreous hemorrhage to clear or intervene? What is the risk of amblyopia?

Rajvardhan Azad - I think LE needs urgent lens sparing vitrectomy to avoid amblyopia. In the right eye since no traction is present, I will inject Avastin and many times it will clear and if not, then do lens sparing vitrectomy. Vitreous hemorrhage in ROP is not very common but does occur and we have reported it. It is primarily due to bleed from fragile vessels. We can see this happening in RE.

Mangat Dogra - Vitreous hemorrhage in this infant is not related to ROP. It could be due to birth trauma or other causes. ROP in this case needs follow up bi-weekly. It is most likely going to regress spontaneously in this case. I would wait approximately three months for spontaneous resolution of vitreous hemorrhage. Critical period for development deprivation amblyopia is first few months of life. Visual deprivation before 4 months of age appears to result in less visual loss. Vitreous surgery for non resolving vitreous hemorrhage has to be undertaken before this age.

Subhadra Jalali - Considering that there is no ‘plus disease’ and no new vessels as far as visible, the vitreous hemorrhage appears to be non-ROP related. Common causes include cord around neck, forceful ventilation, anemia, acquired coagulopathies in newborns including protein C and S deficiencies following Sepsis, DIC, battered baby syndromes etc. Investigations will be directed to these causes and correction of any factors is needed if still deranged - though in most cases these have already been corrected/ events have already occurred by the time baby comes for ROP screening.

Risk of amblyopia is paramount. It is believed, that in a neonate more than a week or two of visual deprivation are amblyogenic. Along with the blood investigations and corrections and getting fitness for general anesthesia, I will instruct parents to keep baby in a propped up position so as to allow gravity to move the hemorrhage away from fovea and posterior pole. In order to avoid sliding down of baby, this is best achieved in a baby car seat or in a baby wash tub basin with padding made all around. I will usually wait for two to three weeks to assess if the hemorrhage is reducing and if fovea and surrounding macular area have started to clear up. If this happens, I will start patching therapy one hour daily for the good eye and assess every 2-4 weeks and in progressive clearing that happens in about 50% cases (limited experience, unpublished data), I would defer surgery.

In case there is no reduction in blood after initial 2-3 weeks, I will do lens sparing vitrectomy with or without an air bubble followed by patching therapy and very close bimonthly refractions. Unilateral lens sparing vitrectomy induces significant myopia and anisometropia and this has to be watched for and treated by appropriate refractive correction and patching in consultation with a pediatric ophthalmologist. Even if there is no anisometropia, patching is continued at least till a reliable visual acuity recording is achieved. I will also follow the left eye at each visit for ROP regression, which is most likely to occur spontaneously at this stage. Newer approaches like using tPA with an air bubble (no gas as that will be amblyogenic) and prone position is an option but I do not have any experience in a neonate with this approach.

Pramod Bhende - The hemorrhage could be due to delivery related trauma and not due to ROP. There is very high possibility of intracranial hemorrhage. I would like to get MRI done to rule out the same. The left eye will need ultrasound scanning to know the status of the retina. The risk of amblyopia is significant as macula is covered with hemorrhage in both the eyes. Still I would like to go ahead with ‘lens sparing vitrectomy’ in both the eyes, probably left eye first.
underlying ROP by performing intraoperative laser if needed. As an option to treat such cases to prevent amblyopia, as well as to treat has a high risk of amblyopia. Lens sparing vitrectomy is a good in such cases. Dense vitreous hemorrhage/ premacular hemorrhage important to rule out ROP related bleeding as management differs to birth trauma or other systemic problems in the sick child. It is often complicates the diagnosis of ROP, but might often be related to the hemorrhage clearing, then we would intervene as after 2 months if there are no signs of the hemorrhage clearing, then we would intervene as after that there is a risk of amblyopia.

Summary (Parijat Chandra): Preteretal / vitreous hemorrhage often complicates the diagnosis of ROP, but might often be related to birth trauma or other systemic problems in the sick child. It is important to rule out ROP related bleeding as management differs in such cases. Dense vitreous hemorrhage/ premacular hemorrhage has a high risk of amblyopia. Lens sparing vitrectomy is a good option to treat such cases to prevent amblyopia, as well as to treat underlying ROP by performing intraoperative laser if needed.

Financial & competing interest disclosure
The authors do not have any competing interests in any product/ procedure mentioned in this study. The authors do not have any financial interests in any product / procedure mentioned.

References
1. Chawla D, Agarwal R, Deorari A, Paul VK, Chandra P, Azad RV. Retinopathy of prematurity. Indian J Pediatr 2012; 79:501–9.
2. Azad R. Retinopathy of prematurity a giant in the developing world. Indian Pediatr 2009; 46:211–2.
3. Azad R, Chandra P, Khan MA, Darswal A. Role of intravenous fluorescein angiography in early detection and regression of retinopathy of prematurity. J Pediatr Ophthalmol Strabismus 2008; 45:36–9.
4. Jalali S, Azad R, Trehan HS, Dogra MR, Gopal L, Narendran V. Technical aspects of laser treatment for acute retinopathy of prematurity under topical anesthesia. Indian J Ophthalmol 2010; 58:509–15.
5. Jalali S, Kesarwani S, Hussain A. Outcomes of a protocol-based management for zone 1 retinopathy of prematurity: the Indian Twin Cities ROP Screening Program report number 2. Am J Ophthalmol 2011; 151:719–24.e2.
6. Chhablani J, Rani PK, Balakrishnan D, Jalali S. Unusual adverse choroidal reaction to intravitreal bevacizumab in aggressive posterior retinopathy of prematurity: the Indian Twin Cities ROP screening (ITCROPS) data base report number 7. Semin Ophthalmol 2014; 29:222–5.
7. Jalali S, Balakrishnan D, Zeynalova Z, Padhi TR, Rani PK. Serious adverse events and visual outcomes of rescue therapy using adjunct bevacizumab to laser and surgery for retinopathy of prematurity. The Indian Twin Cities Retinopathy of Prematurity Screening database Report number 5. Arch Dis Child Fetal Neonatal Ed 2013; 98:F327–33.
8. International Committee for the Classification of Retinopathy of Prematurity. The International Classification of Retinopathy of Prematurity revisited. Arch Ophthalmol 2005; 123:991–9.
9. Mintz-Hittner HA, Kennedy KA, Chuang AZ, BEAT-ROP Cooperative Group. Efficacy of intravitreal bevacizumab for stage 3+ retinopathy of prematurity. N Engl J Med 2011; 364:603–15.
10. Hu J, Blair MP, Shapiro MJ, Lichtenstein SJ, Galasso JM, Kapur R. Reactivation of retinopathy of prematurity after bevacizumab injection. Arch Ophthalmol 2012; 130:1000–6.
11. Bhende P, Gopal L, Sharma T, Verma A, Biswas RK. Functional and anatomical outcomes after primary lens-sparing pars plana vitrectomy for Stage 4 retinopathy of prematurity. Indian J Ophthalmol 2009; 57:267–71.
12. Gopal L, Sharma T, Shanmugam M, Badrinath SS, Sharma A, Agraharam SG, et al. Surgery for stage 5 retinopathy of prematurity: the learning curve and evolving technique. Indian J Ophthalmol 2000; 48:101–6.
13. Patwardhan SD, Azad R, Gogia V, Chandra P, Gupta S. Prevaling clinical practices regarding screening for retinopathy of prematurity among pediatricians in India: a pilot survey. Indian J Ophthalmol 2011; 59:427–30.
14. Sanghi G, Dogra MR, Katoch D, Gupta A. Demographic profile of infants with stage 5 retinopathy of prematurity in North India: implications for screening. Ophthalmic Epidemiol 2011; 18:72–4.
15. Azad R, Chandra P, Patwardhan SD, Gupta A. Importance of the “third criterion” for retinopathy of prematurity screening in developing countries. J Pediatr Ophthalmol Strabismus 2009; 46:332–4; quiz 335–6.
16. Vinekar A, Dogra MR, Sangtam T, Narang A, Gupta A. Retinopathy of prematurity in Asian Indian babies weighing greater than 1250 grams at birth: ten year data from a tertiary care center in a developing country. Indian J Ophthalmol. 2007; 55:331–6.
17. Good WV. Early Treatment for Retinopathy of Prematurity Cooperative Group. Final results of the Early Treatment for Retinopathy of Prematurity (ETROP) randomized trial. Trans Am Ophthalmol Soc 2004; 102:233–48.
18. Gilbert C, Fielder A, Gordillo L, Quinn G, Semiglia R, Visintin P, et al. Characteristics of infants with severe retinopathy of prematurity in countries with low, moderate, and high levels of development: implications for screening programs. Pediatrics 2005; 115:e518–25.
19. Jalali S, Matalia J, Hussain A, Anand R. Modification of screening criteria for retinopathy of prematurity in India and other middle-income countries. Am J Ophthalmol 2006; 141:966–8.
20. Palmer EA, Hardy RJ, Dobson V, Phelps DL, Quinn GE, Summers CC, et al. 15-year outcomes following threshold retinopathy of prematurity: final results from the multicenter trial of cryotherapy for retinopathy of prematurity. Arch Ophthalmol 2005; 123:311–8.
21. Shah PK, Narendran V, Kalpana N. Aggressive posterior retinopathy of prematurity in large preterm babies in South India. Arch Dis Child Fetal Neonatal Ed. 2012; 97:F371–5.