Retinopathy of Prematurity (ROP) — Diagnosis and Treatment

Retinopathy of Prematurity (ROP) is a condition that is characterized by progressive nature and is only seen in premature infants of low birth weight. The condition is caused by the formation of fibrous tissue behind the lens, hence the old term “retrolental fibroplasia”. Infants affected by ROP develop severe visual impairment or can become blind.

Overview of Retinopathy of Prematurity

Retinopathy of Prematurity (ROP) was rare years ago until it was first described by Theodore Terry in 1942. Thus, it is also known as Terry syndrome after the person who first described it. Years later, the care of premature infants of low birth weight has dramatically improved, which resulted in an increase in the survival rate among such infants. Accordingly, the number of children affected by ROP has risen.

Epidemiology of Retinopathy of Prematurity

The incidence of the disease is directly proportional to the gestational age of the patient and inversely proportional to their birth weight. Say the incidence is more than 50% for infants weighing less than 1250 grams.

Risk factors

- Low birth weight.
- Low gestational age.
- Supplemental oxygen therapy.
- Genetic predisposition.
- Infections.
Pathogenesis of Retinopathy of Prematurity

Premature infants of low birth weight are at risk of developing hyperoxia during their care. At term the vascularization of the retina is complete on the nasal half of the retina, the temporal half vascularizes after birth. This is worse in premature infants who may have a poorly developing retinal vascular system.

The disease progresses in some patients despite timely intervention while rarely progresses to severe states in others, thus suggesting some genetic influence on the pathogenesis.

**Two schools of thought have been put forward to explain the pathophysiology of the disease:**

Upon birth, the neonate is exposed to a relative hyperoxic state compared to a hypoxic utero state. This induces damage on the mesenchymal spindle cells behind the retina that develop gap junctions leading to abnormal vascularization.

The two-phase theory as put forward by Ashton states that upon birth, the initial event occurs upon exposure to a hyperoxic environment and instead of vascularization. The vessels undergo vasoconstriction to cause irreversible capillary cell destruction. This triggers the release of mediators such as vascular endothelial growth factor (VEGF) that induces disorganized vascularization and thus do not respond well to proper regulation.

These changes are also associated with the formation of fibrous tissue.

Classification of Retinopathy of Prematurity

In 1984, an international classification of ROP was established. The retina was divided into three zones and ROP was classified according to the extent of involvement of these three zones. The zones start from the most posterior part of the retina to the most anterior part. Retinal imaging, which received more attention and has witnessed significant improvements in the last few years, allowed the clinicians to accurately describe the extent of ROP.

**Zones of the Retina in ROP**

*The retina is classically classified into three concentric zones:*

<table>
<thead>
<tr>
<th>Zone I</th>
<th>Optic disc at the center and spans twice the distance from the disc to the fovea</th>
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<tr>
<td>Zone II</td>
<td>Starts from the edge of zone I and extends to the ora serrata nasally and a similar imaginary boundary temporally</td>
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<tr>
<td>Zone III</td>
<td>Remaining most-anterior part of the retina</td>
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The extent of involvement of the retina in ROP needs to be documented for prognostic figures. This is routinely expressed in a number of clock hours involved. Therefore, the retina can be also classified into clock-hour segments “12 segments”.

**Stages of ROP**

In addition to the extent of the anatomical involvement in ROP, the degree of vascular changes also need to be documented.
Stage 1 ROP
Stage 1 is characterized by a demarcation line between the vascular and avascular retina. This is a thin structure which lies in the plane of the retina.

Stage 2 ROP
The previously described demarcation line grows to occupy a volume and a ridge is formed above the plane of the retina. Popcorn small vessels “due to the formation of small tuffs of new vessels” are seen on the posterior aspect of the ridge.

Stage 3 ROP
In addition to the formation of a retinal ridge, there is retinal fibrovascular proliferation. The fibrovascular tissue is seen to extend from the abnormal retinal ridge into the vitreous.

Stage 4 ROP
Stage 4 is characterized by partial or subtotal retinal detachment. Subtotal retinal detachment in ROP can be exudative or tractional. Partial retinal detachment can be without involvement of the fovea (stage 4A) or can involve the fovea (stage 4B).

Stage 5 ROP
Here, there is total retinal detachment. The patient presents with leukocoria (white pupillary reflex).

Plus disease
This is a severe form of ROP that is characterized by venous dilation and arterial tortuosity of the posterior retinal vessels. Infants with aggressive posterior ROP are at the highest risk of progression to stage 5 ROP.

Screening for ROP
Premature infants of low birth weight should receive regular screening for ROP starting 4 weeks after birth. In the developing world, screening for ROP should be started at 2 weeks after birth because the risk of early aggressive posterior ROP is higher in the developing world.

The pupils are dilated and indirect ophthalmoscopy with a 28D lens is used to examine the retina in the screening process. Pupils dilation should be performed 45 minutes before the ophthalmoscopic examination. A mixture of cyclopentolate and phenylephrine drops can be used to dilate the pupils.

ROP screening is also possible with the RetCam digital camera system which uses a wide-angle lens and allows for sharing of high-resolution images of the retina between experts.

In infants with ROP, it is important to determine the risk of progression. Postnatal weight gain, elevated levels of serum insulin-like growth factor 1, and early aggressive ROP are indicators of early progression of the disease.
Using the weight, insulin-like growth factor 1 levels, and weekly weight from birth until 36 weeks can help in classifying the patients into two categories:

- Infants with low-risk ROP
- Infants with proliferative ROP who require laser treatments

### Treatment of ROP

Not all patients with ROP require treatment. Therefore, the concept of ROP threshold was established which is defined as the threshold of ROP that requires active treatment. Infants with stage 3 ROP involving zones I or II of the retina require treatment.

Infants with pre-threshold ROP might also need treatment to prevent progression of the disease. However, there has been a debate over which infants with pre-threshold ROP require early treatment.

The early treatment for ROP (ETROP) study answered this important question with the following recommendations:

Type 1 ROP is known as high-risk pre-threshold ROP. Type 1 ROP is defined as any stage of ROP in zone I with plus disease, stage 3 in zone I without plus disease, or stage 2 or 3 in zone II with plus disease. Type 1 ROP require active treatment.

Type 2 ROP is known as observational pre-threshold ROP. Type 2 ROP is defined as stages 1 or 2 in zone I without plus or stage 3 in zone II without plus. Patients with type 2 ROP should be given weekly follow-ups without any active treatment.

The currently available active treatments for ROP include cryotherapy, indirect laser photoocoagulation, and anti-vascular endothelial growth factor drugs, such as intravitreal bevacizumab. These three treatment modalities share one common mechanism: they stop the growth and formation of new retinal vessels. Cryotherapy and laser photoocoagulation can destruct the retina and result in visual field loss, hence pharmacological treatments are gaining more acceptance in the current era.

Cryotherapy is stressful for the babies and requires general anesthesia. Moreover, cryotherapy can also cause periocular inflammation. Accordingly, if indirect laser photoocoagulation or anti-vascular endothelial growth factor drugs are available, cryotherapy should not be considered as an option in the active treatment of ROP.

### References


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