The New International Classification of Retinopathy of Prematurity

The international classification of acute retinopathy of prematurity (ROP) appearing in this issue is a timely and important contribution to the ocular examination and management of the retinopathy in these premature infants.

See also p 1130.

During the epidemic period of ROP, generally designated then as retrolental fibroplasia, the survival rate of small premature neonates with birthweights under 1,000 g was less than 10%. By the 1960s, due to improved neonatal care, that survival rate has increased by fourfold or greater. These low-birthweight infants, who are at the highest risk of ROP, are surviving today, but in the early 1950s would not have lived long enough for the disease to develop. Cases of ROP are occurring today despite the most meticulous monitoring of arterial blood gases. The extreme prematurity, combined with factors other than excess oxygen, may be responsible for current cases. With a substantial number of new cases now occurring throughout the world, the need for a standard classification of ROP is apparent.

Twenty-three participating ophthalmologists representing 11 different countries have dedicated themselves to the development of an international classification. Their efforts have succeeded in providing for the first time a precise method of classification and documentation of the ocular changes of ROP.

There are several examples in modern medicine in which the development of a workable classification paved the way for a successful clinical contribution. Most noteworthy, and certainly familiar to all ophthalmologists, is the example of the Diabetic Retinopathy Study sponsored by the National Eye Institute in the 1970s. The development of a classification based on photographic standards played a key role in this highly successful study, which showed the beneficial role of photoocoagulation therapy.

Since the original classification of the disease by Reese and co-workers later attempts at further classification have each refined our understanding of the acute disease, but failed in one respect or another to furnish the clinician with a complete picture of retrolental fibroplasia as observed today.

The new international classification of ROP incorporates not only a description of the degree of vascular changes, but includes the zone of the retina involved and the extent of the changes in hours of the clock in the fundus. The investigators have also developed a useful chart and form for recording the notable findings. Their recording system enables direct computer entry and retrieval, an important aspect of good data management.

The international classification of ROP lays the groundwork for the collaborative clinical trials that are needed to document several forms of promising therapy. Furthermore, the precise quantitative recording of the findings from this classification enables the individual examiner to record much more precisely the sequential changes in the follow up of the same patient.

The photographs adopted as the standards in this classification are of remarkably good quality, recognizing the problems in photographing the peripheral fundus of the small premature infant. Because of their exceptionally good quality, in addition to serving as a standard for classification, they are an instructive and valuable aid to the resident in training. They are also instructive for the ophthalmologist who may be called on to examine the premature infant.

The investigators working in the spirit of true international cooperation have developed a new classification of ROP. They are to be congratulated for their timely and extremely valuable contribution. Their classification will provide a great service to the ophthalmic community and to the premature population at risk.

Arnall Patz, MD
Baltimore

References

An International Classification of Retinopathy of Prematurity

The Committee for the Classification of Retinopathy of Prematurity

Because of modern life-support systems capable of keeping tiny premature infants alive, retinopathy of prematurity has recurred. No classification system currently available adequately describes the observations of the disease being made today. A new classification system, the work of 23 ophthalmologists from 11 countries, is presented in an attempt to meet this need. It emphasizes the location and the extent of the disease in the retina as well as its stages. The term "plus" is employed with the stage to denote progressive vascular incompetence. A computer-compatible diagram for recording the results of the examination employing the new classification system is furnished.

(Arch Ophthalmol 1984;102:1130-1134)

As a result of advances in technology, particularly in life-support systems capable of keeping tiny premature infants alive, and better observation of the premature infant fundus with improved ophthalmoscopic techniques, including the indirect ophthalmoscope, much has been learned about the early active stages of retinopathy of prematurity (ROP). This term is preferred because it can be used to describe all phases of the retinal changes observed in premature infants. The traditional term, retrorenal fibroplasia, is inappropriate in the acute phase of this disorder, for it describes solely those later cicatricial changes that involve the eyes of only the most severely affected infants. Much of what has been learned during the past two decades about the disease in its modern form fails to fit with the Reese classification system, or any other classification system extant. Furthermore, the real incidence of the disease may be increasing, although the evidence on this point is inconclusive. Treatment of the disease in its active and cicatricial form has been advocated, but it is not always clear what disease stage is being treated and what the results of such treatment are. Hence, the need for a new classification system of the acute stages of ROP at this time, with a classification of the cicatricial stages to follow.

LOCATION

For the purpose of defining this variable, three zones of retinal involvement are recognized (Fig 1). Each zone is centered on the optic disc rather than the macula, contrary to standard retinal drawings. The new scheme was selected because normal retinal vascular growth proceeds outward from the disc toward the ora serrata in an orderly fashion. The first two zones occupy that portion of the fundus that lies behind a circle drawn using the disc as the center and the distance to the nasal ora serrata at the horizontal meridian as its radius. Therefore, any ROP that is circumferential must, by definition, fall into one of these two posterior zones. Zone I (posterior pole or inner zone) consists of a circle (Fig 1), the radius of which subtends an angle of 30° and extends from the disc to twice the distance from the disc to the center of the macula. The limits of the zone are consequently defined as twice the disc-fovea distance in all directions from the optic disc, i.e., an arc of 60°.

Zone II extends from the edge of zone I peripherally to a point tangential to the nasal ora serrata (at the 3-o'clock position in the right eye, and the 9-o'clock position in the left eye)
and around to an area near the temporal anatomic equator. The temporal edge of zone II cannot be more accurately defined clinically, as the anatomic landmarks needed to identify the equator in a premature neonate are obscured. Indeed, these landmarks are sufficiently varied in humans to render precise locations difficult at any age.

Zone III is the residual crescent of retina anterior to zone II. This is the zone that is last vascularized in the premature eye and it is the zone, by common agreement of clinicians, most frequently involved with ROP.

**Extent of Disease**

This is specified as hours of the clock. As the observer looks at each eye, the 3-o'clock position is to the right and nasal in the right eye and temporal in the left eye, and the 9-o'clock position is to the left and temporal in the right eye and nasal in the left eye (Fig 1).

**Staging the Disease**

In addition to the above two parameters, the final one to be specified is the level of abnormals vascular response observed. Here, four stages are recognized and staging for the eye as a whole is by the most severe manifestation present. However, for purposes of recording the complete examination, each stage is defined and the extent of each stage by clock hours is recorded.

**Stage 1: Demarcation Line (Fig 2).**

This line is a thin but definite structure that separates the avascular retina anteriorly from the vascularized retina posteriorly. There are recognizable abnormal branching or arcing of vessels leading up to it. It is relatively flat and white and lies within the plane of the retina. Described vascular changes can be apparent prior to the development of the demarcation line. However, these more subtle vascular changes may considerably, cause no known ocular morbidity by themselves, and are difficult to quantitate. They may be noted but do not justify a diagnosis of early ROP.

**Stage 2: Ridge (Fig 3).**

The line of stage 1 now has grown, has height and width, occupies a volume, and extends up out of the plane of the retina. The ridge may change from white to pink and vessels may leave the plane of the retina to enter it. Small isolated tufts of new vessels lying on the surface of the retina may be seen posterior to this ridge structure. Such lesions do not constitute the fibrovascular
choroidal pattern may be subtle and difficult to distinguish through the increasing vitreous haze of severe disease. Serial examinations may be required to be certain of a true detachment. It should be emphasized that the presence of elevated retinal vessels running from the retinal plane to the height of the ridge does not constitute a posterior detachment.

"PLUS" DISEASE

Progressive vascular incompetence, occurring along with the changes described at the edge of the abnormally developing retinal vasculature, is noted by increasing dilatation and tortuosity of the peripheral retinal vessels, iris vascular engorgement, pupillary rigidity, and vitreous haze. When, and only when, the vascular changes are so marked that the posterior veins are enlarged and the arterioles tortuous, then a plus sign is added to the ROP stage number (Fig 6). For example, the ridge of stage 2 ROP combined with posterior vascular dilatation and tortuosity would be written, stage 2+ ROP. When the ROP is located in zone I or posterior zone II and plus disease is present, progression may be rapid.

RECORDING THE RESULTS

For purposes of recording the results of the examination, the appended examination record is recommended (Fig 7). The scheme is computer compatible.

PROBLEMS CONFRONTED

The committee recognizes that no classification, including the present one, is perfect. During the course of our deliberations, several problem areas were encountered for which approximate solutions were developed, realizing that, with time and experience in the use of the classification, better solutions for its users will emerge. The problems were the following.

1. Definition of zone. Anatomical landmarks, other than the disc and the ora, may be difficult to discern in the premature eye and therefore, the boundaries of the zones I and II for example, are only approximate. The same can be said of zone II and III, except that if vascularization has reached the nasal ora, any disease found elsewhere is by definition in zone III. The committee recommends that where doubt exists as to the appropriate zone to locate the disease, it be located in the more posterior zone.

Fig 4.—Fundus photograph and line drawing of extraretinal fibrovascular proliferative tissue of stage 3.

Fig 5.—Fundus photograph and line drawing of shallow exudative retinal detachment characteristic of stage 4 involvement.

Fig 6.—Fundus photograph of posterior venous dilatation and arteriolar tortuosity characteristic of "plus" disease.

Stage 3: Ridge With Extraretinal Fibrovascular Proliferation (Fig 4).—To the ridge of stage 2 is added the presence of extraretinal, fibrovascular, proliferative tissue. The characteristic locations of this proliferating tissue are (1) continuous with the posterior aspect of the ridge, causing a ragged appearance of the ridge as proliferation becomes more extensive; (2) immediately posterior to the ridge but not always appearing to be connected with it; and (3) into the vitreous perpendicular to the retinal plane. Fibrovascular proliferation may be seen in any or all of these locations in stage 3 ROP.

Stage 4: Retinal Detachment (Fig 5).—To the above is added unequivocal detachment of the retina. It may be caused by an exudative effusion of fluid, traction, or both, even in this early stage. In any case, the examiner should specify its location, extent, and nature. It may be particularly difficult to differentiate shallow posterior retinal detachments, as the loss of growth that is a necessary condition for stage 3.
2. Stage 3 disease. The committee clearly recognizes the need to further subdivide stage 3 disease for its potential prognostic importance. To do so, it chose as its yardstick the amount of fibrovascular proliferative tissue present. If only limited amounts can be recognized by the examiner, this would constitute "mild" stage 3 (Fig 8). If, on the other hand, substantial amounts of tissue are seen infiltrating the vitreous, proliferating posterior from the ridge, then this is "moderate" stage 3 (Fig 9). Finally, if massive infiltration of the tissues surrounding the ridge is occurring, the threshold for "severe" stage 3 has been reached (Fig 10).

3. Overlap with cicatricial disease. It is clearly recognized that in this classification, traction detachment forms part of the description of stage 4. Classically, this has been reserved for the cicatricial phase of the disease. Retinopathy of prematurity is a continuum and not easily fitted into any arbitrary, man-made scheme. Nevertheless, the description of stage 4 would be incomplete without allowing for the occurrence of traction detachments as part of it. For the time being, the committee recommends the retention and use of the Reese's classification of cicatricial disease to describe disease changes beyond those described in this classification.

**SPONSORSHIP**

The classification is the product of the joint effort of 23 ophthalmologists from 11 countries. Though the committee was an ad hoc body, it obtained sponsorship for its deliberations from the American Academy of Ophthalmology, the American Academy of Pediatrics, the American Association of Pediatric Ophthalmology and Strabismus, the National Eye Institute, the Division of Maternal and Child Health of the Bureau of Health Care Delivery and Assistance, the March of Dimes, the Alberta Heritage Foundation for Medical Research, and Ross Laboratories. In no small measure, this support has provided the encouragement necessary to complete work on this classification. The success or failure of this classification will be judged by its use within the ophthalmologic and pediatric communities.

**CONCLUSIONS**

The unifying principle underlying this classification system is the following: the more posterior the disease and the greater the amount of involved retinal vascular tissue, the more serious the disease. The staging

---

Fig 7.—Suggested format of ophthalmologic examination record to permit complete recording of detailed examination results, both graphically employing retinal drawing, and numerically, for later analysis, if desired.
of the disease at any given location expresses the natural history and evolution of events at the border between vascularized and avascular retina. The classification system is designed to permit the examiner full latitude in transcribing his or her observations so that they will be immediately intelligible to another examiner who may not have had the opportunity to examine the specific infant.

This study was supported in part by the Alberta Heritage Foundation for Medical Research (conference support Grant 1932); the Public Health Service (research grants EY06515, EY01728, and EY04730; the National Eye Institute (grant MCI-12337)); the US Department of Health and Human Services, PHS Division of Maternal and Child Health, Bethesda, Md; the March of Dimes Birth Defects Foundation, White Plains, NY; and Ross Laboratories, Columbus, Ohio.

**Committee Members**

<table>
<thead>
<tr>
<th>Name</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isaac Ben-Sira</td>
<td>Israel</td>
</tr>
<tr>
<td>August Deutman</td>
<td>Netherlands</td>
</tr>
<tr>
<td>Hans Fiedelius</td>
<td>Denmark</td>
</tr>
<tr>
<td>John Flynn</td>
<td>United States</td>
</tr>
<tr>
<td>Alec Garner (Chairman)</td>
<td>Great Britain</td>
</tr>
<tr>
<td>Glen Gole</td>
<td>Australia</td>
</tr>
<tr>
<td>N. Warren Hindle</td>
<td>Canada</td>
</tr>
<tr>
<td>Hisaeo Ideda</td>
<td>Japan</td>
</tr>
<tr>
<td>James Kingham</td>
<td>United States</td>
</tr>
<tr>
<td>Fritz Koerner</td>
<td>Switzerland</td>
</tr>
<tr>
<td>Walter Koenen</td>
<td>West Germany</td>
</tr>
<tr>
<td>Ahid Majima</td>
<td>Japan</td>
</tr>
<tr>
<td>Andrew McCormick</td>
<td>Canada</td>
</tr>
<tr>
<td>Alan Mashin</td>
<td>Great Britain</td>
</tr>
<tr>
<td>Ilana Nissenkorn</td>
<td>Israel</td>
</tr>
<tr>
<td>Earl Palmer</td>
<td>United States</td>
</tr>
<tr>
<td>Graham Quinn</td>
<td>United States</td>
</tr>
<tr>
<td>Arthur Rosenbaum</td>
<td>United States</td>
</tr>
<tr>
<td>David Schaffer</td>
<td>United States</td>
</tr>
<tr>
<td>Dennis Stark</td>
<td>Australia</td>
</tr>
<tr>
<td>Bjorn Svedberg</td>
<td>Sweden</td>
</tr>
<tr>
<td>Karl Tan</td>
<td>Netherlands</td>
</tr>
<tr>
<td>Yasuiko Tanaka</td>
<td>Japan</td>
</tr>
</tbody>
</table>

**Reference**