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EDITORIAL

What is the gold standard in glaucoma diagnosis?

The ideal gold standard should be the best available method of differentiating between those with and without the disease.

Currently, the diagnosis of glaucoma is based on definitive changes in the optic-nerve head (ONH) and/or repeatable changes in the visual field tested by standard achromatic perimetry (SAP). Elevated intraocular pressure (IOP) defined as IOP greater than 21mm Hg was part of the definition of glaucoma more than 10 years ago. But several studies have shown that many patients with ocular hypertension demonstrated no signs of glaucomatous damage during follow-up periods of up to 20 years, even if the condition was left untreated.[1-4] Given the complex relationship between IOP and glaucoma damage, researchers and professional organizations emphasized a new glaucoma concept in which the disease was described as an optic neuropathy, with IOP as only one of several risk factors.[5-7]

In a single glaucoma examination, critical ONH evaluation is more sensitive and specific for diagnosing glaucoma than IOP measurement or visual field assessment. ONH evaluation has approximately 85% sensitivity and 90% specificity while visual-field examination has approximately 75% sensitivity and 95% specificity.[8] Examination of either one alone, however, is inadequate because the correlation between structural and functional damage in glaucoma is not exactly linear, especially in the early stage of the disease. Several studies have shown that detectable damage to the ONH and retinal-nerve-fiber layer (RNFL) is generally present before detectable alteration in the visual field.[9, 10] Approximately 40 to 50% loss of ganglion cells was present before the first defect was detected in the visual field.[11]

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In recent years, several instruments have been developed to assist clinicians in detecting the presence or absence of glaucoma. They were tested for their accuracy against a "gold standard." In glaucoma, the choice of a gold standard poses several problems. Each of the tools employed in making the diagnosis of glaucoma involves looking at different aspects of the disease. In evaluating the ONH, one looks for the presence of structural damage. In visual-field testing, one looks at the functional damage. Generally, structural damage in the ONH corresponds to functional damage in the visual field with characteristic glaucomatous defects. In the early stage of the disease, however, there may already be structural damage in the ONH without detectable damage in the visual field (preperimetric stage). Hence, combining both features will increase the sensitivity and specificity in the assessment of glaucoma by standard methods.

Varying sensitivities and specificities have been reported for these new glaucoma instruments, the cause of which is probably an imperfect gold standard. The ideal gold standard should be the best available method of differentiating between those with and without the disease. It should effectively discriminate these groups across the full spectrum of the disease. Many times a "perfect" gold standard is still not available. As a result, an imperfect but considered the best available standard may be chosen as the standard of validity.

Many investigators used the glaucoma experts' diagnosis as the gold standard, which was derived from integrating the results of the different glaucoma tests (battery of glaucoma tests) as shown in the article on the *Diagnostic Properties of a Nerve-Fiber Analyzer* (see pages 66 to 72). Others used the definitive diagnosis of glaucoma derived after several years of following up the patient (natural history of the disease). The latter may be more accurate but more time consuming and difficult because of the long latency of the disease.

Among the recently published randomized controlled trials in glaucoma, most investigators used the findings on SAP as definite diagnosis that glaucoma is present. This may be appropriate for the Advanced Glaucoma Intervention Study (AGIS)[12, 13] or the Collaborative Initial Glaucoma Treatment Study (CIGTS)[14] but for studies involving early glaucoma such as The Early Manifest Glaucoma Trial (EMGT)[15] or the Ocular Hypertension Treatment Study (OHTS),[4] a combination of glaucomatous optic-disc findings and/or visual-field defects is used.

Since the publication of the results of several landmark studies in glaucoma, much has been discussed about the role of IOP lowering. We have included in this issue a commentary on several of these randomized controlled studies, summarizing the results, outlining their strengths and weaknesses, and more importantly, analyzing their implications on and application to clinical practice.

—The Editor in Chief

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