

Demographic and clinical characteristics of age-related distance esotropia



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BACKGROUND

Age-related distance esotropia (ARDE), is an acquired, small, comitant esodeviation that is greater at distance than at near. It occurs in older adult patients without a history of neurological event or prior strabismus. It has been observed more frequently in White adults than in other racial groups. The purpose of this study was to assess the demographic and clinical characteristics of patients with ARDE presenting at a tertiary neuro-ophthalmology clinic.

METHODS

In this retrospective study, ICD-9/10 (ICD-9 378.85 and ICD-10 H51.8) codes were used to identify all patients with ARDE from 2005 to 2020 seen in a single tertiary neuro-ophthalmology clinic. ARDE was defined as esotropia greater at distance than near with associated clinical signs of adnexal tissue laxity. Patients with history or findings compatible with other etiologies of strabismus, such as thyroid eye disease, neuromuscular disorders, sensory deviations, sudden onset of diplopia, and high myopia, as well as those with prior strabismus surgery, were excluded.

RESULTS

A total of 89 patients (59 females [66%]) met inclusion criteria. Mean patient age was 76.6 years. All patients were White except for a single patient of African descent. Mean follow-up time was 25.2 months. Mean esodeviation at distance on presentation was 6.6^Δ. Of the 87 patients electing nonsurgical treatment, 80 achieved remission of diplopia symptoms with prism therapy alone. Of the 89 patients, 59 had no neuroimaging.

CONCLUSIONS

ARDE in our neuro-ophthalmology clinic population was diagnosed almost exclusively in older White adults. Prism therapy was effective for a majority of our patients. (J AAPOS 2023;27:145.e1-3)

Divergence insufficiency pattern esotropia is defined as an acquired, comitant esotropia that is greater at distance than at near.¹ Although a similar strabismus pattern may be observed in young adults with high myopia (as in heavy eye syndrome) or in association with serious neurologic diseases, Mittelman and colleagues² proposed a distinct form of divergence insufficiency affecting primarily older adults in the absence of a central neurological etiology, which he called “age-related distance esotropia” (ARDE). In 2009 Rutar and Demer³ proposed that the age-related degeneration of orbital connective tissues was ultimately responsible for acquired divergence insufficiency pattern esotropia observed

in the elderly. They demonstrated inferolateral displacement of the lateral rectus pulley secondary to degeneration of fibroelastic connective tissue spanning the lateral and superior rectus muscles on magnetic resonance imaging and proposed that symmetrical lateral rectus pulley sag was responsible for impaired abduction and ultimately diplopia symptoms in patients with existing esophoria or deficient fusional amplitudes.³ Based on this proposed mechanism, Rutar and Demer³ coined the term *sagging eye syndrome* (SES) to describe patients with ARDE alone or in combination with cyclovertical strabismus who also exhibited bilateral blepharoptosis and deepening of the sulcus, and since its initial description, SES has been increasingly recognized as a common cause of acquired diplopia in adults.

As a result of increased recognition of ARDE and its more specific descriptor, SES, numerous institution-based case series and retrospective reviews have sought to characterize the prevalence of ARDE as well as demographics and clinical features, including age, sex, mean distance esodeviation on presentation, and treatment.⁴⁻⁶ It has been observed more frequently in White adults than other racial groups, and more frequently in women than in men, compared to the frequencies expected based on the demographics of the overall clinic population and local population.⁷ The purpose of our study was to

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determine the demographic and clinical characteristics of patients with ARDE presenting to a tertiary neuro-ophthalmology clinic.

Subjects and Methods

This retrospective study used ICD-9/10 (ICD-9 378.85 and ICD-10 H51.8) codes to identify all patients with primary divergence insufficiency or ARDE from 2005 to 2020 seen in the neuro-ophthalmology clinic at the University of Arkansas for Medical Sciences. The study protocol was approved by the University of Arkansas for Medical Sciences Institutional Review Board (IRB) and adhered to the tenets of the Declaration of Helsinki.

For inclusion in this study, patients were required to have a prism measurement at distance in the primary position of gaze and had to demonstrate esotropia greater at distance than at near, either documented by patient-reported symptoms or by orthoptic measurements. Patients also had to demonstrate one or more of the associated orbital features of SES, including baggy eyelids, superior sulcus deformity, and aponeurotic blepharoptosis. Patients with a history or findings compatible with other etiologies of strabismus (eg, restrictive pathologies such as thyroid eye disease, neuromuscular disorders such as myasthenia gravis, asymmetric visual acuity with the possibility of a sensory deviation, sudden onset of diplopia, and high myopia) were excluded. Additionally, patients with a history of childhood strabismus, history of strabismus surgery prior to initial presentation to our clinic, history of incisional glaucoma surgeries such as tube shunt placement or trabeculectomy, or history of significant head or facial trauma were excluded. The following information was recorded from the medical record for patients who met study criteria: age and sex, self-reported race, length of follow-up, distance esodeviation on presentation, change in esodeviation over the length of follow-up (excluding patients who were eventually referred for surgery), mode of treatment (none, prism therapy, surgery), the presence of neuroimaging obtained by our clinic or by the referring ophthalmologist, and past medical conditions including hypertension, hyperlipidemia, diabetes mellitus, and history of smoking.

Results

A total of 89 patients (59 females [66%]) met inclusion criteria, and the mean patient age was 76.6 years (median, 76 years). All patients were White except for a single male patient of African descent. A comparison group composed of all adult neuro-ophthalmology patients seen in our clinic during June 2021 revealed the following racial breakdown: 63% White, 31% Black, 6% other. Mean follow-up time in our clinic was 25.2 months for 56 patients who were seen at least twice. Mean esodeviation at distance on presentation was 6.6^Δ measured by alternate prism cover testing. Of the 89 patients, 2 patients elected no treatment, 80 patients were treated with either Fresnel prisms or round-in prisms, and 7 patients underwent strabismus surgery. Excluding patients whose deviation was corrected surgically, there

were 56 patients with at least one follow-up visit; among these patients, the esodeviation did not improve in any patient, with an increase over time between 0^Δ and 8^Δ. Of the 89 patients, 59 had no neuroimaging either by our clinic or by the referring physician. Of the 30 patients that underwent neuroimaging, 23 patients underwent magnetic resonance imaging, and 7 underwent computed tomography. None of these patients were found to have pathology identified on cranial imaging other than chronic microvascular changes or cortical atrophy. Prevalence of the most common medical conditions among the 89 patients—hypertension (70%), hyperlipidemia (33%), diabetes (13%), and history of smoking (34%)—was similar to prevalence in the general population of senior adults in the United States.

Discussion

ARDE typically presents in older individuals and is becoming increasingly recognized as one of the most common strabismus disorders in adulthood according to a number of epidemiological studies as well as institution-based retrospective case series.^{4,6} According to the Rochester Epidemiology Project, ARDE comprised 10.6% of adult strabismus cases with a median age of 74 years.⁶ In 2020, Gosecki and colleagues⁴ published a clinic-based prevalence study of causes of adult-onset diplopia that identified SES as the most common cause, representing 31% of all cases.⁴

ARDE typically presents in an elderly individual with an otherwise normal neurological examination who complains of gradual or subacute onset of horizontal diplopia when viewing distance targets during activities such as driving or watching television. This horizontal diplopia is often initially intermittent but may become constant over a period of months to years. Patients with ARDE typically do not complain of diplopia with near work. In general, the distance esodeviation is horizontally comitant. It may be associated with either normal or reduced divergence amplitudes.⁸ The term *divergence insufficiency* has been challenged as a misnomer for this condition, because insufficient divergence amplitudes are no longer generally believed to be the primary cause of this disease-state.⁹

Historically, several investigators suggested that microvascular disease or infarcts in the so-called “divergence center” of the brain were responsible for divergence insufficiency.¹⁰⁻¹⁴ In 2006, Guyton¹⁵ theorized that increased convergence tonus over time, in response to a lifetime of near work, could lead to medial rectus muscle shortening, resulting in an esotropia pattern worse at distance. In 2021, Guyton and colleagues¹⁶ reported an increasing incidence of divergence insufficiency esotropia over time and suggested that this is likely due to increased use of computers and personal devices, as well as the increased use of progressive addition lenses with patients using inadequate plus power for near tasks.

In 2009, Rutar and Demer³ proposed that the age-related degeneration of the orbital pulley system resulted in inferolateral displacement of the lateral rectus pulley and subsequently abduction impairment leading to an esodeviation worse at distance. Demer in 2014 also suggested that adult-onset pulley defects commonly arise from similar age-related tissue involucional changes that result in adnexal laxity such as baggy eyelids, superior sulcus deformity, aponeurotic blepharoptosis, and the likelihood of previous blepharoplasty or similar cosmetic surgery.¹⁷ In our study, external features of adnexal soft tissue laxity were required to make a diagnosis of ARDE. In our experience, examination of the patient's face in well-lit conditions helps to identify this adnexal phenotype.

The ARDE demographics from our clinic compare similarly to other institution-based reports with regard to age and sex.^{2,4} Consistent with a similar but smaller study by Ridley-Lane et al,⁷ we observed a disproportionately high number of ARDE patients who were White. The only non-White patient was a lightly pigmented African American male who presented at the age of 87. For comparison, only 63% of patients seen in our adult neuroophthalmology clinic during June 2021 were White. Wesley and colleagues have reviewed racial differences in skin barrier properties, but reported inconsistent findings regarding skin biomechanics;¹⁸ it is not known whether or not there are differences in the biomechanical properties of orbital connective tissue (including extraocular muscle pulleys) that could explain why ARDE is more commonly diagnosed in Caucasian adults. In addition, because we used external signs of adnexal tissue laxity to diagnose ARDE, we may have excluded cases of ARDE that were not associated with visible signs of tissue laxity, and this may have biased our study findings.

Of the 87 patients who elected treatment, 80 achieved remission of diplopia symptoms with prism therapy alone. Prevalence of the most common medical conditions among the 89 patients—hypertension (70%), hyperlipidemia (33%), diabetes (13%), and history of smoking (34%)—was similar to prevalence in the general population of senior adults in the United States according to the National Health Statistics Report published by the Centers for Disease Control in 2021.¹⁹

An important limitation to this study is the retrospective design, which may result in misclassification bias and referral bias, as our clinic is a nonsurgical neuroophthalmology clinic. This undoubtedly skews our patient population towards individuals with smaller angles of deviation, as those with larger deviations are immediately referred to the surgical strabismus clinic, where 50% of all ARDE patients undergo surgery and where surgery is reported to be successful with a single operation in 87% of patients.²⁰ In these patients, Bunyavee and colleagues²¹ demonstrated that unilateral medial rectus recession with or without lateral rectus resection and bilateral medial rectus recession

surgical approaches produced similar favorable outcomes. Thacker and colleagues²² reported favorable long-term surgical outcomes with unilateral or bilateral lateral rectus resection with minimal risk of overcorrection at near.

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