

Traumatic Iridodialysis in a Student Naval Aviator Applicant

RICHARD A. ROLLER, NATHANIEL B. ALMOND, AND
WARREN ANDERSON

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Iridodialysis is a relatively uncommon but important sequela of blunt trauma to the eye. It classically presents as a form of polycoria or extra pupil observed during a comprehensive eye examination. This defect results from compression of the anterior-posterior aspect of the globe itself, which stretches the anterior ring segments and leads to the separation of the iris root from the ciliary body. Degraded visual acuity and visual confusion from glare as well as several late-stage pathologic sequelae may result from the injury. Establishing the diagnosis in aviators is important since any visual disturbance may incapacitate the pilot, resulting in a mishap or interference with completion of the mission. We present a case of a student naval aviator applicant who presented to the Naval Aerospace Medical Institute on two separate occasions for medical evaluation of duties involving flying after suffering blunt trauma/iridodialysis to his right eye.

Keywords: blunt eye trauma, polycoria, aerospace medicine, visual acuity, glaucoma, cataracts, iris.

OPTHALMOLOGIC conditions are common among individuals of all age groups with the incidence in the military reflecting that of the general population. Flight surgeons and aeromedical examiners have long recognized the importance of normal vision in the aviation community (7). Aviators and astronauts function in hostile ever-changing environments where the accurate perceptions of visual cues are absolutely essential for the safety of flight (8). In fact, visual abnormalities represent one of the most frequent disqualifying conditions we encounter as military flight surgeons, and vary from relatively simple acuity deficits, often correctable with refraction, to more severe traumatic impingements on the structures of the eye. These more severe ophthalmologic disorders often result in permanent disqualification for many military aviators and applicants. The following is a case report of a student naval aviator applicant who presented to the Naval Aerospace Medical Institute (NAMI) Physical Exams for his flight physical with a history of traumatic blunt injury to the eye. He was then referred to the NAMI Ophthalmology Department for further evaluation.

CASE REPORT

A previously healthy 19-yr-old USMC Naval aviation applicant presented to NAMI Code 26 Physical Exams in November of 2001 for an initial flying duty medical

examination. He reported no major medical events or history of deficits on the medical history form (Standard Form 93); however, the flight surgeon noticed an obvious abnormality of the iris OD (**Fig. 1**).

The patient revealed that he had been struck by the eyelet of a fishing pole at age 8 and developed a red eye. By the time he was examined by an ophthalmologist his vision was still "good" and his parents were primarily worried about the apparent blood visible in his eye. He was unsure about his initial diagnosis, but reported to us that his right eye has remained similar in appearance since the initial trauma (**Fig. 1**), and that his vision in both eyes has been "very good" since then. There was no indication for surgical intervention at that time. The applicant was immediately referred to the NAMI Ophthalmology Department for further evaluation and aeromedical disposition. The patient's ophthalmologic exam results are detailed in **Table I**.

His visual acuity appeared unaffected by the defect with distant visual acuity of 20/30 uncorrected in both eyes, correcting to 20/20 OU. His near visual acuity was 20/20 uncorrected OU (**Table I**) with no evidence of glare. The patient denied any glare, double vision, photophobia, or pain. Slit-lamp evaluation revealed a crystalline lens marginal malformation with some small sublaxation/displacement secondary to disrupted and absent zonular fibers (**Fig. 2**). Some prolapse of vitreous humor into the anterior chamber of the eye was also observed.

The applicant was diagnosed with traumatic iridodialysis (separation of the iris) with resulting polycoria (additional "pupil") OD. Since iridodialysis can result in several late sequelae which are incompatible with the harsh aerospace environment and associated aviation duties, he was, therefore, evaluated to be not physically qualified for duties involving flying, with a waiver not recommended. The Navy Code 42 Waiver Authority

From the Naval Aerospace Medical Institute, Pensacola, FL.

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Address reprint requests to: MAJ Richard A. Roller, USA, M.D., Ph.D., M.P.H., M.S., MC, FS, Naval Aerospace Medicine Residency, Naval Aerospace Medical Institute, Code 33, 340 Hulse Rd., Pensacola, FL 3258; raroller@nomi.med.navy.mil.

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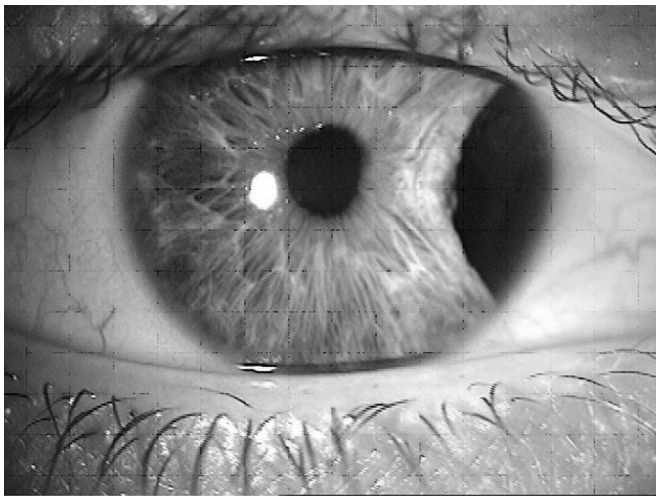


Fig. 1. The patient’s right eye illustrating nasal iridodialysis resulting in polycoria. Note that the pupil is slightly D-shaped in appearance and displaced temporally. Photograph courtesy of Joseph Pasternak, M.D., Bethesda, MD.

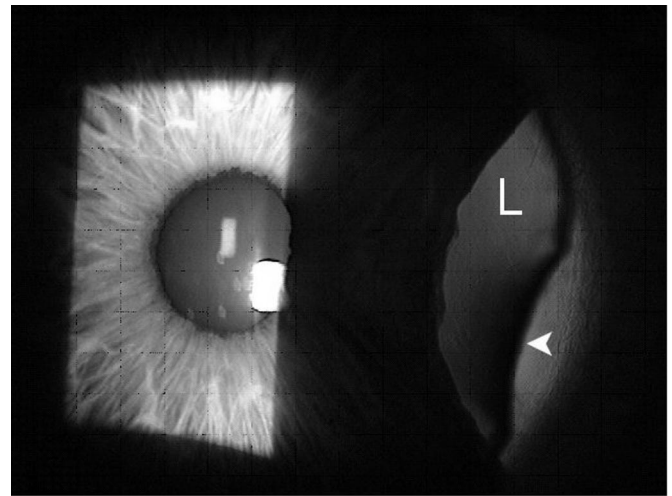


Fig. 2. Retroillumination (slit-lamp) of patient’s right eye revealing a crystalline lens marginal malformation with absent zonular fibers. Direct illumination through the pupil is illustrated on the left side with back-lighting and red light reflecting from the retina (observer’s view) on the right. L = crystalline lens, Arrow = lens marginal defect. Photograph courtesy of Joseph Pasternak, M.D., Bethesda, MD.

upheld the decision. Again, since he was asymptomatic, surgery was not indicated.

Normally, this would be the conclusion of the case; however, the applicant (now 21 yr old) presented again in March of 2004 to the NAMI physical exams as an air traffic control (ATC) candidate student requesting an initial qualifying exam. At this time the individual had no up-chit, no previous waiver, and had never been officially physically qualified for flying duties. He was again seen by Ophthalmology and was evaluated for ATC duties. At that time his current eye exam remained unchanged from the previous exam of 2001 (Table I); again, with no evidence of glare, and there appeared to be no deterioration in his visual acuity or onset of any late sequelae of the blunt trauma to the globe. The student still denied any problem with glare or other visual disturbance. Since the applicant would not be piloting an aircraft or serving as aircrew in direct flying duties, many of the environmental stressors and possible sequelae were of less, although some, concern to his current application. It was determined that his defect remained stable and that it would pose little hazard for any safety of flight issues or any sudden incapacitation

which might interfere with his duties as an air traffic controller. He was, therefore, evaluated to be still not physically qualified for aviation duties with a waiver not recommended for duties involving flight (DIF) for student naval aviator (SNA), student flight officer (SNFO), or student flight surgeon. A waiver was recommended for duties as a Class 3 ATC. His waiver is still pending at the present time.

DISCUSSION

Flying is not without inherent risks. Pioneers in aviation medicine long recognized the essentiality of normal vision for safety of flight (7–9), and in military aviation operations, target acquisition becomes an important additional factor. Since our military units frequently conduct operations in austere locations, other environmental and medical logistic concerns may become important with respect to eye care. Due to the fact that military aviation is inherently different from civilian aviation, in many situations certain aspects of overall flight safety may have to be sacrificed for mission completion. These considerations, as well as the possible lack of immediate definitive medical care emphasize the significance of normal vision, and underscore the importance of the eye exam during the annual physical. Flight surgeons and aeromedical examiners routinely subject aviators to a battery of ophthalmologic exams during the flight physical to ensure that visual standards are met and maintained. We typically hold applicants (SNA, SNFO, and student flight surgeon) to higher vision standards than designated aviators with the understanding that over the flying career an aviator’s visual acuity may deteriorate due to the aging process; however, as stated previously, certain standards must be maintained to ensure the safety of individuals in the air as well as those on the ground.

If one excludes cataracts, trachoma, onchocerciasis, vitamin A deficiency, and glaucoma, ocular trauma

TABLE I. APPLICANT’S OPHTHALMOLOGICAL EXAM.

	OD	OS
Uncorrected DVA	20/30	20/30
Uncorrected NVA	20/20	20/20
Manifest Refraction	-0.25-0.75 × 005*	Plano-0.50 × 090*
IOP	6 mmHg	8 mmHg
Esophoria		0
Exophoria		0
Heterophoria		0
FOV		Full
Depth Perception (AFVT)		8/8
Color Vision (Falant)		9/9
Glare		None

DVA: distant visual acuity, NVA: near visual acuity, IOP: intraocular pressure, FOV: field of view, AFVT: Armed Forces Vision Tester
* Correctable to 20/20⁻⁰

remains one of the major causes of avoidable blindness (10,11). Traumatic eye injury can result from both blunt and sharp forces, which can disrupt not only the internal structures, but also the integrity of the globe itself. Blunt trauma can cause a condition referred to as "polycoria," which literally refers to additional openings (other than the pupil) in the iris. Iridodialysis results from separation of the iris from its thin insertion at the ciliary body, and represents a common form of polycoria (5). The defect itself results in a loss of support for the pupil, and usually extends less than a third of the circumference, resulting in a convex appearance (Fig. 1) (1). Because of this disinsertion of the iris root from the ciliary body, the pupil often takes on a D-shaped appearance (Fig. 1). When viewed with slit-lamp microscopy and retroillumination, the margin of the crystalline lens is usually apparent behind the defect (Fig. 2). If the zonules supporting the lens are disrupted, the vitreous may prolapse into the anterior chamber.

The mechanism of iridodialysis in blunt trauma involves compression of the anterior-posterior aspect of the globe itself, which increases the equatorial diameter and stretches the anterior ring segment (1). The structures located within the anterior ring are attached at their circumferential periphery and are, therefore, prone to distension and tearing. Often, blood vessels are also torn, resulting in a micro- or macroscopic hyphema. Therefore, any aviator with a hyphema should be evaluated with a comprehensive eye exam including gonioscopy and dilation approximately 6 wk post-injury (1). The "Seven Anterior Rings" of ocular tissue susceptible to expansion and tearing include (from anterior/central to posterior/peripheral): 1) rupture of the iris sphincter pupillae (radial tears, keyhole iris); 2) iridodialysis (iris base)/iridoschisis (splitting of stromal layers); 3) angle recession (anterior ciliary body); 4) cyclodialysis cleft (attachment of the ciliary body to the scleral spur); 5) tears, scrolls, and separations in the trabecular meshwork; 6) subluxation and dislocation of the lens (lens zonules); and 7) retinal dialysis and detachment/avulsion of the vitreous base (bucket handle tear) (1). The young applicant in this case report received the blunt trauma as a result of being struck by the distal eyelet of his fishing pole. Tips of rebounding bungee cords, paint balls, BBs, and racquet balls are common causes of blunt ocular trauma in the non-occupational setting, which may be prevented by the use of proper protective eyewear (10).

Iridodialysis, if symptomatic, may be repaired surgically (2), often by suturing under a scleral flap (6); however, the failure rate may be significant. Since the iris stroma is non-proliferative, permanent sutures are required (1). Because of this, irritation from the sutures and erosion of the scleral flap are not uncommon (1).

Aeromedically, when encountering eye trauma or visual defects in an aviator (or applicant) we must consider any potential risk of sudden incapacitation which might result in a mishap. With polycoria secondary to iridodialysis, flight surgeons and AMEs must evaluate the hazards of impaired perception, distraction, and confusion from decreased acuity, glare, and/or multiplopia. Since additional structures may be

damaged during traumatic eye injury, a comprehensive eye exam with slit-lamp microscopy is essential. Even if the potential risk of sudden incapacitation may be minimized, we must consider the late sequelae of such trauma, which could result in acute or progressive incapacitation. These possible sequelae include the further disruption of zonular fibers leading to complete detachment of the iris and subluxation of the lens (possible G-force influence?); angle recession glaucoma; chronic hypotony; cataracts; and retinal detachment. Any of these could, in turn, jeopardize mission accomplishment, safety, or perhaps result in premature loss of service to the aviation community. These conditions could also require medical resources which might be unavailable in remote, austere duty environments. For these reasons, the NAMI Ophthalmology and Physical Qualifications Departments do not routinely recommend waivers for DIF as an SNA for an applicant with a history of significant eye trauma including iridodialysis. In fact, the guidelines for all three military services (Army, Navy, and Air Force) do not recommend waivers for these types of defects. However, waivers may be considered on a case-by-case basis for designated aviators in whom significant training resources have been invested. A search of the U.S. Navy Code 42 database reveals no waivers for iridodialysis or polycoria for SNAs or designated pilots. However, one waiver for iridodialysis/polycoria was recently recommended by NAMI and the Navy's Bureau of Medicine for a SNFO. Naval flight officers do not operate the aircraft except under emergency conditions (i.e., the pilot is incapacitated). The SNFO had injured his left eye bungee jumping in 1995. The injury was noted on his commissioning physical and on his initial flight physical. His defect was considered stable and his visual acuity and manifest refraction was within the standards for a SNFO. He was determined to be "not physically qualified but aeromedically adaptable with waiver recommended for DIF as an SNFO." A waiver was not recommended for DIF as an SNA. A similar inquiry of the U.S. Army database (U.S. Army Aeromedical Activity, Ft. Rucker, AL) and the U.S. Air Force Consultation Service (USAF School of Aerospace Medicine) reveals no waivers granted for iridodialysis in student or designated pilots.

The patient in our case is obviously not qualified for duties involving flying as an SNA; however, his second application as a student air traffic controller poses a new and somewhat different situation. His visual acuity has not deteriorated since his first exam (Table I); in fact, his manifest refraction (discounting the polycoria) qualifies him as an SNA. Since illumination and glare are highly controlled in the ATC work area and the individual had remained visually asymptomatic, it was felt that the risk of sudden incapacitation or other secondary effects (i.e., glaring) were minimal. The risk of sudden incapacitation, while possible, is not likely in the controlled environment of an air traffic controller. If he were suddenly incapacitated, the risk for subsequent mishap would be more reduced than if he were piloting the aircraft. Glaring could be a concern, especially for an air traffic controller; however, as stated previously, these individuals typically operate in the tower, or in

darkened control rooms using terminals where the lighting is rigorously controlled. Additionally, this individual has not exhibited any symptoms to date, was negative for glaring during his comprehensive eye exam, and had already completed several weeks of non-ATC training prior to the exam. It was felt that he would be able to safely perform his aviation duties and would be at minimal risk for any adverse consequences or any sudden incapacitation. Since he would have an ophthalmologic exam as part of his annual flight physical and his waiver requirement, he could be adequately monitored for any of the various sequelae mentioned before.

The patient was noted to have somewhat low intraocular pressures (IOP) on both examinations that had remained stable since his first exam (Table I). His IOP was symmetric and not pathologic. His comprehensive eye exam ruled out any post-traumatic cause of pathologically low IOP such as cyclodialysis cleft or retinal break. His IOPs are normal for him and not a manifestation of hypotony.

One may question the economic wisdom of investing considerable training in an individual who may later develop the secondary sequelae of glaucoma, cataract, or even retinal detachment and possibly be lost to the aviation community. This "Operational Risk Management" represents the cornerstone of what military flight surgeons, safety officers, commanders, and aeromedical consultants deal with on a day-to-day basis. This is particularly critical in flight crew (pilots, Naval flight officers, crew chiefs, etc.) where a sudden incapacitation may result in a catastrophic mishap, or at a minimum, an incomplete mission. While air traffic controllers are not actually operating an aircraft, they are "controlling" airspace with several aircraft at any one time; therefore, their health and well-being is also a priority. As stated above, the environment they work in (as opposed to pilots and other aircrew) is relatively static and controlled with appropriate "checks and balances" as well as backup. The risk management matrix developed by the U.S. military (3,4) can be used to estimate a risk assessment for the applicant in question. The Risk Assessment Code is based on the probability that an sudden adverse event (that would impact safety of flight) would occur in this individual [A] likely to occur immediately or within a short period of time; B) probably will occur in time; C) may occur in time; D) unlikely to occur] and the consequences of such an event [I] may cause death, loss of facility/asset; II) severe injury, illness, property damage; III) minor injury, property damage; IV) minimal threat]. The probability of a sudden incapacitating event occurring in this individual while performing his aviation duties was felt to be unlikely. Of course, if this individual was suddenly incapacitated while controlling an aircraft (or several aircrafts) the results could be catastrophic. Based on the Risk Assessment Matrix, the Risk Assessment Code was calculated to be "moderate"—reflecting the fact that "an unlikely probability of catastrophic loss exists" (3). In reality, the unlikely probability of a catastrophic loss does exist at all times in military aviation, and we attempt to mitigate and reduce this by attempting to control and re-

duce the risk (such as applying annual flight physicals including routine eye exams, controlled lighting, backup controllers, etc).

Based on the above risk assessment, the unique work environment and demands, and the applicant's current physical status, he was evaluated to be an acceptable candidate for ATC training. This is not to say that he will not experience any future sequela of his visual defect, but rather that we have used appropriate aeromedical criteria to mitigate the overall risk of sudden incapacitation, allowing this individual to pursue his career goals and perhaps have many years as a productive air traffic controller. Thus, the best interests of the U.S. Navy are served.

In conclusion, this case represents an atypical ophthalmologic condition not normally encountered during an initial flying-duty examination. It illustrates and emphasizes that flight surgeons must be aware of the differing requirements of the various classes of military flight physicals (class I, II, III, and IV) as they pertain to the specific aviation career track. A solid knowledge of the physical and physiological demands of each aviation specific duty (pilot, Naval flight officer, aircrew, flight surgeon, or ATC) is essential when evaluating applicants for initial flying-duty training. We must also keep in mind that a physical defect, which may be disqualifying for a particular aviation duty such as pilot, may not be disqualifying for another, as in this case.

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