Anisocoria Following Uncomplicated Cataract Surgery

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ABSTRACT

Introduction: In this report, we describe a case of anisocoria following uncomplicated cataract surgery. Clinicians should consider postoperative mechanical and tonic pupils when evaluating patients with anisocoria.

Case Presentation: A 69-year-old White female underwent uncomplicated cataract surgery of her left eye. No intraoperative pupil expansion devices were used, and no floppy iris or iris prolapse occurred during the surgery. Postoperatively, she was found to have anisocoria. Pharmacologic pupillary testing confirmed a tonic and mechanical left pupil.

Discussion: There have been no reported causes of anisocoria from a tonic pupil after cataract surgery. Based on reports of tonic pupils following other eye surgeries, our case likely occurred from a combination of parasympathetic dysfunction and mechanical trauma.

Conclusions: To our knowledge, this is the first report of a tonic pupil following cataract surgery, thus expanding the literature of causes of anisocoria that may be underrecognized in the clinical setting.

INTRODUCTION

Unequal pupil size, termed anisocoria, can be the initial presenting symptom of a broad range of conditions that include both benign and life-threatening etiologies. Causes of anisocoria include physiologic anisocoria, cranial nerve III palsy, pharmacologic mydriasis and miosis, traumatic mydriasis, Horner syndrome, atonic pupil, and tonic pupil.[1] It is important for clinicians to appropriately evaluate and diagnose anisocoria in order to properly manage life-threatening conditions and provide reassurance for patients when necessary.

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A tonic pupil typically presents with anisocoria due to dilation of the affected pupil with a sluggish light reaction and slow redilation with removal of light stimulus. The near reflex is intact and often produces a larger reaction than the unaffected pupil due to denervation supersensitivity. Patients may be asymptomatic or complain of blurry vision and/or light sensitivity.[2] The most common cause is idiopathic (referred to as Adie tonic pupil), but it can result from tumor, inflammation, trauma, surgery, or infection.[3]

The pathophysiology of a tonic pupil is loss of parasympathetic innervation to the sphincter pupillae, which is the muscle responsible for constriction of the pupil. Denervation occurs at the level of the ciliary ganglion, where preganglionic parasympathetic nerves from the Edinger-Westphal nucleus travel along the oculomotor nerve synapse onto postganglionic parasympathetic nerves that innervate the sphincter pupillae (Figure 1). Loss of input to the ciliary ganglion induces upregulation of postsynaptic acetylcholine (ACh) receptors, which is called denervation supersensitivity. Testing for ACh supersensitivity can be completed with dilute (0.125%) pilocarpine that directly stimulates muscarinic receptors on the sphincter pupillae.[4] This testing can distinguish tonic pupil from atonic pupil, which will not demonstrate supersensitivity because it is due to sphincter pupillae dysfunction.

Very few cases of atonic pupil and no cases of tonic pupil after cataract surgery with phacoemulsification have been described previously, to our knowledge.[5] In this study we report a case of a tonic and mechanical pupil following uncomplicated cataract surgery, which represents a postoperative finding that may go unrec-

ognized in the clinical setting. Clinicians evaluating patients with anisocoria should consider tonic and mechanical pupil following ocular surgery and know how to appropriately assess for it as described in this report.

CASE PRESENTATION

A 69-year-old White woman presented with a visually significant cataract of her left eye. Her prior ocular history was pertinent for keratoconus and pseudophakia of the right eye. Preoperatively, no pupillary abnormalities were noted, and her pupils equally dilated to 7 mm bilaterally. Her medical history was significant for hypertension.

She underwent uncomplicated cataract surgery with phacoemulsification. A standard monofocal lens for a myopic target was placed in the capsular bag. The cumulative dissipated energy was 6.51. No pupil expansion devices were used, and no intraoperative floppy iris or iris prolapse occurred during surgery. Anesthesia was achieved with topical tetracaine and intracameral preservative-free lidocaine mixed with epinephrine.

On postoperative day 1, the patient was asymptomatic, and she was noted to have a mid-dilated, round left pupil. Her uncorrected visual acuity was 20/125 and her intraocular pressure was 34 mmHg. Given the slightly elevated eye pressure, she was started on dorzolamide-timolol drops twice daily in the operative eye.

She was seen urgently on postoperative day 4 after complaining of blurry vision and photophobia. She was also concerned her left pupil was still dilated. The pupil again was noted to be mid-dilated and round. There were no transillumination defects, no vitreous in the anterior chamber, and the pupil was not peaked. Her uncorrected visual acuity was 20/300 (pinhole 20/50) and her intraocular pressure was 11 mmHg. The remainder of her ocular exam was unremarkable. She was instructed to stop dorzolamide-timolol and continue the other routine postoperative cares.

At postoperative week 2, the anisocoria was measured to be worse in the light. The left pupil was minimally reactive. The right pupil measured 6 mm in the dark and 4 mm in the light. The left pupil measured 7.5 mm in the dark and 7 mm in the light. There was no afferent pupillary defect and the iris remained round. The

Figure 1. Parasympathetic Pathway to the Sphincter Pupillae

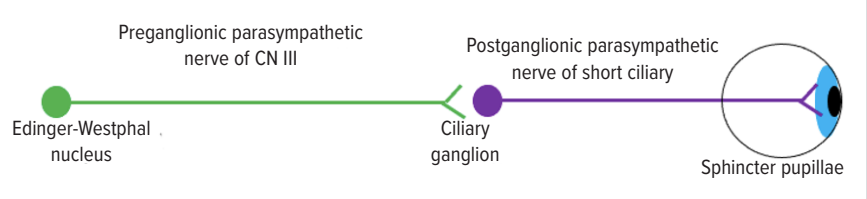
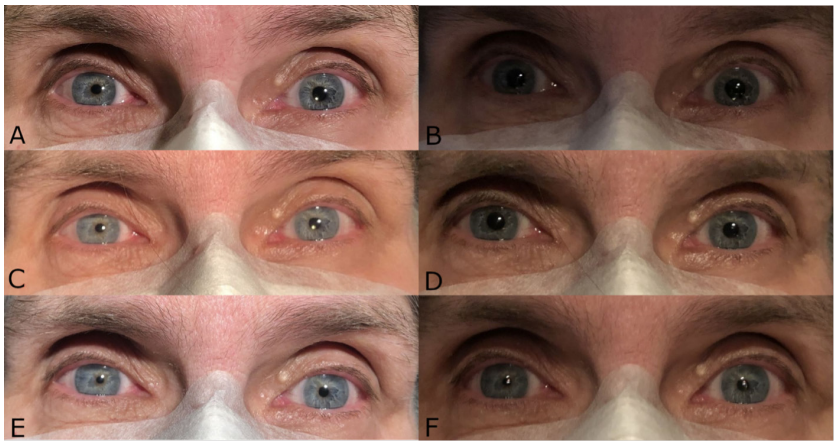


Figure 2. Pharmacologic Pupillary Testing



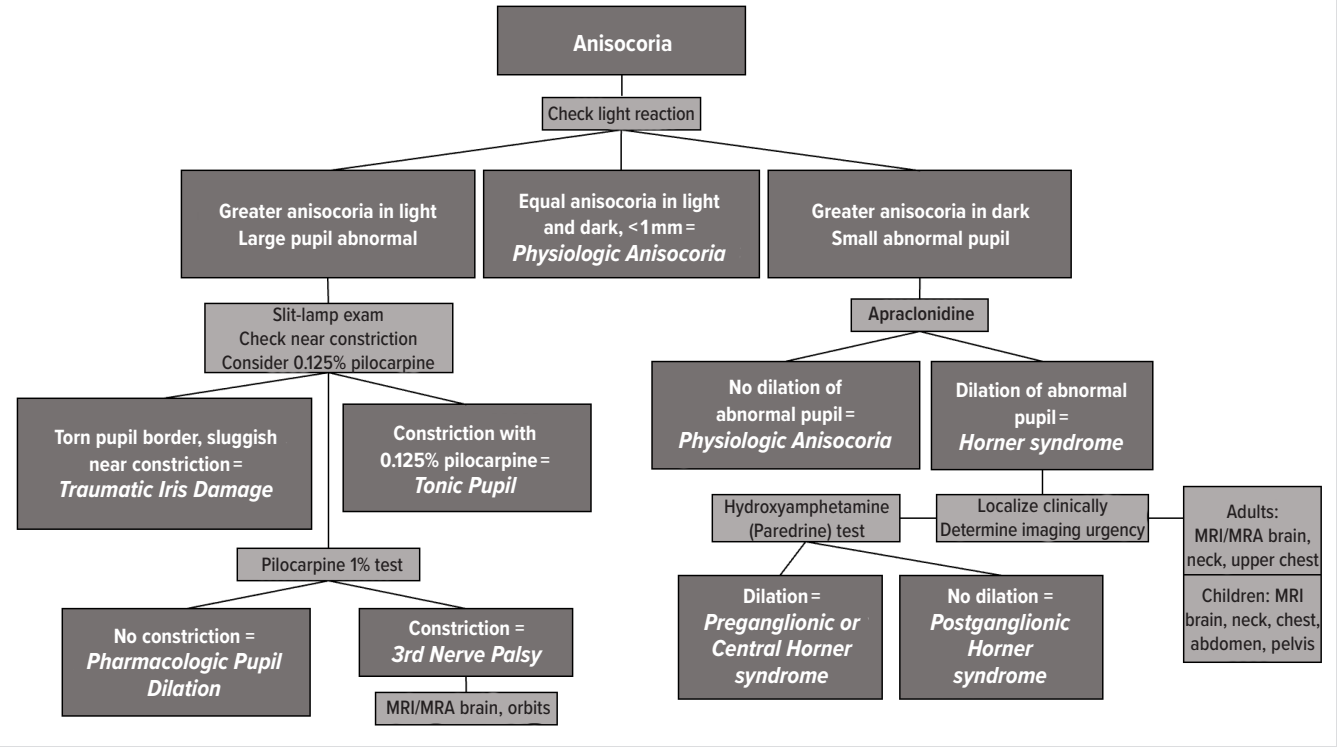
Left eye is the postoperative eye. (A) Pupil appearance under bright conditions prior to installation of any pharmacologic agents. (B) Pupil appearance under dark conditions prior to installation of any pharmacologic agents. (C) The operative (left) eye constricts after instillation of dilute 0.125% pilocarpine. (D) After dilute 0.125% pilocarpine, the nonoperative (right) eye dilated rapidly under dark conditions but the operative (left) eye is sluggish to dilate. (E) Both pupils constrict after instillation of 1% pilocarpine. (F) Both pupils remain relatively constricted under dark conditions.

Table. Pilocarpine Pupillary Testing

Testing Condition	Right Eye Pupil Size (mm)	Left Eye Pupil Size (mm)
Baseline		
Dark	5	6
Light	3	4
Near	2	3.5
Post 0.125% pilocarpine (30 minutes)		
Dark	4.5	3.5
Light	2.5	3
Near	2	3
Post 1% pilocarpine (30 minutes)		
Dark	2	3
Light	2	3
Near	2	2.5–3

Pupil constriction to dilute 0.125% pilocarpine suggested ocular parasympathetic hypersentivity. There was slight light near dissociation. There also was suboptimal constriction to 1% pilocarpine in the left eye, suggesting suboptimal iris mechanical integrity, which could be related to mechanical trauma during the cataract surgery or prior unknown iris trauma.

Figure 3. Evaluation of Anisocoria Algorithm



Abbreviations: MRI, magnetic resonance imaging; MRA, magnetic resonance angiography.

left pupil was noted to constrict to 3 mm with 1% pilocarpine, and she was diagnosed with a tonic pupil. She was prescribed pilocarpine for use as needed.

At her 1-month postoperative visit, her best corrected visual acuity in the left eye was 20/20. She reported not using the pilocarpine drops. The anisocoria, pupil reactivity, and slit lamp exam was unchanged from the 2-week postoperative exam.

The patient was seen by neuro-ophthalmology 2 months after cataract surgery. Color vision was full in both eyes, and there was normal cranial nerve V sensation and corneal reflex. Loose iris strictures were noted in both eyes. Pharmacologic pupillary testing (Figure 2 and Table) confirmed a tonic and mechanical pupil in the operative eye.

DISCUSSION

Anisocoria is a common, often incidental, finding. It is important to diagnose the underlying etiology of anisocoria as some cases are due to life-threatening emergencies. Therefore, it is critical clinicians know how to differentiate the various causes of anisocoria with proper examination techniques, which first involve measuring pupil size in light and dark conditions (Figure 3). Neuroimaging is an important ancillary study for anisocoria. However, it is important to know if the clinical concern is for Horner's syndrome or a third cranial nerve palsy so the correct imaging study can be ordered, which again necessitates a proper pupil exam. Ophthalmologists may perform pharmacologic testing with pilocarpine or apraclonidine to further differentiate the etiology of anisocoria (Figure 3).

Importantly, not all causes of anisocoria need additional workup or imaging. For example, physiologic (also known as simple or essential) anisocoria is a benign condition that does not require further testing. Physiologic anisocoria affects approximately 20% of the population, and it is the most common cause of anisocoria.[1] The degree of anisocoria in this condition remains equal in light and dark conditions, and it may be intermittent or chronic. Additionally, a tonic pupil, atonic pupil, traumatic/mechanical pupil, and congenital pupil anomalies, such as coloboma and ectopic pupil, do not require additional workup. We present an unusual case of anisocoria from a tonic and mechanical pupil following uncomplicated cataract surgery, reflecting the importance of asking pertinent ocular surgical and ocular trauma history questions when evaluating a patient with anisocoria.

There have been 8 reported cases of atonic—but not tonic—pupil following cataract surgery performed under general anesthesia[6] and retrobulbar/peribulbar anesthesia.[7] Of these 8 cases, 1 patient had 20-diopter myopia and 1 patient had primary open angle glaucoma; otherwise the patients had no known ocular history. Proposed mechanisms for these cases include postopera-

tive increased intraocular pressure, toxin exposure, general anesthesia, damage to the ciliary ganglion by retrobulbar injection, iris sphincter trauma during surgery, mechanical vascular compression, and ischemia of iris sphincter. However, no study has been able to find a common etiology for the source of atonic pupil after cataract surgery.[5]

This report describes a case of tonic and mechanical pupil after uncomplicated cataract surgery with phacoemulsification and implantation of an intraocular lens. No other cases of tonic pupil after phacoemulsification have been documented in literature. One case of tonic pupil after scleral buckle and diathermy for retinal detachment repair[8] and 1 case after pars plana vitrectomy and endolaser[9] have been documented. The authors speculate that either endolaser thermal damage to the short ciliary nerves in the suprachoroidal space occurred or retrobulbar anesthetic injection led to increased intraocular pressure causing injury to the short ciliary nerves.[9]

Given these previous reports, we propose a possible mechanism in our case may be thermal damage to the short ciliary nerves from the phacoemulsification probe. However, given the current generation of equipment, this seems unlikely. Another possible mechanism is damage from increased intraocular pressure, as pressure was raised to 55mmHg intraoperatively as standard for cataract surgery, and our patient's pressure was 34 mmHg at her initial postoperative visit. Although no direct trauma to the sphincter pupillae fibers occurred as no pupil expansion devices were used intraoperatively, it is possible that mild iris trauma may have occurred from the surgical instruments, resulting in the subtle suboptimal iris mechanical integrity noted during the pharmacologic testing. It is also possible the short ciliary nerves were damaged from the intracameral lidocaine that was administered for anesthesia. The majority of cases of tonic pupil are idiopathic; thus, our case also may represent an idiopathic etiology that was coincidentally identified after cataract surgery.[2] Nevertheless, postoperative atonic, tonic, and mechanical pupils are likely underrecognized due to lack of symptoms and patients being dilated prior to clinician examination at postoperative visits and, therefore, must be considered in the evaluation of a patient with anisocoria.

CONCLUSIONS

A case of anisocoria following uncomplicated cataract surgery with phacoemulsification and implantation of intraocular lens has been described. The anisocoria occurred from a combination of parasympathetic dysfunction and mechanical trauma given the results of the pupil exam and pharmacologic testing. We believe postoperative anisocoria is likely underreported following ocular surgery and must be considered for patients presenting with anisocoria in the clinical setting.

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