

# Unilateral pupillary mydriasis from nebulized ipratropium bromide: A false sign of brain herniation in the intensive care unit

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## Abstract

Although there are many causes of anisocoria in the intensive care setting, the development of unilateral mydriasis in patients with intracranial hemorrhage or tumor is a neurological emergency, as it may herald the onset of uncal herniation. We describe two patients with a hemiparesis from neurosurgical disorder who subsequently developed a fixed and dilated pupil. The pupillary abnormality was caused by nebulized ipratropium bromide in both cases, and resolved when the medication was discontinued. Nebulized ipratropium may leak from the mask into ipsilateral eye and cause mydriasis in patients with facial weakness. This benign cause of anisocoria in the intensive care setting is distinguished from uncal herniation by the laterality of neurologic findings, and lack of mental status change, ptosis, and extraocular movement impairment.

**Keywords:** Anisocoria, hemiparesis, ipratropium bromide, mydriasis, uncal herniation

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## Introduction

A unilateral dilated and fixed pupil in patients with intracranial tumor or hemorrhage is a major concern for acute intracranial hypertension and uncal herniation. It is therefore essential to differentiate isolated benign mydriasis from uncal herniation-induced oculomotor nerve palsy. Nebulized ipratropium bromide, an anticholinergic medication used for the treatment of asthma and chronic obstructive pulmonary disease, is known to induce benign anisocoria.<sup>[1-6]</sup> We report ipsilateral mydriasis in two neurosurgical patients with facial weakness and hemiparesis after treatment with nebulized ipratropium bromide. The unilateral mydriasis was due to poorly sealed face mask on the side of facial weakness.

## Case Reports

### Case 1

A 69-year-old man with a history of primary lung carcinoma and a right frontal mass was admitted to our intensive care unit (ICU) after a craniotomy for brain biopsy and tumor resection. He had left facial weakness and hemiparesis after craniotomy and was treated with corticosteroids for vasogenic edema. On ICU day 5, he was noted to have a dilated and fixed left pupil (5 vs. 3 mm on the right) without ptosis, extraocular movement impairment, or mental status change. Emergent computed tomography (CT) of the head showed no evidence of mass effect or uncal herniation. Review of medications revealed that he received ipratropium bromide nebulizer treatment (500 µg) every 4 h for respiratory distress. His anisocoria resolved within a few hours after discontinuation of ipratropium bromide treatment.

### Case 2

A 32-year-old, previously healthy woman presented with headache, drowsiness, global aphasia, and right hemiparesis from a left frontal intracerebral hemorrhage. Moyamoya disease was diagnosed and she

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underwent urgent craniotomy for hematoma evacuation. Postprocedurally, her mental status improved with a persistent right facial droop and dense right hemiparesis. On ICU day 4, she was noted to have an isolated dilated and fixed right pupil (9 vs. 3 mm on the left). An urgent CT scan showed no evidence of mass effect or brain herniation. The patient had received nebulized bromide ipratropium every 4 h over the previous few days. The anisocoria resolved within 24 h of ipratropium bromide discontinuation.

## Discussion

Ipratropium bromide is a derivative of atropine that antagonizes acetylcholine at the muscarinic cholinergic receptor. Nebulized ipratropium bromide is one of the most commonly used medications in the ICU. It may cause unilateral mydriasis from topical administration or accidental spillage of ipratropium bromide aerosol or droplets into the eye from a poor-fitting mask<sup>[1-5]</sup> or broken nebulizer circuit.<sup>[6]</sup> The dose of the medication and the frequency of administration may also play a role in inducing mydriasis.<sup>[6]</sup>

The development of unilateral mydriasis in patients with intracranial hemorrhage or tumor is often treated as uncal herniation until proven otherwise. However, a thorough neurological examination may avoid unnecessary imaging studies and therapeutic intervention. In both of our cases, the patients had a stable neurological examination without mental status change. There were no ptosis and extraocular movement impairment. The dilated and fixed pupil was ipsilateral to the facial weakness and hemiparesis, and contralateral to the intracranial tumor or hemorrhage. Therefore, the

mydriasis was unlikely secondary to mass effect and uncal herniation.

Of note, both patients had facial weakness with flattening of the nasolabial fold. The nebulized ipratropium appeared to have leaked into the eye ipsilateral to facial weakness via the poorly sealed nebulizer mask. Our report suggests that ipratropium nebulizer treatment may cause a false herniation sign in patients with facial weakness and hemiparesis. The presence of ipsilateral weakness, as well as the lack of mental status change, ptosis, and extraocular movement impairment helps to differentiate this benign etiology from uncal herniation. Recognition of ipratropium bromide-induced mydriasis in the hospital setting eliminates the need for extensive imaging work-up and emergent intervention.

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