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Nursing Interventions And Pharmacological Treatments For Acute Glaucoma In Emergency Settings: A Narrative Review

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Abstract

Background: Acute angle-closure glaucoma (AACG) is an ophthalmic emergency characterized by a sudden, painful elevation of intraocular pressure (IOP) that can lead to irreversible optic nerve damage and vision loss within hours if not promptly treated. Effective management in the emergency department (ED) is critical to prevent permanent visual impairment.
Aim: This narrative review aims to synthesize current evidence on the efficacy of combined nursing interventions and pharmacological treatments for AACG in emergency settings, evaluating their roles in rapid IOP reduction, patient stabilization, and preparation for definitive therapy.
Methods: A comprehensive literature search was conducted across PubMed, CINAHL, and Cochrane Library databases (2010-2024). Included were clinical trials, observational studies, systematic reviews, and clinical guidelines. Data were extracted and narratively synthesized focusing on interdisciplinary emergency care pathways.
Results: Evidence supports a synergistic approach. Immediate first-line pharmacological therapy (e.g., topical beta-blockers, alpha-2 agonists, systemic carbonic anhydrase inhibitors, and hyperosmotic agents) is foundational. Concurrently, structured nursing interventions—including rapid triage, pain and anxiety management, patient positioning, meticulous medication administration, and preoperative preparation—significantly enhance treatment efficacy, improve patient outcomes, and reduce time-to-definitive care.
Conclusion: Optimal management of AACG in the ED requires a tightly integrated, protocol-driven partnership between emergency clinicians and nursing staff. Combining rapid, stepped pharmacological therapy with dedicated, knowledgeable nursing care is essential for successful emergency intervention and preservation of vision. Standardized, interdisciplinary protocols are recommended for all emergency settings.

Keywords: Acute Angle-Closure Glaucoma; Emergency Nursing; Intraocular Pressure; Ophthalmic Emergency; Pharmacological Management.

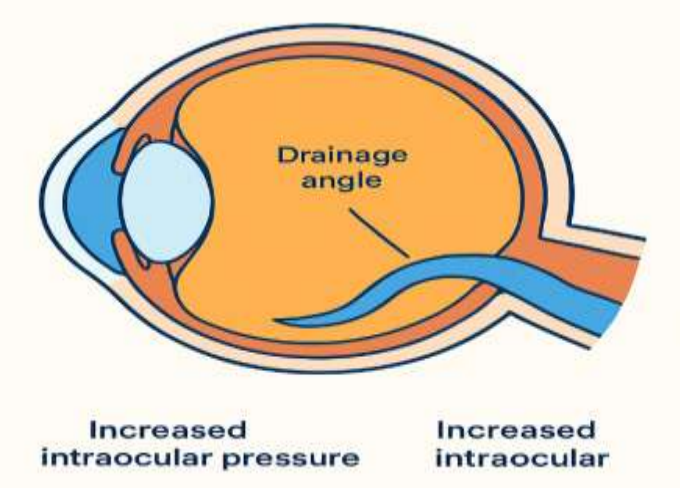
Introduction

Acute angle-closure glaucoma (AACG) represents one of the most urgent ophthalmic crises encountered in emergency departments (EDs) worldwide. It is defined by a precipitous rise in intraocular pressure (IOP), often exceeding 40-50 mmHg, due to a physical blockage of the eye's drainage angle by the peripheral iris (Langridge & Williams, 2017). This mechanical obstruction prevents the outflow of aqueous humor, leading to an accumulation that creates intense pain, corneal edema, nausea, and visual disturbances such as halos around lights. Without swift intervention, the sustained high IOP can cause irreversible damage to the optic nerve head, resulting in permanent vision loss within a matter of hours (Shen et al., 2025). The epidemiological burden of AACG, while lower than that of primary open-angle glaucoma, carries significant morbidity due to its acute and devastating nature, with higher prevalence noted in populations with anatomically shallower anterior chambers,

such as individuals of East Asian and Inuit descent (Chan et al., 2019; Nüssle et al., 2021). The emergency setting, with its inherent challenges of high acuity, diagnostic complexity, and time sensitivity, forms the critical frontline where initial management decisions directly dictate visual prognosis.

The pathophysiology of AACG is rooted in ocular anatomy. Predisposing factors include a shallow anterior chamber, a thickened or anteriorly positioned lens, and a narrow iridocorneal angle (Zhang et al., 2021). Precipitating events can include pharmacologic mydriasis (pupil dilation), dim lighting, emotional stress, or systemic medications with anticholinergic properties (Sng et al., 2023). When the pupil dilates in a predisposed eye, the thickened peripheral iris can fold and block the trabecular meshwork. This leads to an accumulation of aqueous humor, posterior iris bowing (iris bombé), and a self-perpetuating cycle of angle closure and escalating IOP (Kondkar, 2021). The resulting ischemic insult to the optic nerve and mechanical stress on ocular structures generate the classic symptom triad of severe ocular pain, headache, nausea/vomiting, and blurred vision. Recognizing this constellation of symptoms is the first critical step in the emergency management pathway. Figure 1 illustrates how peripheral iris obstruction narrows the drainage angle, preventing aqueous humor outflow and causing a rapid rise in intraocular pressure.

Figure 1: Pathophysiology of Acute Angle-Closure Glaucoma



The primary aim of emergency management is unequivocal: to rapidly lower the elevated IOP and break the acute attack. This objective serves two immediate purposes: to alleviate the patient's severe pain and distress, and to mitigate the risk of permanent optic nerve damage (Gračner, 2019). Achieving this requires a dual-pronged, synergistic approach that integrates immediate, stepped pharmacological therapy with vigilant, protocol-driven nursing care. This narrative review, covering literature from 2010 to 2024, synthesizes current evidence on this interdisciplinary paradigm. It argues that optimal outcomes in AACG are not achieved by pharmacology alone but through the seamless integration of targeted medications with specialized nursing assessments, interventions, and patient advocacy within the chaotic ED environment.

Pharmacological Arsenal in the Emergency Department

The pharmacological strategy for AACG is multi-targeted, aiming to reduce aqueous humor production, increase its outflow, and reduce vitreous volume. Therapy is typically administered in a stepped or simultaneous manner, beginning with topical agents and escalating to systemic medications as needed. Topical Medications form the first line of defense. Topical Beta-Adrenergic Antagonists (e.g., timolol 0.5%) are almost universally employed as an initial agent. They work by inhibiting beta-2 receptors in the ciliary epithelium, reducing aqueous production by approximately 20-30%, with an onset of action within 30 minutes and a peak effect at 2 hours (Bedrood et al., 2023). Their use, however, requires caution in patients with comorbid reactive airway disease or significant bradycardia. Alpha-2 Adrenergic Agonists (e.g., apraclonidine 1%, brimonidine 0.15%) provide a complementary mechanism by both reducing aqueous production and enhancing uveoscleral outflow (Wang et al., 2020; Tanihara et al., 2024). Apraclonidine is particularly favored in the acute setting for its rapid

onset. Topical Carbonic Anhydrase Inhibitors (e.g., dorzolamide 2%, brinzolamide 1%) offer another route to suppress aqueous production by inhibiting the ciliary enzyme carbonic anhydrase. They are often used in conjunction with beta-blockers for an additive effect (Kumari et al., 2021; Miglani & Ullah, 2023).

A cornerstone of acute management is the use of Parasympathomimetic (Miotic) Agents, primarily pilocarpine 1-2%. Its role is to constrict the pupil (miosis), which pulls the peripheral iris away from the trabecular meshwork, potentially opening the angle. Historically, it was a first-line drug, but its use in the initial phase of a severe attack is now debated. In an eye with very high IOP (>50 mmHg), the ischemic sphincter muscle may be unresponsive to pilocarpine. Furthermore, pilocarpine can theoretically increase anterior chamber congestion (Yen et al., 2022). Current guidelines often recommend its administration after IOP has begun to decrease with other agents, typically 30-60 minutes into treatment, to then facilitate angle opening (Young et al., 2023).

When topical therapy is insufficient, Systemic Medications are introduced. Oral or Intravenous Carbonic Anhydrase Inhibitors (e.g., acetazolamide 500 mg IV/PO) are the mainstay of systemic therapy. They provide a powerful suppression of aqueous production, with IV administration offering a more rapid onset (within 15 minutes) compared to oral (1-2 hours) (Dietze et al., 2024). Monitoring for side effects such as paresthesia, metabolic acidosis, and hypokalemia is essential. In cases of severe, refractory pressure elevation, Hyperosmotic Agents (e.g., mannitol 20% 1-2 g/kg IV, or glycerol 50% oral) are employed. These create an osmotic gradient that draws fluid from the vitreous and aqueous compartments into the vasculature, reducing vitreous volume and subsequently IOP (Yang & Lin, 2019). Their use requires careful assessment of cardiovascular and renal status due to risks of fluid overload and electrolyte shifts. Table 1 summarizes the first-line pharmacological agents for AACG in the ED.

Table 1: First-Line Pharmacological Agents for AACG in the ED

Drug Class	Example Agents	Mechanism of Action	Onset / Peak	Key Nursing Considerations
Topical Beta-Blocker	Timolol 0.5%	↓ Aqueous production	Onset: 30 min Peak: 2 hrs	Contraindicated in asthma/COPD, bradycardia. Monitor heart rate, respiratory status.
Topical Alpha-2 Agonist	Apraclonidine 1%	↓ Aqueous production, ↑ uveoscleral outflow	Onset: 1 hr Peak: 3-5 hrs	Can cause eyelid retraction, dry mouth. Monitor for allergy.
Topical CAI	Dorzolamide 2%	↓ Aqueous production	Onset: 2 hrs Peak: 4-8 hrs	Local burning/stinging common. Use with beta-blocker for synergy.
Systemic CAI	Acetazolamide 500mg IV/PO	↓ Aqueous production	IV: 15 min PO: 1-2 hrs	Monitor electrolytes (esp. K+). Assess for sulfa allergy. Watch for paresthesia, nausea.
Hyperosmotic	Mannitol 20% (IV) Glycerol 50% (PO)	↓ Vitreous volume via osmosis	30-60 mins	Strict intake/output. Monitor for CHF, renal impairment. Nausea/vomiting common (PO).
Miotic	Pilocarpine 1-2%	Pupil constriction (miosis)	30-60 mins	Often delayed until IOP starts to fall. Can cause brow ache.

The Integral Role of Emergency Nursing Interventions

While physicians order the pharmacological regimen, emergency nurses are the linchpins of effective execution and patient stabilization. Their role extends far beyond simple task completion to encompass clinical judgment, patient education, and advocacy within a rapid-response framework.

Initial Triage and Rapid Assessment is the critical first nursing action. Recognizing the potential for AACG amidst a busy ED is paramount. Nurses trained to identify the non-specific symptoms—severe headache with nausea/vomiting, blurred vision, a red eye—as a potential ocular emergency can dramatically reduce door-to-treatment time (Uhr et al., 2020; Mahjoub et al., 2023). A focused nursing assessment should document visual acuity (even if crude, e.g., "counts fingers"), pain score using a validated scale, presence of corneal clouding (steamy cornea), pupil size and reactivity, and associated systemic symptoms (Gordon & Khooshabeh, 2023). This rapid, targeted assessment facilitates immediate communication with the attending physician and prioritization of care.

Pain and Anxiety Management is a core nursing responsibility. The pain from AACG is often described as excruciating and is a significant source of extreme anxiety and distress, which can further exacerbate IOP (Sabeti et al., 2021; De Arrigunaga et al., 2021). While specific glaucoma medications will ultimately relieve the pain, immediate analgesic and antiemetic administration as per protocol (e.g., parenteral antiemetics like ondansetron for vomiting, and analgesics like intravenous acetaminophen or judicious use of opioids) is a crucial nursing intervention to stabilize the patient, facilitate cooperation, and potentially reduce IOP spikes from Valsalva maneuvers caused by retching (Jones et al., 2023; Dutra et al., 2024). Calm, confident communication and a reassuring environment are non-pharmacological nursing tools of great importance.

Patient Positioning is a simple yet powerful independent nursing intervention. Elevating the head of the bed to 30-45 degrees promotes gravitational shifting of the lens-iris diaphragm posteriorly, which may help widen the anterior chamber angle (Nongpiur et al., 2011). This should be implemented immediately upon suspicion of AACG and maintained throughout the ED stay.

Meticulous Medication Administration and Monitoring is where nursing precision directly impacts therapeutic success. The correct sequence, timing, and technique of eye drop administration are critical. Nurses must ensure proper technique: gentle eyelid retraction, instilling drops into the lower conjunctival sac without touching the dropper to the eye, and applying sustained pressure (digital compression) at the medial canthus (nasolacrimal occlusion) for 2-3 minutes after certain drops (e.g., pilocarpine) to minimize systemic absorption and maximize ocular bioavailability (Ji et al., 2024; Patton & Lee et al., 2024). Monitoring for both therapeutic effect (reduction in pain, patient-reported improvement) and adverse effects (vital sign changes from systemic absorption, allergic reactions) is a continuous nursing process. For systemic medications like mannitol, nurses monitor for signs of fluid overload (crackles, dyspnea) and ensure adequate IV access for its administration.

Preparation for Definitive Care is the final crucial nursing role. AACG is medically stabilized in the ED, but it is surgically cured. The definitive treatment is a peripheral laser iridotomy (LPI), which creates a small hole in the peripheral iris to equalize pressure and bypass the pupillary block. The ED nurse's role is to prepare the patient both physically and psychologically for this next step. This includes ensuring timely consultation with ophthalmology, reinforcing the necessity of the procedure, obtaining informed consent in collaboration with the physician, and preparing the patient for transfer to the laser suite or operating room (Özmen et al., 2023; Chiam & Sung, 2018). Effective patient education at this juncture helps alleviate anxiety and ensures a smooth transition of care (Table 2). Figure 2 summarizes emergency department nursing actions and first-line pharmacological treatments used to rapidly lower intraocular pressure in acute angle-closure glaucoma.

Table 2: Core Nursing Interventions for AACG in the Emergency Department

Intervention Domain	Specific Nursing Actions	Rationale & Evidence-Based Purpose
Rapid Triage & Assessment	- Identify red flags (HA+N/V+eye pain). - Perform rapid visual acuity check. - Assess pupil size/reactivity, corneal clarity. - Obtain pain score.	Early recognition reduces door-to-treatment time, a key prognostic factor (Mahjoub et al., 2023).
Pain & Symptom Management	- Administer prescribed antiemetics (e.g., ondansetron) promptly.	Reduces suffering, prevents IOP spikes from vomiting,

	- Provide analgesics (IV acetaminophen/opioids with caution). - Provide calm, reassuring environment.	improves patient cooperation (De Arrigunaga et al., 2021).
Therapeutic Positioning	- Elevate head of bed 30-45 degrees. - Encourage patient to maintain position.	Uses gravity to shift lens-iris complex posteriorly, potentially aiding angle opening (Nongpiur et al., 2011).
Precision Medication Admin	- Administer drops in correct sequence/timing. - Perform nasolacrimal occlusion for 2-3 mins. - Monitor for systemic side effects (e.g., bradycardia).	Ensures maximal ocular drug bioavailability and efficacy while minimizing adverse systemic effects (Patton & Lee, 2024).
Patient Education & Advocacy	- Explain procedures and medications simply. - Reassure about the temporary nature of vision loss. - Advocate for timely ophthalmology consult.	Reduces anxiety, improves compliance, and ensures continuity of care (Gordon & Khooshabeh, 2023).
Definitive Care Preparation	- Prepare for transfer to the laser suite/OR. - Verify consent is obtained. - Provide pre-procedure teaching re: LPI.	Facilitates seamless transition from emergency stabilization to definitive surgical treatment (Chiam & Sung, 2018).

Figure 2: Nursing Interventions and Pharmacological Treatments for Acute Angle-Closure Glaucoma

Synthesis of Evidence and Clinical Implications

The literature from the past decade consistently underscores that successful management of AACG is an interdisciplinary endeavor. Studies demonstrate that hospitals implementing standardized AACG protocols in the ED, which explicitly outline roles for both physicians and nurses, achieve significantly faster reductions in IOP and shorter overall lengths of stay (Rashed et al., 2017; Phu et al., 2020). The efficacy of pharmacological agents is well-established, but their optimal impact is contingent upon the nursing infrastructure that supports their delivery. For instance, the correct application of nasolacrimal

occlusion can increase the ocular concentration of a topical drug by up to 70%, a nuance entirely within nursing control (Wang et al., 2024).

Furthermore, evidence highlights that patient outcomes are linked not just to the IOP number but to the entire care experience. Effective nursing management of pain and anxiety correlates with higher patient satisfaction and better tolerance of both emergency treatments and subsequent procedures (Han et al., 2021). The nurse's role as an educator is also vital; patients who understand their condition and the rationale for laser iridotomy are more likely to adhere to follow-up care, which is essential for managing the fellow eye and preventing future attacks (Zhou et al., 2024).

Challenges remain, particularly in resource-limited settings or general EDs without immediate ophthalmology support. Here, the nursing role expands further, requiring greater autonomous judgment in initiating protocol-driven care and advocating for urgent specialist consultation. Tele-ophthalmology consultations are emerging as a valuable tool, where nurses can facilitate digital imaging and communication to expedite diagnosis and treatment plans (Sommer & Blumenthal, 2020).

Conclusion

Acute angle-closure glaucoma is a time-sensitive emergency where vision hangs in the balance. This narrative review confirms that the path to preserving sight lies in a synergistic, protocol-driven partnership between emergency medicine and nursing. Pharmacological treatments provide the essential biochemical tools to lower IOP, while structured nursing interventions—from rapid triage and expert medication administration to compassionate symptom management and patient advocacy—constitute the vital framework that ensures these tools are used safely, effectively, and efficiently. For the patient experiencing the pain and terror of an acute glaucoma attack, this integrated approach represents the difference between darkness and light. Therefore, it is imperative that all emergency departments develop, implement, and regularly train staff on standardized interdisciplinary protocols for the management of AACG, ensuring that every member of the team, from triage nurse to attending physician, is prepared to act swiftly and in concert to save vision.

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تدخلات التمريض والعلاجات الدوائية للجلوكوما الحادة مغلقة الزاوية في أقسام الطوارئ: مراجعة سردية

الملخص

الخلفية :تُعدُّ الجلوكوما الحادة مغلقة الزاوية (AACG) حالة طوارئ عينية تتميز بارتفاع مفاجئ ومؤلم في ضغط العين الداخلي (IOP)، وقد تؤدي إلى تلف دائم في العصب البصري وفقدان البصر خلال ساعات إذا لم تُعالج فورًا. الإدارة الفعالة في قسم الطوارئ ضرورية لمنع الإعاقة البصرية الدائمة.

الهدف :تهدف هذه المراجعة السردية إلى تجميع الأدلة الحالية حول فعالية الجمع بين تدخلات التمريض والعلاجات الدوائية في إدارة الجلوكوما الحادة مغلقة الزاوية في أقسام الطوارئ، مع تقييم دور كل منهما في خفض ضغط العين بسرعة، وتثبيت حالة المريض، وتحضيره للعلاج النهائي.

الطريقة :أُجري بحث شامل في قواعد البياناتPubMed ، CINAHL، و .Cochrane Library (2010-2024)تم تضمين التجارب السريرية، والدراسات الرصدية، والمراجعات المنهجية، والإرشادات السريرية. تم استخراج البيانات وتجميعها سرديًا مع التركيز على مسارات الرعاية الطارئة متعددة التخصصات.

النتائج :تدعم الأدلة النهج التآزري. يُشكِّل العلاج الدوائي الفوري من الخط الأول (مثل حاصرات بيتا الموضعية، ومنشطات ألفا-2، ومثبطات الأنهيدراز الكربونية الجهازية، والعوامل الهايبرأوزموتية) الأساس العلاجي. في الوقت نفسه، تُعزز تدخلات التمريض المنظمة — بما في ذلك الفرز السريع، وإدارة الألم والقلق، ووضعية المريض المناسبة، وإعطاء الأدوية بدقة متناهية، والتحضير قبل الجراحة — فعالية العلاج بشكل ملحوظ، وتحسّن النتائج السريرية، وتقلل الوقت اللازم للوصول إلى العلاج النهائي.

الاستنتاج :تتطلب الإدارة المثلى للجلوكوما الحادة مغلقة الزاوية في قسم الطوارئ شراكة مدمجة بإحكام وموجهة ببروتوكولات بين الأطباء الطوارئ وطاقم التمريض. الجمع بين العلاج الدوائي السريع التدريجي والرعاية التمريضية المتقانية والمبنية على المعرفة أمر ضروري لنجاح التدخل الطارئ وحفظ البصر. يُوصى بتطبيق بروتوكولات موحدة متعددة التخصصات في جميع أقسام الطوارئ.

الكلمات المفتاحية :الجلوكوما الحادة مغلقة الزاوية؛ تمريض الطوارئ؛ ضغط العين الداخلي؛ طوارئ عينية؛ الإدارة الدوائية.