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Review Article

Management of Acute Glaucoma

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Abstract

Introduction: Acute primary angle closure (APAC) is known to be a common ocular emergency that needs immediate treatment to avoid permanent complications like blindness. Narrow anterior chamber angle, older age, female sex, and Asian racial origin are all known to be predisposing factors for the development of Acute primary angle closure. The predictable power of these predisposing factors is, on the other hand, relatively weak, and many debates remain raised as only a relatively small part of the anatomically predisposed eyes consequently develops Acute primary angle closure.

Aim of Work: In this review, we will discuss management of acute glaucoma.

Methodology: We did a systematic search for management of acute glaucoma using PubMed search engine (http://www.ncbi.nlm.nih.gov/) and Google Scholar search engine (https://scholar.google.com). All relevant studies were retrieved and discussed. We only included full articles.

The terms used in the search were: acute glaucoma, angle closure glaucoma, management, treatment, ophthalmology.

Conclusion: Primary angle closure represents a wide spectrum of medical conditions, from a relatively benign anatomical variant to a painful and permanently blinding disease. In order for patients to receive appropriate management, they should first be correctly grouped into one of four groups: PACS, PAC, PACG, or AACC. Although there is limited evidence to confidently suggest any treatment modality in addition to serial gonioscopy in PACS, management of PAC, PACG, and AACC is considered extremely important to prevent or delay glaucomatous optic neuropathy. For many years, management has included pharmacological treatment and LPI as primary modalities. However, as cataract surgery has become a relatively safer, faster, and more affordable procedure, its role in the management of angle closure is coming to the forefront. Randomized clinical trials are required to detect those patients who will consequently benefit most from cataract extraction compared with LPI.

Keywords: *Acute Glaucoma; Angle Closure Glaucoma; Management; Treatment; Ophthalmology*

Introduction

Acute primary angle closure (APAC) is known to be a common ocular emergency that needs immediate treatment to avoid permanent complications like blindness. Narrow anterior chamber angle, older age, female sex, and Asian racial origin are all known to be predisposing factors for the development of Acute primary angle closure. The predictable power of these predisposing factors is, on the other hand, relatively weak, and many debates remain raised as only a relatively small part of the anatomically predisposed eyes consequently develops Acute primary angle closure.

Primary angle closure (PAC) is a medical condition where there is an appositional or a synechial closure of the anterior chamber angle of the eye, possibly causing elevated intraocular pressure (IOP) and glaucoma. It is thought that prolonged and repetitive irido-trabecular contact causes the failure of aqueous filtration and thus peripheral anterior synechiae (PAS). Although pupillary block is known to be the commonest pathophysiology causing closure of the angle, other anatomical factors like the axial length, the diameter of the cornea, the volume of the iris and the insertion of the angle, the size and position of the ciliary body, and the thickness of the lens also have an important role in the development of the condition [1]. The prevalence of PAC differs significantly among different races, from being extremely small in some European populations and Western populations [2] to reach three percent in some Inuit populations [3], Asian individuals [4] and Indian [5] populations. However, not all 'angle closure' cases are considered to be equal and the disease should be well-defined and categorized before a management plan is determined. Given the anatomical basis causing a narrow iridocorneal angle, the closure of the angle is most usually a bilateral condition. The most worrisome complication that follows this anatomical variant is the development of what is called an acute angle closure crisis (AACC), where there is a sudden increase in intra-ocular pressure secondary to an acute and a complete or a near-complete anterior chamber angle closure. On the other hand, the more common scenario, specifically among Western and European patients, is a more slow and chronic closure of the angle. A primary angle closure suspect (PACS) is known to be having at least 1,808 of the iridotrabecular contact without peripheral anterior synechiae or elevated intra-ocular pressure. primary angle closure also has at least 1,808 of the iridotrabecular contact, but with peripheral anterior synechiae and elevated intra-ocular pressure. Primary angle closure glaucoma (PACG) is known to be primary angle closure with the concomitant presence of glaucomatous optic neuropathy. The aim of this review is to explore the previously mentioned types of angle closure and present the evidence for management plans of each type.

Methodology

We did a systematic search for management of acute glaucoma using PubMed search engine (http://www.ncbi.nlm.nih.gov/) and Google Scholar search engine (https://scholar.google.com). All relevant studies were retrieved and discussed. We only included full articles.

The terms used in the search were: acute glaucoma, angle closure glaucoma, management, treatment, ophthalmology.

Demographic risk factors

The prevalence of Primary angle closure glaucoma differs among varying geographic areas and racial groups. Asians, for example, have been shown to have the highest prevalence of Primary angle closure glaucoma, except for the Inuit people.25; 26 The average incidence rates of Primary angle closure glaucoma in the countries of Croatia, Finland, and the United Kingdom, on the other hand, are 4.1, 3.8 and 4.14 cases per 100,000 persons-year, respectively [6]. In other countries like Singapore and Hong Kong, the incidence among individuals aged thirty years and older is 12.2 and 10.4 per 100,000 persons-year, respectively. In addition, in southwestern rural Japan, 0.6 percent of the general population has a history of or were diagnosed with Acute primary angle closure at least once during their lifetime. studies in northern Italy, on the other hand, demonstrated that the overall prevalence of angle-closure glaucoma is only 0.2 percent. According to these results, Asians suffer from Acute primary angle closure about three times more than whites do.

Environmental factors

It is usually seen that cases of Acute primary angle closure tend to develop in groups of patients and seem to be more common in the months during the winter season. A previous study that was conducted in England demonstrated a higher incidence of Acute primary angle closure in the winter seasons; on the other hand, no statistically significant correlation was found between Acute primary angle closure and the temperature of the air, the pressure of the atmosphere, the presence of rain, or the concentrations of the terrestrial magnetic fields. In Finland, Teikari., *et al.* reported that the incidence of Acute primary angle closure was increased in both winter and autumn seasons when compared to spring and summer seasons; on the other hand, in Singapore, Acute primary angle closure was found to be more common during days with higher temperature [7]. Higher incidence rates of Acute primary angle closure were detected during northeast monsoon climate in Malaysia. in another study, on the other hand, David et al. 30 demonstrated that a significant preponderance of attacks happened during summer and winter seasons, coinciding with periods of extremities of temperatures. They suggested that the cold weather in the winter seasons and the hot desert weather in the summer season tend to drive everyone, especially the older individuals, indoors, where less light acts as a darkroom pro-vocative test. Another study done in Croatia, on the other hand, did not show any statistically significant correlations between Acute primary angle closure attacks and seasonal variations.

Anatomic factors

Anterior segment

Acute primary angle closure eyes often have a shorter AL, shallower anterior chamber, smaller diameter of the cornea, and greater thickness of the lens (LT) than normal healthy eyes. Pupillary block is known to be a main pathophysiology of Acute primary angle closure. The pressure difference between the anterior chamber and the posterior chamber due to pupillary block stimulates a forward bowing of the peripheral iris, further leading to narrowing or closure of the angle. The higher prevalence of Acute primary angle closure in Asian patients, on the other hand, is not fully understood by racial disparities in the proportion of eyes with smaller dimensions. With the advanced technologies, such as ultrasound bio-microscopy and anterior segment optical coherence tomography, our knowledge of the pathophysiology of Acute primary angle closure has significantly improved. A UBM study demonstrated racial disparities in the anterior parameters, with a thinner ciliary body and a more anteriorly positioned lens in Chinese individuals when compared to those in white populations [8]. More recent studies that used anterior segment optical coherence tomography have detected newer anatomic factors that are associated with Acute primary angle closure. These include shallower width of the anterior (ACW), smaller are of the anterior chamber (ACA) and smaller volume of the anterior chamber volume (ACV), increased vault of the lens (LV), and greater area of the iris (IA) and greater volume of the iris (IV).

Posterior segment

Uveal effusion is considered to be a common phenomenon that follows closure of the angle. In patients originating from Singapore, uveal effusion was detected in up to percent of PACG and twenty-five percent of Acute primary angle closure eyes [9]. Gazzard., *et al.* demonstrated that the choroid became thicker by about 140 to 400 μm in three eyes shortly following Acute primary angle closure attack. Using B scan echography, De Moraes., *et al.* detected elevated thickness of the choroid (CT) in glaucomatous eyes during the water-drinking test. They demonstrated a transient intra-ocular pressure elevation that was preceded by an elevation in the ocular pulse amplitude linked to CT. In 2003, Quigley., *et al.* suggested that the expansion of the choroid is another mechanism for the closure of the angle and that might may precede or even precipitate Acute primary angle closure. It was suggested that acute choroidal expansion could immediately elevate intra-ocular pressure throughout the eye. As aqueous humor leaves the anterior chamber to restore the normal intra-ocular pressure, a pressure differential could then occur between the vitreous cavity and the posterior chamber. This differential will result in forward lens movement, that could potentially deteriorate the pupillary block. In eyes with a baseline narrowed angle, the dynamic expansion of the choroid could possibly contribute to a higher possibility for Acute primary angle closure.

Primary angle closure suspect

As we mentioned previously, patients with Acute primary angle closure do not show clinical manifestations of permanent obstruction of the aqueous outflow including peripheral anterior synechiae or elevated intra-ocular pressure. The patients are usually known to simply have 'narrow angles'. These patients, who are in fact a large proportion of all patients who have 'angle closure', might be at risk of developing either chronic synechial closure or AACC later. The decision on how to manage patients with Acute primary angle closure is based mainly on the relative risk of developing PAC, PACG, or AACC. Unfortunately, there is not enough evidence literature to give sufficient guidance regarding this large population, specifically among those of European origins. moreover, the few present evidence use varying definitions of suspect patients with 'occludable' angles.

The present rates of developing AACC in this group ranged between six and ten percent, and rates of PAC or PACG were seventeen to thirty-five percent [10]. A study that used those definitions demonstrated the rate of progression from PACS to PAC to be up to eleven percent over five years, with only 0.9 percent of controls progressing to PAC over the same period of time; no individuals developed PACG or AACC [11]. This last study was conducted in India, where the population has been recently found to be at a significantly very higher risk of developing angle closure glaucoma.

Although performing a laser peripheral iridotomy (LPI) is considered quick and usually well-tolerated, several following adverse events have been reported, including the development of elevated intra-ocular pressure, decompensation of the corneal endothelium, hyphema, iritis, posterior synechiae, and the formation of cataracts. On the other hand, a relatively uncommon adverse event following a common procedure might be a too high risk, specifically in populations where the incidence of PACS might high up to twenty-five percent. With the current lack of sufficient data, specifically in populations of European origins, the preferred management for PACS might be strict monitoring and serial gonioscopy. This might be specifically true in an era with healthcare funding is considered to be an important concern. In fact, A recent cost analysis of Medicare glaucoma beneficiaries demonstrated that LPIs are responsible for more than fifty percent of all dollars spent on patients with PACS [12]. Despite this, one should manage the patients and consider the special consequences, which include clinical manifestations which are suggestive of intermittent closure of the angle, systemic pharmacological agents that might increase the risk of pupillary block, or lack of proper access to healthcare.

Primary angle closure and primary angle closure glaucoma

Patients with primary angle closure demonstrate manifestations of chronic angle damage as shown by peripheral anterior synechiae and increased intra-ocular pressure, with the absence of manifestations of glaucomatous optic neuropathy. Management of patients with primary angle closure aims to stop the natural progression from primary angle closure into PACG. In addition, patients with PACG are managed to stop continuous glaucomatous optic nerve damage. There is little debate as to whether these two types of angle closure patients should be cured. The management algorithm for primary angle closure and PACG patients includes LPI plus, if needed, the use of pharmacological or surgical treatments to sufficiently control intra-ocular pressure. Despite the previously mentioned risks of LPI, lack of proper management could potentially have more adverse effects and it has thus been recommended as the standard of care.

Recently, extraction of cataract has been recommended as an alternative to LPI in primary angle closure and PACG. Although a Cochrane Review that was published in 2006 demonstrated insufficient evidence to suggest the performance of cataract extraction over LPI in patients with chronic angle closure glaucoma [13], there is increasing evidence to recommend extraction of lens as a first-choice procedure. Some studies have demonstrated that extraction of cataract and placement of intraocular lens (IOL) could possibly increase the depth of anterior chamber, open the iridocorneal angle, and often lead to reduced intra-ocular pressure [14].

Moreover, Lam., *et al.* [15] concluded that extortion of cataract could be an alternative approach to LPI in patients who have sustained an AACC, although this is not directly applicable to primary angle closure or PACG. nevertheless, these results recommend the use of extraction of cataract as a first line treatment among patients with primary angle closure or PACG and cataracts, specifically among

Asian patients. Tham., *et al.* [16] more recently assessed the of use clear lens extraction versus the use of trabeculectomy in patients with medically uncontrolled angle closure glaucoma over two years. This study concluded that both phacoemulsification and trabeculectomy decreased intraocular pressure by thirty-four percent and thirty-six percent respectively.

Despite that patients who did trabeculectomy used less pharmacological agents post-operatively, they also maintained statistically significant higher rates of adverse events. Three eyes (twelve percent) of the phacoemulsification group needed later trabeculectomy for intra-ocular pressure control and two eyes (eight percent) were recommended to undergo trabeculectomy but rejected to do so at the time when the study closed. Six eyes (twenty five percent) in the trabeculectomy group did 10 more surgical procedures: 5 surgeries for cataract, 3 needling procedures in 2 eyes, 1 reformation of the anterior chamber and later bleb revision. Three more cataracts were noticed in the trabeculectomy group but had not been cured at the study end-point. Additionally, Barbosa., *et al.* [17] published recently a study describing extraction of clear lens for PACG. About 5 patients with PACG and increased intra-ocular despite maximal tolerated medical therapy underwent extraction of lens and IOL placement. Post-operatively, 3 patients had well controlled intra-ocular pressure without pharmacological treatment. One patient had better intra-ocular pressure, but still needed topical treatment for sufficient intra-ocular pressure control. One patient had no change in intra-ocular pressure and regardless of the use of maximum topical agents, consequently needed surgery for glaucoma. The efficacy in Angle-closure Glaucoma of Lens Extraction (EAGLE) Study Group is a multicenter, randomized controlled trial comparing extraction of lens and LPI in patients who have newly diagnosed primary angle closure or PACG [18]. The primary endpoints for this study included intra-ocular pressure, quality of life of the patient, and the cost effectiveness at three years. Despite the fact that this study is still in progress, it might finally lead to a significant change in the current practice patterns or might confirm the efficacy of current treatments.

Acute angle closure crisis (AACC) is a serious blinding event that is characterized by the development of a sudden and dramatic elevation in intra-ocular pressure with linked pain in the eyes, headache, the development of corneal edema, decreased vision, vascular congestion, and a mid-dilated pupil. Despite being uncommon within populations of European origins, the incidence of AACC has been estimated to be about 1.5 percent annually among Chinese individuals aged older than fifty years. Within such high-risk populations, prevention of an AACC is of the utmost importance.

Conclusion

Primary angle closure represents a wide spectrum of medical conditions, from a relatively benign anatomical variant to a painful and permanently blinding disease. In order for patients to receive appropriate management, they should first be correctly grouped into one of four groups: PACS, PAC, PACG, or AACC. Although there is limited evidence to confidently suggest any treatment modality in addition to serial gonioscopy in PACS, management of PAC, PACG, and AACC is considered extremely important to prevent or delay glaucomatous optic neuropathy. For many years, management has included pharmacological treatment and LPI as primary modalities. However, as cataract surgery has become a relatively safer, faster, and more affordable procedure, its role in the management of angle closure is coming to the forefront. Randomized clinical trials are required to detect those patients who will consequently benefit most from cataract extraction compared with LPI.

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