10.5.1. Angle-Closure Glaucoma (I): Primary Angle Closure (I)

Introduction to ACG

- 67 million patients with glaucoma worldwide
  - one-half are of Asian descent
- prevalence of angle-closure glaucoma (ACG) is higher than that of other types of glaucoma among Asians
- ratio of OAG to ACG in Chinese individuals ranges from 1:1 to 2:6:1
  - PACG is responsible for 91% of the bilateral blindness in China
- pathogenesis
  - primary pathology is anatomical, proximal to the trabecular meshwork
  - peripheral iris impedes the access of aqueous to the trabecular meshwork
- onset
  - acute ACG (20%–30%)
  - chronic ACG (70%–80%)
- 2 main categories
  - primary
    - no identifiable underlying pathology
    - only an anatomical predisposition to pupillary block
    - rare <40 years
  - secondary
    - an identifiable pathologic cause initiates the angle closure

Pathogenesis and Pathophysiology of Angle Closure

- apposition or adhesion of the peripheral iris to the trabecular meshwork
  - appositional
    - transient and intermittent
  - synechial
    - permanent
- 2 mechanisms
  1. mechanisms that push the iris forward from behind
  2. mechanisms that pull the iris forward
  - See Table 5-1
- dynamic changes in iris volume and water content
  - most eyes show a loss of iris volume with dilation of the pupil
  - eyes at risk for angle closure may have less ability to rid the iris stroma of water upon dilation
- pupillary block
  - most frequent cause of angle closure
  - flow of aqueous from the posterior chamber through the pupil is impeded at the level of the lens–iris interface
    - pressure gradient between posterior and anterior chambers
    - peripheral iris bows forward against the trabecular meshwork
  - PACG results from anatomical factors at the lens–iris interface
    - iris contact with
      - lens
      - intraocular lens
      - capsular remnants
      - anterior hyaloid
      - vitreous space–occupying substance (air, silicone oil)
  - maximal when the pupil is in mid-dilated position

Figure 5-1 (© 2020 American Academy of Ophthalmology)

  - secluded pupil
    - absolute pupillary block as a result of 360° of posterior synechiae
  - may be broken by an unobstructed peripheral iridectomy
- angle closure without pupillary block
  - iris and/or lens being pushed, rotated, or pulled forward
- lens-induced angle-closure glaucoma
  - increased pupillary block caused by
    - intumescent lens (phacomorphic glaucoma)
    - dislocated/subluxated lens
    - lens bloc
      - zonular laxity
        - allows the lens to move forward
        - prone position may aggravate the tendency of the lens to move forward
- iris-induced angle closure
  - peripheral iris, either directly or indirectly, is the cause of the iridotrabecular apposition
  - developmental anomalies
    - anterior cleavage abnormalities
      - iris insertion is more anterior into the scleral spur or meshwork
  - thick peripheral iris
    - on dilatation "rolls" into the trabecular meshwork
  - anteriorly displaced ciliary processes
    - secondarily rotate the peripheral iris forward into the meshwork (plateau iris)
  - aniridia
    - rudimentary iris leaflets rotate into the angle

Risk Factors for Developing Primary Angle Closure

- race
  - prevalence of PACG in patients >40 years
    - 0.1%–0.8% in whites
    - 0.1%–0.2% in blacks
    - 2.1%–5.0% in the Inuit
    - 0.4%–1.4% in East Asians
      - cannot be explained by biometric parameters alone
      - the burden of ACG is greater in asian countries
    - 0.3% in the Japanese
    - 2.3% in a mixed ethnic group in South Africa
  - most angle closure presents as an asymptomatic chronic disease without an acute attack
  - references
- ocular biometrics
  - small, "crowded" anterior segments
  - shallow anterior chamber
    - anterior chamber depth (ACD) <2.5 mm
      - most patients with PACG have ACD <2.1 mm
    - strong correlation of increasing PAS formation with ACD <2.4 mm
    - angle closure still occurs with deep anterior chambers
  - thick lens
    - prevalence of ACG increases with each decade after 40 years of age
      - increasing thickness and forward movement of the lens with aging
  - increased anterior curvature of the lens
  - short axial length (AL)
  - small corneal diameter and radius of curvature
  - references
- gender
  - 2-4 x more common in women
  - have smaller anterior segments and ALs
  - not enough to explain this gender predilection
- family history
  - incidence increased in first-degree relatives of affected individuals
    - Whites
      - 1%–12%
    - Chinese
      - 4 x greater risk
    - Inuit
      - 3.5 x greater risk
  - genetic influence in ACG
- refraction
  - hyperopia
  - ACG in a patient with significant myopia should alert the clinician to secondary mechanisms
    - microspherophakia
    - plateau iris configuration
    - pl ta ue ir is co nf ig ur at io n

Acute Primary Angle Closure

- symptoms
  - ocular pain
  - headache
  - blurred vision
  - rainbow-colored halos around lights
  - nausea and vomiting
- signs
  - high IOP
  - mid-dilated, sluggish, and irregularly shaped pupil
  - corneal epithelial edema
  - congested episcleral and conjunctival blood vessels
  - shallow anterior chamber
  - mild amount of aqueous flare and cells
- definitive diagnosis
  - gonioscopy
    - dynamic gonioscopy
      - appositional closure vs. synechial closure
      - may also be therapeutic in breaking the attack of acute angle closure
      - clearing of corneal edema with medical treatment of elevated IOP or topical glycerin may be necessary
    - pupillary constriction stimulated by the slit-lamp beam may open the angle and the narrow recess may go unrecognized

Figure 5-2 (© 2020 American Academy of Ophthalmology)

    - gonioscopy of the fellow eye reveals a narrow, occludable angle
      - presence of a deep angle in the fellow eye should alert the clinician to alternative causes of elevated IOP
- complications
  - glaucomatous optic nerve damage
  - ischemic nerve damage
  - retinal vascular occlusion
  - PAS can form rapidly
  - IOP-induced iris ischemia
    - sector atrophy of the iris
    - pigment release from the iris
      - pigmentary dusting of the iris surface and corneal endothelium
    - iris sphincter muscle ischemia
      - permanently fixed and dilated pupil
  - Glaukomflecken
    - small anterior subcapsular lens opacities
- treatment
  - treatment modalities
    - treatment of choice
      - laser iridotomy
    - when laser iridotomy cannot be accomplished
      - less commonly
        - surgical iridectomy
      - with or without goniosynechialysis
        - lensectomy
      - flattens the peripheral iris
        - laser iridoplasty
      - relieves pupillary block
        - laser pupilloplasty
    - cholinergic agents (pilocarpine 1%–2%)
      - mild attacks
      - pupillary sphincter may be ischemic and unresponsive to miotic agents if IOP >40–50 mm Hg
      - increase the vascular congestion of the iris or rotate the lens–iris interface more anteriorly
        - stronger miotics should be avoided
    - other IOP lowering medications
      - cause pupillary dilation and iris ischemia
        - nonselective adrenergic agonists
          - avoid
      - cause pupillary dilation and iris ischemia
        - medications with significant α1-adrenergic activity (apraclonidine)
      - β-adrenergic antagonists
      - α2-adrenergic agonists
      - prostaglandin analogues
      - oral, topical, or intravenous carbonic anhydrase inhibitors
    - hyperosmotic agent
      - orally or intravenously
    - paracentesis
      - 30-gauge needle
      - reduce the IOP to enable the miotic agent to constrict the pupil and break the block
    - globe compression
    - dynamic gonioscopy
  - improved IOP does not necessarily mean that the angle has opened
    - IOP may remain low for weeks following acute angle closure
      - ciliary body ischemia causes reduced aqueous production
    - reevaluate the angle by gonioscopy!
      - to assess the degree of residual synechial angle closure
      - confirm the reopening of at least part of the angle
  - the fellow eye is at high risk of developing acute angle closure
    - especially if the inciting mechanism included systemic sympathomimetic agent (e.g. nasal decongestant) or an anticholinergic agent
    - pain and emotional upset from the involvement of the first eye may increase sympathetic flow to the fellow eye
    - perform peripheral iridotomyin the other eye if a similar angle configuration is present
    - if the contralateral eye has a significantly different angle configuration, secondary ACGs must be strongly considered
      - posterior segment mass
      - zonular insufficiency
      - iridocorneal endothelial (ICE) syndrome

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