CHARGE Association

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Risk

- Newborns: 1 in 10,000

Perioperative Risks

- Respiratory failure in the neonate (due to choanal atresia)
- Difficult airway (cleft lip and palate and tracheomalacia)
- Aspiration risk
- Congenital heart disease

Worry About

- If pt has respiratory insufficiency, consider subglottic stenosis.
- Postop respiratory failure.

Overview

- The term CHARGE was coined in 1981 to describe pts with coloboma, congenital heart defects, choanal atresia, retardation of growth and/or other development, genital anomalies, and ear anomalies with deafness.
- Traditionally diagnosed clinically, using Blake or Verloes criteria; now diagnosis can be confirmed by molecular genetic testing.
- In the past, CHARGE was an association. However, it is now accepted as a genetic syndrome.
- It shares many clinical features with velocardiofacial (22q11 deletion syndrome) and Kallmann syndrome.
- Major features (features that are more specific to CHARGE):
  - Coloboma of the iris and/or retina, with or without microphthalmia.
  - Choanal atresia or stenosis.
  - Characteristic CHARGE ear deformity.
  - External ear: Cup-shaped ear with absent ear lobes.
  - Middle ear: Stapes abnormalities and cochlear anomalies.
  - CN dysfunction (oculomotor dysfunction, weak chewing, facial palsy, hearing difficulties, and swallowing problems).
- Minor features (significant, but less specific for diagnosis of CHARGE):
  - Hypothalamo-hypophyseal dysfunction, congenital diaphragmatic hernia, tracheoesophageal fistula, brain anomalies, hypotonia, developmental delay, kidney anomalies, genital hypoplasia, and lacrimal duct atresia.
  - Characteristic face: Broad forehead, square face, and facial asymmetry.
  - Scoliosis, obstructive sleep apnea, and webbed neck.
- Rare features: Immune deficiency, limb anomalies, epilepsy, and anal atresia.
- Four features almost always present with CHD7 mutation: external ear anomalies, cranial nerve dysfunction, semicircular canal hypoplasia, and delayed milestones.
- Congenital heart defects present in 76% of CHD7-positive pts and 85% of clinical diagnosis of CHARGE syndrome.

Etiology

- CHD7 gene mutation
- De novo mutations in almost all cases, with parent-to-child transmission only seen occasionally (autosomal dominant with variable expression)

Usual Treatment

- Multidisciplinary care, including genetic counseling
- Cardiac assessment with possible medical treatment or surgical correction of congenital cardiac anomalies
- Tracheostomy as indicated
- Surgical correction of choanal atresia as needed
- Feeding therapy and speech therapy
- Gastrostomy in pts who fail traditional feeding therapy
- Renal, endocrine, and immunologic evaluations
- Hearing aids and possible deaf-blind services
- Psychologic evaluation because some pts may need assistance in coping with developmental and behavioral management

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	Choanal atresia Cleft lip +/– palate Micrognathia	Dyspnea	Can be unilateral, failure to pass NGT	
CV	Conotruncal anomalies (tetralogy of Fallot, truncus arteriosus, interrupted aortic arch), AV canal defects, ASD, VSD, PDA	Activity level Cyanosis Weight	Murmurs	ECHO
RESP	Aspiration pneumonitis Airway obstruction below choanae in 70% of patients (laryngomalacia—40%, tracheomalacia—20%, subglottic stenosis—10%) TEF	Dyspnea Cyanosis Review prior records Snoring	Rales, wheezing	
GI	Swallowing difficulties, FTT			
CNS	CN dysfunction (facial palsy, hearing loss, dysphagia) Hypotonia Developmental delay	Variable		Swallowing study IQ <70 in over 70%
GU	Renal insufficiency, Polyhydramnios Cryptorchidism and micropenis/hypoplastic labia			BUN, Cr
ENDO	Hypogonadotropin deficiency Short stature, delayed puberty			LH, FSH
HEME/ID	Immunodeficiency (lymphopenia, SCID)			CBC+diff

Key References: Hsu P, Ma A, Wilson M, et al: CHARGE syndrome: a review, *J Paediatr Child Health* 50(7):504–511, 2014; Bergman JE, Janssen N, Hoefsloot LH, et al: CHD7 mutations and CHARGE syndrome: the clinical implications of an expanding phenotype, *J Med Genet* 48(5):334–342, 2011.

Perioperative Implications

Preoperative Preparation

- Premedication with midazolam can be helpful because many pts with CHARGE syndrome have developmental delay and autistic-like behaviors.

Monitoring

- Standard as indicated by coexisting disease(s) and surgical procedure

Airway

- Anticipate difficult airway. Rarely, airway becomes more difficult as CHARGE pts age. Case reports exist for failed direct laryngoscopy, failed laryngeal mask airway, and failed Glidescope intubation. Therefore multiple airway adjuncts must be immediately available.
- May need PEEP to help with ventilating pts with OSA and tracheomalacia.
- Anticholinergic may be helpful with excessive salivation.
- Consider requesting ENT surgeon in the room for known difficult airway pts.

Preinduction/Induction

- Inhalational or intravenous induction. Maintain spontaneous ventilation until proven that airway can be managed safely.

Maintenance

- Routine

Extubation

- Residual muscle relaxant may worsen preexisting hypotonia.
- Anticipate airway obstruction especially if pt was difficult to ventilate during induction.
- Be prepared to reintubate.

Postoperative Period

- Postop airway events occur in 35% of CHARGE pts. Risk factors include cardiac, GI, or airway procedures.

Anticipated Problems/Concerns

- Desaturation needing intervention
- Excessive secretions
- Aspiration
- Arrhythmias or other heart rate abnormalities
- Stridor
- Failed extubation