orphanaesthesia

Anaesthesia recommendations for

Cleidocranial Dysplasia

Disease name: Cleidocranial Dysplasia

ICD 10:

Synonyms: Scheuthauer-Marie-Sainton syndrome; Marie-Sainton syndrome

Disease summary: Cleidocranial dysplasia (CCD) is a skeletal abnormality characterized by aplasia of one or both clavicles, dental deformities and defective ossification of the skull bones. Fontanelles can remain open until adulthood, but sutures usually close with the interposition of wormian bones (*ossa suturarum*). Mental development is usually normal, but conductive hearing loss can occur due to recurrent ear infections. CCD is an autosomal dominant genetic disease caused by a defect in the CBFA1 gene (Core Binding Factor A1). Mutations in the CBFA1 gene located on chromosome 6p21, also known as RUNX2 (Runt Related Transcription Factor 2), prevent the transformation of mesenchymal stem cells into osteoblasts that are essential for membranous and endochondral bone formation. The disease has no predilection for genders and ethnic groups. It presents variable expressiveness and complete penetrance. The estimated incidence is 1:1,000,000 births.[1,2]

CCD is also known as Scheuthauer-Marie-Sainton syndrome, the eponyms are related to Gustav Scheuthauer, Pierre Marie and Paul Sainton who initially described this disease in the late 19th century.[3,4]

Calvarial bossing develops in the frontal, parietal and occipital regions and gives the skull a large globular shape with a proportionately small face. Other abnormalities may include maxillary hypoplasia and absent paranasal sinuses. There may be an abnormality of the temporomandibular joint (TMJ) with mandibular prognathism, micrognathia and a hypoplastic hyoid bone. High arched palate with the possibility of cleft palate have been reported. Tooth abnormalities are common, including delayed eruption of permanent teeth, multiple impacted teeth, enamel hypoplasia, crown and root abnormalities and supernumerary teeth. [1]

Patients have hypoplastic clavicles that are absent in rare cases, resulting in approximation of the shoulders anterior to a small narrowed thoracic cage. Cardiac and respiratory pathophysiology can manifest due to the chest deformity and precipitate early acute respiratory distress. Anomalies of the clavicle can lead to injury to the subclavian artery. Patients exhibit short stature, hypoplastic iliac bones with a narrow pelvis and delayed or absent ossification leading to a widened pubic symphysis. The skeletal dysplasia is widespread and may extend to vertebral anomalies such as scoliosis, kyphosis, spondylosis and spondylolisthesis in the hands, metacarpal pseudoepiphyses and hypoplastic phalanges are observed.[1]

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Perhaps new knowledge

Every patient is unique

Perhaps the diagnosis is wrong

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Emergency information

A	**AIRWAY / ANAESTHETIC TECHNIQUE**	All types of anaesthesia can be considered, although neuraxial might be more difficult than usual. Difficult airway is common due to craniofacial abnormalities. Given the high-risk airway and associated respiratory co-morbidities, delayed extubation is justified, particularly after long procedures. It is prudent to monitor patients with CCD in a critical care setting following anaesthesia.
B	**BLOOD PRODUCTS (COAGULATION)**	No special considerations regarding blood transfusion. No association with coagulation disorders reported.
C	**CIRCULATION**	There have been reports of upper limb ischemia from subclavian artery compression due to the clavicular defects in CCD.
D	**DRUGS**	No known contraindications to common anaesthetic agents.
E	**EQUIPMENT**	Difficult airway equipment should be available. Proper positioning and careful protection of pressure areas are crucial. Use ultrasound guidance for regional blocks.

Typical surgery and procedures

Due to dental abnormalities, many paediatric and adult patients with CCD will require multiple tooth extractions and complex orthodontic procedures. [5-7]

Corrective orthopaedic and orthognathic surgeries are also common. Additionally, there is a higher prevalence of caesarean section in the obstetric population due to cephalopelvic disproportion. [8-11]

Type of anaesthesia

In addition to general anaesthesia, there are reports of several types of anaesthesia, including spinal anaesthesia, epidural anaesthesia, and combined spinal-epidural anaesthesia. All techniques have been performed successfully.

It is recommended to use ultrasound guidance for regional blocks, especially in the upper limb, due to unique anatomical changes from clavicular agenesis or hypoplasia. [7]

Necessary additional pre-operative testing (beside standard care)

CCD is a disease with great variability in its clinical presentation. In the perioperative workup, cardiorespiratory evaluation is important, due to the narrowed chest wall and spinal deformities causing restrictive lung physiology. Radiological imaging of the chest and pulmonary function tests may be beneficial.

Craniofacial deformities in CCD often coincide with upper airway obstruction. Formal polysomnography is indicated in patients with symptoms of obstructive sleep apnoea. An echocardiogram should be considered if there are concerns of secondary cor-pulmonale. Preoperative imaging of the odontoid process is recommended, as atlantoaxial subluxation with consequent myelopathy has also been reported in these patients. Ultrasound or magnetic resonance imaging of the spine may be indicated before neuraxial blocks given the increased prevalence of spinal deformities in CCD. [11,12]

Particular preparation for airway management

In addition to a standard history and physical examination, anaesthesiologists should consider all CCD patients to have difficult airways. It is important to check previous anaesthetic records in planning airway management.

Facial dysmorphia gives the skull a globular shape with a proportionately larger occiput but smaller face. Other high-risk features include midface hypoplasia, mandibular prognathism from TMJ dysfunction, and micrognathia. [1]

High arched palate and cleft palate have been reported. Dental abnormalities are significant including delayed tooth eruption, enamel hypoplasia, root abnormalities, supernumerary teeth, dental crowding, abnormal bite and malocclusion. [13]

There must be a judicious approach to an airway strategy following key principles of managing a difficult airway according to established international guidelines. This is crucial in the paediatric patient when intravenous access may pragmatically require pre-medication or inhalational sedation. A skilled anaesthetic assistant, typical airway adjuncts and advanced equipment, such as a video laryngoscope, fibreoptic bronchoscope and emergency front of neck access kits must be readily available. [7]

Pre-operative consultation with an otolaryngologist should be considered on a case by case basis.

Particular preparation for transfusion or administration of blood products

No recommendations reported.

Particular preparation for anticoagulation

No recommendations reported.

Particular precautions for positioning, transportation and mobilisation

Adequate protection in pressure areas is extremely important. Patients should be carefully positioned and padded as the bones are fragile and osteoporotic, susceptible to fractures and the joints have hypermobility that easily leads to injuries. [11]

There have been reports of upper limb ischemia from subclavian artery compression due to the clavicular defects in CCD. It is important to periodically check the peripheral pulses after positioning the patient and during anaesthesia.[14]

Interactions of chronic disease and anaesthesia medications

No recommendations reported.

Anaesthetic procedure

- There are no particular recommendations regarding the choice of specific anaesthetic drugs or mode of anaesthesia. In regards to airway management, anatomical abnormalities of the skull, facial bones and teeth contribute to difficult mask ventilation and endotracheal intubation, while spinal abnormalities can represent a challenge to neuraxial techniques.[15]

- Hypoplasia or aplasia of the clavicles distorts the anatomical reference points for the insertion of a subclavian intravenous catheter or for performing an infraclavicular anaesthetic block. Ultrasound-guided approaches to central venous lines and brachial plexus blocks are recommended in these patients with clavicular hypoplasia.[1]

- Upper limb ischemia is an extremely rare condition described in CCD due to vascular compression and thrombosis of the axillary-subclavian arteries.[14]

- Limited pulmonary reserves and increased sensitivity to respiratory depression are deleterious, so preoperative sedation should be cautiously considered.

- The ability to provide adequate ventilation on a dysmorphic face with a mask should be assessed before using respiratory depressants and sedatives. The appropriate equipment to deal with the difficult airway must be readily available, including indirect laryngoscopy devices.[15]

- In cases of limited mouth opening, the videolaryngoscope has been shown to be useful in facilitating endotracheal intubation. Patients who present limited mouth opening due to ankylosis and temporomandibular joint deformities, or a history of previous orthognathic surgeries must be thoroughly evaluated. Avoid hyperextension and hyperflexion of the cervical spine. Preoperative radiological evaluation of the odontoid process is recommended, as atlantoaxial subluxation with consequent myelopathy has also been reported in these patients. [7]

- For dental procedures under general anaesthesia, routine nasotracheal intubation is safe with the aid of a videolaryngoscope and/or Magill forceps. [5-7,13]

- A narrow chest can cause breathing difficulties in early childhood and decrease the perioperative respiratory reserve at any age. Due to coexisting respiratory complications of CCD, postoperative monitoring of respiratory function in high dependency or intensive care units is recommended. Early physiotherapy should be part of the post-operative care bundle for CCD patients. [1,15]

Particular or additional monitoring

None in particular. Additional monitors are at the discretion of the anesthesiologist, according to the changes imposed by the disease and the magnitude of the procedure.

Possible complications

In addition to difficult intubation, patients with CCD can also be challenging to extubate due to pre-existing craniofacial and cervical spine abnormalities that are compounded by post-surgical changes from corrective head and neck surgery.

Patients with CCD have a higher risk of perioperative respiratory failure and prolonged assisted / mechanical ventilation. All patients should be monitored in a high dependency or intensive care environment post-operatively.

Post-operative care

As per the issues related to a high-risk airway and respiratory co-morbidity, delayed extubation is justified particularly after long procedures. it is prudent to monitor patients with CCD in a critical care environment after anaesthesia.

Disease-related acute problems and effect on anaesthesia and recovery

Refer to above sections.

Ambulatory anaesthesia

Patients with CCD may be more susceptible to respiratory depression and airway obstruction after general anaesthesia, ambulatory surgery should be reserved only for the most minor procedures.

Obstetrical anaesthesia

There are no contraindications for neuroaxial techniques or general anaesthesia for obstetric procedures. Caeserean section is commonly indicated due to cephalopelvic disproportion.

Ioscovich et al. reported the anaesthetic management of a patient with cleidocranial dysplasia who underwent four caesarean deliveries, vaginal delivery and a uterine curettage, using different types of anaesthesia, including spinal anaesthesia, epidural anaesthesia, combined spinal-epidural anaesthesia and general anaesthesia. All techniques were performed without complications.[8]

Neuraxial techniques can be more challenging in parturients with CCD to vertebral abnormalities or previous corrective spinal surgery. Patients with such history may benefit from spinal imaging before neuraxial blockade, including point-of-care-ultrasound.

Rozdarz & Riordan managed a parturient with spinal anaesthesia after an ultrasound of the lumbar spine that excluded hidden spina bifida and other detectable anomalies.[9]

Nishio et al used magnetic resonance imaging to exclude vertebral and spinal abnormalities, which facilitated a successful combined spinal-epidural anaesthesia**.** For general anaesthesia, the issues related to the difficult obstetric airway are exacerbated by the craniofacial deformities of CCD. Refer to the principles of airway management mentioned above.[10]

References

1. Baum VC, O'Flaherty JE. Anesthesia for Genetic, Metabolic, & Dysmorphic Syndromes of Childhood, 3rd Ed, Lippincott Williams &. Wilkins, Philadelphia. 2015;85-86.
2. Lerusse J, Kaux JF. Cas clinique : Maladie de Marie et Sainton ou dysostose cléido-crânienne [The Pierre Marie-Sainton syndrome or cleidocranial dysplasia]. Rev Med Liege. 2020;75(10):639-43.
3. Scheuthauer G. Kombination rudimentärer Schlüsselbeine mit Anomalien des Schädels beim erwachsenen Menschen. Allgemeine Wiener medizinische Zeitung, 1871;16:293-5.
4. Marie P, Sainton P. Observation d'hydrocéphalie héréditaire (père et fils), par vice de dévelopment du crâne et du cerveau. Bulletins et memoires de la Société medicale des hôpitaux de Paris, 1897;14:706-12.
5. Almenrader N, Passariello M, Cascone P. Anaesthesia for a child with cleidocranial dysplasia. Pediatr Anesth Crit Care J 2013;1:29-30.
6. Balakrishnan S, Jacob KK, Shabna K, Shenoy M. General anaesthesia for a child with Cleidocranial Dysplasia: A case report. Journal of Evolution of Medical and Dental Sciences 2014;3(67):14549-14552. DOI: 10.14260/jemds/2014/3953
7. Wang CJ, Neustein SM. General anesthesia in a patient with cleidocranial dysplasia. Middle East J Anesthesiol 2012;21:889-890.
8. Ioscovich A, Barth D, Samueloff A, et al. Anesthetic management of a patient with cleidocranial dysplasia undergoing various obstetric procedures. Int J Obstet Anesth 2010;19:106-108.
9. Rozdarz K, Riordan J. Anaesthetic management of an obstetric patient with cleidocranial dysplasia. International Journal of Obstetric Anesthesia, 2018:33;94–96. DOI:10.1016/j.ijoa.2017.07.003
10. Nishio Y, Hiraki T, Taniguchi H, Ushijima K. Anesthetic management during a cesarean section in a patient with cleidocranial dysplasia: a case report. JA Clinical Reports 2018;4:2. DOI 10.1186/s40981-017-0141-2.
11. Baig T. Cleidocranial Dysplasia: A case report under spinal and general anesthesia in adult female. J Anesth Clin Res 2014;5:433. DOI:10.4172/2155-6148.1000433
12. Datta R, Agarwal J, Sharma D. Anaesthetic considerations in an orphan disease with skeletal anomalies. Indian J Anaesth 2016;60:780-2.
13. Sundaram A, Veluthamanil S, Mercyline AS, Gilbert A, Jino G, Dhas SK. Anesthetic management of a case of cleidocranial dysplasia. Karnataka Anaesth J 2017;3:82-4.
14. Campos Júnior W, Cardoso RM, Fidelis R, Silva ES, Ramos R. A familial case of cleidocranial dysostosis presenting upper limb ischemia. Sao Paulo Med J 2005; 123(6):292-294. Available from: http://dx.doi.org/10.1590/S1516-31802005000600009.
15. Oliveira CRD, Nunes RR, Azevedo RA. Scheuthauer-Marie-Sainton, Síndrome de (Displasia Cleidocranial). Anestesia e doenças incomuns coexistentes. Rio de Janeiro, Sociedade Brasileira de Anestesiologia/SBA, 2017:183-184.

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