European Archives of Oto-Rhino-Laryngology (2021) 278:3605–3611
https://doi.org/10.1007/s00405-020-06546-y

REVIEW ARTICLE

Neonatal nasal obstruction

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Received: 20 October 2020 / Accepted: 1 December 2020 / Published online: 3 January 2021

Abstract

Purpose Congenital nasal obstruction can be a significant cause of respiratory distress in the newborn, given that they are considered to be obligate nasal breathers. Several different causes have been described, which can be broadly classified as anatomical/malformative, non-tumoral masses and cysts, benign and malignant neoplasia, inflammatory/infectious, traumatic/iatrogenic, and miscellaneous. The purpose of this review is to provide updated and useful clinical information for teams involved in neonatal care, especially in a hospital setting.

Methods A review of the available literature was performed. Studies were sourced from PubMed with searching of relevant headings and sub-headings and cross-referencing.

Results The most common etiology is inflammatory, which can have different precipitating factors or be idiopathic, a condition known as neonatal rhinitis. On the other hand, some less frequent but nonetheless relevant conditions causing severe nasal obstruction include choanal atresia, midnasal stenosis, and pyriform aperture stenosis. Some cystic lesions, such as dacryocystoceles with intranasal mucocele, can also produce significant obstruction. Diagnosis usually requires a nasal endoscopy and in some cases imaging such as computed tomography. Management includes different medical and surgical strategies and will greatly depend on the etiology and the severity of symptoms.

Conclusion Congenital nasal obstruction can be a significant cause of respiratory distress in the newborn. The wide spectrum of differential diagnoses requires a thorough knowledge of nasal anatomy, physiology, and pathology; as well as different management strategies.

Keywords Nasal obstruction · Newborn · Otorhinolaryngology · Choanal atresia · Rhinitis

Introduction

Mild nasal congestion is a common finding in neonates, but fortunately clinically relevant nasal obstruction resulting in distress is infrequent. However, it is an important condition to recognize and treat, as newborns are generally considered to be obligate nasal breathers in the first months of life [1–5].

The neonatal pharynx is functionally separated in two compartments, allowing for breathing and swallowing simultaneously [4–8]; as the larynx lies on a more superior position, with the epiglottis reaching closer to the soft palate, creating a respiratory pathway from the nose to the larynx. Milk goes from the oral cavity through two lateral channels towards the piriform sinuses and into the esophagus [2, 4, 5, 8].

Nasal obstruction in the neonate can have multiple short- and long-term consequences, affecting not only breathing—even with potential life-threatening results—but also sucking, growth, and craniofacial development [3, 6, 7, 9]. Severity of symptoms will mainly depend on the degree of obstruction, with complete bilateral blockage causing evident distress, whereas partial, intermittent, and/or unilateral problems will produce milder symptoms, sometimes not diagnosed until later in life.

The aim of this article was to provide a diagnostic approach to nasal obstruction in newborns, describing the most frequent etiologies and their respective treatment strategies.

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Assessment

History and physical examination

A thorough clinical history will consider familial genetic disorders and allergies; prenatal background including diseases of pregnancy, sexually-transmitted infections, teratogen exposure, ultrasound findings and other prenatally diagnosed conditions; and birth history including gestational age, method of delivery, trauma, Apgar score, and need of resuscitation maneuvers, among others.

Most clinical features revolve around two main areas, breathing and feeding. Signs related to breathing may include hyponasal cry, nasal stertor, snoring; and signs of increased respiratory effort such as tachypnea, nasal flaring, intercostal indrawing or apneas. A highly suggestive finding is cyclical cyanosis, which intermittently improves with crying as mouth-breathing occurs [1, 6, 7, 10, 11]. Feeding-related signs will include distress or cyanosis while feeding, frequent pauses, and aerophagia with abdominal distention. Failure to thrive is considered a sign of alarm [1, 7, 9].

Increased work of breathing needs to be accounted for and managed promptly, keeping in mind that cyanosis and lethargy can be signs of impending respiratory failure [6].

Physical examination will evaluate for facial asymmetries, deformities or midline defects. Anterior rhinoscopy is performed to assess for malformations, masses or secretions. Airflow can be detected below the nostrils by placing a mirror to look for misting, holding a strand of cotton wool to look for movement, or by auscultation. Some clinicians still attempt to pass a thin 5 or 6 F catheter through the nose into the oral cavity, to demonstrate its patency [6, 7].

Endoscopy

The next step to determine the location and etiology of the obstruction is to perform a nasal endoscopy, using a rigid or flexible scope. This is a simple, minimally invasive, low-risk procedure when performed by a properly trained specialist, which provides relevant information about the anatomy of the nasal cavities [1, 6, 7, 12]. Importantly, if a nasal mass is found, intracranial extension must be ruled out before attempting to obtain a biopsy sample.

Imaging

If clinical and endoscopic evaluation is not sufficient, computed tomography (CT) is the imaging modality of choice in the workup of most causes of neonatal nasal obstruction, as it provides excellent spatial resolution and bone detail. In some cases, it can be useful to perform a nasal toilet with application of topical vasoconstrictor drops 30 min before the exam. On the other hand, magnetic resonance imaging (MRI) provides a better definition of soft tissues and is mainly indicated in nasal masses when intracranial involvement needs to be ruled out [6, 12–15].

Swallowing assessment

Investigations for deglutition might be indicated in more severe cases, considering breathing–swallowing coordination status. These can include clinical swallowing tests, videofluoroscopy, and/or fiberoptic endoscopic evaluation of swallowing (FEES) [15].

Table 1 Causes of neonatal nasal obstruction (adapted from references [1, 6, 12])

Structural	Inflammatory	Intranasal masses	Miscellaneous
Nasal agenesis	Upper respiratory tract infections	Non-Neoplastic - Nasolacrimal duct cyst - Dermoid cyst - (Meningo)encephalocele - Glioma - Heterotopic brain tissue	Intrauterine positional asymmetry Metabolic (e.g.: hypothyroidism)
Pyriform aperture stenosis	Gastroesophageal reflux disease		
Septal deviation	Neonatal rhinitis	Neoplastic - Teratoma - Hemangioma - Neurofibroma - Lipoma / Lipoblastoma - Lymphoma - Rhabdomyosarcoma	Foreign body Non-accidental injuries Iatrogenic - Birth trauma - Pressure injury (e.g.: nasotracheal tube) - Mucosal irritation by suctioning - Rhinitis medicamentosa - Maternal drug use (e.g.: methyldopa)
Inferior turbinate hypertrophy	Allergic rhinitis		
Midnasal stenosis	Congenital syphillis ("snuffles")		
Choanal atresia or stenosis	Chlamydial nasopharyngitis		
Associated with craniofacial syndromes (e.g. Binder, CHARGE, Treacher Collins, Crouzon, Apert)			

Differential diagnosis

The main causes for nasal obstruction in the newborn can be classified into anatomical/malformative; non-tumoral masses and cysts; benign and malignant neoplasia; inflammatory/infectious; traumatic/iatrogenic; and miscellaneous (Table 1). Anatomical and tumoral etiologies will be often treated surgically, whereas the treatment of inflammatory conditions will be initially oriented to managing the factors precipitating mucosal edema.[15] Below we will describe some of the most relevant etiologies, providing general guidelines on diagnosis and management.

Choanal atresia

The congenital obliteration of the posterior nasal aperture is a relatively infrequent condition, with an incidence of 1: 7000–8000 live newborns. It is more common in females and more often unilateral than bilateral [1, 13, 16–20]. Obstruction can be partial (stenosis) or complete (atresia), and can be classified as bony or mixed (membranous and bony), explaining 30–70% of cases, respectively [21, 22].

There are four theories about the pathogenesis of choanal atresia, none universally accepted: persistence of the buccopharyngeal membrane of the anterior foregut; persistence or abnormal localization of mesodermal tissue causing adhesions in the nasochoanal region; persistence of the nasobuccal membrane of Hochstetter; and abnormal migration of cells from the neural crest and mesoderm [19–25].

Up to 50% can be associated with other congenital anomalies, especially in bilateral cases [16, 18, 26]. One case series reported a second airway anomaly in 34% of cases, such as tracheomalacia, laryngomalacia or subglottic stenosis; and association to craniofacial anomalies in 21% of cases, including CHARGE, Treacher Collins, Pfeiffer and Apert syndromes [26]. Of these, the most frequent syndrome is CHARGE (an acronym for Coloboma, Heart defects, Atresia choanae, Retarded growth, Genital abnormalities and Ear abnormalities) [9, 18, 21]. Given the high rate of coexisting malformations, it is recommended that patients with choanal atresia are studied with echocardiogram, renal ultrasound, and ophthalmological and audiological evaluations [1, 13].

Clinical presentation will mainly depend on whether the obstruction is unilateral or bilateral, and if there are other congenital malformations. Unilateral atresia is characterized by unilateral nasal obstruction and rhinorrhea and is frequently diagnosed later in life, even into adulthood. Bilateral cases manifest early in the neonatal period with upper airway obstruction, respiratory distress, and intermittent cyanosis which deteriorates with feeding and improves when crying. Patients with other congenital anomalies can have complex airway problems, sometimes presenting with more severe and acute symptoms, which could even require a tracheostomy before definitive surgical treatment [1, 13, 19, 21, 27].

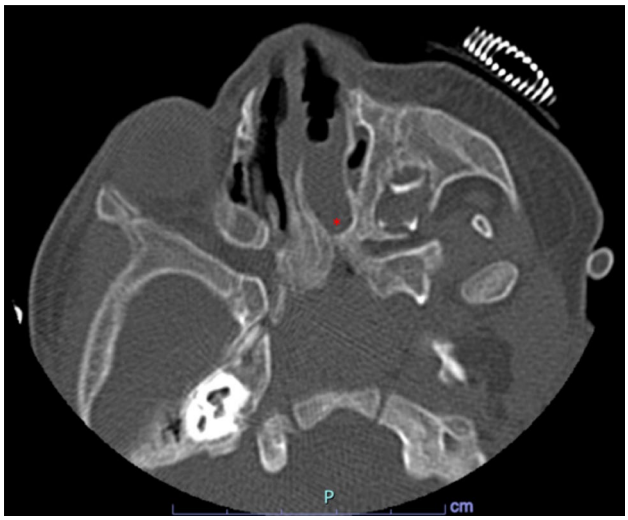

Fig. 1 Axial CT showing left-sided choanal atresia (red asterisk)

As discussed previously, nasal endoscopy and CT will confirm the diagnosis (Fig. 1), provide anatomical detail and rule out other nasal, skull base or nasopharyngeal anomalies. It is important to also search for temporal bone malformations, as semicircular canal abnormalities are commonly found in patients with CHARGE syndrome [9, 13].

In bilateral cases, initial management includes securing an oral airway with a McGovern nipple, Guedel airway or orotracheal intubation if required, and orogastric tube feeding [18, 19]. These measures will help stabilize the newborn, allowing for proper assessment of other existing anomalies and surgical planning, which should be performed as soon if the condition of the patient allows it [9, 15]. In unilateral cases, diagnosis and, therefore, treatment are often delayed, but should be ideally resolved before the age of 5 years, to help manage persistent nasal secretion [9]. Definitive surgical treatment can be performed via transnasal puncture, endoscopic transnasal resection, or transpalatal resection.

Transnasal puncture with progressive dilatation is a less complex procedure that has been traditionally described. It has the benefit of easier work in a narrow space, such as the neonatal nasal fossa and although some authors consider it to have high recurrence rates, other studies have not shown significative differences compared to more complex or aggressive procedures [20, 21, 28], especially in atresia with a thin bony component. It has the potential risk of inadvertent damage to nearby structures such as the skull base. Transoral control using a 120° endoscope and the use of drills can help to improve safety and success rates.

Endoscopic transnasal repair allows direct visualization of the atresia and the ability to raise flaps to cover raw areas, aiming to reduce restenosis. It is technically more difficult

because of a narrow surgical field, but has similar success rates and less complications than the transpalatal approach, so many authors consider it to be the method of choice [7, 21, 29].

Transpalatal repair is seldom used nowadays, as it is a more aggressive approach. It provides a better exposure at the expense of drilling part of the hard palate, carrying higher risks of postoperative complications such as fistula formation, velopharyngeal insufficiency or altering craniofacial development [19–21].

As all techniques carry a risk of postoperative restenosis, complementary use of stents or mitomycin C are sometimes advocated, although evidence of their effectiveness is controversial [19, 21, 29].

Pyriform aperture stenosis

The pyriform aperture is the narrowest part of the bony nasal airway; thus, even a small decrease on its cross-sectional area can determine significative increase in resistance and respiratory difficulties. Congenital stenosis is determined by overgrowth of the nasal process of the maxillary bone [1, 30]. It is an infrequent cause of neonatal nasal obstruction and its incidence is unknown [31]. This can be an isolated condition or can be part of a spectrum of midline anomalies and holoprosencephaly and sometimes associated with the presence of a single central mega-incisor tooth [32, 33].

Clinical presentation is similar to choanal atresia and can be suspected by a difficult intranasal examination because of a narrow anterior bony nasal aperture [32]. Diagnosis can be confirmed with a CT scan showing an aperture diameter < 11 mm (in a term neonate), measured at the level of the inferior turbinate in an axial plane [34]. If associated anomalies are suspected, investigations may include endocrine and electrolyte tests, and a brain MRI [6, 31].

After establishing a secure airway when needed, specific treatment will depend on symptom severity rather than size of the stenosis [30, 35]. Mild cases can be managed with topical treatment using saline solution, intranasal steroids and/or decongestants [1]. Surgical treatment involves enlarging the pyriform aperture through a sublabial approach and will be indicated in patients with poor response to medical treatment, persistent respiratory distress or failure to thrive [1, 11, 32]. This technique is safe, avoids visible scars and provides immediate results [36], although craniofacial dysmorphisms and neurological abnormalities can be associated with decreased outcomes [30]. Some surgeons will use postoperative stents for a few days, to prevent cicatricial stenosis [32, 35, 36].

Midnasal stenosis

Less commonly described condition characterized by bilateral narrowing of the middle part of the nasal fossae, secondary to an uneven growth of the lateral walls of the nose or an excessive infolding of the nasal septum [1, 14, 37]. It is often seen in children with midface hypoplasia such as in Apert or fetal alcohol syndrome [5, 37]. Clinical manifestations are similar to other causes of neonatal nasal obstruction. Nasal endoscopy will reveal a stenotic nasal fossa, past the pyriform aperture, that does not allow visualization of the middle turbinate [14, 37]. Diagnosis will be confirmed with a CT scan, showing a bony narrowing of the midpart of the nasal fossae.

Conservative management with saline drops is indicated in most cases, to allow midfacial growth to relieve the obstruction, usually around 6 months of age [1, 5]. Surgical treatment is reserved for patients with respiratory distress or failure to thrive and generally involves mechanical dilatations or endoscopic inferior turbinate lateralization [1, 14, 37]. The latter technique is safe and decreases the risk of mucosal injury. Some authors recommend a short-term period of postoperative stenting, with early removal aiming to avoid complications such as obstruction, migration, infection and pressure injuries, among others [14].

In severe cases, such as those associated with some craniosynostoses, an adequate nasal airway might not always be achieved, so upfront discussions about expectations with the family and close follow-ups are required. Sometimes, additional procedures—including a tracheostomy—might be necessary.

Dacryocystocele

The nasolacrimal duct allows drainage of tears from the medial canthus into the inferior meatus of the nasal cavity [1, 38]. Defective lacrimal drainage is frequent, affecting up to 20% of newborns, but often self-resolving before the first year of age [39]. However, when congenital distal obstruction at the level of Hasner's valve is accompanied by a proximal obstruction, a cystic lesion, called dacryocystocele, can result [1, 38]. This is an uncommon and severe form of nasolacrimal duct obstruction, which is unilateral in 90% of cases and usually presents within the first days or weeks of life [40, 41].

On examination, a gray-blue mass inferior to the medial canthus can be noted, usually associated with epiphora or mucopurulent discharge. Manual compression does not show tear reflux, confirming a closed system [41] Secondary infection occurs in 25–50% of patients [40, 42, 43].

Anterior rhinoscopy must be performed to rule out association with an intranasal component, which can cause nasal obstruction in up to 20% [41, 42]. If bilateral, this can lead

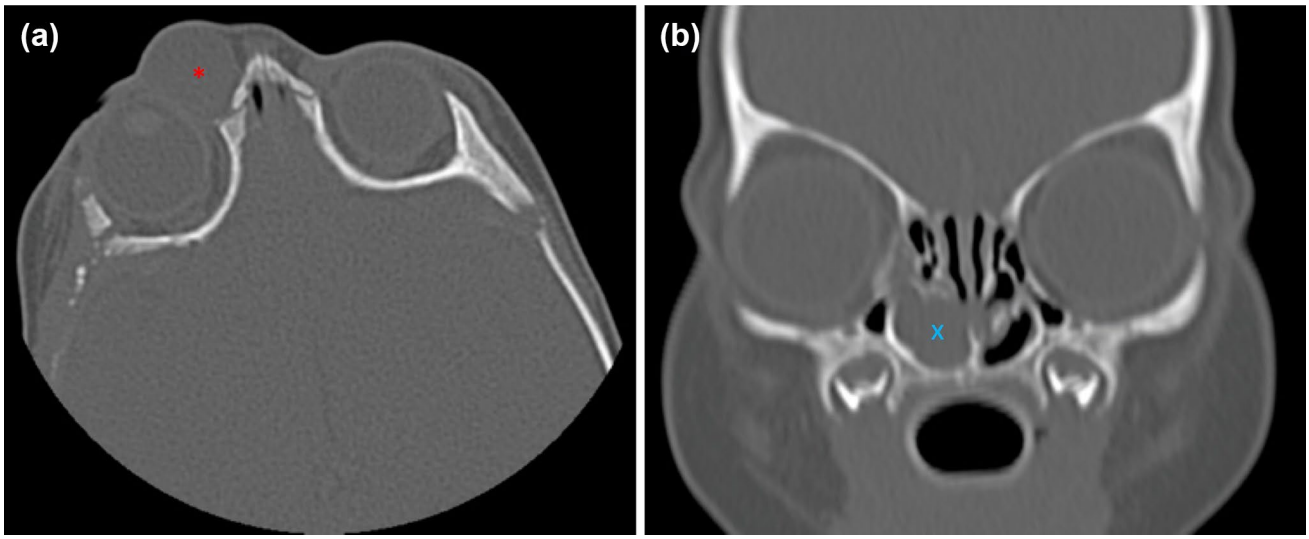

Fig. 2 Congenital dacryocystocele with intranasal mucocele. **a** Axial CT showing a right-sided congenital dacryocystocele (red asterisk). **b** Coronal CT showing the intranasal mucocele (blue cross)

to severe respiratory distress in a newborn. As for imaging, CT can be used to confirm the diagnosis (Fig. 2a, b) [1, 41].

Conservative management includes nasal decongestants, warm compresses and massage and can be effective in up to 85% of cases within the first 3 weeks. In case of intranasal cyst, nasal obstruction or treatment failure, surgery is indicated [5, 41, 42]. Alternatives include duct probing and irrigation; endoscopic marsupialization and endoscopic intranasal dacryocystorhinostomy [38, 44] Intranasal components should receive endoscopic treatment [41], and marsupialization is often a straight-forward procedure.

Neonatal rhinitis and inferior turbinate hypertrophy

Rhinitis is the commonest cause of nasal obstruction in the newborn, clinically presenting with nasal obstruction, mucosal edema and mucous rhinorrhea, producing obstruction by itself or exacerbating another condition [6, 12]. Although symptoms are often mild and self-resolving, it can occasionally cause significant distress.

Neonatal rhinitis refers to an idiopathic condition, differentiating itself from other etiologies such as gastroesophageal reflux [6], cow's milk protein allergy or hypothyroidism [12, 45]; infectious diseases like upper respiratory tract viruses, chlamydia or syphilis;[1] or maternal causes like estrogen stimulus or medications including methyldopa, propranolol and tricyclic antidepressants [12, 46].

Examination will reveal mucosal edema, and imaging is often not required [5, 47] Initial management considers saline drops and suctioning [3, 5]. Although off-label, short-term use of topical decongestants and/or courses of intranasal steroids have been empirically used and described in the literature [47–49], and can help to stabilize more severe cases or to avoid aggressive procedures. On the other hand, some caution should be exerted with these medications, as newborns might be more susceptible to adverse effects [50].

It is not well defined if congenital inferior turbinate hypertrophy can be considered as part of neonatal rhinitis or if it constitutes a separate entity. Anyways, in case of treatment failure and severe ongoing obstruction, after ruling out other causes, there can be a role for surgery [51]. This could include intranasal dilatation, inferior turbinate lateralization or turbinoplasty. Temporary use of nasopharyngeal airway cannulas can also be considered.

Conclusions

Congenital nasal obstruction can be a significant cause of respiratory distress in the newborn. As such, it is important to accurately and promptly recognize, diagnose and treat

these conditions. The wide spectrum of differential diagnoses requires a thorough knowledge of nasal anatomy, physiology and pathology; as well as different management strategies. There are some limitations to this review, as some of these conditions are relatively infrequent and not all treatment strategies are supported by good quality evidence. Further studies are required on the safety and efficacy of topical nasal treatments and coadjuvant measures such as postoperative mitomycin C and stenting.

Acknowledgements We would like to thank Mr. Graeme van der Meer, pediatric otolaryngologist at Starship Children's Hospital (Auckland, New Zealand) for revising this article.

Funding No funding was received for this article.

Compliance with ethical standards

Conflict of interest The authors declare no potential conflicts of interest.

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