PAEDIATRIC NEURORADIOLOGY

Pediatric nasal chondromesenchymal hamartomas: a case series

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Abstract

Purpose Nasal chondromesenchymal hamartomas (NCMH) are rare, predominantly benign tumors of the sinonasal tract. The distinction from higher grade malignancy may be challenging based on imaging features alone. To increase the awareness of this entity among radiologists, we present a multi-institutional case series of pediatric NCMH patients showing the varied imaging presentation.

Methods Descriptive assessment of imaging appearances of the lesions on computed tomography (CT) and magnetic resonance imaging (MRI) was performed. In addition, we reviewed demographic information, clinical data, results of genetic testing, management, and follow-up data.

Results Our case series consisted of 10 patients, with a median age of 0.5 months. Intraorbital and intracranial extensions were both observed in two cases. Common CT findings included bony remodeling, calcifications, and bony erosions. MRI showed heterogeneous expansile lesion with predominantly hyperintense T2 signal and heterogenous post-contrast enhancement in the majority of cases. Most lesions exhibited increased diffusivity on diffusion weighted imaging and showed signal drop-out on susceptibility weighted images in the areas of calcifications. Genetic testing was conducted in 4 patients, revealing the presence of DICER1 pathogenic variant in three cases. Surgery was performed in all cases, with one recurrence in two cases and two recurrences in one case on follow-up.

Conclusion NCMHs are predominantly benign tumors of the sinonasal tract, typically associated with DICER1 pathogenic variants and most commonly affecting pediatric population. They may mimic aggressive behavior on imaging; therefore, awareness of this pathology is important. MRI and CT have complementary roles in the diagnosis of this entity.

Keywords Chondromesenchymal hamartoma · Pediatric neuroimaging · DICER1 · Tumor susceptibility syndrome

Introduction

Nasal chondromesenchymal hamartomas (NCMH) are rare and predominantly benign tumors of the sinonasal tract, most commonly affecting infants or young children [1].

Symptomatology is variable, with a visible mass and nasal obstruction being the most common clinical presentation [2]. NCMHs may appear as heterogeneous and locally destructive masses, and this makes the radiological distinction from malignancy challenging [1]. To date, most of the imaging

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literature on NCMHs is from single case reports. To increase the awareness of this entity among radiologists, we present a multi-institutional case series of pediatric NCMH patients showing the varied imaging presentation.

Methods

This retrospective, multi-center case series of pediatric NCMH patients was a result of collaboration between five institutions. Inclusion criterion was pathologically proven NCMH in a pediatric (< 19 years) patient. We performed a descriptive assessment of imaging appearances of the lesions on computed tomography (CT) and magnetic resonance imaging (MRI). We also reviewed demographic information, clinical data on presentation, results of genetic testing, management, and follow-up data.

Results

Our case series consisted of 10 patients (6 females) with pathologically proven NCMH (Fig. 1). CT imaging was available in 9 patients (7 with intravenous contrast) and post-contrast MRI was performed in 8 patients. Six patients had both CT and MRI data available.

Initial age at presentation ranged from 0 to 104 months (median 0.5 months; IQR 0–58.5 months). Five NCMHs were congenital. The most common clinical symptom was visible mass or facial deformity present in 7 patients. One child had exophthalmos and 2 children presented with respiratory difficulty.

On CT imaging, bony remodeling was present in eight patients, calcifications in seven patients, and bony erosions in six patients. MRI showed an expansile lesion in all cases with predominantly hyperintense signal on T2-weighted sequence in six cases and cystic appearing areas in three cases (Fig. 2). T1-weighted images showed predominantly intermediate signal in most patients ($n = 6$), with focal hyperintensities within the lesion in 1 patient.

Diffusion MR imaging was performed in five patients and showed relatively high diffusivity with only a portion of one lesion demonstrating lower ADC values. SWI was performed in three cases and showed areas of signal drop out in all of them, corresponding to the presence of calcifications. Most tumors were centered on the nasal cavity (5 on the left and 4 on the right side, one was bilateral). One left-sided tumor also involved the nasopharynx. Intraorbital and intracranial extensions were both observed in two cases. Size of the tumors ranged from 10×8 mm to 62×21 mm in the axial plane. Additional CT and MRI images of selected patients including another patient with intracranial extension of the neoplasm are shown in Fig. 3.

Differential diagnoses that were reported on the initial imaging included NCMH (50%), teratoma (30%), sarcoma (30%), nasal glioma (10%), and hematoma (10%). Genetic testing was performed in 4/10 and among these, three cases were positive for a pathogenic *DICER1* variant. Two cases with *DICER1* pathogenic variants had a history of pulmonary pleuroblastoma and the third had a history of multiple malignancies (rhabdomyosarcoma, spindle cell sarcoma of the kidney, and papillary thyroid carcinoma). Surgery was performed in all cases, with one recurrence in two cases and two recurrences in one case on follow-up.

Discussion

NCMHs are composed of mature and immature hyaline cartilage, areas of calcification, spindle cells, and myxoid stromal tissue [1, 3]. Aggressive characteristics are usually absent on histology, although malignant transformation has been reported [4].

Typical presentation is in the first years of life [1], but cases have been reported in adults [3]. In our pediatric series, the commonest presentation was with nasal mass or facial deformity, which is concordant with previous publications [3]. Depending on the location, presentation may also be with respiratory or feeding difficulties, rhinorrhea, epistaxis or otitis media [3]. Orbital involvement is common, resulting in strabismus, hypertelorism, proptosis, enophthalmos or ophthalmoplegia [1]. Intracranial extension may also be encountered, resulting in hydrocephalus or oculomotor disturbances [3, 5].

Fig. 1 Photograph from nasal endoscopy demonstrating a large, smooth walled lesion expanding the nasal cavity

Fig. 2 Coronal CT (**a**) shows a lesion expanding the left nasal cavity. The lesion has a rings and arcs calcification pattern reminiscent of chondroid tissue (arrow). Note osseous re-modeling (arrowheads). On MRI, the lesion shows mixed T2 (**b**) and T1 signal (**c**), and heterogeneous post-contrast enhancement (**d**), with non-enhancing and T2 hyperintense cystic areas (arrows in **b** and **d**)
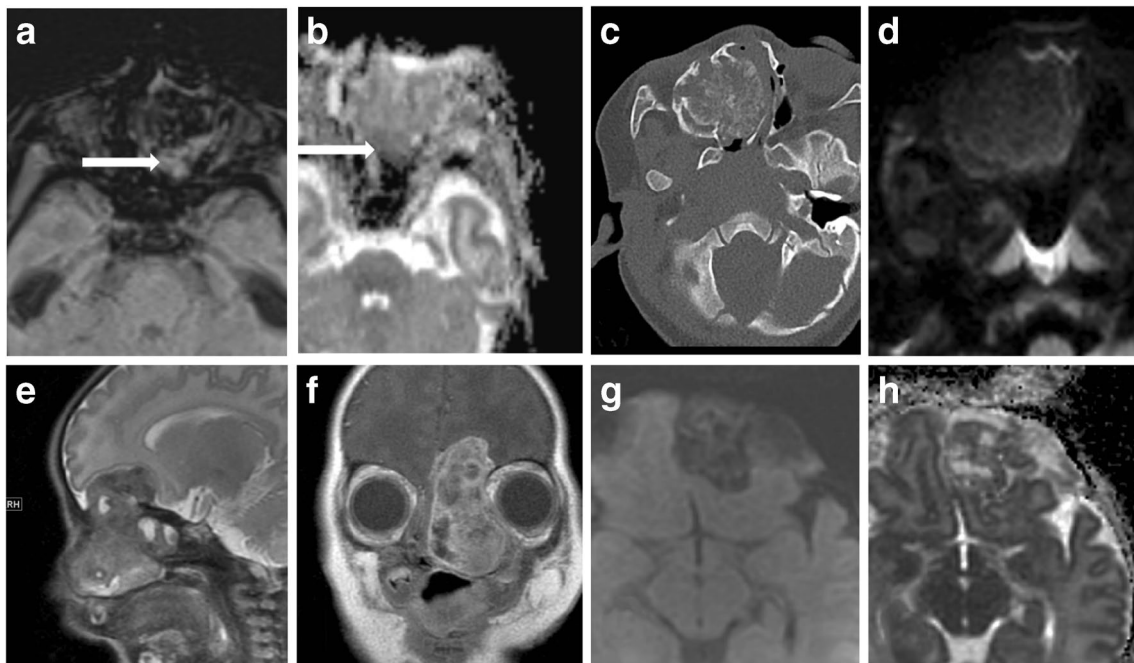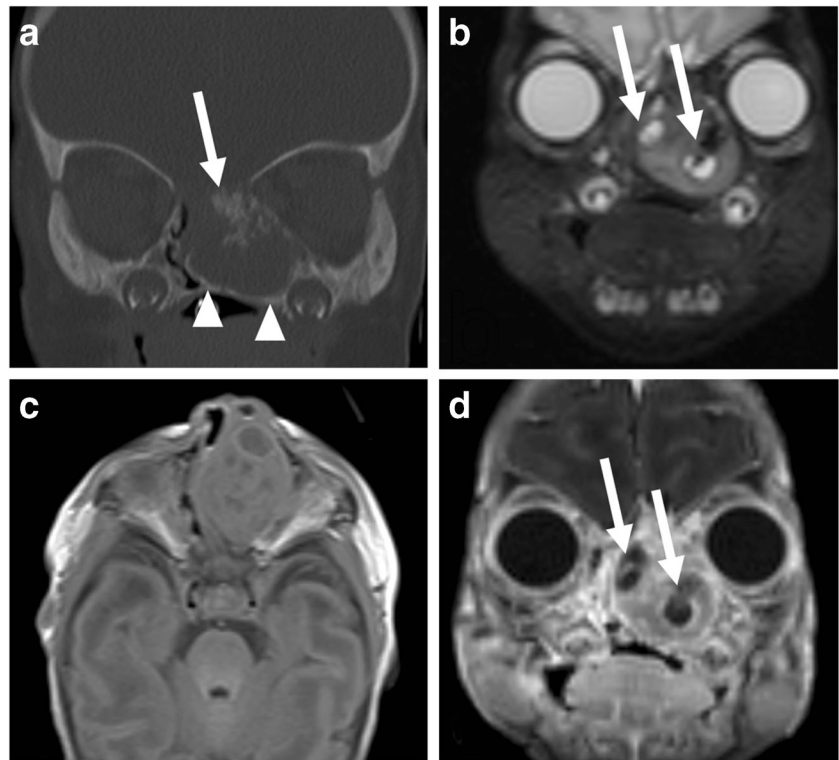

Fig. 3 SWI (**a**) and ADC map (**b**) of a child with NCMH show low to intermediate ADC values (between 900 and 1200 mm.^{2}/s) with no corresponding hypointensity on SWI to suggest hemorrhage or calcification in the dorsal part of the tumor (arrows in **a** and **b**). Imaging in another child showing extensive bony remodeling with calcifications on CT (**c**) with associated low to intermediate signal intensity on DWI (**d**). T2-weighted image (**e**), contrast enhanced T1-weighted image (**f**), DWI (**g**), and ADC map (**h**) of an infant show heterogeneous, predominantly T2 hypointense, heterogeneously enhancing lesion centered in the left nasal cavity with intracranial extension. There is intermediate to high diffusivity (which may in part be due to a non-enhancing cystic area).

In most cases, physical examination is sufficient for the initial diagnosis of the intranasal mass [3]. However, further characterization of the lesion and the evaluation of the adjacent structures with CT or MRI is usually required [5]. On CT, NCMHs display presence of calcification in ~70% and osseous remodeling in majority of cases. Bony erosion may be seen, most commonly involving the cribriform plate and the lamina papyracea [3–19], although frank bony destruction is usually absent [3, 5]. Osseous changes are generally better appreciated on CT [19], but areas of mineralization within the cartilaginous matrix may also be suggested on MRI, specifically by hypointense T2 signal [19], or with the use of SWI. On the other hand, cystic and myxoid components are in general much better appreciated using MRI (Fig. 3). T2-weighted images most commonly show heterogeneous mass, with signal characteristics ranging from predominantly hyperintense in approximately 50% to predominantly hypointense in ~25% of cases [5–9, 11, 13, 14, 18–25]. Most of NCMHs show intermediate to hypointense T1 signal [5, 7, 8, 10, 22, 23, 25], with heterogeneous contrast enhancement present in ~75% of cases [5, 7, 9, 13, 15, 19, 23, 24]. Of note, enhancement may only be peripheral in about 15% of cases [8, 25]. Most of the lesions show increased diffusivity; however, we do report a case with relatively low ADC values (Fig. 1). Importantly, intratumoral hemorrhage may also be the source of low ADC [8], and this may be addressed by utilizing SWI. On the other hand, extensive hypointensities on SWI due to calcifications were present in all three of our patients in whom SWI was performed. Non-enhancing cystic areas may be appreciated in about half of cases [5, 7, 8, 11, 14, 15, 19, 25]. In addition, MRI is also superior in evaluation of the intraorbital and intracranial extension of the disease [19].

In our series, initial imaging diagnoses included teratoma, sarcoma, nasal glioma, and hematoma. In pediatric population, inverted papilloma, giant cell reparative granuloma, chondro-osseous respiratory adenomatoid hamartoma, aneurysmal bone cyst, and rhabdomyosarcoma may also be considered. In addition, esthesioneuroblastoma and chondrosarcoma may present in a similar fashion, but are more common in adolescents and adults [3]. Rarely, the extensive cystic component of the tumor may even mimic encephalocele [25].

We confirmed *DICER1* pathogenic variants in 3/4 tested patients, and all of them had history of previous malignancy. This is similar to the report from Stewart et al. who confirmed the mutation in 6/8 cases [26]. NCMH may therefore be considered a part of *DICER1* familial tumor susceptibility syndrome, conferring the increased risk most commonly for pleuropulmonary blastoma, but also ovarian sex cord-stromal tumors, Sertoli–Leydig cell tumor, juvenile granulosa cell tumor and gynandroblastomas, and less commonly cystic nephroma, thyroid gland tumors, ciliary

body medulloepithelioma, botryoid-type embryonal rhabdomyosarcoma, renal sarcomas, pituitary blastomas, and pineoblastomas [1, 26].

Surgical removal is curative [26] and may be performed endoscopically in cases limited to nasal cavity [3]. However, local recurrences may occur in around 25% of cases [26].

Summary

NCMHs are predominantly benign tumors of the sinonasal tract, typically associated with *DICER1* pathogenic variants and most commonly affecting pediatric population. They may mimic aggressive behavior on imaging; therefore, awareness of this pathology is important. MRI and CT have complementary roles in the diagnosis of this entity.

Declarations

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