Audio-Otologic Pathology in Polyostotic Fibrous Dysplasia

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ABSTRACT

Objectives:
1. To characterize the spectrum of otologic disease in patients with polyostotic fibrous dysplasia (PFD) and McCune-Albright Syndrome (MAS)
2. To correlate audiometric analysis with temporal bone computed tomography (CT) findings in this cohort

Methods:
A retrospective review was performed in a cohort of individuals with PFD/MAS (n= 123) followed in a longitudinal natural history protocol. Patients with craniofacial involvement and those who underwent comprehensive otologic evaluation, audiologic analysis, and cranial CT imaging evaluation were included.

Results:
Evaluations were available for 107 patients. Fibrous dysplasia (FD) of the temporal bones was identified in the majority (71%). Clinically significant hearing loss (.5/1/2/4 kHz PTA >20 dB HL) was identified in 30 ears (15.6 %). Conductive loss (66%) was more frequent than a sensorineural loss (30%) and overall was primarily mild (76%). External auditory canal stenosis, epitympanic involvement, and internal auditory canal involvement were found to be rare potential contributors to overall hearing loss. While canal cholesteatoma can be a major complication, it was only identified in one patient.

Conclusion:
FD of the temporal bones in patients with PFD/MAS was common. Clinical manifestations depend on the location and degree of skeletal involvement. Otologic problems and hearing loss were present in a minority and were generally mild. Serious complications were rare. Conservative management may often be the best plan of care.

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INTRODUCTION

Polyostotic fibrous dysplasia (PFD) and McCune-Albright Syndrome (MAS) are diseases marked by fibrous dysplasia of bone in multiple skeletal sites and are caused by the same somatic mutation of the *GNAS* gene.[1] MAS has additional diagnostic characteristics of café-au-lait spots, precocious puberty and/or other hyper-functioning endocrinopathies (Figure 1). While craniofacial fibrous dysplasia is frequently present in these rare disorders,[2] the overall significance of otologic disease has not been well described. The present study aims to characterize the audiologic phenotype, clinical findings, patterns of involvement and to correlate these findings with those on computed tomography (CT).

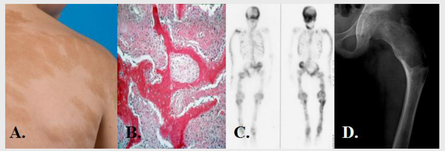

Figure 1. Classic characteristics of McCune-Albright Syndrome. (A) Café-au-lait spots (B) Typical histological section with 'Chinese character' appearance (C) Bone scan demonstrating multiple areas of fibrous dysplasia. (D) X-ray of proximal femur fibrous dysplasia.

METHODS AND MATERIALS

From 1998 to 2010, subjects diagnosed with PFD and MAS were enrolled into an IRB approved natural history protocol at the NIH. Patients underwent a baseline evaluation including history and physical exam, endocrine evaluation, audiological assessment and craniofacial computed tomography (CT) as indicated. The majority (88%) also underwent comprehensive otolaryngologic evaluation. Yearly follow-up was attempted.

Charts were reviewed and clinical findings collected on patients with craniofacial FD. Standard audiometric and immittance testing was performed and clinically significant hearing loss was determined by a four frequency pure tone average (.5/1/2/4 kHz) > 20 dB HL. CT scans with a slice width of less than 2.5mm were evaluated in the axial and coronal reconstructed planes. Dimensions of the internal and external auditory canals were recorded as were sites of involvement within the temporal bone. For patient followed for more than 4 years, measurements from their first and last scan were evaluated for progression. Any clinical complications as a result of temporal bone fibrous dysplasia were noted.

Patient Characteristics	
Total patients:	n = 107
Mean age (range):	23.7 years (3.3 – 80.4)
Gender – M : F:	47 : 60
Mean age at diagnosis (range):	6.8 years (0.2 - 79)

Table I. Summary of patient characteristics.

Clinical Symptoms	Percent Affected (n)	Endocrinopathy	Percent Affected (n)
Tinnitus	16% (13)	Precocious puberty	50% (53)
Vertigo	4% (3)	Hyperthyroidism	29% (31)
Aural fullness	15% (6)	Growth hormone excess	28% (30)
Recurrent otitis media	9% (6)	Cushing's syndrome	4% (4)
Prior otologic surgery	11% (10)	Renal Phosphate wasting	34% (39)
-Tympanostomy Tubes	-10% (9)		
-Canaloplasty	-1% (1)		

Table II. Summary of clinical findings.

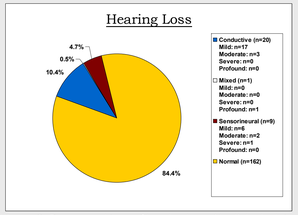

Figure 2. Degree and type of hearing loss. (*Audiologic data available for 192 ears.*)

CT Findings	n (%)	CT Findings	n (%)
Temporal bone involvement (any degree)		IAC involvement	
Bilateral:	59 (46.7)	Bilateral:	17 (15.8)
Right:	25 (23.3)	Right:	20 (18.7)
Left:	21 (19.6)	Left:	17 (15.8)
None:	11 (10.2)	None:	52 (48.5)
EAC involvement		Middle ear involvement	
Bilateral:	26 (24.2)	Bilateral:	26 (24.2)
Right:	25 (23.3)	Right:	28 (26.1)
Left:	20 (18.7)	Left:	21 (19.6)
None:	36 (33.6)	None:	32 (29.9)

Table III. Summary of CT findings.

RESULTS

- Otologic symptoms/complaints were uncommon in the studied cohort (Table II)
- Hearing loss (HL) was present in a minority (15.6%) of ears and was frequently mild (77%)
  - When present, HL was most commonly conductive (20/30 ears [66%], Figure 2)
- FD commonly affected the temporal bones (68% of ears, Table III), but demonstrated clinical impact in a minority of these (Figure 2)
- Narrowing of the EAC due to FD was highly variable (Figure 3)
  - Only 2 ears with EAC narrowing demonstrated a conductive component to their HL
- IACs with FD involvement were found to be significantly longer and narrower than IACs without FD involvement ones (Table IV)
  - No significant association with SNHL was identified
- Due to the low incidence of hearing loss, no correlation could be made with endocrinopathy*
- There was no progression of disease noted with regards to changing IAC dimensions or EAC narrowing in patients followed > 4 years*
- Apparent impingement of the epitympanum by FD overgrowth was noted on CT scans in 16% of ears
  - Air-bone gaps were significantly larger in these ears (Figure 7), but the majority had normal hearing (Figure 8)
- Only two complications in addition to HL were identified (1 ear each)
  - Canal cholesteatoma (Figure 4B)
  - EAC stenosis requiring canaloplasty

* = *data not shown*

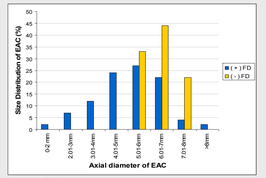

Figure 3. Distribution of bony EAC axial diameter as measured by CT scan in both normal ears and those affected by FD.

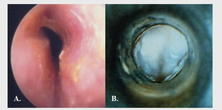

Figure 4. (A) EAC narrowing secondary to FD. (B) Canal cholesteatoma in a different patient.

	Normal IAC (n =137)	IAC with FD involvement (n =65)	p-value
IAC (mean, in mm)			
Length (coronal):	12.44	13.81	< 0.0001
Height:	4.53	3.96	< 0.00001
Width:	4.97	4.67	.07
Length (axial):	11.71	13.57	< 0.0000001

Table IV. Comparison of normal IACs and those affected by FD. (*Students t-test)*

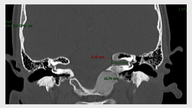

Figure 5. CT of patient with unilateral FD. Note that the medial portion of the left IAC is afftected by FD, but is not narrowed or significantly lengthened.

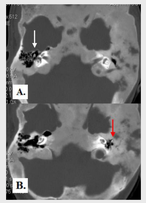

Figure 6. CT of patient with severe FD. (A) White arrow demonstrating normal epitympanum. (B) Red arrow demonstrating impingement of the epitympanum by FD.

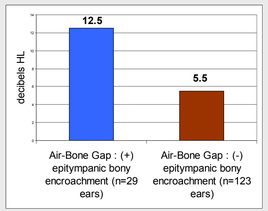

Figure 7. Air-bone gap in ears with epitympanic FD impingement vs. unaffected ears. *p=0.006. (Students t-test)*

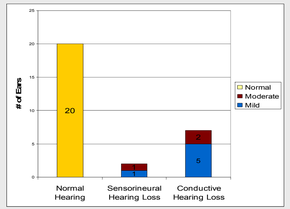

Figure 8. Hearing loss in ears with epitympanic FD impingement (n=29 ears).

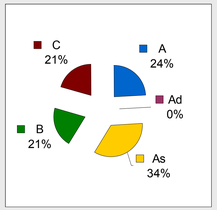

Figure 9. Tympanograms for ears with epitympanic FD impingement (n = 29 ears). The majority demonstrated a stiffened middle ear system (Type As+B=55%)

DISCUSSION

Fibrous dysplasia affecting the temporal bone is uncommonly reported in the literature. While a spectrum of otologic disease has been described, the majority focus on involvement and subsequent narrowing of the EAC leading to a conductive hearing loss[3] as the most frequent presentation. Other mechanisms of hearing loss have been reported; IAC narrowing [4], epitympanic fixation[5], and otic capsule involvement. Canal cholesteatomas have been reported in up to 40% of cases[3].

The present study represents the largest presented cohort and demonstrates that despite temporal bone involvement by fibrous dysplasia, hearing loss and complications occur only in a minority and are often mild. Despite alterations in EAC and IAC dimensions in these FD patients, clinical significance was rarely identified. While epitympanic impingement by FD does appear to be responsible for a small but significant increase in air-bone gap, it is only rarely causes clinically significant hearing loss. Only a single case of canal cholesteatoma was identified and refutes prior reports that this is a frequent occurrence in FD patients.

Clinical management of these patients, with regards to their otologic disease, should take a conservative approach. Since symptoms are most commonly mild, if at all present, surgical intervention should be reserved for the more severely afflicted and those with complications.

CONCLUSIONS

- Fibrous dysplasia of the temporal bones is not uncommon in MAS and PFD patients
- Clinically significant otologic disease only occurs in a minority
- Complications such as canal cholesteatoma are rare

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