Otologic Manifestations of Ectodermal Dysplasia

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Objectives: To determine the range and prevalence of otologic disorders in patients with ectodermal dysplasia (ED) and provide a general review of its multiple otolaryngological manifestations.

Design: Case series.

Setting: Ectodermal dysplasia family conference.

Patients: Sixty-nine individuals with ED were evaluated. The average age was 11 years (range, 1-56 years). Most were male patients (44 [64%]), and most had Christ-Siemens-Touraine syndrome/hypohidrotic ED (42 [61%]), with the remaining having Hay-Wells, Clouston, and ectrodactyly ED clefting syndromes and unclassified types of ED.

Interventions: Questionnaire including a quality-of-life assessment modeled after the Otitis Media 6 instrument, physical examination, screening audiogram, and tympanometry.

Results: Of the 69 patients, 15 (22%) had a known history of hearing loss, and over half reported some level of difficulty processing verbal information (30 patients [43%] reported speech problems and 4 patients [6%] required hearing aids). A history of otitis media was common, with 15 patients (21%) presenting with tympanostomy tubes in place. The mean±SD quality-of-life rating was 2.0±1.1 (range 1-7), with lower scores suggesting less of a problem. On physical examination, 18 patients (26%) had pinna anomalies. One case of advanced cholesteatoma and 2 cases of external auditory canal stenosis were identified. Of the 24 patients who received 4-tone screening audiogram, 2 (8%) had a highest pure-tone average threshold of 50 to 65 dB, whereas 5 patients (21%) had a 30- to 45-dB threshold, with the remaining having a 0- to 25-dB threshold.

Conclusion: In our study, which is, to our knowledge, the largest reported collection of ED patients evaluated for otologic disease, most patients were found to have 1 or more otologic abnormalities, ranging from auricular anomaly to complications of otitis media to profound hearing loss.

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The ectodermal dysplasia (ED) syndromes comprise a group of genetic disorders characterized by deficient function of at least 2 ectodermal derivatives. More than 170 different ED subtypes have been identified since Charles Darwin identified the first of these syndromes in 1860. The incidence of ED is estimated to be 0.7 to 1 per 100,000 births, and a large number of these patients present with otolaryngologic manifestations. The most common type is the X-linked recessive Christ-Siemens-Touraine syndrome or anhidrotic/hypohidrotic ED, in which affected patients have hypoplastic sweat glands with subsequent heat intolerance. They may present with deficient nasal cilia with subsequent chronic infections (rhinitis, pharyngitis, and otitis media), epistaxis, ocular drying with corneal injury, dysphagia, hearing loss, bronchitis, dysphonia, eczematoid skin changes, unusual facies, hypodontia, and sparse hypopigmented scalp hair. Patients affected with many other ED subtypes also present with otolaryngologic manifestations. Those with ectrodactyly ED clefting syndrome present with cleft lip or palate, abnormality of tear duct development with hyperlacrimation or blepharitis, hypopigmented skin and hair, and conductive hearing loss. They also have ectrodactyly, often affecting both hands and toes. In addition, patients with Hay-Wells or ankyloblepharon ED clefting syndrome present with cleft palate, ankyloblepharon, chronic scalp dermatitis, sparse hair and eyelashes, deficient sweating, and hypodontia. Patients with Clouston syndrome have buccal hypopigmentation and alopecia of their lateral eyebrows.
as well as thick, slow-growing nails, sparse hair, and epi-
dermal hyperplasia over their palms and soles.

Proper ectodermal development is especially crucial
to normal ear development. There is an ectodermal com-
ponent of each branchial arch, with the first and second
of these forming the hillocks of His, which give rise to
the auricle. The external auditory canal is formed when
the ectoderm of the first branchial groove migrates medially,
as a solid core of epithelial cells is recanalized at 6 to 7
months of gestation. In addition, the labyrinth develops
with invagination of the ectoderm of the otic placode to
form the otic vesicle at the third week of gestation.

While ED is a relatively infrequent disorder over-
all, the regularity with which affected patients have oto-
larngologic disease makes them a compelling group for
study, as evidenced by previous retrospective reviews of
smaller series in the literature.4,5 Given the prominent role
of the ectoderm in the formation of the ear, as well as
the crucial developmental issues related to hearing loss
and otitis media, in this prospective study we have fo-
cused specifically on the otologic manifestations of ED.

 METHODS

A prospective study was designed to determine the impact
of ED on hearing, otitis and its complications, and auricular
development. Affected volunteers who were attending 2 ED family
conferences were evaluated by use of a questionnaire that
included a section modeled after the Otitis Media 6 (OM-6) in-
strument.6 This instrument for measuring disease-related qual-
ity of life has a scoring mechanism with a scale of 1 to 7, with
higher numbers corresponding to lower quality. It has dem-
onstrated properties of validity, reliability, and responsiv-
eness. The OM-6 instrument has been previously described to
evaluate otitis media–associated physical suffering, hearing loss,
speech impairment, emotional distress, activity limitations, and
caregiver concerns in patients with chronic or recurrent otitis
media.6 Although the entire ED population did not meet the
strict inclusion criteria defined in the original report and a pe-
riod of greater than 4 weeks was of interest, we similarly wanted
to evaluate the health-related quality of life in these subjects,
even if we could not benefit from the evaluative and discrimi-
native properties of a validated instrument. Therefore, ques-
tions regarding the domains of physical suffering, hearing loss,
speech impairment, emotional distress, activity limitations, and
caregiver concerns regarding otologic health were composed
as in the OM-6. In addition, physical examination by 2 oto-
laryngologists was performed. Hearing evaluation was per-
formed with tuning forks, and screening audiograms with tym-
panometry were completed. Records were stored in a Microsoft
Access (Microsoft Corp, Redmond, Wash) database and statis-
tical analysis was performed using SAS 8.0 software (SAS In-
itute Inc, Cary, NC).

 RESULTS

 PATIENT POPULATION

Sixty-nine individuals with ED were evaluated. The mean
age at the time of evaluation was 11 years (range, 1-56
years). The mean age at diagnosis was 2 years. More re-
ponders were male (n=44 [64%]) than female. Most pa-
tients were affected with Christ-Siemens-Touraine syn-
drome/hypohidrotic ED, with the remaining having
ectodactyly ED, Hay-Wells syndrome, Clouston syn-
drome, and unclassified types of ED.

<table>
<thead>
<tr>
<th>Subtype of ED Represented</th>
<th>Patients, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christ-Siemens-Touraine/ hypohidrotic ED</td>
<td>42 (61)</td>
</tr>
<tr>
<td>Hay-Wells</td>
<td>4 (6)</td>
</tr>
<tr>
<td>Clouston</td>
<td>3 (4)</td>
</tr>
<tr>
<td>Ectodactyly ED</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Unclassified</td>
<td>19 (27)</td>
</tr>
</tbody>
</table>

 QUESTIONNAIRE RESPONSES

Nearly 22% (n = 15) of the patients had a known history
of hearing loss, and almost 22% (n = 15) had a recent au-
diogram (Figure 1). In conjunction with this, approxi-
mately 18% (n = 12) reported difficulty with verbal direc-
tions and 17% (n = 12) with distinguishing between
sounds. More than half of the study population reported frequently requesting spoken repetition from others. Of the responders, 30 (43%) experienced speech problems, with many requiring speech therapy. Four patients (6%) required regular use of hearing aids. Nearly half of the patients had a history of otitis media (Figure 1), but the effect on quality of life was on average between “no problem” and “somewhat of a problem” (Figure 2). The mean ± SD score for the individual domains was 2.0±1.1 (range, 1-7), with lower scores suggesting less of a problem.

**PHYSICAL EXAMINATION AND AUDIOMETRY**

On examination, 18 patients (26%) had pinna anomalies, including cup ear, atypical helical folds, and tragal abnormalities (Figure 3). In accordance with the frequent history of otitis media, 15 patients (21%) had tympanostomy tubes in place. The mean±SD age for those with tubes was 6±3 years (range, 2-11 years). Active seborrheic dermatitis was present in 5 subjects (7%). One case of advanced cholesteatoma and 2 cases of external auditory canal stenosis were identified. Hearing was screened with tuning forks at 512 Hz, and speech reception thresholds were determined in 45 subjects, in 27 of whom this was confirmed by history and reproducible results. Nine (33%) of these 27 subjects had corroborated abnormal testing results. Screening audiogram was performed on the additional 24 patients, revealing that 2 (8%) had a 50- to 65-dB pure-tone average threshold, while 5 (21%) had a 30- to 45-dB threshold, with the remaining having a 0- to 25-dB threshold. Therefore, by both screening methods, approximately one third had abnormal responses to hearing tests. In addition, 6 (35%) of 17 patients with pinna anomalies and unequivocal hearing results were noted to have hearing loss vs 10 (19%) of 51 patients with normal pinna. Conversely, 6 (38%) of 16 patients with abnormal hearing had normal pinna vs 11 (21%) of 52 of those with normal hearing. All cases of hearing loss associated with pinna anomalies were mild to moderate. Tympanometry was assessed in 24 patients, in whom 11 (46%) had type A, 7 (29%) type B, and 6 (25%) type C.

In this study, which is, to our knowledge, the largest reported collection of patients with ED evaluated for otologic disease, most patients were found to have 1 or more...
otologic abnormalities, ranging from pinna anomaly to complications of otitis media to profound hearing loss. The results of this study demonstrate internal consistency, with one third of patients with abnormal screening audiometry results falling within the 17% to 56% of subjects (n = 12 – 39) reporting a range of hearing and speech difficulties. The propensity for hearing loss in our patient population is consistent with the previous case series in which there was hearing loss in 2 of 7 patients with ED.4 Our finding of approximately one third of subjects with hearing loss is higher than historical control rates of 5% to 15% in the general population.7,10

Otitis media was frequent, and this proclivity for otitis media may be due to diminished eustachian tube function from hypoplastic mucous glands or cleft palate associated with certain ED syndromes.5,11 The somewhat high proportion with tympanostomy tubes (present in one half of those reporting a history of otitis) suggests that otitis media may be more recalcitrant in this population. In addition, a previous series reported that 3 of 7 subjects with ED had recurrent otitis media, 2 of whom required 3 sets of bilateral tympanostomy tubes.4

Auricular abnormalities associated with ED have been only minimally addressed in the previous literature, with a mention that “low set and pointed ears may be observed.”12 In this population, there was a notable proportion of subjects with pinna anomalies affecting the helix, tragus, and concha. Also, these pinna anomalies showed some association with decreased hearing. In addition, the skin of the auricle and canal is prone to dermatitis, which can culminate in otitis externa, and often these processes were noted. These features are again consistent with the known pathogenesis of this ED.

This study has several limitations. First, not all ED subtypes are included. With more than 150 known subtypes,1,3 it is difficult to amass a sample population that encompasses all the potential varieties. Our study does, however, include the 2 major subtypes (ie, Christ-Siemens-Touraine syndrome and Clouston syndrome),2,4 as well as several others. Another limitation of this study lies in the sampling of volunteers. It is possible that those caregivers and patients who already had concerns about known otologic problems would be more likely to present for evaluation than those without otologic complaints. Finally, one more issue lies in our evaluation of the impact of otologic disease on the quality of life. Ideally, such an assessment would be performed using an instrument validated especially for the study population of interest. In this case, however, there is no instrument validated specifically for the evaluation of the otologic health of patients with ED. Furthermore, it is difficult to identify the impact of speech and physical suffering problems that are the specific result of otologic disease in this population that may often have associated dental, palatal, and laryngeal abnormalities. Therefore, the results of this quality-of-life assessment are purely descriptive in this patient population. The discriminative and evaluative properties are limited, and before this questionnaire could be used as an outcome measure for comparative statistics, it would need to be validated in this specific population.

While ED is a relatively uncommon disease, it would benefit otolaryngologists to familiarize themselves with it, since affected patients often present with complaints of the ear, nose, and throat. In addition, the population affected by ED is potentially already at a higher risk for speech and language difficulties secondary to dental, palatal, and laryngeal abnormalities.3,11 These potential setbacks, combined with the relatively increased frequency with which these patients present with otologic complaints, direct us to have a heightened awareness when evaluating patients with this remarkable disease.

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REFERENCES