

Genetics for the Educational/Pediatric Audiologist

Mary M. Whitaker, Au.D.
Jennifer Holst, Au.D.
Tina Mladenka, NP, RN

Emily: “Do you think my hearing loss is genetic?”

- Age 17
- Has received your services since she was in preschool, age 4 years
- Identified with mild to moderate loss at age 18 months, has progressed over the years to severe/profound loss
- Father has hearing loss, paternal grandmother has hearing loss
- Has younger brother in middle school with no hearing loss

Early Intervention Case Study

- Female from a wonderful young family seen at 10 months old for hearing eval.
- Small for her age
- Craniofacial abnormalities noted
- Parents concerned that she was not babbling and demonstrated inconsistent responses to sound.
- History
 - 30 days in NICU/antibiotics no oxygen
 - Low birth weight (3.6 lbs)
 - Born early (8 weeks)
 - Passed hearing screening in NICU
 - Parents received a lot of positive feedback about how good child was doing upon release from NICU, no concerns from physician at discharge.
 - No family history of hearing loss or other reported concerns although further exploration of the family history resulted in new information.
 - No history of middle ear problems
 - Parents reported development was delayed in other areas
 - Reported no diagnosis for a syndrome or other disorders.

Early Intervention Case Study

- Results of Hearing Evaluation (10 months of age)
 - Possible middle ear pathology
 - Otoacoustic Emissions did not meet criterion for normal outer hair cell function.
 - Referred back to physician for medical evaluation of middle ear
 - Return for further evaluation following any treatment.

Case Study: A Bit of Background I found out later

- **Parents were concerned with child’s development around 8-9 months. Parents switched physicians. Physician reportedly commented the child was “off the charts” developmentally.
- **Physician made immediate referral to ophthalmologist for concerns regarding the child’s visual tracking. Same physician also made referral for sedated CT/MRI for evaluation of fontanelles/ craniofacial differences, optic nerves.
- Around this time, family received developmental monitoring questionnaire from Infant Toddler.

Early Intervention Case Study

- Re-evaluation (12 months of age)
- Parents report that she has been diagnosed with vision disorder/blindness and that she is to see a pediatric neurologist and a geneticist.
 - Dad describes child’s vision loss as retinal disorder with light perception similar to what it would be like to look through a spray-painted window.
 - It was also reported that Mom was expecting second child.
- Auditory Brainstem response evaluation results suggest a severe to profound loss in both ears. Possibly with continued middle ear involvement.
 - “A child with a loss of this degree will not hear spoken conversation without the use of strong amplification or a cochlear implant. Very loud environmental sounds may be audible but not always identifiable.”

Early Intervention Case Study

- Referred to ENT for medical consult and clearance for amplification use.
- Referral to ISDB for habilitation services and loaner hearing aids. Teacher of the deaf and blind.
- Genetic evaluation would have been recommended following the diagnosis of hearing loss. Genetic evaluation was re-affirmed.
- Cleared for use of hearing aids at 13 months, fit with hearing aids at 13.5 months, re-evaluation of hearing sensitivity at 14 months.

Early Intervention Case Study

- Sedated ABR results suggested severe hearing loss in both ears.
- Cochlear Implant candidacy discussed.
- Due to vision loss auditory input is very important.
 - Continued hearing aid use.
 - Did have cochlear implant evaluation.
 - Not a candidate now but may be once she is two years old.
- To see Geneticist soon.

Early Intervention Case Study

- Genetic Evaluation:
 - Case History
 - Physical Exam
 - Blood Sample
 - X-rays
 - **Skin tissue samples
- At the initial evaluation only the child was tested.
- Physician looking to make a diagnosis by ruling out various possibilities based on most obvious features present and age of presentation.

What we will learn:

- Why the educational/pediatric audiologist needs to know about genetics and genetic evaluation.
- What the educational/pediatric audiologist needs to know about genetics and genetic evaluation.
- Where are your resources?
- How do you make a referral?

Health Care Professional and Genetics

- National Coalition for Health Professional Education in Genetics (NCHPEG, 2007):

At a minimum, each health-care professional should be able to:

a. examine one's competence of practice on a regular basis, identifying areas of strength and areas where professional development related to genetics and genomics would be beneficial.

b. understand that health-related genetic information can have important social and psychological implications for individuals and families.

c. know how and when to make a referral to a genetics professional.

www.nchpeg.org

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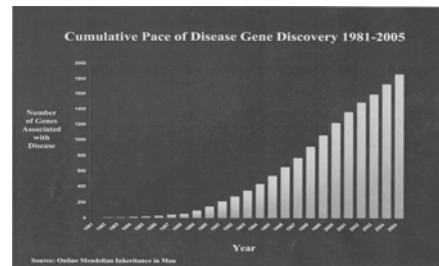
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What areas should the pediatric/educational audiologist be familiar with relative to genetics?

- Basic Genetic Information
- Potential that hearing loss may have a genetic etiology.
- Consequences and sequelae of genetic hearing loss.

Disease Genes Discovered



Human Genome Project

- Complete set of Human DNA
- International Governmental Project
- Map completed April 2003
- 20,000+ genes; new ones discovered frequently
- 3 billion base pairs which reside in the paired 23 chromosomes within the nucleus of all human cells
- 99.9% of DNA in all humans are identical; only 0.1% make each unique
- The function of more than 50% of discovered genes is unknown
- Only 1.5-2% of genes discovered are encoding genes.

Human Genome Project

- The human genome is sequenced as completely as it can be with today's technology; scientists continue to develop and apply new technologies to the few remaining gaps.
- As researchers study information from the Human Genome Project, improved genetic testing, more effective diagnostic tools, and highly efficacious treatments for diseases will be developed and implemented in years to come.
- Ethical, legal and social implications were considered from the beginning of the project in order to maximize potential for beneficial effects and minimize the risk of detrimental effects and inappropriate practices.

Basic Genetics/Genetic Terms: Which can you define?

- | | |
|-----------------|------------------------------|
| • Chromosome | • Hemizygous |
| • Gene | • Penetrance |
| • DNA | • Variable Expressivity |
| • Somatic cell | • Karyotype |
| • Gamete | • Punnet Square |
| • Allele | • Polymorphism |
| • Genotype | • Polygenic |
| • Phenotype | • Hap Map Project |
| • Replication | • Personalized medicine |
| • Transcription | • Epigenetics |
| • Translation | • Family History |
| | • Human Genome Project (HGP) |

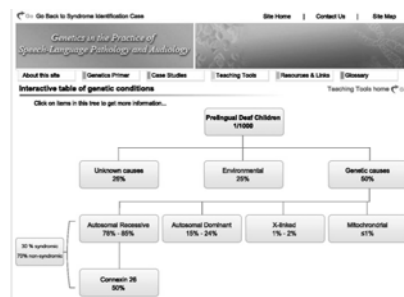
Family History: The 1st Genetic Test

- Family History is a common risk factor.
- Family History can help to identify or rule out syndromes
- Family History improves prevention efforts.
- Taking a family history uses skills YOU have and can develop others.
- Family History helps build rapport with your patients
- Failure to discuss family history with your patient is a missed opportunity.

Tools Used to Test for Risk and Diagnosis of Genetic and Genomic Diseases

- Family History with 3 Generation Pedigree is the **initial** Genetic Screening Test
 - www.familyhistory.hhs.gov
 - Pedigree Software
 - Guttmacher, AE, Collins, FS, & Carmona, RH (2004). The family history-More important than ever. *The New England Journal of Medicine*, 351(22), pp2333-2336.
 - Beery, TA & Shooner, KA. (2004). Family history The first genetic screen. *The Nurse Practitioner Journal*, 29(11), pp14-25.

Is this hearing loss genetic?



Consequences and Sequelae

- Some genetic hearing losses are syndromic others are not.
- Those that are may have multiple organ systems involved and have devastating consequences.
- We can not look just at the ears.
- If only hearing is involved parents and families still need to be offered genetic evaluation services.

Syndrome Identification

- Is there more than one organ system involved?
- Are there similar issues in other family members to the same or varying degrees?
- Is there any dysmorphism or a characteristic appearance among family members?

Genetic Red Flags

- Family History of a known or suspected disorder, birth defect or chromosomal abnormality
- Multiple affected family members with the same or related disorders
- Multiple affected generations
- Earlier age at onset than expected
- Disease in the less often affected sex
- Mental retardation or developmental delays
- One or more major malformations in any organ system
- Abnormalities in growth
- Occurrence of disease in the absence of traditional risk factors or after prevention measures
- Two or more pregnancy losses
- Close biological relationship of parents
- Ethnic predisposition to genetic disorder

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Social and Psychological Implications

- Social- how their family views genetic testing; how culture views it; how friends view it; religious beliefs;
- Legal- GINA: insurance and employment concerns with positive tests. With positive tests, what legal "duty" does health care provider have to tell family members?
- Psychological- why individual would want testing? what will individual do with info? How might positive results effect him/her? Would he/she want family to know? Risk of mispaternity or results not anticipated?
- Ethical issues: Does individual and health care provider have ethical responsibility to tell family members? Use information to make decisions to terminate pregnancy? Access to genetic counseling and testing not available to some but is to others. Informed Consent. Late onset adult disorders and testing minors

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Counseling And Referrals

- Overwhelming amounts of information are available to the consumer.
- Genetic Counseling is important to help consumers understand what the information is telling them or not telling them.
 - Help consumer find and use reliable information.
 - Keep in mind that a negative genetic test does not mean a particular trait is not genetic.
 - Having a particular mutant gene does not mean you will always absolutely have a particular trait.
 - Help individual's understand no one has a "perfect" set of genes.
 - We all have 5-10 recessive traits (not bad out of 33,000)
 - Genetic mutation is not bad. It is what it is.

Counseling And Referrals

- Genetic Counseling is important to help consumers understand what the information is telling them or not telling them.
- What are their choices?
 - Ex. Autosomal recessive,
 - 25% chance siblings will also be affected, 50% chance being asymptomatic carrier, 25% chance of being unaffected and not a carrier
 - 50% chance that siblings of proband's parents are carriers
 - Prenatal testing is available (blood vs cultured skin fibroblasts)
 - Carrier testing (biochemical testing can not identify carriers)
 - Pre-implantation testing available if an affected individual has had specific mutation identified.
 - Refer early. Give families choices.
 - Non directive
 - Help persons to make educated decisions

Case Study

- Genetic Evaluation:
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Making a Referral

- May need to hear it more than once.
- Why are you making the referral?
- What will happen during a genetic evaluation?
- Where can services be obtained?
- What information will be obtained or not be obtained?
- Importance of counseling.

How and when to make a referral?

- Example: How to find resources.
 - www.geneclinics.org
 - Clinic Directory
 - Laboratory Directory

- Example: Making a genetic referral.