Ototoxic Monitoring for the Pediatric Patient

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Disclosure Statement

I have the following financially relevant relationships in the service and/or product communicated, compared, evaluated and/or reviewed in this presentation. I am an employee of Audiology Systems / GN Otometrics North America.

otometrics & audiologysystems

- Who Are We?
  - Otometrics – Develops, manufactures and markets computer based audiological, otoneurologic & vestibular instrumentation in more than 70 countries globally. Product brands include MADSEN, AURICAL, ICS & HORTMANN
  - Audiology Systems– National partnership of industry professionals, audiologists and local audiology & vestibular experts who work together to distribute products, educate and serve as a resource to our customers

3

Snapshot of the Next Hour

- Ototoxic Monitoring in Pediatrics
  - Consequences of ototoxic medications
  - Speech and language development
  - Psychosocial development

- Protocols
  - Benefits and limitations of current audiologic tests with pediatric patients undergoing therapy with ototoxic agents
- Multi Disciplinary Team
  - Methods and benefits of implementing a multi disciplinary team
  - Business Case

4

Consequences of Pediatric Hearing Loss

- Speech and Language Acquisition
- Educational Challenges
- Psychosocial Challenges
- Social Interactions
- Economic Status
- Quality of Life

5

Pediatric Hearing Loss

- Pediatrics – early detection of hearing loss
- Newborn Hearing Screening Programs
  - Congenital
  - High risk factors
  - Connexin 26 & 30
  - Enlarged Vestibular Aqueducts Syndrome (EVAS)

6

Pediatric Hearing Loss

- One of the most common reason for acquired hearing loss in pediatrics

Ototoxicity

7

What Are Ototoxic Medications / Therapies?

8

What is an Ototoxic Medication?

- Primarily Oncology Medications & Treatments
  - Platinum based chemotherapy
    - cisplatin
    - carboplatin
- Radiotherapy to ear, midline of brain, or brainstem

9

What is an Ototoxic Medication?

- Aminoglycoside antibiotics
  - gentamicin
  - tobramycin
  - amikacin
    - long term use with Cystic Fibrosis patients
- Chelation therapy with dexferrioxamine
  - Sickle Cell Anemia patients

10

So My Pediatric Patient is Taking an Ototoxic Medication?

What Do I Do?

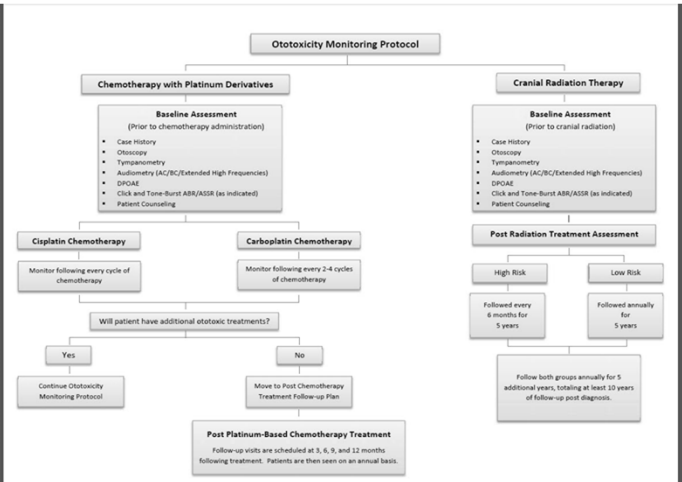
11

Protocol for Ototoxic Monitoring of Pediatrics Patients

- No widely used and accepted protocol for ototoxic monitoring
- AAA and ASHA both have position statements with guidelines
  - Not very specific
- St. Jude Children's Research Hospital created a flow chart guideline
  - http://www.asha.org/uploadedFiles/Ototoxicity-Monitoring-Protocol-Flowchart.pdf
- Most pediatric oncology patients are "on study"
  - Following a specific treatment protocol from National Cancer Institute (NCI)

12

St. Jude Children's Research Hospital Protocol



13

Example Protocol

POLICY: Patients receiving ototoxic medication will be monitored audiometrically.

1. Platinum-based chemotherapy (e.g., cisplatin, carboplatin)
2. Aminoglycoside antibiotics (e.g., gentamicin, tobramycin, amikacin)
3. Loop diuretics (e.g., furosemide)
4. Radiotherapy to ear, midline of brain or brainstem
5. Chelation therapy with desferrioxamine

PURPOSE: Hearing ability should be monitored audiometrically at designated intervals before, during, and after a patient receives ototoxic medication.

14

14

Example Protocol

PROCEDURE:

Tests to be performed for children receiving ototoxic medications include the following:

1. Obtain baseline testing for all children scheduled to receive potentially ototoxic therapy.
    a. Children age 0-3 years – ABR (clicks and tone bursts), DPOAEs, tympanometry, otoscopy
    b. Children age 3 years and up – bilateral pure tone air and bone testing (250-8000 Hz and high frequency inter-octaves) , extended high frequency testing (8,000-20,000 Hz), speech detection / reception thresholds, word recognition scores, DPOAEs, tympanometry, otoscopy
    c. Exception: Children receiving carboplatin should not receive DPOAEs as they will appear normal even if hearing loss is present. Carboplatin affects inner haircells only.
    d. It is left to the audiologist's discretion to delete any portion of testing based on patient's attention span or patient's ability to maintain a conditioned response.

Example Protocol

Suggested guidelines for follow-up testing include the following:

2. Test high-risk patients prior to each platinum-based chemotherapy course (patients who meet any of the following criteria):
    a. All children $\leq$ 3 years of age
    b. All children who have received brain or ear irradiation
    c. All children with a diagnosis of CNS neoplasm
    d. All children concurrently receiving other ototoxic or investigational agents
    e. All children who have received cumulative cisplatin doses above 360 mg/m^2 or cumulative carboplatin dose >1500 mg/m^2

Example Protocol

3. Test lower risk patients prior to every other platinum-based chemotherapy course (patients who meet all of the following criteria):
    a. Children $\geq$4 years of age with no history of brain or ear irradiation
    b. diagnosis other than CNS neoplasm
    c. receiving no other ototoxic or investigational agent
    d. cumulative cisplatin dose $\leq$360 mg/m^2 or cumulative carboplatin dose $\leq$1500 mg/m^2
4. Test at least 3 weeks after any previously administered course containing platinum based chemotherapy (hearing deficits may be delayed following administration of platinum) or as directed by treatment protocol.

17

Example Protocol

5. Test 6-8 weeks after final chemotherapy course or as directed by treatment protocol
6. Test if child reports subjective decrease in hearing or increased tinnitus or dizziness
7. Test periodically for children treated with aminoglycoside antibiotics, loop diuretics, or chelation therapy with desferrioxamine – schedule to be determined based on frequency and duration of treatment with these agents (note: Amikacin requires more frequent monitoring, optimally 1-2x per week during therapy).

18

Example Protocol

8. For children off-treatment test at the following intervals:
   a. Children who have received platinum-based chemotherapy annually for seven years
   b. Radiation to the ear, midline of brain, or brainstem annually for five years; if child is younger than 10 years of age, continue testing until age 10; then if no hearing loss is detected, test every 5 years
   c. Aminoglycoside antibiotics or loop diuretics test once at the end of treatment.
9. If hearing loss is detected at anytime, hearing should be monitored at regular intervals per the treating audiologist.

19

Audiology's Role on a Multi Disciplinary Team

20

What is a Multidisciplinary Team?

- A team of professionals including representatives of different disciplines who work in a coordinated fashion toward a common goal in order to improve patient care.

Oncology Team

- Leader – Neuro Oncologist
- Organizer/Scribe – Neurosurgery Nurse Practitioner
- Neurosurgeon
- Neurologist
- Radiation Oncologist
- Neuropsychologist
- Social Worker
- Audiologist

Audiology's Role

• Patients receiving ototoxic medication should be monitored audiometrically.

- Platinum-based chemotherapy (e.g., cisplatin, carboplatin)
- Aminoglycoside antibiotics (e.g., gentamicin, tobramycin, amikacin)
- Loop diuretics (e.g., furosemide)
- Radiotherapy to ear, midline of brain or brainstem
- Chelation therapy with desferrioxamine

Why be part of an Oncology Multidisciplinary Team?

- Patient care
  - Patient population that needs audiologic services
- Marketing tool
  - Part of an existing team/entity
- Business model
  - Repeat testing – covered by insurance
  - Hearing aids – often covered by insurance

I Don't Have a Team…How Do I Start One?

25

Start a Multi Disciplinary Team

- Contact your oncology department
- Find local oncologists in the area – find out who they are referring patients to…or if they are at all?
- Discuss why their patients need audiology services

26

Things To Remember

- Cumulative effects of ototoxicity
- Genetics plays a role in ototoxicity
- Importance of hearing conservation with patients who have been exposed to ototoxic medications
- Future role of mannitol, sodium thiosulfate, D-methionine, acetylcysteine as otoprotective agents and the possibility to induce inner ear hair cell proliferation

27

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28

Thank You!

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29