Modeling the risk of hearing loss from radiotherapy in childhood cancer survivors: Initial results from the (PENTEC) hearing loss task force

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Background

- RT Dose
- Age at RT

Hearing Loss

- Language Development
- Neurocognitive outcomes
- Social Functioning
- Quality of Life
Objectives

To utilize published investigations to determine the impact of the following variables on hearing loss:

- Radiation Dose
- Age at Treatment
- Time from Treatment
- Receipt of Ototoxic chemotherapy
Materials/Methods

- 731 abstracts screened
- 23 studies reviewed
- 15 studies included in meta-analysis
- 2 studies included in data extraction
- 457 ears (RT only)
- 58 ears (chemoRT) available for logistic regression model
Results

- Risk of HL was <5% in ears receiving a mean dose of \( \leq 35 \text{ Gy} \), but risk increased to approximately 30% at 50 Gy.

- HL risk ranged from 25-40% in children under 5 yo, in contrast to only 10% in older children.

- Average onset of HL was 3.6 years (range 0.4-13.2) after RT.

- High-frequency HL was more common than low or intermediate frequency HL for any given cochlear exposure.
Hearing Loss vs. RT Dose

Variation of Incidence of Hearing Loss with Dose

- Rate of clinical hearing loss
- 68% confidence interval
- Logistic regression model

Incidence of Clinical Hearing Loss vs. Dose (Gy)
Hearing Loss vs. Age at RT

Variation of Incidence of Hearing Loss with Age

- Incidence of clinical hearing loss
- Age at treatment (years)
- Rate of hearing loss
- 68% confidence interval
Frequency of Hearing Loss

Frequency and dose dependence of hearing loss

- fit, low frequencies (Hua)
- fit, int. frequencies (Hua)
- fit, high frequencies (Hua)
- observed rate low frequencies (Hua)
- observed rate int. frequencies (Hua)
- observed rate high frequencies (Hua)
- observed rate 4kHz (chemo, Scorbila)
- observed rate 6kHz (chemo, Scorbila)
Limitations

- Heterogeneity of grading systems used, and one standard needs to be adopted. This analysis was simplified by defining HL as any frequency HL with dB threshold of 25 or higher. (Johnnie Bass/T Yock are proposing new comprehensive scale for future use.)

- More granular data is needed to better delineate the time to onset of HL

- More data is needed to better determine the effects of chemoradiotherapy on hearing loss
Conclusions

- In children treated with RT alone, rates of HL below 35 Gy were <5%, but without a clear RT dose dependence.

- Prevalence of HL rose significantly when the cochlear dose exceeded ≥ 35 Gy.

- High frequency HL was more prevalent than low or intermediate frequency HL, but HL at all levels were affected by radiation dose.

- This analysis suggests that children <5 years may be at highest risk of developing RT-related HL, although independent effects of dose and age could not be fully elucidated.
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