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Feasibility of Distortion-product Oto-acoustic Emission in identification of Cisplatin-induced ototoxicity in adult cancer patients

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Introduction

Cisplatin has been shown to cause tinnitus and hearing loss in 23–50% of adults receiving it (WHO,2021). There is a need for exploration of the feasibility of Oto-acoustic Emission in identifying cancer treatment-induced ototoxic hearing loss.

Objective

To check the feasibility of Distortion-product Oto-acoustic Emission (DP-OAE) in ototoxicity assessment by comparing it with the findings of Pure-tone Audiometry (PTA) at different time points during Cisplatin-Based Chemotherapy in adult cancer patients.

Participants

Inclusion

- Head Neck Cancer patients within 18-60 years of age
- Valid Baseline and at least one subsequent audiological evaluation
- Underwent Cisplatin-chemotherapy between August 2022 to January 2023

Ear-wise Exclusion

- Conductive Hearing loss at baseline/ at all other subsequent evaluation
- DPOAE-SNR ≤ 6 dB SPL and/or amplitude ≤ -10 dBSPL at any two consecutive test frequencies between 1.5 to 6 kHz
- AC thresholds >50dBHL at any test frequency

Audiological Evaluation

Test Frequencies: PTA (0.25,0.5,1,2,4,8 kHz), DP-OAE (1.5,2,3,4,5,6,7,8 kHz)

Baseline (T1)	Time Point 2(T2)	Time Point 3(T3)	Ototoxic Time Point (OTT)
Within one month Before initiation of Chemotherapy	After 2-3 cycles of chemotherapy or in case of subjective complaints of Hearing loss/ Tinnitus	Within 1-3 months of completion of chemotherapy	When Ototoxicity was first detected by PTA or in case of no toxicity, then the last evaluation

Criteria of Ototoxicity

ASHA (1994) Guideline

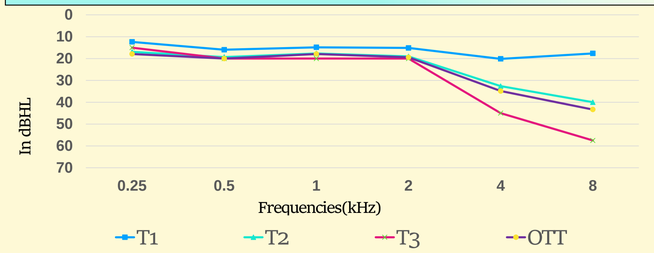
- Threshold shift of ≥20 dBHL at any test frequency
- Threshold shift of ≥ 10 dBHL at any two consecutive test frequencies
- No response at any of three consecutive test frequencies

PTA(Gold Standard) — DP-OAE (Proposed Criteria)

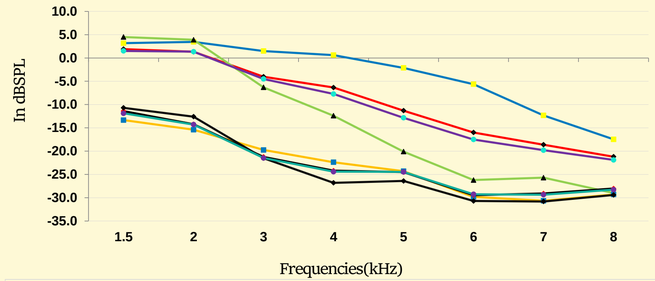
SNR < 6 dBSPL and/ or amplitude< -10dBSPL at-

- (i)two consecutive test frequencies between 1.5 to 6 kHz
- (ii)50% test frequencies between 1.5 to 6 kHz
- (iii)50% test frequencies between 1.5 to 8 kHz

Results



Picture 1-Comparision of AC Thresholds across timepoints



Picture 2:Comparision of DP-OAE Amplitude and Noise across time points

Table 1

Frequencies (in kHz)	T1-T2	T1-T3	T1-OTT
0.25	.002*	.178**	.000*
0.5	.008*	.021*	.001*
1	.018*	.003**	.002*
2	.002*	.006**	.001*
4	.000*	.001**	.001*
8	.000*	.000**	.000**

Table 2

Frequencies (in kHz)	SNR			Amplitude		
	T1-T2	T1-T3	T1-OTT	T1-T2	T1-T3	T1-OTT
1.5	.011**	.122**	.011**	.351**	.798*	.798**
2	.001**	.093**	.001**	.069**	.932*	.932**
3	.126*	.041*	.034*	.033*	.041*	.041*
4	.007*	.003*	.001*	.002*	.001**	.001**
5	.002*	.000**	.000**	.002*	.000**	.000*
6	.000*	.000**	.000**	.000**	.000**	.000**
7	.002*	.005**	.000*	.005*	.004**	.004*
8	.006**	.047**	.001**	.061*	.041**	.041**

Statistical Significance of difference ('p' Value) of AC Thresholds (Table 1), SNR, Amplitude (Table 2) across time points (*)- Wilcoxon Signed Rank test,(**)- Paired 't' test

- 39 ears(19 right, 20 left) of 24 patients(19 Male, 5 Female) with mean age at baseline-42 years, range 34-59 years were included in the study.
- The study reported statistically significant reduction of AC thresholds, DP-OAE SNR and amplitude levels at subsequent evaluations compared to the baseline.
- The Proposed criteria (i) and (iii) showed better agreement with PTA, higher Sensitivity, and Specificity at all the time points of evaluation during cancer treatment.

		Criteria (i)	Criteria (ii)	Criteria (iii)
T2	Agreement(k)	0.778(p=0.000)	0.618(p=0.000)	0.778(p=0.000
	Sensitivity	84.21%	63.16%	84.21%
	Specificity	94.12%	100.00%	94.12%
T3	Agreement(k)	0.744(p=0.011)	0.421(p=0.087)	1.00(p=0.001)
	Sensitivity	88.89%	66.67%	100.00%
	Specificity	100.00%	100.00%	100.00%
OTT	Agreement(k)	0.772 (p=0.000)	0.576 (p=0.000)	0.772 (p=0.000)
	Sensitivity	86.36%	63.64%	86.36%
	Specificity	92.86%	100.00%	92.86%

Table 3:Agreement, Sensitivity, Specificity of DP-OAE Criteria (i),(ii), (iii) across time points

Abbreviations

"WHO-World Health Organization", "SNR-Signal-to-Noise Ratio", "dB-SPL- Decibel Sound Pressure Level", "kHz-kilo Hertz", "AC-Air Conduction", "ASHA-American Speech and Hearing Association"

Conclusion

- DP-OAE has high diagnostic value in identifying Cisplatin-induced ototoxicity in adult cancer patients.
- Cisplatin-induced-ototoxic changes in DP-OAE findings correspond to the findings of PTA in adult cancer patients.
- DP-OAE can be useful for well-informed treatment decisions, counseling and overall audiological monitoring protocol in adult cancer patients. .
- Larger Prospective studies warranted to further validate DP-OAE in this study population.

References

World Report on Hearing (2021)-https://www.who.int/publications/i/item/9789240020481

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