

## Original Research Article

# Prevalence of sensorineural hearing loss in patients with head and neck malignancy who underwent chemotherapy and or radiotherapy

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### ABSTRACT

**Background:** Our study aimed to focus on the importance of the rate at which the sensory neural hearing loss (SNHL) is caused by chemotherapy (CT) and or radiotherapy (RT). This study also tells about the importance of informing the patient and the caretakers prior to the start of treatment for carcinoma, so that they can be prepared for it if it happens.

**Methods:** Total 75 patients who were diagnosed to have any form of head and neck malignancy formed the study group. Pure tone audiometry was recorded pre-treatment, one month after treatment and six months after treatment. All the data obtained were bio statistically analysed by running in SPSS software version 26.

**Results:** There is a correlation between CT, RT and concurrent chemo radiotherapy (CRT) and SNHL. It is also found that most of the patients who have undergone CRT suffered SNHL in the long run.

**Conclusions:** It is high time the patients are made aware of the side effects like SNHL before the start of the proposed treatment. This will allow them to be prepared and then face it.

**Keywords:** Head and neck malignancy, Sensory neural hearing loss, Chemotherapy, Radiotherapy, Concurrent chemo radiotherapy

### INTRODUCTION

Head and neck cancer has a worldwide incidence of approximately 780,000 new cases per year, and more than 70% of these patients present with Stage III and IV disease.<sup>1</sup>

A combination of radiotherapy (RT) and chemotherapy (CT) shows improved response rates and allows for organ preservation. Taking this into consideration and aiming to increase drug doses in the tumour with minimal systemic toxicity, a super selective intra-arterial administration scheme of high-dose cisplatin with sodium thiosulfate for cisplatin neutralization combined with RT was designed.<sup>2,3</sup>

However, this treatment scheme induces an incidence of 60% sensorineural hearing loss (SNHL) at speech frequencies.<sup>4</sup>

Cisplatin (CDDP), which is widely used as an effective antineoplastic drug for these cancers, is also known to cause ototoxicity. Therefore, it is expected that the use of concurrent chemo radiotherapy (CRT) results in greater sensorineural hearing loss than using RT alone, which was shown to be the case in several reports.<sup>5</sup>

CRT has become increasingly important for treatment of head and neck squamous cell carcinoma.<sup>1,2</sup> In the past, high-dose cisplatin CT schemes induced a 58% to 81%

incidence of hearing loss at frequencies from 0.250 to 8 kHz.<sup>6</sup>

In this study, we aimed at evaluating the prevalence and severity of hearing loss after irradiation for head and neck carcinoma, to determine the characteristic of SNHL due to RT, CT or CRT and to focus on the importance of informing the patients about this common side effect of the treatment.

## METHODS

This is a prospective study that was done in Sree Mookambika Institute of Medical Sciences, the Department of ENT. The study duration was nine months (May, 2020 to January, 2021). The patients who were diagnosed with head and neck malignancy and underwent CT and or RT, with no previous history of SNHL and who was willing to give consent for research were included in the study. Patients who were not willing for regular follow up or with any comorbidities were excluded from the study.

Taking the incidence of SNHL in head and neck malignancy cases who have undergone CT and or RT that was published in a similar article as a standard the sample size of this study was calculated. All head and neck malignancy cases who underwent CT and or RT except those who have undergone a surgery for the malignancy during the study period and who was willing to get enrolled for the study was included in the study.

After obtaining written informed consent form from the patients in their local language and calculating the sample size, 75 head and neck malignancy cases were selected. Their diagnosis and line of management were recorded. Pure tone audiometry was taken prior to the start of treatment, after one month and after six months of treatment. Examination of ear and impedance was also done as a part of complete ear examination. All data was run in SPSS software version 26 and was analysed statistically.

## RESULTS

A total of 75 patients (30 females and 45 males) were included in the study. They belonged in age group 20 to 80 years of age. 25 out of 75 underwent CT (group 1) while another 25 underwent RT (group 2) and the remaining underwent both CRT (group 3). Out of 75 patients, 50 of them developed sensory neural hearing loss. The prevalence obtained from this study is 67%. 19 patients who underwent CT developed SNHL. 8 patients who underwent RT developed SNHL. 23 patients who underwent CRT developed SNHL.

On calculating the relation between the effects of CT on SNHL, RT and SNHL and CRT and SNHL the following significant values were obtained (Table 1).

**Table 1: p value of each group.**

Group	p value
Group 1	0.02
Group 2	0.99
Group 3	0.04

p value is significant at <0.05

**Table 2: Sex distribution among each group.**

Treatment	Male (affected with SNHL)	Female (affected with SNHL)
CT	16 (15)	9 (4)
RT	14 (5)	11 (3)
CRT	15 (15)	10 (8)

**Table 3: Age distribution among each group.**

Age (years)	Male	Female
20-40	9	3
40-60	15	10
60-80	21	17

## DISCUSSION

A total of 75 patients (30 females and 45 males) were included in the study. They belonged in age group 20 to 80 years of age. 25 out of 75 underwent CT while another 25 underwent RT and the remaining underwent CRT. All patients underwent pretreatment and post treatment pure tone audiometry and impedance. We followed all cases for six months (Table 2).

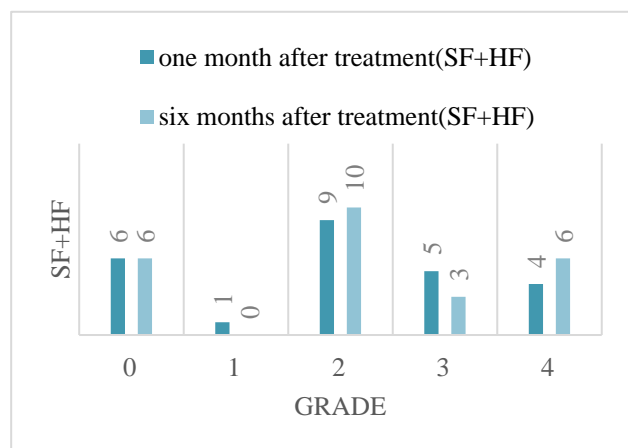
The prevalence obtained from this study is 67%. In a study done by Theunissen, incidence rates of SNHL after RT and CRT varied considerably, with percentages ranging from 0% to 43% and 17% to 88%, respectively.<sup>7</sup> The prevalence obtained from this study is in par with that published by Theunissen et al.

In CT there were two types. One with low dose of cisplatin (30 mg), while the other with high dose (cisplatin 40 mg). Cisplatin (CDDP), which is widely used as an effective antineoplastic drug for these cancers, is also known to cause ototoxicity.<sup>8</sup> 14 patients underwent the low dose modality while 11 patients underwent the high dose modality. Patients with malignancy of buccal mucosa (3), parotid malignancy (1), malignancy of cricopharynx (3), malignancy of tongue (5), malignancy of oropharynx (1) and malignancy of hypopharynx (2) underwent low dose regime. Malignancy of tonsil (1), nasopharyngeal Malignancy (1), Malignancy of external auditory canal (1), malignancy of submandibular gland (1), malignancy of pyriform fossa (3), malignancy of supraglottis (3) and Malignancy of floor of mouth (1) underwent high dose regime. Pure tone audiometric findings are given in Table 3.

**Table 4: Comparison between the degree of SNHL and CT.**

Grade	dBHL	Severity	one month after treatment (n) (SF+HF)	six months after treatment (n) (SF+HF)
0	25 or lesser in better ear	No impairment	6	6
1	26-40	Slight	1	0
2	41-60	Moderate	9	10
3	61-80	Severe	5	3
4	81 or greater	Profound	4	6

SF= Speech frequency hearing loss; HF= High frequency hearing loss



**Figure 1: Comparison between the degree of SNHL and CT.**

Out of the 25 patients who underwent CT 19 of them (male: 16, female: 3) developed SNHL. Here all 19 of them developed some degree of SNHL within first month of treatment. Three of them went to the next level of hearing loss within the next five months. None of them recovered. So we can understand that it is a permanent loss of hearing. After six months, 24% belonged to grade 0, none belonged to grade 1, 40% belonged to grade 2, 12% belonged to grade 3 and 24% belonged to grade 4.

**Table 5: Comparison between the degree of SNHL and RT.**

Grade	dBHL	Severity	After one month of treatment (n) (SF+HF)	After six months of treatment (n) (SF+HF)
0	25 or lesser in better ear	No impairment	16	16
1	26-40	Slight	3	3
2	41-60	Moderate	4	4
3	61-80	Severe	2	1
4	81 or greater	Profound	0	1

SF= Speech frequency hearing loss; HF= High frequency hearing loss

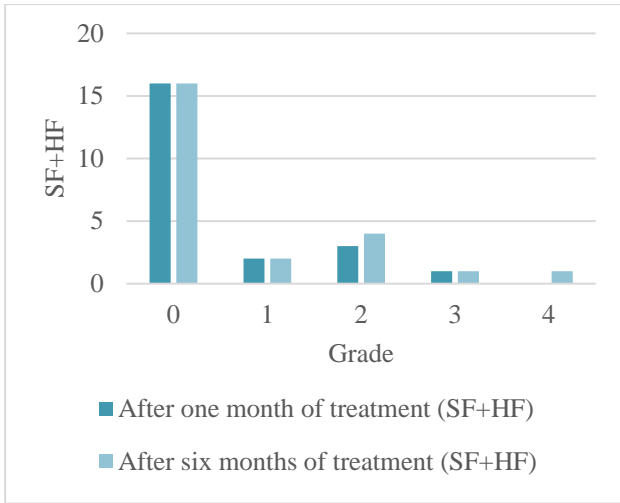
Total 8 out of 25 underwent RT developed SNHL. 6 of them developed SNHL within one month of treatment. Remaining 2 of them developed SNHL after a month of treatment. After six months, 64% did not get SNHL, 12% belonged to grade 1, 16% belonged to grade 2, 4% belonged to grade 3 and 4% belonged to grade 4. As the p value is 0.99 which is not less than 0.05, the above statistics indicate that there is no bio statistically significant correlation between RT and SNHL although

As the p value is 0.02 which is less than 0.05, the above statistics indicate that there is a strong correlation between CT and SNHL both clinically and bio statistically.

From our study it is observed that patients who were exposed with high dose of cisplatin developed more severe SNHL when compared with low dose group of patients. This is in line with the work published by S. H. Chain in Sensorineural hearing loss after treatment of nasopharyngeal carcinoma: a longitudinal analysis which state that the incidence and severity of high-frequency SNHL are significantly related to the mean cochlea radiation dose and the dose of concurrent cisplatin.<sup>9</sup>

Out of 25 patients who underwent RT, 5 underwent IMRT, 10 underwent 3D RT and the remaining 10 underwent 2D RT. Patients diagnosed to have NPC (2), Malignancy of tonsillar fossa (2) and malignancy of glottis (1) underwent IMRT.<sup>10</sup> patients who underwent 2D RT included those diagnosed to have malignancy of tongue (4), malignancy of buccal mucosa (3) and Malignancy of hypo pharynx (3). Patients who underwent 3D RT included malignancy of cricopharynx (3), malignancy of tongue (2), malignancy of hypopharynx (2) and malignancy of buccal mucosa (3). Pure tone audiometric findings are given in Table 4.

there is a mild relation clinically. According to the study done by Cheraghi in short-term cohort study on sensorineural hearing changes in head and neck RT, SNHL is one of the serious adverse effects of RT of head and neck tumours during and after the treatment because the auditory apparatus usually receives a significant dose of radiation.<sup>10</sup> From our study clinically we could derive a correlation between SNHL and RT.



**Figure 2: Comparison between the degree of SNHL and RT.**

Out of 25 patients who underwent concurrent CT and RT 23 patients developed SNHL. None of them recovered. This mainly tells us about the severity of the synergistic effect of CRT. 8% did not get SNHL. Nobody belonged to grade 1 category after treatment. 12% belonged to grade 2 while 48% belonged to grade 3. 32% of them belonged to grade 4.

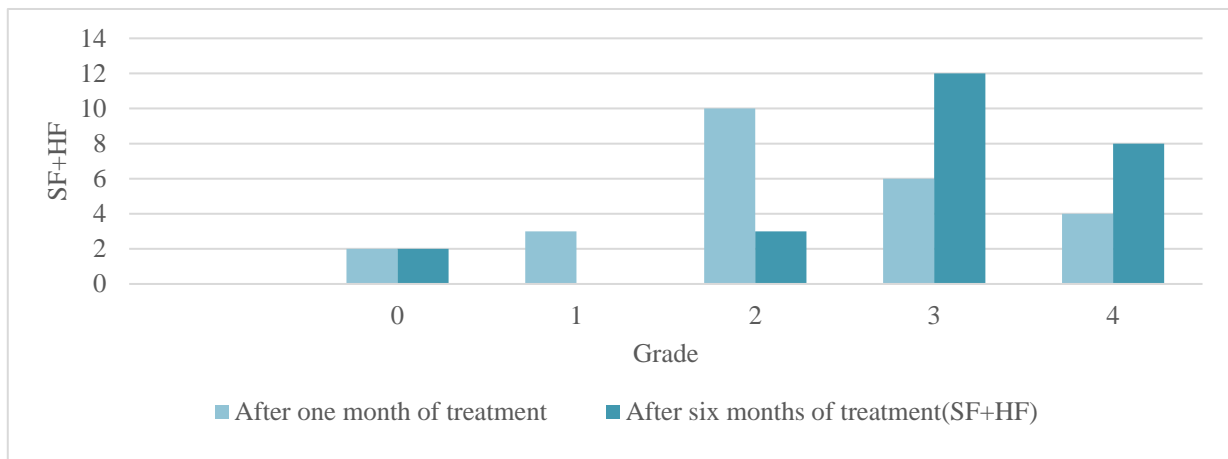
This is in comparable to what is published by Zuur in the article on the risk factors of ototoxicity after cisplatin-based chemoradiation in patients with locally advanced head-and neck cancer: a multivariate analysis.<sup>11</sup>

Most of the patients who underwent CRT suffered SNHL within six months after the treatment. Also from the study it is very clear that there is no recovery in due course of time. SNHL deteriorated in some patients as time progressed.

**Table 6: Comparison between the degree of SNHL and CRT.**

Grade	dBHL	Severity	After one month of treatment (n) (SF+HF)	After six months of treatment (n) (SF+HF)
0	25 or lesser in better ear	No impairment	2	2
1	26-40	Slight	3	0
2	41-60	Moderate	10	3
3	61-80	Severe	6	12
4	81 or greater	Profound	4	8

SF= Speech frequency hearing loss; HF= High frequency hearing loss



**Figure 3: Comparison between the degree of SNHL and CRT.**

By this study we could only follow up the patients for six months after the treatment. Further studies with longer duration of follow up would be helpful to understand the progression of the effect of CT, RT or CRT on SNHL induced by it.

**CONCLUSION**

From this study we can conclude that one of the causes of SNHL is a side effect of CT, RT or CRT. We can also come to an agreement that the dose of cisplatin also has a

role in the degree of hearing loss a patient suffers. Higher the dose more severe the hearing loss. RT is also a causative for SNHL. CRT and CT has the maximum number of patients with SNHL. Almost in all scenarios the hearing loss is irreversible. Sometimes there is a chance of deterioration of hearing over a period of time. All these findings help us to understand the need to educate the patients regarding the adverse effects of these modalities of cancer treatment on their hearing so that when they face it they will be prepared. Thus it can help in reducing the mental stress the patient has to undergo if

he is forced to suffer SNHL without informing about the side effect of the treatment. This anticipation will also help the patient in the rehabilitation of hearing loss if it manifests.

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