

Sensorineural Hearing Loss after Radiotherapy for Brain Tumors in Radiotherapy Department Erbil City

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Abstract

Background: Hearing loss is a well-known complication of radiotherapy among patients treated for tumors that arise in the head and neck region, more specifically, among those treated with postoperative radiotherapy for parotid gland tumors. **The purpose** of this study was to evaluate the effects of radiotherapy on hearing function in patients who underwent radiotherapy for tumors of the brain.

Methods & Materials: In this study pure ton Audiometer was used to measure hearing loss. The mean dose on middle ear, cochlea, and Eustachian tube was estimated with a Linear accelerator (linac.) CT-Scan planning. Bone conduction hearing thresholds were performed before treatment and at 1 week, 6 months & 1 year after completion of **radiotherapy**.

Results: A hearing loss of >20 dB in 8 frequencies was found of the 40 patients included in the study. Patients with an asymmetrical hearing loss received a higher mean dose on the hearing structures ($p < .001$). The threshold dose for clinically relevant hearing loss was found at > **50 Gy** on the inner ears.

Conclusions: Radiation-induced hearing loss is a common Complication. A mean dose of > **50 Gy** on the inner ears should be avoided.

Keywords: radiotherapy; hearing loss; audiometry & CT-planning.

Introduction

Radiation therapy uses high-energy radiation to shrink tumors and kill cancer cells .X-rays, gamma rays, and charged particles are types of radiation used for cancer treatment. The radiation may be delivered by a machine outside the body (external-beam radiation therapy), or it may come from radioactive material placed in the body near cancer cells (internal radiation therapy, also called brachytherapy). (1)

However detailed information regarding the magnitude and type of hearing loss is limited. The same accounts for the specific causes of radiation induced hearing loss and the clinical implications in daily life. During radiation and the first 6 months after completion of radiotherapy, mainly acute and/or sub chronic otitis media and otitis external occur. (2)

Systemic radiation therapy uses radioactive substances, such as radioactive iodine, that travel in the blood to kill cancer cells. About half of all cancer patients receive some type of radiation therapy sometime during the course of their treatment. (3)

Besides these acute side effects, late radiation- induced complications may occur, such as progressive and permanent sensorineural hearing loss. These late complications usually occur within 1 year after completion of treatment. (4, 5) The reported incidence of permanent radiation induced hearing loss after irradiation of the parotid region ranges from 0% to 50 %. (6, 7)

Material and Method

Patients:

During the year 2011 to year 2013 for the first time in Kurdistan Region Government in Iraq this type of research have done. 40 patients aged (35 to 75) years, 12 female and 28 male. Newly diagnosed patients were randomly assigned to the radiotherapy group. Bone conduction hearing thresholds were performed before treatment and at 1 week, 6 months, 1year, and 2 years after completion of radiotherapy.

Hearing Tests:

A hearing (audiometric) test is part of an ear examination that evaluates a person's ability to hear by measuring the ability of sound to reach the brain after treatment and before treatment radiotherapy . The sounds we hear start as vibrations of air, fluid, and solid materials in our environment. The vibrations produce sound waves, which vibrate at a certain speed (frequency) and have a certain height (amplitude). The vibration speed of a sound wave determines how high or low a sound is (pitch). The height of the sound wave determines how loud the sound is (volume). Hearing happens when these sound waves travel through the ear and are turned into nerve impulses. These nerve impulses are sent to the brain, which "hears" them. (8)

External-beam radiation therapy:

Many types of external-beam radiation therapy are delivered using a machine called a linear accelerator (also called a LINAC) (9). A LINAC uses electricity to form a stream of fast-moving subatomic particles. This creates high-energy radiation that may be used to treat cancer.

Results

40 patients were randomly assigned to the **radiotherapy** group for different ages and sexes with taken pure tone Audiometer tests before and after **radiotherapy**, **hearing** thresholds for (500,1000,2000,4000 & 8000) dB could be studied at 1 week to 6 months and 1 year after treatment respectively. These declining enrollments were the result of patients who declined further audiologist assessments, patients who were lost to follow-up, or patients who died from advanced disease, so in 40 patients just remained **21 patients**. **Analysis** The **hearing** levels in the **radiotherapy** at different post radiotherapy time points are illustrated in **Tables**.

Table one is the mean hearing threshold before radiotherapy for both ears in different ages and different sex but table two is the mean hearing threshold after radiotherapy.

Table [1]: Mean hearing threshold Before radiotherapy for right and left ears.

Before Radiotherapy		
Frequency/HZ	Mean Hearing Threshold/dB	Mean Hearing Threshold/dB
	Right Ear	Left Ear
500	18.57	19.04
1000	22.85	20.95
2000	25	20.71
4000	31.42	29.28
8000	38.57	34.76

Table [2]: Mean hearing threshold after radiotherapy for right and left ears.

After Radiotherapy		
Frequency/HZ	Mean Hearing Threshold/dB	Mean Hearing Threshold/dB
	Right Ear	Left Ear
500	19.76	22.8
1000	25.71	26.2
2000	28.57	25.95
4000	38.61	36.66
8000	48.6	45.71

Discussion

Radiotherapy only for the first cycle 5dB in week1; (5-10) dB in week 3; and (10-20) dB in week 5, Radiotherapy 2Gy/d. (10)

Radiation induced sensorineural hearing loss has been recognizing important adverse effect. Early sensorineural Hearing loss occurs during or shortly after radiation. Late sensorineural hearing loss typically occurs several months or years after radiation. The extent of hearing loss is related to the radiation dose used. (11)

In this study we show in tables that increasing hearing loss dependent on the type of tumor and the position of tumor, also dependent on the amount of radiation dose in each patient.

The hearing loss in the present study is in agreement with the rates reported in the literature. (12,13) we found that this hearing loss was mainly sensorineural and most significant in the frequencies of 4 and 8 kHz.(14,15).

Conclusion

Hearing loss occurred after radiotherapy on the brain tumor . A threshold dose of about _ 50 Gy on the inner ears was found. These patients experienced significantly more hearing handicaps and disabilities in life than patients without hearing loss.

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