

Hearing morbidity post head and neck radiotherapy

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المخلص: المقدمة: العلاج الإشعاعي يحمل دورا هاما في علاج سرطان الرأس والعنق. تعرض الخلايا للإشعاع المؤين تنتج عنه مجموعة متنوعة من التغيرات البيولوجية والجزيئية التي قد تظهر سريريا مثل قتل الورم أو سمية الأنسجة الطبيعية وشدة هذه الآثار تعتمد على متغيرات مثل شدة الطاقة ونوع الإشعاع، والتكوين الباثولوجي للأنسجة المستهدفة و تركيبها الخلوية والجزيئية، ومدة التعرض. يتم تحصيل إشارة الصوت في البيئة من خلال الصيوان، ويمر من خلال القناة السمعية الخارجية والضربات الاهتزازات من طبلة الاذن يتم إرسالها إلى الصفيحة القدمية للعظم الركابي من خلال سلسلة العظيمات بالإضافة إلى غشاء الطبلة تسبب هذه التحركات تغيرات في الضغط والتي تسبب تحرك الغشاء القاعدي. هذا يحفز خلايا من جهاز كورتني. ومن هذه الخلايا والتي تكون بمثابة محولات الطاقة وتحويل الطاقة الميكانيكية إلى نبضات كهربائية التي تسافر على طول العصب السمعي.

الهدف: لتحديد تأثير العلاج الإشعاعي على عملية السمع.
الطريقة: دراسته على 45 مريضا في مستشفى الديوانية التعليمي يعانون من أورام في الرأس والرقبة تم تشخيصها من خلال العينات النسيجية المرضية، من كلا الجنسين، وتعرضوا للعلاج الإشعاعي تم تضمينها في الدراسة. يتم استبعاد المريض الذي يعاني من ضعف السمع والتهاب الأذن الوسطى المزمن والذين يتلقون العلاج الكيميائي في وقت سابق من الدراسة. تم تقييم السمع قبل الخضوع للإشعاع من خلال تخطيط السمع و6-8 أسابيع بعد الانتهاء من العلاج و6 أشهر بعد ما يعود المريض إلى وحدة الأورام للمتابعة المجموعة (أ) بينما المجموعة الثانية يتم اختيار 45 شخص سليم من موظفي المستشفى وكلية الطب بعد إعلان للمتطوعين في دراسة .
النتائج: متوسط العمر للمجموعة (أ) كانت 53 عاما يتراوح بين 30-70 سنة، مع نسبة الذكور: الإناث 4: كان 1 بينما لمجموعة المراقبة (ب) 49 سنة يتراوح بين 25-60 سنة، ونسبة الذكور إلى الإناث 2 : 1. كان الورم الأكثر شيوعا من سرطان الحنجرة يليها سرطان الانف، وسرطان البلعوم وتجويف الفم والجيوب الأنفية وفيما يتعلق السمع حوالي 38 (42.18%) من المرضى (المجموعة أ) لم تتأثر بالأشعة بينما 43 مريضا (47.75%) حصلت على السمع أسوأ بعد العلاج الإشعاعي، وكان فقط 9 مرضى (9.99%) تحسین السمع. بينما في المجموعة الضابطة 73 (81.11%) لم يتغير، 6 (6.66%) تتدهور وكان تحسین السمع في 11 (12.22%) الاستنتاجات

1. تحدث مشاكل في السمع العلاج الإشعاعي الناجم في عدد كبير في المريض مع أورام الرأس والعنق.
2. تقديم المشورة للمرضى قبل العلاج الإشعاعي عن الإعاقة السمعية.
3. معظم حالات فقدان السمع هي عصبية.
4. مزيد من الدراسات طويلة المدى وعينة أكبر

Abstract

Introduction: radiation therapy carries an important role in the treatment of head and neck (H&N) cancers. Exposure of cells to ionizing radiation produces a variety of biological and molecular changes that may manifest clinically as tumor killing or normal tissue toxicity, the type and severity of these effects depend on variables such as the energy and type of radiation, the composition of target biologic tissue, the cellular and molecular response, duration of exposure, and cellular microenvironment. A sound signal in the environment is collected by the pinna, passes through external auditory canal and strikes the tympanic membrane_ Vibrations of the tympanic membrane are transmitted to stapes footplate through a chain of ossicles coupled to the tympanic membrane Movements of stapes footplate cause pressure changes in the labyrinthine fluids which move the basilar membrane. This stimulates the hair cells of the organ of Corti. It is these hair cells which act as transducers and convert the mechanical energy into electrical impulses which travel along the auditory nerve.

Objective: to determine the effect of radiotherapy on hearing process.

Method: Prospective case control study on 45 patients (90 ears) in al diwanayah teaching hospital from January 2013 to October 2016 with head and neck malignant tumors diagnosed by histopathological specimens, of both sexes and treated with radiotherapy are included in the study. Patient with history of hearing impairment (disabling or documented sever to

profound hearing loss), chronic otitis media and those who receive chemotherapy previously are excluded from study. Pre radiotherapy pure tone audiogram and 6 month after when the patient come back to oncology unit for fellow up their condition those patients allocated in group A while group B (control) 45 healthy person (90 ears) are chosen from staff of hospital and college of medicine after announcement for volunteers in study pure tone audiogram done for them as in case group.

Results: Regarding the mean of age for group A was 53 years with range from 30-70 years , with male: female ratio 4:1 while for control group(B) was 49 years with range 25-60 years and male to female ratio 2:1. Most common neoplasia was carcinoma of larynx followed by nasopharyngeal , oropharyngeal and hypo pharyngeal carcinoma, oral cavity and paranasal sinuses Regarding hearing about 38 (42.18%) of patients (group A) not affected by radiotherapy while 43 patients (47.75%) got worse hearing after radiotherapy, only 9 patients (9.99%) had hearing improvement. While in control group 73 (81.11%) not changed, 6(6.66%) deteriorate and 11(12.22%) had improve hearing.

Conclusions:

1. Radiotherapy induced hearing problems occur in significant number in patient with head and neck tumors.
2. Hearing morbidity post radiotherapy mainly sensory neural
3. Patient counselling before radiotherapy about hearing disabilities should be regarded.
4. Further long term studies and larger sample are needed.

Introduction

Radiation therapy carries an important role in the treatment of head and neck (H&N) cancers. Radiation can be given as a curative treatment or to palliate tumor-related symptoms in patients with incurable cancers. Curative treatment with radiation can be either definitive, where radiation is the principle modality, or adjuvant, to reduce the incidence of recurrence from surgery.¹, Exposure of cells to ionizing radiation produces a variety of biological and molecular changes that may manifest clinically as tumor killing or normal tissue toxicity. The type and severity of these effects depend on variables such as the energy and type of radiation, the composition of target biologic tissue, the cellular and molecular response, duration of exposure, and cellular microenvironment.¹Most normal tissues can tolerate varying amounts of moderate radiation doses without losing structural or functional integrity. However, distinct radiation-induced tissue injuries occur when critical numbers of clonogenic Cells are killed, leading to an inadequate replenishment of mature cells that are lost through normal physiologic wear-and-tear processes. The timing of when the damage is manifested is often classified as acute,

subacute, or late (chronic) and varies greatly among different tissue types and depends on several factors, including the organizational structure, and cell kinetics and turnover. The timescale involved between the breakage of chemical bonds and the biologic effect may occur in hours or even years, depending on the type of damage¹. A sound signal in the environment is collected by the pinna, passes through external auditory canal and strikes the tympanic membrane_ Vibrations of the tympanic membrane are transmitted to stapes footplate through a chain of ossicles coupled to the tympanic membrane Movements of stapes footplate cause pressure changes in the labyrinthine fluids which move the basilar membrane. This stimulates the h air cells of the organ of Corti. It is these hair cells which act as transducers and convert the mechanical energy into electrical impulses which travel along the auditory nerve² Sensorineural (SN) hearing loss results from lesions of the cochlea (sensory type) or VIIIth nerve and its central connections (neural type). The term retro cochlear is used when hearing loss is due to lesions of VIIIth nerve, and central deafness, when it is due to lesions of central auditory connections².The causes of SNHL lie in cochlea, cranial nerve (CN) VIII, brainstem and temporal lobe. They may be

congenital, traumatic, infectious, inflammatory, iatrogenic, neoplastic, senile or miscellaneous³. Head and neck cancer is the sixth most prevalent type of cancer worldwide⁴ There are more than 40,000 new cases of head and neck cancer every year in the United States, and 500,000 worldwide, predominantly consisting of squamous cell carcinoma of the upper aero digestive tract¹. Despite aggressive multidisciplinary treatment approaches, including preoperative or postoperative chemotherapy, radiotherapy, or both, with reconstructive surgery, there has been only modest improvement in outcomes over the past 20 years⁵. Radiation therapy (RT) may damage the cochlea and/or acoustic nerve, leading to sensorineural hearing loss (SNHL), with resultant long-lasting compromise in the quality of life⁶.

Objective: to determine the effect of radiotherapy on hearing process.

Method:

Prospective case control study on 45 patients (90 ears) in al diwaniyah teaching hospital from January 2013 to October 2016

with head and neck malignant tumors diagnosed by histopathological specimens, of both sexes and treated with radiotherapy are included in the study. Patient with history of hearing impairment (disabling or documented sever to profound hearing loss), chronic otitis media and those who receive chemotherapy previously are excluded from study. Pre radiotherapy pure tone audiogram and 6 month after when the patient come back to oncology unit for fellow up their condition those patients allocated in group A while group B (control) 45 healthy person (90 ears) are chosen from staff of hospital and college of medicine after announcement for volunteers in study pure tone audiogram done for them as in case group.

Results:

Regarding the mean of age for group A was 53 years with range from 30-70 years , with male: female ratio 4:1 36 male ,9 female while for control group(B) was 49 years with range 25-60 years and male to female ratio 2:1 30 male and 15 female.

TABLE 1 age distribution in study

Age group/years	group A	Group B
21-30	0	2
31-40	5	13
41-50	13	19
51-60	15	10
61-70	12	1
total	45	45

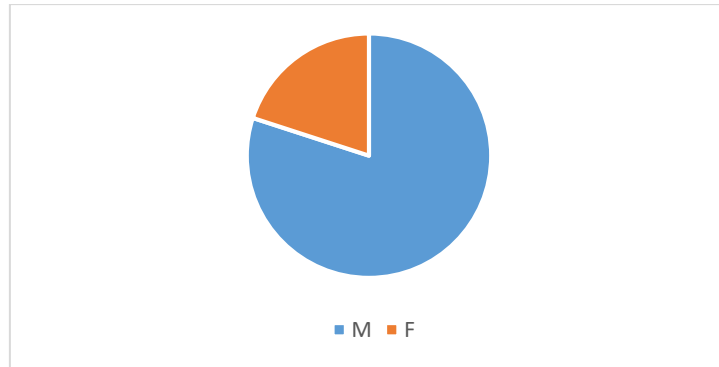


FIGURE 1 MALE: FEMALE RATIO IN GROUP A

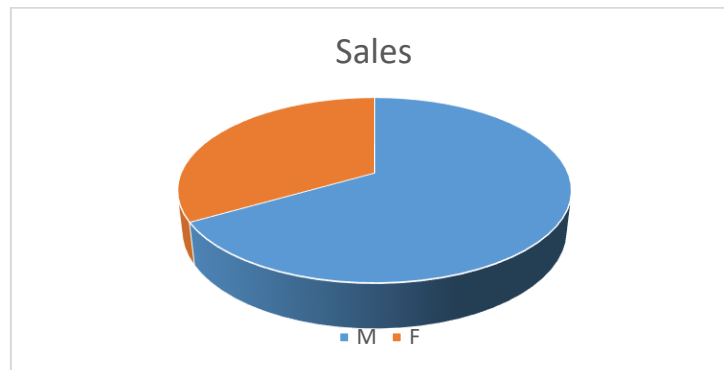


FIGURE 2 MALE: FEMALE RATIO IN GROUP B

Most common neoplasia was carcinoma of larynx followed by nasopharyngeal, oropharyngeal and hypopharyngeal carcinoma, oral cavity and paranasal sinuses as in table 2.

Table 2 site distribution of tumor

Site of tumor	Subsite	No. of patients	percentage
larynx	-----	16	35.55%
pharynx	nasal	7	15.55%
	oral	7	15.55%
	hypo	6	13.33%
Oral cavity	tongue	4	8.88%
	palate	2	4.44%
Nose & paranasal	-----	3	6.67%
total		45	~100%

Regarding hearing about 38 (42.18%) of patients (group A) not affected by radiotherapy while 43 patients (47.75%) got worse hearing after radiotherapy, only 9 patients (9.99%) had hearing improvement.

Table 3 hearing status after radiotherapy

Degree hearing decibel	of in	fixed		decrease		increase		total
		No.ears	%	No,ears	%	No,ears	%	
0-25		21	23.33%	20	22.22%	0	0%	41
26-40	C	4	4.44%	2	2.22%	0	0%	6
	S	5	5.55%	6	6.66%	0	0%	11
	M	0	0%	2	2.22%	0	0%	2
41-55	C	0	0%	5	5.55%	3	3.33%	8
	S	3	3.33%	2	2.22%	2	2.22%	7
	M	0	0%	2	2.22%	0	0	2
56-70	C	1	1.11%	1	1.11%	2	2.22%	4
	S	3	3.33%	2	2.22%	0	%	5
	M	0	0%	1	1.11%	2	2.22%	3
71-90	C	1	1.11%	0	%	0	%	1
	S	0	%	0	%	0	%	0
	M	0	0%	0	0	0	0	0
91-		0	%	0	%	0	%	0
total		38	42.18%	43	47.75%	9	9.99%	90

C conductive deafness, S sensorineural deafness, M mixed deafness

Table 4 hearing status in control group

Degree hearing	of	fixed		decrease		increase		total
		No.ears	%	No,ears	%	No,ears	%	
0-25		45		2		0		47
26-40	C	10	11.11%	1	1.11%	10	11.11%	21
	S	7	7.77%	2	2.22%	0	%	9
	M	10	11.11%	1	1.11%	0	%	11
41-55	C	1	1.11%	0	0	1	1.11%	2
	S	0	%	0	%	0	%	0
	M	0		0		0		0
56-70	C	0		0		0		0
	S	0		0		0		0
	M	0		0		0		0
71-90	C	0		0		0		0
	S	0		0		0		0
	M	0		0		0		0
91-		0		0		0		0
total		73	81.11%	6	6.66%	11	12.22%	90

C conductive deafness, S sensorineural deafness, M mixed deafness

While in control group 73 (81.11%) not changed, 6(6.66%) deteriorate and 11(12.22%) had improve hearing.

P value calculated by chi-squared test and was less than 0.001 between case and control group. As shown in table

Table 5 p value between patients and control group

	Patients	Control	
Fixed	38	73	reference
Decreased	43	6	<0.001
Increased	9	11	<0.001

Kwong DL⁹, Chen WC¹⁰, while this conversely to Borsanyi S et al¹¹ Jereczek-Fossa BA et al¹², Upadhya I et al¹³ who found that most short term effect of radiotherapy is on conductive mainly. The precise mechanism of post radiotherapy hearing loss is controversial while some observe that at early stage therapeutic doses causes inflammatory reaction in endothelium of blood vessels leading first onto vasodilatation and later on narrowing and obliteration of vascular lumen¹⁴, other said it's due to degenerative changes of organ of Corti¹⁵.

Improvement mainly occur in cases of conductive deafness which can be explained by better Eustachian tube function after radiotherapy¹⁶.

Conclusions:

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2. Hearing morbidity post radiotherapy mainly sensory neural
3. Patient counselling before radiotherapy about hearing disabilities should be regarded.
4. Further long term studies and larger sample are needed.

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4. Christiane Schultz et al Hearing Loss and Complaint in Patients With Head and Neck Cancer Treated With Radiotherapy Arch

Discussion:

Radiotherapy is proven effective modality in treatment of malignant tumors although it's not without side effect and adverse effect of radiation can be classified in to short term and long term, in this study we observe the effect of radiotherapy in case of head and neck tumors on hearing process.

In the normal individual, hearing ability and the effect of hearing impairment vary greatly and based on person lifestyles, their attitude, and even their general health condition. Among cancer patients, much has been talked on quality of life, but few studies have dealt with hearing loss and the limitations and difficulties encountered because of it⁴.

In our study we found that mean of age for group A was 53 years with range from 30-70 years , with male: female ratio 4:1 while for control group(B) was 49 years with range 25-60 years and male to female ratio 2:1.

Regarding hearing about 38 (42.18%) of patients (group A) not affected by radiotherapy while 43 patients (47.75%) got worse hearing after radiotherapy, only 9 patients (9.99%) had hearing improvement, While in control group 73 (81.11%) not changed, 6(6.66%) deteriorate and 11(12.22%) had improve hearing

P value between control and patients group was calculated by chi-sequred and was<0.001 which is clinically significant.

by Bhandare et al is earlier study observed that radiotherapy toxicity is observed in all parts of the auditory system⁶, Anteunis et al who described that the changes found in middle and inner ear, auditory nerve and brain stem⁷.

We found that most cases are sensory neural deafness which agree with Morrenti JA et al⁸,

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