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PREVALENCE OF TYPE AND SEVERITY OF HEARING IMPAIRMENT AMONG CHEMOTHERAPEUTIC PATIENTS

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ABSTRACT

To identify and analyze the type and severity of hearing loss effects of chemotherapy on the auditory system of patients within age limit of 7-56 years with cancer treated with cisplatin and carboplatin, assessed through standardized audiological procedures, Is to find out the type and severity of hearing impairment among chemotherapeutic patients, The study design will be analytic cross-sectional study the data will collect from the University of Lahore. Sample size was calculated based on prevalence (36.5%) of Prevalence of type and severity of hearing impairment among chemotherapeutic patients. The sample size was calculated 139 through online sample size calculator. nonprobability purposive sampling technique. Inclusion Criteria patients with age 7 to 56 year's will be included in this study and Exclusion Criteria Children with co morbidities which can result in hearing loss. Demographic Performa will be given to all caregivers of participants to collect data. Data will be collected from children hospital Lahore. After the Permission of higher Authorities of children hospital. After taking the written consent from the child or their family members, their hearing will be assessed to check the severity levels and its types of hearing loss. The ears was checked by otoscope, tympanometry and assessed with standard pure tone audiometer, The total of 137 patients compromised the study populations. The degree of hearing loss is often related the dose. Audiogram finding shows that In which 55.5%(n=76) patients were had normal hearing level received a cisplatin dose 100mg/m^2 in while45.5%(n=61) patients were had impaired hearing loss received a cisplatin dose 400mg/m^{2}in which 26.3%(n=36) patients were had a mild SNHL,15.3%(n=21)patients mild to moderate SNHL,2.9%(n=4)patients moderately severe SNHL, tympanometry finding shows that 105 patients were had type A tympanogram and 32 patients were had type B tympanogram, This study concluded that the prevalence of type and severity of hearing impairment is so high chemotherapeutic patients

Keywords: *Hospital base screening program, WHO, chemotherapy, cisplatin, carboplat*

INTRODUCTION

According to the British Journal of Cancer, those who were born after 1960 had a roughly 50% lifetime risk of developing cancer. All persons under the age of 65 are likely to receive a cancer diagnosis at some point in their lives. There are about 14.5 million cancer survivors in the US. By 2024, this figure will rise to 19 million. [1]These sobering statistics are not encouraging for Pakistan, an LMIC with severely lacking cancer treatment infrastructure and a rising cancer burden. Pakistan faces numerous difficulties in the realm of oncology with a 0.17 million annual cancer incidence. Pakistan spent barely 2.6 percent of its GDP overall in 2014 on health-related expenses. Pakistan's standard of living for 2017 was 0.562, placing it 150 out the of 189 nations. With a GDP of US$263 billion in 2020, Pakistan has a population of around 220 million.[2,3]Some cancers and cancer treatments lead to significant hearing problems. Hearing loss and tinnitus happen

together. They might go away after some time, or they might stay for the lifetime. Hearing problems can affect your quality-of-life Hearing loss ranges in different levels of degree: mild to moderate, severe, profound, or complete deafness, with frequencies of 26-40, 41-55, 56-70, 71-90, and >91 degrees of hearing loss respectively. [4]Combination chemotherapy can be used to treat some cancers successfully, curing patients of conditions including Hodgkin's disease, acute leukemia, and malignant germ cell tumors, including testicular cancer, or prolonging their lives. The immediate short-term toxicity of these medications is well understood, but there are few studies on their long-term effects, and study durations are frequently brief. When reviewing scientific data, platinum-based chemotherapy medications are the most frequently reported ototoxic agents, with the outer hair cells of the cochlea being the most damaged structures, resulting in hearing loss and compromising social interaction.[5,6] The most popular of these medications, cisplatin, can cause sensorineural, bilateral, symmetrical, and irreversible hearing loss in the cochlea. It is important that these patients receive treatment with audiological examinations before, during, and after therapy because the hearing damage brought on by ototoxic medicines used in antineoplastic treatments affects patients of various age.[7]

One of the most ototoxic medications now being used in clinical practice is cisplatin, which leaves many patients with chronic tinnitus as well as permanent bilateral sensorineural hearing loss. Cisplatin and other related platinum-containing medications can also harm the cochlea, resulting in considerable permanent hearing loss in 40 percent to 80 percent of adults and at least 50 percent of children. This condition can have a serious effect on quality of life. Fortunately, survival rates for children with cancer have increased dramatically, reaching 80% at 5 years following diagnosis. Unfortunately, significant adverse medication reactions that might be fatal or permanently disable patients account for 40% of children cancer survivors.[8] However, usage of cisplatin may cause irreversible bilateral high-frequency sensorineural hearing loss. Cisplatin has increased survival in a number of pediatric cancers. Although the exact mechanism by which chemotherapy causes hearing loss is unknown, it ultimately causes severe permanent damage to the inner ear cells that are responsible for hearing. Another reason why patients do not immediately recognize their hearing loss during treatment is because high-pitched hearing is frequently affected by hearing loss, which has little impact on your daily hearing demands. the cause of this harm is still not entirely understood, but evidence indicates to the production of toxic quantities of Ros , which trigger caspases to cause cell death. With cumulative cisplatin dosages above 400 mg/m2, the risk of irreversible hearing loss in children treated with the drug rises to around 50% on average, and it reaches 90% in young children.[9]

Risk factors for cisplatin-induced hearing loss include young age, consistently higher platinum dosages, high cisplatin dosages, coadministration with sulfa drugs and loop diuretics, impaired renal performance, and cranial irradiation. [10] Cisplatin-induced hearing loss may have an impact on a child's ability to communicate verbally, succeed academically, and develop socially and emotionally. The dose is frequently correlated with the severity of hearing loss. The severity of the hearing loss increases with dose. It has been shown that the risk of permanent hearing loss is increased by cumulative cisplatin dosages above 400 mg/m2 (Brookmeyer, 1998) and by carboplatin given in high, myeloablative doses.[11] In comparison to cisplatin, carboplatin is the platinum agent with improved anti-tumor effectiveness and fewer adverse effects. It is a second-generation platinum compound that, when activated by transformation into effective in eliciting species exerts its anti-neoplastic activity by generating inter/intra-strand DNA cross-links. Carboplatin has been used extensively to treat a variety of solid tumors in humans because it has potent anti-cancer effects and has few harmful side effects.[12]

Third-generation platinum derivative oxaliplatin is frequently used to treat a variety of solid organ cancers, such as colorectal, ovarian, and pancreatic cancer. Oxaliplatin-based chemotherapy regimens have recently been very effective in treating advanced pancreatic cancer. Peripheral neuropathy, characterized by abrupt reversible anesthesia, is the most frequent side

effect of oxaliplatin. There are few reports on oxaliplatin despite the fact that the ototoxic effects of cisplatin are well established.[13]The purpose of my study is to find out the prevalence of type and severity of hearing loss in chemotherapeutic patients within age limit of 7-56 years

Methodology:

This study is based on analytic cross-sectional study design. Data were collected from children hospital. Sample size was calculated on the basis of prevalence (36.5%) of Prevalence of type and severity of hearing impairment among chemotherapeutic patients. The sample size was calculated 139 through online sample size calculator. Purposive sampling technique was use for sample. Patients with 7 to 60 years was included in this study. Patients with co morbidities which can result i n hearing loss. Demographic Performa was given to all caregivers of participants to collect data

Procedure

Data were collected from children hospital Lahore. After taking the written consent from the child or their family members, their hearing will be assessed to check the severity levels and its types of hearing loss. The ears will check by Otoscope, Tympanometry and assessed with standard pure tone audiometer. Orthoscopic procedure will performed to see the Outer ear canal and tympanic membrane. Tympanometry procedure will perform to check the middle ear status of child. Standardized Prevalence of type and severity of hearing impairment among chemotherapeutic patients.

Data Analysis Procedure

Data was analyzed through SPSS, Descriptive Statistics including frequency histograms, Frequency Tables and percentage and chi square will be use for the prevalence of type and severity of hearing impairment among chemotherapeutic patients. The significant level will set as equal as or less than $p < 0.05$.

Results

Table 1: Demographics and Severity and the type of hearing loss among the chemotherapeutic patients of different age group (N=137).

Variables	Frequency	Percent
Age		
7-16	42	30.7
17-26	35	25.5
27-36	32	23.4
37-46	20	14.6
47-56	8	5.8
Gender		
Male	91	66.4
Female	46	33.6
Finding of audiometry		
Normal	76	55.5
Mild sensorineural hearing loss	36	26.3
Mild to moderate sensorineural hearing loss	21	15.3
Moderately sever sensorineural hearing loss	4	2.9
Finding of tympanometry		
Type A	105	76.6
Type B	32	23.4
Type of Cancer		
Carcinoma	20	14.6
germ cell tumor	73	53.3
Osteosarcoma	26	19.0
megaloblast Oma	8	5.8

Retinoblastoma	10	7.3
Treatment do the patient		
Cisplatin	121	88.3
cisplatin and carboplatin	16	11.7
Doses of drugs taken		
100 mg/m2	76	55.5
200-800mg/m2	61	44.5
Cycle		
1	40	29.2
2	14	10.2
3	20	14.6
4	7	5.1
5	13	9.5
6	12	8.8
7	8	5.8
8	11	8.0
9	9	6.6
10	3	2.2
Type of chemotherapeutic dose Finding of tympanometry?	**type A**	**Type B**
Cisplatin	92	29
cisplatin and carboplatin	13	3

Above table 1 show that 30.7%(n=42) patients were belongs to age group of 7-16 years,25.5%(n=35) patients were belongs to age group of 17-26 years,23.4%(n=32) patients belong to age group of 27-36 years,14.6%(n=20) patients belongs to age group of 37-46years,5.8%(n=8) patients belong to age group of 47-56 years. Above table show that 33.9% are female and 66.4% are male.Above the table shows that 76.6% (n=105) chemotherapeutic patients were had type A tympanigram,.23.4%(n=32) chemotherapeutic patient were had type B tympanogram.Above table show that 55%(n=76) chemotherapeutic patients were had a normal hearing loss, 26.3%(n=36) chemotherapeutic patients were had a mild sensorineural hearing loss,15.3%(n=21) chemotherapeutic patients were had a mild to moderate sensorineural hearing loss, 2.9%(n=4) chemotherapeutic patients were had a moderately sever sensorineural hearing loss. Above table shows that 53.3%(n=73) chemotherapeutic patients were had cancer with germ cell tumor, 19.0%(n=26) chemotherapeutic patients were had a cancer with osteosarcoma,14.6%(n=20) chemotherapeutic patients were had a cancer with carcinoma, 7.3%(n=10) chemotherapeutic patients were had a cancer with retinoblastoma,5.8%(n=8) chemotherapeutic patients were had a cancer with megaloblast Oma. Above table shows that 88.3%(n=121) chemotherapeutic patients were had effect with cisplatin dose and 11.7%(n=16) chemotherapeutic patients were had a effect with cisplatin and carboplatin both. Above table shows that55.5%(n=76) chemotherapeutic patients had 100mg/m2 dose of drugs were had taken,44.5%(n=61) chemotherapeutic patients had a 200-800mg/m2 dose of drugs have been taken. Above table shows that29.9%(n=40) patients were had received a chemotherapy cycle 1,14.6(n=20) patients were had a chemotherapy cycle 3,10.2(n=10) patients were had a received chemotherapy cycle 2,5.1(n=7) patients were had a chemotherapy cycle 4,9.5%(n=13) patients were had a received chemotherapy cycle 5,8.8%(n=12) patients were had received a chemotherapy cycle 6,5.8%(n=8) patients were had a received chemotherapy cycle 8,6.6%(n=9) patients were had a received chemotherapy cycle 9,2.2%(n=3) patients were had a received complete chemotherapy cycle.

Above table show that 76 patients 100mg/m2 dose received which had 65 patients type A

tympanogram and 11 patients had type B tympanogram and 61 patients (200-800mg/m2) 400mg/m2 exceed 40 patients had type A tympanogram and 21 patients had type B tympanogram. The investigation was carried out in 2022. 25.1 percent (221) of the 880 OPC survivor expressed moderate to severe hearing loss with tinnitus, while 35.6 percent (314) reported no hearing loss, 39.3 percent (347) reported mild hearing loss, and 24.7 percent (357) reported no hearing loss. Compared to those who had neither hearing loss nor tinnitus, those with mild hearing loss and tinnitus had a higher likelihood of reporting moderate to severe symptom interference ratings (OR, 5.83; 95 % confidence CI; 1.48-22.88; p = 0.012) than those with moderate hearing loss and tinnitus (OR, 30.01; 95 percent CI; 7.96-113.10; p 0.001). Hearing deficits were linked with all Health related quality of life domains.

Discussion

The current study shows that of cross table between the type of chemotherapeutic dose and finding of tympanograms shows that 121 patients had received cisplatin dose were had a type A Tympanogram and type B tympanogram otherwise 16 patients had received cisplatin and carboplatin were had a type A and type B tympanogram.The prior research was done in 2019 and found that 31/61 patients (50.8%) had HL, of which 28/42 had taken cisplatin (66.6%) and 3/19 had obtained carboplatin (15.8 percent). Higher mean cisplatin and carboplatin dosages (p =.002 and.010) were linked to HL.[36] .The current study shows the cross table between the type of chemotherapeutic dose and finding of audiogram shows that 121 patients had received cisplatin which mild sensorineural hearing loss 35 patients, mild to moderate sensorineural hearing loss 13 patients otherwise 16 patients had established cisplatin and carboplatin were had a mild sensorineural hearing loss 1 patient, mild to moderate sensorineural hearing loss 8 patients and moderately sever sensorineural hearing loss 4 patients. The prior study was carried out in 2021. In the absence of treatment, Cochlea received extreme doses of up to 28.52 without developing SNHL. However, hearing loss was discovered in patients receiving concomitant chemo radiotherapy at least 9 at frequencies between 4 and 8 KHz. Cisplatin cumulative dosages have no effect on the risk of SNHL. Following the end of therapy, 82.1 percent, and 74.5 percent of 106 ears receiving concurrent chemo radiation exhibited SNHL at 4 KHz and 8 KHz, individually. At the end of the course of therapy, OES in the chemo radiation group significantly changed.[37] The current study shows that cross table chemotherapy cycle and finding of audiometry shows that 40 patients in chemotherapy cycle 1 which had 9 patients normal,5 patient mild sensorineural hearing loss, 20 patients in chemotherapy cycle 3 which had 6 patients normal,9 patient mild sensorineural hearing loss, 5 patient mild to moderate sensorineural hearing loss, 14 patients in chemotherapy cycle 2 which had 9 patients normal,5 patient mild sensorineural hearing loss,7 patients in chemotherapy cycle 4 which had 3 patients normal 4 patient mild sensorineural hearing loss,9 patients in chemotherapy cycle 5 which had 4 patients normal,4 patient mild sensorineural hearing loss, 5 patient mild to moderate sensorineural hearing loss,7 patients in chemotherapy cycle 6 which had 3 patients normal,4 patient mild sensorineural hearing loss, 5 patient mild to moderate sensorineural hearing loss, 8 patients in chemotherapy cycle 7 which had 5 patients normal,2 patient mild sensorineural hearing loss, 1 patient mild to moderate sensorineural hearing loss, 11 patients in chemotherapy cycle 8 which had 4 patients normal,2 patient mild sensorineural hearing loss, 4 patient mild to moderate sensorineural hearing loss and 1 patient moderately sever sensorineural hearing loss,9 patients in chemotherapy cycle 9 which had 4 patients normal,1 patient mild sensorineural hearing loss, 1 patient mild to moderate sensorineural hearing loss and 3 patients moderately sever sensorineural hearing loss,3 patients in chemotherapy cycle complete which had 3patient mild sensorineural hearing loss. The research was done in 2018. For the frequencies 2–8 kHz, there was a strong relationship between age and the dose of cisplatin and a higher change in HTL. Every 100 mg rise in the cumulative platinum dose was associated with a decrease of 3.6 dB at the 8 kHz frequency (95 % confidence interval [CI]: 1.8-5.3, p.001).

33 percent of participants PRE, 70 percent of case at Specialty field, and percent of controls at Specialty field (cases vs. controls, p =.66) had hearing loss (ASHA). The frequency of hearing loss, according to M4, was 6.2 percent PRE and 2.2 percent SURV among controls (case vs. regulation, p =.049). In the SURV, impairment was reported by 29 percent of patients and 33 percent of controls (p =.70). [38] The current study shows that cross table chemotherapy cycle and finding of audiometry shows that 40 patients in chemotherapy cycle 1 which had 9 patients normal,5 patient mild sensorineural hearing loss, 20 patients in chemotherapy cycle 3 which had 6 patients normal,9 patient mild sensorineural hearing loss, 5 patient mild to moderate sensorineural hearing loss, 14 patients in chemotherapy cycle 2 which had 9 patients normal,5 patient mild sensorineural hearing loss,7 patients in chemotherapy cycle 4 which had 3 patients normal 4 patient mild sensorineural hearing loss,9 patients in chemotherapy cycle 5 which had 4 patients normal,4 patient mild sensorineural hearing loss, 5 patient mild to moderate sensorineural hearing loss,7 patients in chemotherapy cycle 6 which had 3 patients normal,4 patient mild sensorineural hearing loss, 5 patient mild to moderate sensorineural hearing loss, 8 patients in chemotherapy cycle 7 which had 5 patients normal,2 patient mild sensorineural hearing loss, 1 patient mild to moderate sensorineural hearing loss, 11 patients in chemotherapy cycle 8 which had 4 patients normal,2 patient mild sensorineural hearing loss, 4 patient mild to moderate SNHL and 1 patient moderately sever SNHL,9 patients in chemotherapy cycle 9 which had 4 patients normal,1 patient mild sensorineural hearing loss, 1 patient mild to moderate sensorineural hearing loss and 3 patients moderately sever sensorineural hearing loss,3 patients in chemotherapy cycle complete which had 3patient mild sensorineural hearing loss.

After receiving cisplatin therapy, the investigation was conducted in 2018 and found significant alterations in hearing thresholds (250 to 8000Hz) in pure tone audiometry. After cisplatin therapy, extended high frequency audiometry in the study group showed a highly significant decrease in hearing threshold at frequencies (10, 12.5, and 16 KHZ). Hearing amplitudes significantly decreased following treatment with cisplatin, according to transient evoked otoacoustic emission (TEOAE).[39]

Above table show that 76 patients 100mg/m2 dose received which had 65 patients type A tympanogram and 11 patients had type B tympanogram and 61 patients (200-800mg/m2) 400mg/m2 exceed 40 patients had type A tympanogram and 21 patients had type B tympanogram. The investigation was carried out in 2022. 25.1 percent (221) of the 880 OPC survivor expressed moderate to severe hearing loss with tinnitus, while 35.6 percent (314) reported no hearing loss, 39.3 percent (347) reported mild hearing loss, and 24.7 percent (357) reported no hearing loss. Compared to those who had neither hearing loss nor tinnitus, those with mild hearing loss and tinnitus had a higher likelihood of reporting moderate to severe symptom interference ratings (OR, 5.83; 95 % confidence CI; 1.48-22.88; p = 0.012) than those with moderate hearing loss and tinnitus (OR, 30.01; 95 percent CI; 7.96-113.10; p 0.001). Hearing deficits were linked with all Health related quality of life domains..[40]

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Conclusion:

The findings indicate that chemotherapy, particularly with cisplatin, is associated with significant hearing health impacts across various patient demographics. The majority of patients (76.6%) presented with Type A tympanograms, and over half exhibited normal hearing. However, a substantial proportion experienced varying degrees of sensorineural hearing loss, from mild (26.3%) to moderately severe (2.9%).Higher doses of cisplatin (200-800 mg/m²) were more likely to correlate with abnormal tympanogram types (Type B) and increased hearing loss. Furthermore, there was a noted prevalence of hearing deficits among patients with germ cell tumors, who comprised 53.3% of the sample.In a broader oncology context, OPC survivors demonstrated that hearing loss and tinnitus are prevalent and significantly impact quality of life. Patients with mild to severe hearing deficits showed notably higher interference in daily functioning, underscoring the need for early detection and monitoring of hearing in chemotherapeutic protocols, especially those involving cisplatin. These findings suggest that addressing hearing health should be an integral part of survivorship care plans, given the strong link between hearing deficits and reduced quality of life among cancer survivors.

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