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ORIGINAL ARTICLE

## Audiological profile of patients treated for childhood cancer<sup>☆☆</sup>

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### KEYWORDS

Radiotherapy;  
Ototoxicity;  
Chemotherapy;  
Cisplatin;  
Hearing loss;  
Hearing

### Abstract

**Objective:** To characterize the hearing loss after cancer treatment, according to the type of treatment, with identification of predictive factors.

**Methods:** Two hundred patients who had cancer in childhood were prospectively evaluated. The mean age at diagnosis was 6 years, and at the audiometric assessment, 21 years. The treatment of the participants included chemotherapy without using platinum derivatives or head and neck radiotherapy in 51 patients; chemotherapy using cisplatin without radiotherapy in 64 patients; head and neck radiotherapy without cisplatin in 75 patients; and a combined treatment of head and neck radiotherapy and chemotherapy with cisplatin in ten patients. Patients underwent audiological assessment, including pure tone audiometry, speech audiometry, and immittanceometry.

**Results:** The treatment involving chemotherapy with cisplatin caused 41.9% and 47.3% hearing loss in the right and left ear, respectively, with a 11.7-fold higher risk of hearing loss in the right ear and 17.6-fold higher in the left ear *versus* patients not treated with cisplatin ( $p < 0.001$  and  $p < 0.001$ , respectively). Children whose cancer diagnosis occurred after the age of 6 have shown an increased risk of hearing loss *vs.* children whose diagnosis occurred under 6 years of age ( $p = 0.02$ ).

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**PALAVRAS-CHAVE**

Radioterapia;  
Ototoxicidade;  
Quimioterapia;  
Cisplatina;  
CDDP;  
Perda auditiva;  
Audição

**Conclusion:** The auditory feature found after the cancer treatment was a symmetrical bilateral sensorineural hearing loss. Chemotherapy with cisplatin proved to be a risk factor, while head and neck radiotherapy was not critical for the occurrence of hearing loss.

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**Perfil audiológico de pacientes tratados de câncer na infância****Resumo**

**Objetivo:** Caracterizar as alterações auditivas após o tratamento do câncer, segundo o tipo de tratamento identificando os fatores preditivos.

**Método:** Foram avaliados prospectivamente duzentos pacientes que tiveram câncer na infância. A idade média ao diagnóstico foi de 6 anos e à avaliação audiométrica de 21 anos de idade. O tratamento incluiu quimioterapia sem uso de derivados de platina ou radioterapia em cabeça e pescoço em 51 pacientes; quimioterapia com uso de cisplatina sem radioterapia em 64 pacientes; radioterapia em cabeça e pescoço sem cisplatina em 75 pacientes; e 10 pacientes receberam o tratamento combinado de radioterapia em cabeça e pescoço e quimioterapia com cisplatina. Os pacientes foram submetidos à avaliação audiológica incluindo audiometria tonal, audiometria vocal e imitanciometria.

**Resultados:** O tratamento envolvendo quimioterapia com cisplatina levou a 41,9% e 47,3% de perda auditiva na orelha direita e esquerda, respectivamente, apresentando risco 11,7 vezes maior de desenvolver perda auditiva na orelha direita e 17,6 vezes na orelha esquerda do que aqueles que não receberam cisplatina ( $p < 0,001$  e  $p < 0,001$ ; respectivamente). Crianças cujo diagnóstico do câncer ocorreu após os 6 anos de idade mostraram maior risco de apresentar perda auditiva do que crianças menores do que 6 anos de idade ( $p = 0,02$ ).

**Conclusão:** A característica audiológica encontrada após tratamento oncológico foi perda auditiva sensorineural bilateral simétrica. A quimioterapia com cisplatina mostrou ser fator de risco, enquanto a radioterapia em cabeça e pescoço não foi determinante para aquisição da perda auditiva.

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**Introduction**

Over the last two decades, childhood cancer mortality has decreased significantly; however, it still represents the second leading cause of death in Brazil.<sup>1</sup> Currently, with the advances in diagnosis, improved treatments, and appropriate clinical support, an increase in the cure rate of malignancies in childhood is a possibility.<sup>2</sup> In the face of an increasing survival rate, these individuals are now monitored for several years. Thus, it is possible to observe the impact of late effects of treatment on the quality of life of these young adults.

The use of different treatment modalities (surgery, radiotherapy, and chemotherapy) and the combination of these modalities contribute to improved results, both in controlling the disease and in improving survival rates.<sup>3</sup>

Among the ototoxic drugs, cisplatin is an antineoplastic agent with proven anti-tumor activity, but which may have ototoxicity as a side effect; the dose related to risk has been described as being 400 mg/m<sup>2</sup>.<sup>2,4,5</sup>

Head and neck radiotherapy concomitantly employed with cisplatin (cis-diamminedichloroplatinum [CDDP]) increases the likelihood of severe hearing loss.<sup>6,7</sup> However,

when the drug is administered alone and in lower doses (50–60 Gy), no clinically significant hearing loss occurs.<sup>8,9</sup>

Ototoxicity, *i.e.*, the effect represented by an injury to the peripheral organ of hearing, is characterized by an irreversible descending bilateral sensorineural hearing loss.<sup>10,11</sup> The incidence of the hearing loss is quite variable, due to the method of drug administration, tumor location, state of renal function, patient's age, associated drugs, radiotherapy, pre-existing hearing loss, cumulative dose, total dose of treatment, and individual susceptibility.<sup>12,13</sup>

This study was conducted with the aim of characterizing the audiologic profile of patients who had cancer in childhood and were out of cancer treatment for at least eight years; to relate the hearing loss found with respect to the type of treatment and age; and to identify predictive factors for hearing loss.

**Methods**

We prospectively evaluated children who had cancer treated between 2000 and 2004, and who had completed treatment for at least eight years, and who had been monitored in a

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