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Original Article

Incidence of Cisplatin-Induced Renal Impairment, Ototoxicity, and Peripheral Neuropathy and Impact of Chemotherapy on Health-Related Quality of Life Among Various Cancer Patients

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ABSTRACT

Background: Cisplatin is a commonly used chemotherapeutic agent whose clinical utility is limited by dose-related toxicities. The present study aimed to assess the incidence and clinical impact of cisplatin-induced toxicities nephrotoxicity, ototoxicity, and peripheral neuropathy and to evaluate their effects on Health-Related Quality of Life (HRQoL) and patient satisfaction among hospitalized cancer patients. **Materials and Methods:** A prospective cohort study was conducted over a ten-month period (August 2024-May 2025) at a tertiary care oncology center. Adult patients receiving cisplatin-based chemotherapy were enrolled. Clinical toxicities were documented, and patient-reported outcomes were assessed using validated instruments, including the European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire (EORTC QLQ-C30), EORTC QLQ-CIPN20, and EORTC IN-PATSAT32. Descriptive statistical analysis was performed. **Results:** Peripheral neuropathy was the most frequently observed toxicity, affecting over 20% of patients, with a significant post-treatment increase across all domains of the EORTC QLQ-CIPN20. Nephrotoxicity was identified in 25.6% of patients, comprising mild (16.1%), moderate (5.7%), and severe (3.8%) renal impairment. Ototoxicity was reported in 15.09% of patients and was characterized by Grade 2 high-frequency hearing loss. HRQoL assessment revealed marked impairment in physical, emotional, cognitive, and social functioning, with financial difficulties reported by 52.8% of participants. Despite these toxicities, patient satisfaction with inpatient oncology care remained high. **Conclusion:** Cisplatin therapy is associated with clinically significant toxicities that adversely affect HRQoL. Routine monitoring, early detection, and individualised management of toxicities, along with the integration of patient-reported outcome measures, are crucial for enhancing therapeutic outcomes and patient-centred oncology care.

Keywords: Cisplatin, Chemotherapy-induced toxicity, Nephrotoxicity, Peripheral neuropathy, Ototoxicity, Quality of life.

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INTRODUCTION

Worldwide, cancer remains a significant health issue, especially in high-income nations, where lung, colorectal, breast, melanoma, and prostate cancers are the most widespread (Schwartz *et al*., 2024). While cancer is relatively uncommon in children and adolescents, its incidence increases significantly with advancing age. Cisplatin, a platinum-based chemotherapeutic agent, is among the most widely used anticancer drugs and has demonstrated effectiveness against a range of malignancies, including cancers of the head and neck, lung, ovary, bladder, and testicular cancers (Dasari and Tchounwou, 2014). Cisplatin exerts its antitumor properties by inducing the formation of DNA cross-links, which interfere with DNA replication and transcription, thereby activating DNA damage response pathways. This process ultimately results in cell cycle arrest and apoptosis (Kopacz-Bednarska and Król, 2022). Although cisplatin has markedly enhanced survival rates in various tumors, its clinical use is limited by numerous dose-related toxicities. The primary adverse effects encompass ototoxicity, nephrotoxicity, and Chemotherapy-Induced Peripheral Neuropathy (CIPN). Of

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these, ototoxicity leads to sensorineural hearing loss and is more severe in pediatric patients (Brown *et al*., 2019; Aldossary, 2019). Nephrotoxicity primarily affects the renal proximal tubules, potentially resulting in acute kidney injury and long-term renal dysfunction (Schellack and Naude, 2013). CIPN typically presents with symmetrical sensory disturbances accompanied by neuropathic pain and tends to persist in patients long after therapy has ended (Basheer *et al*., 2025; Lanvers-Kaminsky and Ciarimboli, 2017). The toxicities associated with cisplatin not only hinder adherence to treatment but also adversely influence patients' Health-Related Quality of Life (HRQoL). Gaining insight into the mechanisms, risk factors, and clinical consequences of these toxicities is essential for developing preventive strategies, enhancing patient outcomes, and informing treatment choices in the field of oncology (Ganesan *et al*., 2018).

The widespread clinical use of cisplatin in cancer therapy, together with the severity of its associated toxicities, underscores the need for a comprehensive understanding of its adverse effects, particularly ototoxicity, nephrotoxicity, and peripheral neuropathy (Tan and Vlajkovic, 2023). The present study aimed to assess the incidence and clinical impact of cisplatin-induced toxicities-nephrotoxicity, ototoxicity, and peripheral neuropathy and to evaluate their effects on Health-Related Quality of Life (HRQoL) and patient satisfaction among hospitalized cancer patients. Enhancing awareness and promoting early detection may facilitate more effective management strategies and improve therapeutic outcomes for patients receiving cisplatin-based chemotherapy.

MATERIALS AND METHODS

Study Design and Setting

This prospective cohort study was conducted over ten months, from August 2024 to May 2025, at the Department of Medical Oncology, Sri Ramachandra Medical Centre, Sri Ramachandra Institute of Higher Education and Research (SRIHER), Porur, Chennai. The main aim of the research was to assess the frequency and clinical implications of toxicities induced by cisplatin, such as ototoxicity, nephrotoxicity, and peripheral neuropathy, among adult patients with cancer.

Participant selection

Eligible participants were aged 19 years or older, had received cisplatin-based chemotherapy, were able to read and communicate in Tamil or English, and had experienced at least one cisplatin-induced toxicity. Patients younger than 19 years, those with cognitive impairment, individuals unable to complete written questionnaires, or those unwilling to provide informed consent were excluded from the study. The study was conducted in accordance with ethical principles, and ethical approval was obtained from the Institutional Ethics Committee (IEC No: CSP/24/NOV/153/415). Written informed consent was obtained from all participants prior to enrolment.

Data Collection

A total of 53 patients were recruited after obtaining written informed consent. Clinical and demographic data collected included age, gender, comorbidities, past medical and medication history, presenting complaints, cancer type and stage, chemotherapy regimen, and number of chemotherapy cycles. Participants completed three validated questionnaires: the EORTC IN-PATSAT32 to assess patient satisfaction with inpatient care, the EORTC QLQ-CIPN20 to evaluate chemotherapy-induced peripheral neuropathy, and the EORTC QLQ-C30 to assess health-related quality of life.

Assessment and Grading of Cisplatin-Induced Toxicities

Nephrotoxicity was assessed using serum creatinine levels, creatinine clearance, and estimated Glomerular Filtration Rate (eGFR), and graded according to established clinical guidelines for acute kidney injury (KDIGO Work Group, 2012). Ototoxicity was evaluated using pure-tone audiometry, with grading based on hearing threshold shifts; a shift greater than 25 dB was classified as Grade 2 hearing loss, in accordance with commonly accepted ototoxicity assessment criteria (ASHA, 1994; Paken *et al*., 2019).

Statistical Analysis

The sample size was calculated with a 95% confidence interval using the Master statistical program. Data were analyzed using IBM SPSS Statistics for Windows, Version 26.0. Descriptive statistics were used to summarize patient characteristics and clinical findings. Categorical variables, including gender, cancer type, and symptom frequency, were expressed as counts and percentages, while continuous variables such as age, Glomerular Filtration Rate (GFR), and creatinine clearance were presented as Mean ± Standard Deviation (SD).

RESULTS

Patient Characteristics

A total of 53 adult cancer patients were included in the study, with a mean age of 53.98 ± 14.05 years. The majority were aged 41–60 years (54.7%). Gender distribution was nearly equal (50.9% female, 49.1% male). The most common cancer types were breast and lung (each 17%), followed by cervical (11.3%) and buccal mucosal cancer (9.4%). Most participants were married (94.3%) and over half were uneducated (58.5%). More than half (54.7%) had no comorbidities; diabetes (13.2%) and hypertension (7.5%) were the most frequent conditions. Cisplatin was administered at doses ranging from 30-70 mg, with 30 mg (35.8%) and 40 mg (30.2%) being most common. Most patients were in advanced chemotherapy cycles, with 37.7% in cycle 6 and 32.1% in cycle 7.

Table 1 shows demographic and clinical Characteristics of Study Participants..

Quality of Life (EORTC QLQ-C30)

Significant declines were observed in physical (p<0.01), cognitive (p=0.03), social (p<0.01), and role functioning (p<0.05) from baseline to three months post-treatment. Symptom burden increased significantly, especially fatigue (p<0.001), nausea/vomiting (p<0.001), insomnia (p<0.01), appetite loss (p<0.001), and diarrhea (p<0.001). Global quality of life decreased significantly (p=0.02) represented in Table 2.

Table 1: Demographic and Clinical Characteristics of Study Participants.

Characteristic	Frequency (%)
Age Group (years)	
31–40	18.9
41–50	32.1
51–60	22.6
61–70	13.2
71–80	7.5
81–90	5.7
Gender	
Male	49.1
Female	50.9
Common Cancer Types	
Breast	17.0
Lung	17.0
Cervical	11.3
Buccal Mucosa	9.4
Co-morbid Conditions	
None	54.7
Diabetes Mellitus	13.2
Hypertension	7.5
HTN + DM	9.4

Peripheral Neuropathy (EORTC QLQ-CIPN20)

There was a significant increase in sensory (p<0.001), motor (p<0.001), and autonomic symptoms (p=0.002) post-treatment. Physical exams confirmed sensory deficits, with the most common findings being reduced joint position sense (28.3%) and vibration sense (26.4%). Peripheral neuropathy outcomes showed a significant increase in symptoms across all domains after chemotherapy as shown in Table 3.

Physical assessments corroborated patient-reported symptoms. Reduced joint position sense (28.3%) and reduced vibration sense (26.4%) were the most frequently observed deficits. Reduced light touch was impaired in 22.6% of cases, while reduced sterognosis was present in 20.7% as shown in Table 4.

Nephrotoxicity

Mild (16.1%), moderate (5.7%), and severe (3.8%) nephrotoxicity were observed. GFR and creatinine clearance assessments showed that 22.6% had clearance <60 mL/min, and 9.4% had GFR in the 15-59 mL/min range. Renal function assessment revealed varying levels of nephrotoxicity among the patients.

Ototoxicity

Ototoxicity was detected in 15.1% of patients, with 15.09% having Grade 2 hearing loss (>25 dB threshold shift). The most affected frequencies were in the high-frequency range (4000-8000 Hz). Hearing assessments indicated that ototoxicity primarily affected high-frequency hearing thresholds, represented in Table 5.

Patient Satisfaction (EORTC IN-PATSAT32)

Overall, patients reported high satisfaction with their care. Physicians scored highest in attention to physical problems (mean = 91.5) and willingness to listen (mean = 91.3). Nurses were highly rated for their communication abilities and supportive

Table 2: EORTC QLQ-C30 Scores: Pre-treatment vs. Post-treatment.

Scale/Domain	(T1) Mean (SD)	(T2) Mean (SD)	p-value
Physical Functioning	66.2 (18.3)	52.4 (21.5)	<0.01
Cognitive Functioning	71.3 (22.4)	63.9 (24.8)	0.03
Emotional Functioning	62.7 (25.6)	57.1 (27.2)	0.07
Social Functioning	58.5 (23.9)	47.6 (26.1)	<0.01
Role Functioning	60.4 (21.7)	50.2 (23.3)	<0.05
Fatigue	42.3 (23.6)	59.2 (21.9)	<0.001
Nausea/Vomiting	16.8 (15.4)	33.7 (18.3)	<0.001
Insomnia	38.9 (27.1)	50.2 (28.8)	<0.01
Appetite Loss	29.5 (24.6)	45.7 (25.9)	<0.001
Diarrhea	18.4 (19.3)	33.6 (20.2)	<0.001
Global Health/QoL	64.8 (18.7)	55.3 (19.9)	0.02

Table 3: EORTC QLQ-CIPN20 Scores: Pre-treatment vs. Post-treatment.

Domain	T1 Mean (SD)	T2 Mean (SD)	p-value
Sensory Scale	12.84 (8.30)	28.56 (11.24)	<0.001
Motor Scale	10.37 (7.65)	22.43 (9.87)	<0.001
Autonomic Scale	6.52 (5.28)	12.74 (6.41)	0.002

Table 4: CIPN Physical Examination.

Sl. No.	Physical Examination	Frequency (Percentage)
1	Reduced Light Touch	12 (22.64%)
2	Reduced Pain/Temperature	8 (15.14%)
3	Reduced Joint Position Sense	15 (28.30%)
4	Reduced Vibration Sense	14 (26.41%)
5	Reduced Graphathesia	10 (18.87%)
6	Reduced Sterognosis	11 (20.75%)
7	Reduced Two Point Discrimination Sense	7 (13.20%)
8	Reduced Point Localization Sense	5 (9.43%)

Table 5: Ototoxicity Evaluation (N = 53).

Characteristic	Frequency (%)
No Hearing Loss	84.9
Mild to Moderate Hearing Loss	15.1
Grade 2 Hearing Loss (>25 dB)	15.1
High-Frequency Affected (4–8 kHz)	83.0

care. The organizational aspects of care were also positively regarded, especially the delivery of discharge information (mean score = 90.4) and the hospital setting (mean score = 86.3). The overall mean score for patient satisfaction was 83.5 ± 13.6. Evaluation through the EORTC IN-PATSAT32 questionnaire revealed consistently elevated levels of patient satisfaction across all assessed domains, as detailed in Table 6.

DISCUSSION

Cisplatin is a commonly utilized platinum-containing chemotherapeutic drug for addressing various malignancies, such as cancers affecting the head and neck, lungs, bladder, testes, and ovaries. Nevertheless, its clinical application is often constrained by toxicities that are dependent on cumulative dosage, with nephrotoxicity, peripheral neuropathy, gastrointestinal issues, ototoxicity, and hematologic complications being the most significant (Paken *et al.*, 2019; Albany *et al.*, 2021; Ibrahim and Ehrlich, 2020). Our results demonstrate that nephrotoxicity and peripheral neuropathy emerged as the most common adverse

Table 6: Selected IN-PATSAT32 Satisfaction Scores.

Item	Mean (SD)
Physician Attention to Physical Needs	91.5 (8.9)
Physician Willingness to Listen	91.3 (9.2)
Nurse Human Qualities	84.7 (12.8)
Discharge Information	90.4 (9.7)
Overall Satisfaction with Care	83.5 (13.6)

effects, consistent with findings from earlier research (Seretny *et al.*, 2014; Hanewinckel *et al.*, 2016; Hanewinckel *et al.*, 2016). The cumulative effects of these toxicities significantly impact treatment adherence, patient satisfaction, and Health-Related Quality of Life (HRQoL).

Cisplatin induces nephrotoxicity mainly by accumulating in the renal proximal tubular epithelial cells, which leads to oxidative stress, mitochondrial dysfunction, and cellular damage (Fukuda *et al.*, 2017; Jamieson *et al.*, 2003). This renal dysfunction is often acute in nature and is characterized by elevated serum creatinine levels, reduced glomerular filtration rate, and electrolyte imbalances, including hypomagnesemia and hypokalemia (Kanat *et al.*, 2017; Doughty and Seyedsadjadi, 2018). Although adequate hydration practices and magnesium supplementation were employed, a significant proportion of patients within our cohort developed renal toxicity, highlighting the need for enhanced preventive measures (dos Santos *et al.*, 2012; Burns *et al.*, 2021).

Peripheral neuropathy represents another commonly observed and debilitating adverse effect. The neurotoxicity associated with cisplatin typically manifests as a cumulative sensory neuropathy that starts distally and often progresses proximally as treatment continues (Langer *et al.*, 2002). The core pathophysiological mechanisms include damage to the dorsal root ganglia due to the generation of DNA adducts and mitochondrial dysfunction, which culminates in enduring neurological impairments (Yasuyuki *et al.*, 1994; Macedo and Mehta, 2018). In this study, the patients exhibited symptoms like numbness, tingling, and difficulties in performing fine motor tasks, which correspond with the established clinical manifestations of neurotoxicity caused by cisplatin (KDIGO Work Group, 2012). In certain instances, these symptoms persisted for several months, significantly affecting daily activities and social interactions (Trask *et al.*, 2009).

Gastrointestinal adverse effects, particularly nausea and vomiting, were regularly reported. Despite the implementation of serotonin (5-HT_3) receptor antagonists and neurokinin-1 (NK_1) antagonists, which have diminished the occurrence of acute vomiting, delayed nausea remains a concern for a considerable number of patients (Donaldson, 2004). These symptoms lead to nutritional deficiencies and weight reduction, while also adversely affecting psychological health, thereby exacerbating the challenges associated with cancer treatment (Kanat *et al.*, 2017).

Ototoxicity, which is a well-documented side effect of cisplatin, was reported in a subset of our patients. This toxicity manifests as bilateral high-frequency hearing loss accompanied by tinnitus and is frequently irreversible, with the pediatric and elderly demographics being disproportionately affected (Holzner *et al.*, 2006). While audiometric screening is recommended during therapy, its application continues to be inconsistent across various clinical settings.

The substantial frequency of these adverse effects significantly affects patients' satisfaction with their treatment and their inclination to continue with chemotherapy. This underscores the critical need to integrate routine Patient-Reported Outcome Measures (PROMs) into clinical practice to aid in the early identification and management of treatment-related toxicities. Moreover, executing Quality-of-Life (QoL) assessments can support shared decision-making by allowing treatments to be tailored to the specific tolerance and expectations of each patient. Our data reveal that cisplatin therapy is associated with a range of toxicities that have a profound effect on patients' quality of life and their overall treatment experience. Among the toxicities observed, nephrotoxicity and peripheral neuropathy are especially significant and tend to persist even when standard preventive approaches are employed. It is imperative to address these complications through personalized patient management, early symptom detection, and sustained research into protective interventions to optimize outcomes for patients receiving cisplatin-based chemotherapy. A limitation of this study is the relatively small sample size, which resulted from the fixed study duration, strict inclusion criteria, and patient willingness to participate; however, the findings still provide clinically relevant insights into cisplatin-induced toxicities and their impact on HRQoL.

CONCLUSION

This study meticulously evaluated the incidence and clinical implications of cisplatin-induced toxicities-specifically nephrotoxicity, ototoxicity, and peripheral neuropathy-in patients with a range of malignancies. Moreover, the research investigated the effects of these toxicities on Health-Related Quality of Life (HRQoL) and patient satisfaction with inpatient oncology care. Peripheral neuropathy emerged as the most frequently reported adverse effect, affecting over 20% of patients. Nephrotoxicity was identified in 25.6% of participants, with mild, moderate, and severe renal impairment observed in 16.1%, 5.7%, and 3.8% of cases, respectively. Ototoxicity was noted in 15.09% of patients, characterized by hearing threshold shifts exceeding 25 dB (Grade 2 hearing loss). Post-treatment assessments revealed a significant increase in chemotherapy-induced peripheral neuropathy across all domains of the EORTC QLQ-CIPN20. Evaluation using the EORTC QLQ-C30 demonstrated substantial impairment in physical, emotional, cognitive, and social functioning, along with financial difficulties reported by 52.8% of participants. Despite these clinical challenges, overall patient satisfaction with inpatient oncology care remained high, as reflected by EORTC IN-PATSAT32 scores.

These findings underscore the need for a multidisciplinary approach incorporating early detection, individualized toxicity management, patient education, and psychosocial support. Such an integrated strategy is essential for optimizing therapeutic outcomes and delivering comprehensive, patient-centered cancer care.

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ABBREVIATIONS

CIPN: Chemotherapy-Induced Peripheral Neuropathy; **DNA:** Deoxyribonucleic Acid; **EORTC:** European Organisation for Research and Treatment of Cancer; **eGFR:** estimated Glomerular Filtration Rate; **GFR:** Glomerular Filtration Rate; **HRQoL:** Health-Related Quality of Life; **KDIGO:** Kidney Disease: Improving Global Outcomes; **NK_1:** Neurokinin-1; **PROMs:** Patient-Reported Outcome Measures; **QoL:** Quality of Life; **SD:** Standard Deviation; **SRIHER:** Sri Ramachandra Institute of Higher Education and Research; **5-HT_3:** Serotonin (5-hydroxytryptamine type 3); **ASHA:** American Speech-Language-Hearing Association; **CSP:** Clinical Studies Protocol; **DM:** Diabetes Mellitus; **HTN:** Hypertension; **IBM SPSS:** International Business Machines Statistical Package for the Social Sciences; **IEC:** Institutional Ethics Committee; **IN-PATSAT32:** Inpatient Satisfaction with Care questionnaire (32 items); **QLQ-C30:** Quality of Life Questionnaire Core 30; **QLQ-CIPN20:** Quality of Life Questionnaire Chemotherapy-Induced Peripheral Neuropathy 20; **RH:** Running Head; **T1:** Time Point 1 (Pre-treatment); **T2:** Time Point 2 (Post-treatment); **dB:** Decibel; **Hz:** Hertz; **kHz:** Kilohertz; **mL/min:** Milliliters per minute; **mg:** Milligrams.

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