

## A PROSPECTIVE COMPARATIVE STUDY OF TOXICITY PROFILE IN CANCER PATIENTS RECEIVING PLATINUM COMPOUNDS: CISPLATIN, CARBOPLATIN AND OXALIPLATIN

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### ABSTRACT

**Background:** Cancer remains a major global health burden, with increasing incidence in developing countries such as India. Platinum-based chemotherapeutic agents—cisplatin, carboplatin, and oxaliplatin—are widely used in the management of various malignancies due to their proven efficacy. However, their use is often limited by distinct toxicity profiles, which can impact treatment adherence and patient outcomes. Comparative real-world data on these toxicities are limited. **Materials and Methods:** This prospective observational study was conducted over one year at Rajiv Gandhi Government General Hospital, Chennai. A total of 165 patients receiving platinum-based chemotherapy were enrolled and categorized into three groups: cisplatin (n=55), carboplatin (n=50), and oxaliplatin (n=50). Data on demographic characteristics, clinical details, and laboratory parameters were collected using a structured proforma. Toxicities were assessed using the Common Terminology Criteria for Adverse Events (CTCAE), while neurotoxicity was evaluated using the EORTC QLQ-CIPN-20 questionnaire. Patients were followed up across chemotherapy cycles, and statistical analysis was performed using ANOVA and Chi-square tests, with  $p < 0.05$  considered significant. **Results:** The mean age of participants was comparable across groups ( $p=0.059$ ). Hematological toxicity was most pronounced in the carboplatin group, with significant reductions in hemoglobin, leukocyte count, and platelet count across cycles ( $p<0.05$ ). Cisplatin demonstrated the highest nephrotoxicity, with a marked increase in serum creatinine from 1.2 mg/dL at baseline to 2.7 mg/dL after 4 cycles. Oxaliplatin exhibited the least hematological and renal toxicity but showed the highest incidence of cumulative neurotoxicity. Gastrointestinal toxicity, particularly nausea and vomiting, was highest in the cisplatin group, while diarrhoea was more frequent in the oxaliplatin group. Liver function abnormalities were more pronounced in the cisplatin and carboplatin groups compared to oxaliplatin ( $p=0.001$ ). **Conclusion:** Platinum-based chemotherapeutic agents exhibit distinct toxicity profiles. Carboplatin is associated with greater hematological toxicity, cisplatin with significant nephrotoxicity and gastrointestinal adverse effects, and oxaliplatin with pronounced neurotoxicity. Understanding these differences is crucial for individualized treatment selection, toxicity monitoring, and improving patient outcomes.

## INTRODUCTION

Cancer is a major global health challenge and remains one of the leading causes of morbidity and mortality worldwide.<sup>[1]</sup> In developing countries such as India, the burden of cancer is steadily increasing due to rapid urbanization, lifestyle changes, population aging, and improved diagnostic

capabilities.<sup>[2]</sup> According to recent estimates, the incidence of cancer in India is projected to rise significantly in the coming years, posing a substantial strain on healthcare systems.<sup>[3]</sup> Despite advances in early detection and therapeutic strategies, chemotherapy continues to play a pivotal role in the management of both solid and hematological malignancies.<sup>[4]</sup> Chemotherapy exerts its effect by

targeting rapidly dividing cells; however, this lack of selectivity results in damage to normal proliferating tissues such as bone marrow, gastrointestinal mucosa, and hair follicles.<sup>[4]</sup> Consequently, patients undergoing chemotherapy often experience a range of adverse effects including myelosuppression, mucositis, alopecia, and organ-specific toxicities. These toxicities not only compromise the patient's quality of life but may also necessitate dose reduction, treatment delay, or discontinuation, ultimately affecting treatment outcomes.<sup>[5,6]</sup>

Among the various classes of chemotherapeutic agents, platinum-based compounds—namely cisplatin, carboplatin, and oxaliplatin—have emerged as cornerstone drugs in the treatment of a wide spectrum of solid tumors, including head and neck cancers, gastrointestinal malignancies, and gynecological cancers. These agents act primarily by forming DNA cross-links, thereby inhibiting DNA replication and transcription, leading to apoptosis of cancer cells.<sup>[7]</sup> Although they share a common mechanism of action, their pharmacokinetic properties and toxicity profiles differ significantly.<sup>[8]</sup> Cisplatin, one of the earliest and most widely used platinum compounds, is highly effective but is associated with dose-limiting toxicities such as nephrotoxicity, severe nausea and vomiting, and ototoxicity.<sup>[9]</sup> Carboplatin, a second-generation analogue, was developed to reduce the renal toxicity associated with cisplatin; however, it is more commonly associated with hematological toxicities, particularly thrombocytopenia and anemia.<sup>[10]</sup> Oxaliplatin, a third-generation platinum compound, has demonstrated significant efficacy in colorectal and gastrointestinal cancers and is characterized by a comparatively favorable hematological and renal toxicity profile but is notably associated with cumulative peripheral neurotoxicity.<sup>[11]</sup> The choice of platinum compound in clinical practice is often guided not only by tumor type and stage but also by patient-related factors such as age, performance status, and pre-existing comorbidities.<sup>[12]</sup> Understanding the comparative toxicity profiles of these agents is therefore essential for optimizing therapeutic decisions, minimizing adverse effects, and improving patient compliance and outcomes. While several studies have described the toxicities of individual platinum agents, direct comparative data in real-world clinical settings remain limited.<sup>[13,14]</sup>

In this context, the present study was undertaken to prospectively evaluate and compare the toxicity profiles of cisplatin, carboplatin, and oxaliplatin in cancer patients receiving chemotherapy at a tertiary care center. The findings of this study are expected to aid clinicians in early identification and management of toxicities and in selecting the most appropriate platinum-based regimen tailored to individual patient needs.

## MATERIALS AND METHODS

### Study Design and Setting

This was a prospective observational study conducted in the Department of Oncology, Rajiv Gandhi Government General Hospital, Chennai, in collaboration with the Institute of Pharmacology, Madras Medical College. The study was carried out over a period of one year (January 2019 to December 2019).

### Study Population

The study included adult patients diagnosed with malignancy and receiving platinum-based chemotherapy regimens as part of their treatment protocol.

### Sample Size and Sampling Technique

A total of 165 patients were enrolled in the study. Sample size was calculated using the formula:

$$N = \frac{(Z_{\alpha} + Z_{\beta})^2 \times 2\sigma^2}{(\mu_1 - \mu_2)^2}$$

Based on prior estimates, the calculated sample size was approximately 55 patients per group. Due to recruitment constraints, 50 patients each were included in the carboplatin and oxaliplatin groups. Patients were recruited using consecutive sampling based on eligibility criteria.

### Study Groups

Participants were categorized into three groups based on the platinum compound received:

- **Group 1 (Cisplatin group):** 55 patients
- **Group 2 (Carboplatin group):** 50 patients
- **Group 3 (Oxaliplatin group):** 50 patients

### Inclusion Criteria

- Age between 18–60 years
- Both male and female patients
- Histologically confirmed malignancy
- Newly diagnosed patients receiving platinum-based chemotherapy
- Adequate baseline renal, hepatic, and bone marrow function
- Patients willing to participate and provide written informed consent

### Exclusion Criteria

- Patients who had received previous chemotherapy cycles
- Known cases of peripheral neuropathy
- Patients with chronic kidney disease
- Patients with severe comorbid conditions affecting study outcomes

### Chemotherapy Regimens

Patients received standard chemotherapy regimens as per institutional protocol:

#### Cisplatin Group:

Cisplatin (50–75 mg/m<sup>2</sup>) + 5-Fluorouracil (750 mg/m<sup>2</sup> infusion, Day 1–3)

Repeated every 21 days for up to 6 cycles

#### Carboplatin Group:

Carboplatin (400 mg/m<sup>2</sup>) + Paclitaxel (175 mg/m<sup>2</sup>, Day 1)

Repeated every 21 days for up to 6 cycles

**Oxaliplatin Group (FOLFOX-4 regimen):**

Oxaliplatin (85 mg/m<sup>2</sup>, Day 1 & 15) + Leucovorin + 5-Fluorouracil

Administered over 4 cycles

**Premedication and Supportive Care**

All patients received premedication prior to chemotherapy, including:

- Inj. Dexamethasone 8 mg IV
- Inj. Ondansetron 8 mg IV
- Inj. Ranitidine 50 mg IV

Adequate hydration was ensured before and after chemotherapy administration.

**Data Collection Tools**

Data were collected using a structured and pre-validated proforma designed for the study. The proforma included comprehensive demographic details such as age, sex, height, weight, and body surface area. Clinical information including type of cancer, staging, and treatment plan was also recorded. Laboratory investigations were systematically documented, comprising hematological parameters (hemoglobin, total leukocyte count, and platelet count), renal function tests (serum urea and creatinine), and liver function tests (bilirubin, SGOT, SGPT, alkaline phosphatase, total protein, and albumin). Neurotoxicity was assessed using the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire–Chemotherapy-Induced Peripheral Neuropathy 20 (EORTC QLQ-CIPN-20), a validated 20-item patient-reported tool that evaluates sensory, motor, and autonomic symptoms on a 4-point Likert scale. Functional status of patients was evaluated using the World Health Organization (WHO) Performance Status Scale, which measures the patient’s general well-being and ability to perform daily activities. Adverse drug reactions (ADRs) were documented using the standardized reporting form provided by the Pharmacovigilance Programme of India (PvPI).

**Follow-Up and Monitoring**

All patients were followed up at the end of each chemotherapy cycle. During each follow-up visit, detailed clinical evaluation was performed, and any adverse drug reactions were recorded. Laboratory parameters, including hematological, renal, and liver function tests, were reassessed. Performance status was evaluated using the WHO scale, and neurotoxicity was assessed through the EORTC QLQ-CIPN-20 questionnaire. This systematic follow-up enabled continuous monitoring of toxicity progression across treatment cycles.

**Outcome Measures**

The primary outcome measures of the study included assessment of various chemotherapy-induced toxicities. Hematological toxicity was evaluated based on the occurrence of anemia, leucopenia, and thrombocytopenia. Renal toxicity was assessed

through changes in serum urea and creatinine levels. Neurotoxicity was measured using peripheral neuropathy scores obtained from the questionnaire. Gastrointestinal toxicity included symptoms such as nausea, vomiting, and diarrhoea, while dermatological toxicity was assessed based on the presence of alopecia.

**Toxicity Grading**

All observed toxicities were graded according to the Common Terminology Criteria for Adverse Events (CTCAE). Toxicities were categorized into five grades: Grade 1 (mild), Grade 2 (moderate), Grade 3 (severe), Grade 4 (life-threatening), and Grade 5 (death related to adverse events). This standardized grading system ensured uniform assessment and comparison across study groups.

**Causality Assessment**

The relationship between the suspected drug and the observed adverse drug reactions was evaluated using the WHO Causality Assessment Scale. Based on this assessment, all adverse drug reactions observed in the study were categorized under the “possible” category.

**Statistical Analysis**

Data were entered into a database and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as percentages. Repeated measures analysis of variance (ANOVA) was used to compare changes in parameters across multiple chemotherapy cycles. The Chi-square test was applied for comparison of categorical variables between groups. A p-value of less than 0.05 was considered statistically significant.

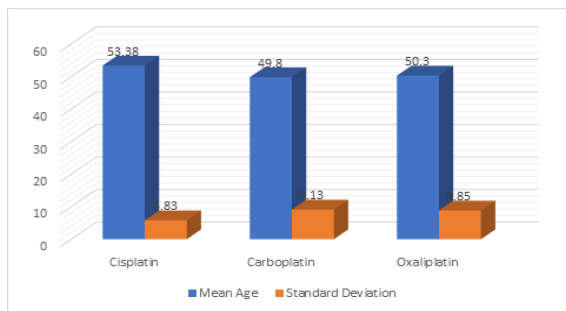
**Ethical Considerations**

The study was conducted after obtaining approval from the Institutional Ethics Committee, Madras Medical College (IEC No: 44112018 dated 13.11.2018). The study adhered to the ethical principles outlined in the Indian Council of Medical Research (ICMR) National Ethical Guidelines and the International Council for Harmonisation–Good Clinical Practice (ICH-GCP) guidelines. Written informed consent was obtained from all participants prior to their enrollment in the study.

## RESULTS

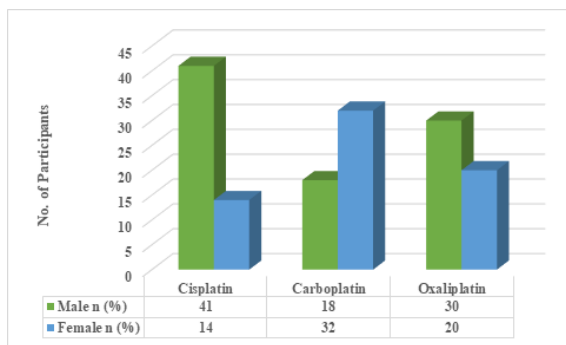
**Demographic Characteristics**

The mean age of patients in the cisplatin group was slightly higher (53.38 years) compared to the oxaliplatin (50.30 years) and carboplatin (49.80 years) groups (Figure 1). However, the difference was not statistically significant (p = 0.059), indicating that the study groups were comparable in terms of age distribution. This minimizes age-related bias in toxicity comparison.



**Figure 1: Age Distribution Among Study Groups**

There was a predominance of male patients in the cisplatin (74.5%) and oxaliplatin (60%) groups, whereas the carboplatin group had a higher proportion of females (64%) (Figure 2). Overall, males constituted the majority of the study population (57.4%). This distribution reflects the underlying cancer types treated in each group.



**Figure 2: Sex Distribution Among Study Groups**

**Table 1: Baseline Hematological Parameters**

Parameter	Cisplatin (Mean ± SD)	Carboplatin (Mean ± SD)	Oxaliplatin (Mean ± SD)	p-value
Hemoglobin	10.1 ± 1.2	10.1 ± 1.6	10.0 ± 1.3	0.891
Total Count	7291.6 ± 2709	5729 ± 1303	6615.7 ± 1349	0.001
Platelets	311.2 ± 104.6	303.7 ± 52.9	308.5 ± 60.9	0.884

The baseline renal parameters of the study participants are summarized in Table 2. A statistically significant difference was observed in both urea and creatinine levels among the three treatment groups ( $p = 0.001$ ). The mean urea levels were highest in the Carboplatin group ( $38.6 \pm 25.1$  mg/dL), followed by the Cisplatin group ( $32.5 \pm 8.4$  mg/dL), and lowest in the Oxaliplatin group ( $24.5 \pm$

### Baseline Laboratory Parameters

The baseline hematological parameters of the study participants are presented in Table 1. The mean hemoglobin levels were comparable among the Cisplatin ( $10.1 \pm 1.2$  g/dL), Carboplatin ( $10.1 \pm 1.6$  g/dL), and Oxaliplatin ( $10.0 \pm 1.3$  g/dL) groups, with no statistically significant difference observed ( $p = 0.891$ ). Similarly, platelet counts showed no significant variation across the three groups, with mean values of  $311.2 \pm 104.6 \times 10^3/\mu\text{L}$  in the Cisplatin group,  $303.7 \pm 52.9 \times 10^3/\mu\text{L}$  in the Carboplatin group, and  $308.5 \pm 60.9 \times 10^3/\mu\text{L}$  in the Oxaliplatin group ( $p = 0.884$ ). However, as shown in Table 1, the total leukocyte count demonstrated a statistically significant difference among the groups ( $p = 0.001$ ). The Cisplatin group had the highest mean total count ( $7291.6 \pm 2709$  cells/ $\mu\text{L}$ ), followed by the Oxaliplatin group ( $6615.7 \pm 1349$  cells/ $\mu\text{L}$ ), while the Carboplatin group exhibited comparatively lower values ( $5729 \pm 1303$  cells/ $\mu\text{L}$ ). These findings indicate that, although most baseline hematological parameters were similar, there was a significant variation in total leukocyte count between the groups.

3.9 mg/dL). Similarly, as shown in Table 2, serum creatinine levels also demonstrated significant variation across the groups ( $p = 0.001$ ). The Cisplatin group had the highest mean creatinine level ( $1.2 \pm 0.4$  mg/dL), followed by the Carboplatin group ( $1.0 \pm 0.1$  mg/dL), while the Oxaliplatin group showed the lowest values ( $0.7 \pm 0.1$  mg/dL).

**Table 2: Baseline Renal Parameters**

Parameter	Cisplatin	Carboplatin	Oxaliplatin	p-value
Urea	32.5 ± 8.4	38.6 ± 25.1	24.5 ± 3.9	0.001
Creatinine	1.2 ± 0.4	1.0 ± 0.1	0.7 ± 0.1	0.001

### Hematological Toxicity

The changes in hematological parameters across treatment cycles are presented in Table 3. A declining trend in hemoglobin levels was observed in all three groups with increasing chemotherapy cycles. In the Cisplatin group, mean hemoglobin decreased from 10.1 g/dL at baseline to 9.1 g/dL after 2 cycles and further to 8.5 g/dL after 4 cycles. A similar pattern was noted in the Carboplatin group, with values

declining from 10.1 g/dL to 9.1 g/dL and 8.3 g/dL across the respective cycles. In contrast, the Oxaliplatin group showed a relatively lesser decline, from 10.0 g/dL at baseline to 9.2 g/dL and 9.0 g/dL after 2 and 4 cycles, respectively.

As shown in Table 3, total leukocyte counts also decreased progressively in all groups. The Cisplatin group showed a reduction from 7291 cells/ $\text{mm}^3$  at baseline to 6714 and 6271 cells/ $\text{mm}^3$  after 2 and 4

cycles, respectively. The Carboplatin group demonstrated a more pronounced decline from 5729 to 3921 and further to 3363 cells/mm<sup>3</sup>. The Oxaliplatin group showed a moderate reduction from 6615 to 5773 and 5236 cells/mm<sup>3</sup> across the cycles. Platelet counts exhibited a decreasing trend in both the Cisplatin and Carboplatin groups. In the Cisplatin group, platelet counts declined from 311 to 282 and 256 cells/mm<sup>3</sup>, while in the Carboplatin group, they

decreased from 303 to 257 and 216 cells/mm<sup>3</sup> over successive cycles. However, in the Oxaliplatin group, platelet counts remained relatively stable, with values of 308 at baseline, 310 after 2 cycles, and 304 after 4 cycles. Overall, the reduction in hematological parameters was more pronounced in the Carboplatin group compared to the Cisplatin and Oxaliplatin groups.

**Table 3: Hematological Parameters Across Cycles**

Cycle	Group	Hemoglobin (g/dl)	Total Count (cells/mm <sup>3</sup> )	Platelets (cells/mm <sup>3</sup> )
Baseline	Cisplatin	10.1	7291	311
2 Cycles	Cisplatin	9.1	6714	282
4 Cycles	Cisplatin	8.5	6271	256
Baseline	Carboplatin	10.1	5729	303
2 Cycles	Carboplatin	9.1	3921	257
4 Cycles	Carboplatin	8.3	3363	216
Baseline	Oxaliplatin	10	6615	308
2 Cycles	Oxaliplatin	9.2	5773	310
4 Cycles	Oxaliplatin	9	5236	304

The severity of anemia across chemotherapy cycles, as per CTCAE grading, is depicted in Table 4. In the Cisplatin group, anemia was predominantly Grade II during Cycle II and progressed to a combination of Grade II–III in Cycles III and IV, indicating a gradual increase in severity. In contrast, the Carboplatin group demonstrated comparatively more severe anemia. As shown in Table 4, patients exhibited

Grade II–III anemia in Cycle II, which progressed to predominantly Grade III anemia in Cycles III and IV, suggesting a higher hematological toxicity profile. The Oxaliplatin group showed relatively milder anemia compared to the other groups. In Cycle II and III, anemia was mainly Grade II, while in Cycle IV, it improved to Grade I–II.

**Table 4: Anemia Severity (CTCAE Grading)**

Cycle	Cisplatin	Carboplatin	Oxaliplatin
II	Grade II predominant	Grade II–III	Grade II
III	Grade II–III	Grade III highest	Grade II
IV	Grade II–III	Grade III highest	Grade I–II

The changes in renal parameters across chemotherapy cycles are presented in Table 5. In the Cisplatin group, both urea and creatinine levels showed a progressive increase with successive cycles. The mean urea levels increased from 32.5 mg/dL at baseline to 36.2 mg/dL after 2 cycles and 36.8 mg/dL after 4 cycles. Similarly, serum creatinine levels rose markedly from 1.2 mg/dL at baseline to 1.8 mg/dL and further to 2.7 mg/dL, indicating a significant decline in renal function over time. In the Carboplatin group, a moderate increase in renal parameters was observed. As shown in Table

5, urea levels increased from 38.6 mg/dL at baseline to 40.9 mg/dL after 2 cycles, with a slight reduction to 40.4 mg/dL after 4 cycles. Creatinine levels also increased from 1.0 mg/dL to 1.7 mg/dL and 2.0 mg/dL across the respective cycles, suggesting a gradual impact on renal function. In contrast, the Oxaliplatin group demonstrated comparatively stable renal parameters. Urea levels increased from 24.5 mg/dL at baseline to 31.1 mg/dL after 2 cycles but decreased to 27.4 mg/dL after 4 cycles. Serum creatinine showed only a mild rise from 0.7 mg/dL to 1.0 mg/dL and 1.1 mg/dL over the treatment period.

**Table 5: Renal Parameters Across Cycles**

Cycle	Group	Urea (mg/dl)	Creatinine (mg/dl)
Baseline	Cisplatin	32.5	1.2
2 Cycles	Cisplatin	36.2	1.8
4 Cycles	Cisplatin	36.8	2.7
Baseline	Carboplatin	38.6	1
2 Cycles	Carboplatin	40.9	1.7
4 Cycles	Carboplatin	40.4	2
Baseline	Oxaliplatin	24.5	0.7
2 Cycles	Oxaliplatin	31.1	1
4 Cycles	Oxaliplatin	27.4	1.1

The progression of neurotoxicity across chemotherapy cycles is presented in Table 6. In the Cisplatin group, neurotoxicity was moderate during Cycles I and II, which gradually increased to

moderate–high in Cycle III and reached high levels by Cycle IV, indicating a steady rise in neurotoxic effects with continued treatment. In the Carboplatin group, neurotoxicity remained comparatively lower.

As shown in Table 6, patients experienced mild to moderate neurotoxicity in Cycle I, which reduced to mild in Cycle II and increased to moderate levels in Cycles III and IV, suggesting relatively minimal neurotoxic impact compared to the other agents. In

contrast, the Oxaliplatin group demonstrated the most pronounced neurotoxicity. Neurotoxicity was moderate in Cycle I but increased to high in Cycle II, very high in Cycle III, and reached the highest levels by Cycle IV.

**Table 6: Neurotoxicity Scores Across Cycles**

Cycle	Cisplatin	Carboplatin	Oxaliplatin
I	Moderate	Mild–Moderate	Moderate
II	Moderate	Mild	High
III	Moderate–High	Moderate	Very High
IV	High	Moderate	Highest

The comparative analysis of hematological, renal, and biochemical parameters after 2 and 4 chemotherapy cycles is presented in Table 7. Hemoglobin levels were comparable among the groups after 2 cycles ( $p = 0.704$ ); however, a statistically significant difference was observed after 4 cycles ( $p = 0.001$ ), with the Oxaliplatin group maintaining relatively higher levels compared to Cisplatin and Carboplatin. Total leukocyte count showed a significant reduction in the Carboplatin group at both 2 and 4 cycles ( $p = 0.001$ ), indicating greater myelosuppression compared to Cisplatin and Oxaliplatin. Similarly, platelet counts differed significantly among the groups at both time points ( $p = 0.002$  and  $p = 0.001$ ), with the Carboplatin group exhibiting a more pronounced decline, while the Oxaliplatin group maintained relatively stable platelet levels. Renal parameters also showed significant variation. As shown in Table 7, urea levels differed significantly at both 2 and 4 cycles ( $p = 0.007$

and  $p = 0.001$ ), with higher values observed in the Carboplatin group. However, creatinine levels did not show statistically significant differences among the groups at either 2 cycles ( $p = 0.159$ ) or 4 cycles ( $p = 0.081$ ), despite a rising trend, particularly in the Cisplatin group. Liver function parameters demonstrated significant differences across the groups. Bilirubin, SGOT, SGPT, and ALP levels were significantly elevated in the Cisplatin and Carboplatin groups compared to Oxaliplatin at both 2 and 4 cycles ( $p = 0.001$  for most parameters). This indicates greater hepatic impact in these groups, whereas Oxaliplatin showed relatively lower enzyme levels. Total protein and albumin levels also showed statistically significant differences at both time points. The Oxaliplatin group demonstrated comparatively lower protein and albumin levels, especially after 4 cycles ( $p = 0.030$  and  $p = 0.001$ ), suggesting a possible impact on nutritional or hepatic status.

**Table 7: Analysis of parameters after 2 and 4 chemotherapy cycles**

Parameter	Cycle	Cisplatin (Mean $\pm$ SD)	Carboplatin (Mean $\pm$ SD)	Oxaliplatin (Mean $\pm$ SD)	p-value
Hemoglobin (g/dl)	2 cycles	9.1 $\pm$ 1.1	9.1 $\pm$ 1.1	9.2 $\pm$ 0.9	0.704
	4 cycles	8.5 $\pm$ 1.0	8.3 $\pm$ 1.0	9.0 $\pm$ 0.8	0.001
Total Count (cells/mm <sup>3</sup> )	2 cycles	6714 $\pm$ 2500.5	3921 $\pm$ 1076.4	5773.5 $\pm$ 675.8	0.001
	4 cycles	6271.2 $\pm$ 2228.5	3363 $\pm$ 671.4	5236 $\pm$ 532.2	0.001
Platelet Count (cells/mm <sup>3</sup> )	2 cycles	282.9 $\pm$ 101.5	257.5 $\pm$ 45.6	310.7 $\pm$ 59.5	0.002
	4 cycles	256.7 $\pm$ 116.6	216.7 $\pm$ 56.2	304.3 $\pm$ 61.5	0.001
Urea (mg/dl)	2 cycles	36.2 $\pm$ 9.9	40.9 $\pm$ 24.1	31.1 $\pm$ 2.8	0.007
	4 cycles	36.8 $\pm$ 7.5	40.4 $\pm$ 25.2	27.4 $\pm$ 3.4	0.001
Creatinine (mg/dl)	2 cycles	1.8 $\pm$ 3.8	1.7 $\pm$ 0.6	1.0 $\pm$ 0.1	0.159
	4 cycles	2.7 $\pm$ 0.2	2.0 $\pm$ 0.6	1.1 $\pm$ 0.1	0.081
Bilirubin (mg/dl)	2 cycles	1.1 $\pm$ 0.4	1.2 $\pm$ 0.3	0.5 $\pm$ 0.1	0.001
	4 cycles	1.1 $\pm$ 0.3	1.4 $\pm$ 0.3	0.6 $\pm$ 0.1	0.001
SGOT (IU/L)	2 cycles	35.9 $\pm$ 13.3	31.8 $\pm$ 6.3	22.1 $\pm$ 3.6	0.001
	4 cycles	41.1 $\pm$ 13.5	33.0 $\pm$ 7.7	26.7 $\pm$ 3.6	0.001
SGPT (IU/L)	2 cycles	39.2 $\pm$ 14.4	33.9 $\pm$ 5.5	21.9 $\pm$ 5.6	0.001
	4 cycles	40.1 $\pm$ 13.1	35.3 $\pm$ 5.2	22.8 $\pm$ 6.6	0.001
ALP (IU/L)	2 cycles	86.5 $\pm$ 15.4	117.4 $\pm$ 23.4	83.3 $\pm$ 7.8	0.001
	4 cycles	97.0 $\pm$ 17.2	118.3 $\pm$ 25.4	92.3 $\pm$ 4.6	0.001
Total Protein (g/dl)	2 cycles	6.4 $\pm$ 0.5	9.5 $\pm$ 14.7	5.4 $\pm$ 0.4	0.046
	4 cycles	6.5 $\pm$ 0.4	8.2 $\pm$ 2.5	4.8 $\pm$ 0.5	0.030
Albumin (g/dl)	2 cycles	3.5 $\pm$ 0.5	4.1 $\pm$ 0.9	3.3 $\pm$ 0.3	0.001
	4 cycles	3.5 $\pm$ 0.5	3.9 $\pm$ 1.0	2.4 $\pm$ 0.5	0.001

## DISCUSSION

The present prospective observational study evaluated and compared the toxicity profiles of three commonly used platinum-based chemotherapeutic agents—cisplatin, carboplatin, and oxaliplatin—in a

tertiary care setting. The findings demonstrate distinct toxicity patterns among the three agents, consistent with their known pharmacological properties, while also highlighting variations observed in real-world clinical practice. In this study, the demographic characteristics were comparable

across the three groups, with no statistically significant difference in age distribution ( $p = 0.059$ ). This is in line with the findings of Arany and Safirstein (2003), who emphasized that patient-related factors such as age may influence toxicity but are less likely to confound outcomes when evenly distributed across study groups.<sup>[15]</sup> The predominance of male patients in the cisplatin group and female patients in the carboplatin group reflects the underlying distribution of cancer types, similar to observations reported by Jemal et al. (2011).<sup>[16]</sup> Hematological toxicity was found to be significantly higher in the carboplatin group compared to cisplatin and oxaliplatin. A marked reduction in hemoglobin levels, leukocyte counts, and platelet counts was observed across chemotherapy cycles, with carboplatin showing the greatest decline. This finding is consistent with studies by Calvert et al. (1989),<sup>[17]</sup> and Go and Adjei (1999),<sup>[18]</sup> which reported that carboplatin is associated with dose-limiting myelosuppression, particularly thrombocytopenia. In contrast, oxaliplatin demonstrated relatively stable hematological parameters, corroborating findings from de Gramont et al. (2000), who reported lower hematological toxicity with oxaliplatin-based regimens such as FOLFOX.<sup>[19]</sup> Renal toxicity was most pronounced in the cisplatin group, with a progressive increase in serum creatinine levels across cycles. This observation aligns with the well-established nephrotoxic profile of cisplatin, as described by Pabla and Dong (2008), who attributed cisplatin-induced nephrotoxicity to tubular cell injury and oxidative stress.<sup>[20]</sup> The relatively lower renal toxicity observed with carboplatin and oxaliplatin is consistent with findings from Hartmann and Lipp (2003), who noted that structural modifications in these agents reduce renal accumulation and toxicity. Neurotoxicity was significantly higher in the oxaliplatin group, showing a cumulative increase across treatment cycles. This is in agreement with studies by Kim and Erlichman (2007) and Park et al. (2013), which reported that oxaliplatin-induced peripheral neuropathy is dose-dependent and often limits long-term therapy.<sup>[22,23]</sup> In contrast, carboplatin exhibited minimal neurotoxicity, while cisplatin showed moderate neurotoxic effects, consistent with previous literature. Gastrointestinal toxicity, particularly nausea and vomiting, was most severe in the cisplatin group, followed by carboplatin and oxaliplatin. These findings are comparable to those reported by Hesketh (2008), who classified cisplatin as a highly emetogenic agent.<sup>[24]</sup> The lower incidence of gastrointestinal toxicity in oxaliplatin-treated patients further supports its relatively favorable tolerability profile. Liver function abnormalities were more prominent in the cisplatin and carboplatin groups compared to oxaliplatin. Although hepatotoxicity is not the primary dose-limiting toxicity of platinum agents, similar trends have been reported by Extra et al. (1990), suggesting transient elevations in liver enzymes during chemotherapy.<sup>[25]</sup> The findings of this study are largely consistent with

existing literature; however, certain differences may be attributed to variations in patient population, chemotherapy regimens, supportive care practices, and sample size. The prospective design and real-world clinical setting add strength to the study, providing practical insights into toxicity patterns encountered in routine oncology practice in India.

### Limitations

This study has several limitations that should be considered while interpreting the findings. First, it was conducted at a single tertiary care center, which may limit the generalizability of the results to other populations or healthcare settings. Second, the sample size, although adequate, was relatively modest, and subgroup analysis based on specific cancer types or regimens was limited. Third, the study duration was restricted to one year, which may not capture long-term or late-onset toxicities, particularly cumulative effects such as chronic neuropathy. Additionally, there were baseline differences in renal and liver function parameters among the groups, which could have influenced the observed toxicity profiles. The study also relied on observational design without randomization, making it susceptible to selection bias and confounding factors. Variations in supportive care, patient compliance, and individual susceptibility to adverse effects were not fully controlled. Finally, quality-of-life assessment was limited, and more comprehensive patient-reported outcomes could provide deeper insights.

## CONCLUSION

This study demonstrates that cisplatin, carboplatin, and oxaliplatin exhibit distinct and clinically significant toxicity profiles in patients undergoing chemotherapy. Carboplatin is predominantly associated with higher hematological toxicities, including anemia, leucopenia, and thrombocytopenia. Cisplatin shows a greater propensity for nephrotoxicity and severe gastrointestinal adverse effects such as nausea and vomiting. In contrast, oxaliplatin has a comparatively favorable hematological and renal safety profile but is strongly linked to peripheral neuropathy and diarrhoea. These differences were statistically significant, highlighting the importance of individualized treatment selection based on patient characteristics, baseline organ function, and risk of specific toxicities. Early detection and appropriate management of adverse drug reactions are essential to improve treatment adherence and outcomes. Overall, careful choice of platinum agents can enhance therapeutic efficacy while minimizing toxicity, thereby improving the quality of life in cancer patients.

## REFERENCES

1. CISPLATIN C. A comparative study: effect of platinum compounds viz. cisplatin, carboplatin and oxaliplatin on blood

- parameters. *Indian Journal of Clinical Anatomy and Physiology*. 2015;2(2):97-104.
2. Kumar N, Singh H, Gupta AK, Singh A, Fuloria N. Comparative study of the toxicity profile in patients receiving cisplatin-paclitaxel vs carboplatin paclitaxel in ovarian cancer. *World Journal of Pharmaceutical Research*. 2019;8(3):1063-70.
  3. Go RS, Adjei AA. Review of the comparative pharmacology and clinical activity of cisplatin and carboplatin. *Journal of Clinical Oncology*. 1999;17(1):409-.
  4. Ho GY, Woodward N, Coward JI. Cisplatin versus carboplatin: comparative review of therapeutic management in solid malignancies. *Critical reviews in oncology/hematology*. 2016;102:37-46.
  5. Alami N, Li Z, Engel J, Leyland-Jones B. Comparative preclinical antiproliferative activity of lobaplatin vs cisplatin, carboplatin, oxaliplatin and satraplatin in breast and ovarian cancers. *Cancer Research*. 2007;67(9\_Supplement):4780-.
  6. Schoch S, Gajewski S, Rothfuß J, Hartwig A, Köberle B. Comparative study of the mode of action of clinically approved platinum-based chemotherapeutics. *International journal of molecular sciences*. 2020;21(18):6928.
  7. O'Dwyer PJ, Stevenson JP, Johnson SW. Clinical status of cisplatin, carboplatin, and other platinum- based antitumor drugs. *Cisplatin: chemistry and biochemistry of a leading anticancer drug*. 1999:29-69.
  8. Boulikas T, Vougiouka M. Cisplatin and platinum drugs at the molecular level. *Oncology reports*. 2003;10(6):1663-82.
  9. Rixe O, Ortuzar W, Alvarez M, Parker R, Reed E, Paull K, Fojo T. Oxaliplatin, tetraplatin, cisplatin, and carboplatin: spectrum of activity in drug-resistant cell lines and in the cell lines of the National Cancer Institute's Anticancer Drug Screen panel. *Biochemical pharmacology*. 1996;52(12):1855-65.
  10. Ruggiero A, Trombatore G, Triarico S, Arena R, Ferrara P, Scalzone M, Pierri F, Riccardi R. Platinum compounds in children with cancer: toxicity and clinical management. *Anti-cancer drugs*. 2013;24(10):1007-19.
  11. Graham MA, Lockwood GF, Greenslade D, Brienza S, Bayssas M, Gamelin E. Clinical pharmacokinetics of oxaliplatin: a critical review. *Clinical cancer research*. 2000;6(4):1205-18.
  12. Quiroga W, Ríos-Rivera C, Martínez-Rojas Z, Forero-Pineda N. Evolution of platinum-based drugs: From cisplatin to oxaliplatin. *Afinidad. Journal of Chemical Engineering Theoretical and Applied Chemistry*. 2026;83(608):20-30.
  13. Tsvetkova D, Ivanova S. Application of approved cisplatin derivatives in combination therapy against different cancer diseases. *Molecules*. 2022;27(8):2466.
  14. Ivanova S. Comparative assessment of clinical trials, indications, pharmacokinetic parameters and side effects of approved platinum drugs. *Pharmacia*. 2022 ;69:1-7.
  15. Arany I, Safirstein RL. Cisplatin nephrotoxicity. In *Seminars in nephrology 2003* (Vol. 23, No. 5, pp. 460-464). WB Saunders.
  16. Jemal A, Bray F, Center MM, Ferlay J, Ward E, Forman D. *Global cancer statistics. CA: a cancer journal for clinicians*. 2011;61(2):69-90.
  17. Calvert AH, Newell DR, Gumbrell LA, O'Reilly S, Burnell M, Boxall FE, Siddik ZH, Judson IR, Gore ME, Wiltshaw E. Carboplatin dosage: prospective evaluation of a simple formula based on renal function. *Journal of Clinical Oncology*. 1989;7(11):1748-56.
  18. Go RS, Adjei AA. Review of the comparative pharmacology and clinical activity of cisplatin and carboplatin. *Journal of Clinical Oncology*. 1999;17(1):409-.
  19. de Gramont AD, Figer A, Seymour M, Homerin M, Hmissi A, Cassidy J, Boni C, Cortes-Funes H, Cervantes A, Freyer G, Papamichael D. Leucovorin and fluorouracil with or without oxaliplatin as first-line treatment in advanced colorectal cancer. *Journal of Clinical Oncology*. 2000;18(16):2938-47.
  20. Pabla N, Dong Z. Cisplatin nephrotoxicity: mechanisms and renoprotective strategies. *Kidney international*. 2008;73(9):994-1007.
  21. Hartmann JT, Lipp HP. Toxicity of platinum compounds. *Expert opinion on pharmacotherapy*. 2003;4(6):889-901.
  22. Kim GP, Erlichman C. Oxaliplatin in the treatment of colorectal cancer. *Expert Opinion on Drug Metabolism & Toxicology*. 2007;3(2):281-94.
  23. Park SB, Goldstein D, Krishnan AV, Lin CS, Friedlander ML, Cassidy J, Koltzenburg M, Kiernan MC. Chemotherapy-induced peripheral neurotoxicity: a critical analysis. *CA: a cancer journal for clinicians*. 2013;63(6):419-37.
  24. Hesketh PJ. Chemotherapy-induced nausea and vomiting. *New England Journal of Medicine*. 2008;358(23):2482-94.
  25. Extra JM, Espie M, Calvo F, Ferme C, Mignot L, Marty M. Phase I study of oxaliplatin in patients with advanced cancer. *Cancer chemotherapy and pharmacology*. 1990;25(4):299-303.