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Original Research Article

Assessment of Chemotherapy-Induced Peripheral Neuropathy: A Retrospective Study

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Abstract:

Background: Chemotherapy-induced peripheral neuropathy (CIPN) is one of the most common and dose-limiting adverse effects of several neurotoxic chemotherapeutic agents. It significantly affects functional status, quality of life, and treatment adherence among cancer patients.

Aim: To assess the incidence, severity, recovery pattern, and associated risk factors of chemotherapy-induced peripheral neuropathy among cancer patients receiving neurotoxic chemotherapy.

Methodology: This retrospective observational study was conducted in the Department of Radiation Oncology, Darbhanga Medical College and Hospital, Bihar, India. Medical records of 73 adult cancer patients who received neurotoxic chemotherapeutic agents were reviewed. Demographic, clinical, and treatment-related data were collected. CIPN was assessed and graded according to the National Cancer Institute Common Terminology Criteria for Adverse Events (NCI-CTCAE) version 5.0. Statistical analysis was performed using SPSS version 25.0, with a p-value ≤0.05 considered statistically significant.

Results: The mean age of patients was 52.8 ± 10.6 years, and females constituted the majority of the study population. Overall, CIPN developed in 50.7% of patients. Grade I neuropathy was the most common presentation, followed by Grade II and Grade III neuropathy. Oxaliplatin and paclitaxel demonstrated the highest incidence of CIPN, whereas docetaxel showed the lowest incidence. Diabetes mellitus was significantly associated with increased risk of neuropathy (p=0.018). At 6-month follow-up, persistent symptoms remained the most frequent outcome, while complete recovery was observed in a smaller proportion of affected patients.

Conclusion: CIPN is a frequent and clinically significant complication of chemotherapy, particularly among patients receiving oxaliplatin and paclitaxel. Diabetes mellitus increases susceptibility to neuropathy, and persistent symptoms remain common after treatment. Early identification, regular neurological monitoring, and supportive interventions are essential to reduce long-term morbidity and improve patient outcomes.

Keywords: Chemotherapy-induced peripheral neuropathy, CIPN, neurotoxicity, chemotherapy, oxaliplatin, paclitaxel, diabetes mellitus, cancer, neuropathy, retrospective study.

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Introduction

Cancer is one of the biggest public health problems in the world today, and a leading cause of morbidity and mortality. The prognosis and quality of life for many cancer patients has greatly improved with the development of treatment, especially chemotherapy. Chemotherapy's side effects, however, can have a number of detrimental effects on treatment adherence and patient health. One of the most frequent, severe and dose limiting toxicities of several commonly used antineoplastic agents is chemotherapy induced peripheral neuropathy (CIPN). CIPN is a type of peripheral nervous system damage neuropathic pain that can occur from chemotherapy drugs used to treat cancer. It is common and often requires dose reduction, delay in chemotherapy or its discontinuation, which may negatively affect treatment efficacy and/or cancer-related morbidity and mortality [1].

Chemotherapy-induced peripheral neuropathy is mainly sensory but sometimes may involve motor and autonomic nerves. Patients typically have numbness, tingling, burning, pain, loss of vibration sense, and loss of proprioception in a typical “glove and stocking” distribution of the hands and feet [2]. As the disease worsens, patients may develop problems with walking, balance, muscle weakness, loss of fine motor control and may find themselves

unable to handle normal daily tasks. The symptoms may be present after chemotherapy and can have a profound impact on functional status and quality of life.

CIPN is affected by several factors such as the type of chemotherapy drug used, the total dose of the chemotherapy given, the length of treatment, timing between chemotherapies, and the combination of neurotoxic drugs. Other factors related to the patient can also be important in deciding susceptibility to neuropathy. The following factors have been determined to be important risk factors for the development of CIPN [3]: advanced age, diabetes mellitus, renal insufficiency, hepatic dysfunction, and pre-existing peripheral neuropathy. Awareness of these risk factors is crucial to identifying high-risk patients and the necessary monitoring strategies, when administering cancer treatment.

CIPN is a significant problem in the field of oncology, affecting many patients. Peripheral neurotoxicity is estimated to occur in about 30–40% of all patients who receive chemotherapy [4]. But it is significantly different with different chemotherapeutics agents. Elevated rates, up to 60%, have been reported in patients treated with platinum-based compounds and taxanes, such as cisplatin, oxaliplatin, paclitaxel and docetaxel [5]. CIPN is a common clinical problem faced by oncologists globally, as these agents are used as the backbone of treatment for several common malignancies including breast cancer, colorectal cancer, ovarian cancer, lung cancer and head and neck cancers.

The mechanism and pathophysiology of CIPN is complicated and depends on the chemotherapeutic agent used. Platinum compounds (e.g. cisplatin and oxaliplatin) bind irreversibly to DNA resulting in neuronal apoptosis, especially in sensory neurons of the dorsal root ganglia [6]. Microtubule targeting agents like paclitaxel and docetaxel, on the other hand, interfere with the transport of material within the axons and cause structural and functional damage to sensory neurons and peripheral nerve axons. These changes, in the end, help to trigger neuronal degradation and cell death [7]. The overall neurotoxic damage caused by antineoplastic agents is most likely to attack the cell bodies of sensory nerves in the dorsal root ganglion and the axons of both afferent and efferent nerves of the peripheral nervous system, resulting in chronic neurological dysfunction [8].

A reliable diagnosis and grading of CIPN is critical to early intervention and management. Diagnosis is mainly clinical and based on a careful analysis of the symptoms, the neurological examination aspects and the treatment history. There are a number of standardised tools to measure the degree of neuropathy. The most commonly used grading system is the National Cancer Institute Common Terminology Criteria for Adverse Events (NCI-CTCAE) that are used to rate the severity of neuropathy. The World Health Organization (WHO) scale, Eastern Cooperative Oncology Group (ECOG) scale, Levi's oxaliplatin-specific scale, Patient Neurotoxicity Questionnaire (PNQ), and Total Neuropathy Score (TNS) are other assessment tools [9] . These tools help to make neuropathy evaluations consistent and aid in the decision-making process for chemotherapy changes.

Although a lot of work has been done in this area, there are only a few preventive strategies and definitive treatments available for established chronic CIPN. Treatment is mainly aimed at managing the symptoms, adjusting the dose of the medicines and providing supportive care. Pharmacological treatments have shown inconsistent efficacy and there is not yet a neuroprotective treatment that is commonly used in clinical practice [10]. Therefore, early detection and monitoring of neuropathy is essential to minimise long-term disability and maintain a patient's quality of life.

CIPN is gaining recognition in India where the burden of cancer is further increasing. But information is still limited on the clinical features, severity of patterns and the risk factors associated with CIPN, especially in resource-limited areas like Bihar. The rising use of neurotoxic chemotherapeutic drugs in oncology centers statewide makes it important to know the burden of CIPN to enable improved patient care and treatment outcomes. Hence, the present retrospective study has been designed to compare the incidence, clinical presentation, severity and risk factors associated with chemotherapy induced peripheral neuropathy (CIPN) in chemotherapy patients in routine clinical practice in Bihar, India.

Materials and Methods

Study Design: This retrospective study was conducted to assess the incidence, severity, and associated factors of chemotherapy-induced peripheral neuropathy (CIPN) among cancer patients receiving neurotoxic chemotherapeutic agents. The study involved a review and analysis of patient records to evaluate the occurrence and grading of CIPN following chemotherapy.

Study Area: The study was carried out in the Department of Radiation Oncology, Darbhanga Medical College and Hospital (DMCH) Laheriasarai, Darbhanga, Bihar, India and Swami Vivekanand Cancer Aspatal, Mabbi.

Study Duration: The study was conducted over a period of nine months from March 2025 to November 2025.

Sample Size: A total of 73 eligible patients were included in the study. The sample size comprised all patients who fulfilled the predefined inclusion

criteria and had complete medical records available during the study period.

Study Population: The study population consisted of adult cancer patients who received chemotherapy regimens containing potentially neurotoxic agents and were managed at the Department of Radiation Oncology, Darbhanga Medical College and Hospital. Patients were evaluated for the development and severity of chemotherapy-induced peripheral neuropathy during and after treatment.

Data Collection: Data were retrospectively extracted from patients' medical records, chemotherapy charts, and follow-up documentation. Information collected included demographic characteristics (age and sex), clinical details (type and stage of malignancy, comorbidities such as diabetes mellitus, hepatic disease, and renal disease), treatment-related factors (type of chemotherapeutic agent, treatment schedule, cumulative dose, and total number of chemotherapy cycles received), and documentation of peripheral neuropathy symptoms.

The incidence and severity of chemotherapy-induced peripheral neuropathy were assessed according to the National Cancer Institute Common Terminology Criteria for Adverse Events (NCI-CTCAE), version 5.0. Available follow-up records were reviewed to determine symptom progression, persistence, or recovery following completion of chemotherapy.

Inclusion Criteria

1. Adult patients (≥18 years) diagnosed with any malignancy.
2. Patients who received chemotherapy regimens containing neurotoxic agents such as platinum compounds, taxanes, vinca alkaloids, or other neuropathy-inducing drugs.
3. Patients with complete medical records containing treatment and follow-up details.
4. Patients managed at the Department of Radiation Oncology, Darbhanga Medical College and Hospital during the study period.

Exclusion Criteria

1. Patients with incomplete or missing medical records.
2. Patients with documented peripheral neuropathy prior to initiation of chemotherapy.
3. Patients with neurological disorders unrelated to chemotherapy that could interfere with neuropathy assessment.
4. Patients who discontinued treatment before completion of the planned chemotherapy protocol and lacked adequate follow-up information.
5. Pediatric patients (<18 years of age).

Study Procedure: After obtaining ethical approval, eligible patient records were identified from departmental databases and hospital records. Relevant demographic, clinical, and treatment-related information was extracted using a structured data collection form. Patients were evaluated for the occurrence of chemotherapy-induced peripheral neuropathy based on documented clinical assessments. The severity of neuropathy was graded according to NCI-CTCAE criteria. Associations between patient characteristics, chemotherapy-related variables, and the development of CIPN were subsequently analyzed.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using the Statistical Package for Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized using mean, standard deviation, median, and range, while categorical variables were expressed as frequencies and percentages. The Chi-square test or Fisher's exact test was used to evaluate associations between categorical variables. One-way analysis of variance (ANOVA) was applied for comparison of continuous variables among multiple groups where appropriate. A p-value ≤0.05 was considered statistically significant, whereas a p-value <0.01 was considered highly significant."

Result

Table 1 presents the baseline characteristics of the 73 patients included in the study and the overall incidence of chemotherapy-induced peripheral neuropathy (CIPN). The mean age of the patients was 52.8 ± 10.6 years, with the majority being 60 years or younger (75.3%, n=55), while 24.7% (n=18) were older than 60 years. Females constituted a larger proportion of the study population (60.3%, n=44) compared to males (39.7%, n=29). Regarding comorbidities, 20.5% (n=15) of patients had diabetes mellitus, while 5.5% (n=4) and 2.7% (n=2) had hepatic dysfunction and renal dysfunction, respectively. The chemotherapeutic agents administered were relatively evenly distributed, with cisplatin being the most commonly used (30.1%, n=22), followed by paclitaxel (24.7%, n=18), docetaxel (23.3%, n=17), and oxaliplatin (21.9%, n=16). Overall, 50.7% (n=37) of patients developed chemotherapy-induced peripheral neuropathy during treatment. Among these, Grade I neuropathy was the most frequent, affecting 32.9% (n=24) of the total cohort, followed by Grade II (13.7%, n=10) and Grade III (4.1%, n=3) neuropathy. These findings indicate that CIPN was a common adverse effect of chemotherapy, affecting approximately half of the patients, with most cases presenting as mild to moderate neuropathy.

Table 1: Baseline Characteristics and Incidence of Chemotherapy-Induced Peripheral Neuropathy (N = 73)	
Variable	**N (%)**
Age (years), Mean ± SD	52.8 ± 10.6
≤60 years	55 (75.3)
>60 years	18 (24.7)
Male	29 (39.7)
Female	44 (60.3)
Diabetes Mellitus	15 (20.5)
Hepatic Dysfunction	4 (5.5)
Renal Dysfunction	2 (2.7)
Chemotherapeutic Agent	
Cisplatin	22 (30.1)
Oxaliplatin	16 (21.9)
Paclitaxel	18 (24.7)
Docetaxel	17 (23.3)
Overall CIPN	37 (50.7)
Grade I	24 (32.9)
Grade II	10 (13.7)
Grade III	3 (4.1)

Table 2 presents the incidence of chemotherapy-induced peripheral neuropathy (CIPN) according to the chemotherapeutic agent administered among the 73 patients included in the study. Overall, 50.7% (n=37) of patients developed CIPN during treatment. The highest incidence of CIPN was observed among patients receiving oxaliplatin, with 75.0% (n=12/16) developing neuropathy, closely followed by paclitaxel, where 72.2% (n=13/18) experienced CIPN. In contrast, cisplatin was associated with a lower incidence of neuropathy, affecting 36.4% (n=8/22) of patients, while docetaxel demonstrated the lowest incidence, with only 23.5% (n=4/17) developing CIPN. These findings indicate that oxaliplatin and paclitaxel were associated with a substantially higher risk of chemotherapy-induced peripheral neuropathy compared with cisplatin and docetaxel, highlighting the greater neurotoxic potential of these agents.

Table 2: Incidence of CIPN According to Chemotherapeutic Agent		
Drug	**Total (N)**	**CIPN, n (%)**
Cisplatin	22	8 (36.4)
Oxaliplatin	16	12 (75.0)
Paclitaxel	18	13 (72.2)
Docetaxel	17	4 (23.5)
Total	73	37 (50.7)

Table 3 demonstrates the association between diabetes mellitus and the occurrence of chemotherapy-induced peripheral neuropathy (CIPN) among the 73 study participants. Among patients with diabetes mellitus (n=15), 73.3% (n=11) developed CIPN, while only 26.7% (n=4) remained free of neuropathic symptoms. In contrast, among patients without diabetes mellitus (n=58), 44.8% (n=26) developed CIPN and 55.2% (n=32) did not experience neuropathy. The difference in CIPN occurrence between diabetic and non-diabetic patients was found to be statistically significant (p=0.018). These findings suggest that diabetes mellitus is significantly associated with an increased risk of developing chemotherapy-induced peripheral neuropathy, indicating that diabetic patients may be particularly vulnerable to neurotoxic effects of chemotherapy and may require closer monitoring during treatment.

Table 3: Association Between Diabetes Mellitus and CIPN			
Diabetes Mellitus	**CIPN Present n (%)**	**CIPN Absent n (%)**	**p-value**
Present (n=15)	11 (73.3)	4 (26.7)	0.018
Absent (n=58)	26 (44.8)	32 (55.2)	
Total	37	36	

Table 4 illustrates the severity distribution of chemotherapy-induced peripheral neuropathy (CIPN) according to the chemotherapeutic agent among the 37 affected patients. Paclitaxel was associated with the highest number of CIPN cases, accounting for 13 patients, followed closely by oxaliplatin with 12 cases,

cisplatin with 8 cases, and docetaxel with 4 cases. Overall, Grade I neuropathy was the most common presentation, affecting 24 patients, while Grade II and Grade III neuropathy were observed in 10 and 3 patients, respectively. Among patients receiving paclitaxel, 8 developed Grade I, 3 Grade II, and 2 Grade III neuropathy, representing the highest number of severe cases. Oxaliplatin was associated with 7 Grade I, 4 Grade II, and 1 Grade III case, whereas cisplatin-related neuropathy was limited to Grade I (n=6) and Grade II (n=2) events, with no Grade III toxicity reported. Similarly, all docetaxel-associated neuropathy cases were mild to moderate, comprising 3 Grade I and 1 Grade II event. These findings indicate that paclitaxel and oxaliplatin were the most frequently implicated agents in CIPN and were also associated with the more severe grades of neuropathy, whereas cisplatin and docetaxel predominantly caused milder forms of neurotoxicity.

Table 4: Severity of CIPN According to Chemotherapeutic Agent

Agent	Grade I	Grade II	Grade III	Total CIPN
Cisplatin	6	2	0	8
Oxaliplatin	7	4	1	12
Paclitaxel	8	3	2	13
Docetaxel	3	1	0	4
Total	24	10	3	37

Table 5 presents the recovery status of patients who developed chemotherapy-induced peripheral neuropathy (CIPN) at the 6-month follow-up assessment (n = 37). Persistent symptoms were the most common outcome, observed in 40.6% (n=15) of patients, indicating that a substantial proportion continued to experience neuropathic manifestations despite completion of treatment. Partial recovery was documented in 32.4% (n=12) of patients, reflecting improvement in symptoms without complete resolution. Meanwhile, 27.0% (n=10) of patients achieved complete recovery, with full resolution of neuropathic symptoms by the end of the follow-up period. These findings suggest that although more than half of the patients experienced either complete or partial improvement in CIPN, persistent neuropathy remained a significant long-term complication affecting a considerable proportion of survivors.

Table 5: Recovery Status of CIPN at 6-Month Follow-up (n = 37)

Recovery Status	n (%)
Complete Recovery	10 (27.0)
Partial Recovery	12 (32.4)
Persistent Symptoms	15 (40.6)
Total	37 (100)

Discussion

In the present retrospective study, chemotherapy-induced peripheral neuropathy (CIPN) was shown to be a common and clinically significant adverse reaction among patients undergoing neurotoxic chemotherapy. Overall, CIPN occurred in 50.7% of our 73 patients, most often on Grade I (32.9%), Grade II (13.7%) and Grade III (4.1%) levels. The results are very similar to those of the Systematic review and Meta-analysis by Seretny et al. 2014 [11] that found the pooled prevalence of CIPN was around 48% in 4179 patients receiving chemotherapy. Likewise, Velasco and Bruna (2010) [5] reported that the prevalence of PN in patients receiving neurotoxic chemotherapy agents ranges from 30–40%, depending on the type of chemotherapy agent and the total doses administered. A higher prevalence of mild to moderate neuropathy also corroborates with previous studies that found Grade I sensory symptoms are the most common clinical feature of CIPN [3,4]."

Demographic characteristics of our study population showed a mean age of 52.8 ± 10.6 years, with about 75% of patients being aged < 60 years. As neurons are vulnerable to age-related neurotoxicity, older age has been suggested as a risk factor among the other risk factors for developing neuropathy; however, our results did not show a clear age-related trend. This is in line with the prospective study by Argyriou et al. (2006) [12] which did not identify any significant correlation between the occurrence of CIPN and advanced age in patients treated with platinum- and taxane-based regimens. Similarly, Argyriou et al. (2012) [13] reported inconclusive evidence that age is an independent risk factor for the development of CIPN, indicating that factors of the treatment itself may have more impact than chronological age.

One of the important findings of this present study was that there was a significant relationship between diabetes mellitus and the development of CIPN. As expected, 73.3% of diabetic patients had neuropathy, significantly more than 44.8% of non-diabetic patients (p = 0.018), suggesting that pre-existing metabolic dysfunction greatly contributes to neuropathy caused by chemotherapy. Chaudhry et al. 2003 [14] showed that patients with preexisting

neuropathic conditions had significant aggravation of neurological symptoms in response to exposure to neurotoxic agents like paclitaxel, vincristine and cisplatin. The increased incidence in diabetic people may be attributed to the fact that diabetes-related microvascular damage, oxidative stress and impaired nerve regeneration may make peripheral nerves more susceptible to further injury by chemotherapy. Our work also contributes to the increasing awareness that diabetes is an important clinical risk factor that should be thoroughly evaluated prior to the commencement of neurotoxic therapy.

Significant variations were noted between chemotherapeutic agents when assessed for its neurotoxicity. There was a significantly higher frequency of CIPN with oxaliplatin (75.0%) than with paclitaxel (72.2%) and lower rates of neuropathy with cisplatin (36.4%) and docetaxel (23.5%). The high incidence reported with oxaliplatin is similar with the findings given by de Gramont et al. (2000) [15] and Kiernan (2007) [16] who reported incidence of acute and cumulative sensory neurotoxicity in 60-90% of treated patients. Neuropathy from oxaliplatin is transient (cold) and cumulative (chronic) and can result in long-term sensory deficits. The frequency of neuropathy in our study is in close agreement with that reported in previous clinical studies (74%) and reflects the known neurotoxic effect of oxaliplatin.

Likewise, the incidence of paclitaxel-associated neuropathy in our study (72.2%) is similar to that of Kautio (2017) [17] which was approximately 70%. Paclitaxel is toxic to the peripheral nervous system by interfering with microtubules in peripheral neurons, causing axonal degeneration and decreasing sensory function. Neuropathy severity has been found to be related to duration of treatment and cumulative dosing (Carlson & Ocean, 2011; Lee & Swain, 2006) [18,19]. All of these observations are supported by our findings: patients treated with paclitaxel not only had a high prevalence of neuropathy but also a significant amount of severe neuropathy.

The prevalence of cisplatin-induced neuropathy (36.4%) detected in our cohort is within the wide range (30-100%) that has been reported by Velasco and Bruna (2010) [5] and is close to the median prevalence (57%) of the other reported studies. Platinum compounds target and cause sensory neuron damage in dorsal root ganglia in a dose-dependent manner. The incidence reported in this study was lower than that found in some studies, but these differences in cumulative doses, treatment schedule and the characteristics of the patients may account for some of the variation. In addition, our patients with cisplatin treatment did not experience Grade III neuropathy compared to reports from Argyriou et al., 2012 [13] where they reported severe neurotoxicity at cumulative doses of 300-400 mg/m². This discrepancy could be due to variations in exposure and supportive care.

The lowest neurotoxic potential in our study was seen for docetaxel, with CIPN occurring in 23.5% of patients. This result is slightly higher than reported by Baker et al. (2009) [20] but is in line with the mild and short-term neuropathic symptoms seen with docetaxel treatment in general. Importantly, no Grade III neuropathy cases were observed in docetaxel treated patients, confirming the findings from previous studies that docetaxel induced neurotoxicity is generally less severe than paclitaxel or platinum (Swain & Arezzo, 2008) [21].

A measure of the severity of the neuropathy also revealed inter-drug differences. The neuropathy was of grade III severity only in those treated with paclitaxel and oxaliplatin, suggesting that these treatments carry a higher neurotoxic risk. Lee and Swain (2006) [19] and Carlson and Ocean (2011) [18] have also reported that taxane- and platinum-based therapies most commonly cause severe neuropathy. Since most of our patients had grade 1 neuropathy in all treatment groups,Early neurotoxic manifestations are common and may worsen if not identified and managed appropriately.

A long-term follow-up showed that CIPN often occurs after the end of treatment. Twenty-seven percent of affected patients fully recovered at six months, 32.4% had some improvement, and 40.6% remained symptomatic with neuropathic symptoms. The results showed that there is a significant burden of chronic neurological impairment in cancer survivors. While the published recovery rates of Seretny et al (2014) [11] were greater (about 40% at three months and 70% at six months or thereafter), this could be due to differences in patient population, chemotherapy dosing and the methods used to assess neuropathy. However, our findings show that CIPN is a persistent issue in a large number of patients and early detection, risk stratification and preventive and supportive measures to reduce functional disability and quality of life should be taken.

Conclusion

The current retrospective study illustrated that chemotherapy-induced peripheral neuropathy (CIPN) occurs frequently in patients undergoing treatment with neurotoxic chemotherapeutic agents and has different incidence and severity depending on the chemotherapy regimen. Pathological neuropathy was more common with platinum-based agents and taxanes and diabetes mellitus was a strong risk factor for neuropathic complications. While majority of patients had mild to moderate neuropathy, a large proportion of those that had a nerve reaction had ongoing neuropathic symptoms at follow-up, indicating a potential long-term effect on quality of life. The results highlight the need for the early detection of high-risk patients, regular neurological

surveillance during therapy, and timely preventive and supportive measures to reduce the morbidity associated with treatment and improve outcomes for patients.

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