Original Research Article

Assessment And Management Pattern of Chemotherapeutic Drug Induced Adverse Effects Among Cancer Patients at Tertiary Care Centre

Syed Meraj Fatmi[1]*, Kavita Dhar[2], Jyotsna Sharma[2], Shaktibala Dutta[3]

[1]PhD Scholar, Department of Pharmacology, Santosh Medical College& Hospital, Santosh University Ghaziabad. India
[2]Associate Professor, Department of Pharmacology, Santosh Medical College& Hospital, Santosh University Ghaziabad. India
[3]Professor, Department of Pharmacology, Santosh Medical College& Hospital, Santosh University Ghaziabad. India

Authors' contributions

This work was carried out in collaboration between all four authors. In this study author Syed Meraj Fatmi designed the study proposal, conducted the study and involved in every stage of the study. Author Kavita Dhar involved in data collection and data refining of the study. Author Jyotsna Sharma involved in statistical analysis and literature searches in the study, and author Shaktibala Dutta reviewed and managed the analysis of the study and approved the final manuscript. Final Manuscript is finalized by all above author. All authors read and approved the final manuscript

ABSTRACT

Aim and Objective: Cancer chemotherapy drugs causes substantial toxicity and produces number of adverse effects which can significantly reduce patient's health related quality of life. The aim of this study was to perform the assessment and explore the management practice of chemotherapy induced side effects among cancer patients.

Material and Methods: Demographic characteristics of patient undergone cancer chemotherapy and adverse drug reactions (ADRs) of chemotherapeutic drugs were noted in patient's case report form. Assessments of ADRs were performed for Severity, Causality and Preventability of each ADR. Association between occurrence of severe ADRs and patient' characteristics were studied using chi square statistics. Frequencies of ameliorative therapy were studied in each patient.

Results: 120 patients were selected and included in the study and a total of 412 ADRs were detected after cancer chemotherapy. Majority (60%) of the participant were female. Most common cancer was found as breast cancer (23%). Commonly used chemotherapy regimens were combination of carboplatin and paclitaxel (14%). Upon severity assessment of ADR, more than one third categorized as "Severe" ADR (36.4%). Majority of the Severe ADR were alopecia and nausea & vomiting. Most of the ADRs (73%) on preventability assessment were found as Not-Preventable. There is a significant association between occurrence of severe ADRs and age, sex & chemotherapy regimen. Combination of palonosetron, dexamethasone and pantoprazole were used as ameliorative therapy (43.3%).

Conclusion: Cancer chemotherapy drugs produce numerous adverse effects. Assessment of severity of ADRs and associated triggering factor may support in management practice of side effects.

Keywords: Chemotherapy, causality assessment, ameliorative therapy.

1. INTRODUCTION

Cancer has been reported as the one of the most common leading cause of death in the world (1). In India, numbers of new cases of cancer and deaths due to cancer increased double fold in last decades. Consumption of tobacco and increase in alcohol intake has been attributed to the risk factor for oral, oesophageal, larynx and liver cancers in India(2). Modernization and practice of unhealthy life style which involves cigarette smoking, high fat and low fibrous content diets are also majorly associated for higher incidence of cancer in developing countries(3). Most common sites of cancer reported in India are breast, lung, mouth, cervix, uterus, and tongue (4). Therapeutic strategies for cancer are influenced by clinical characteristics of tumor like signs and symptoms, stage, localization and histological type. Most commonly used chemotherapeutic drugs are pyrimidine analogues (5-Fluorouracil (5-FU), Capecitabine), purine analogues (Mercaptopurine) and platinum compound (Cisplatin, Oxaliplatin). These drugs are having narrow therapeutic index and show dose related inter-individual effects due to their variation in metabolism(5). Among all treatment modalities, chemotherapy still represents a centre of pharmacological strategy for different types of solid cancer treatments and improves patient conditions (6). Chemotherapeutic drug produces toxicity as an extension of their therapeutic action and may hamper the patient quality of life by producing numerous adverse effects (7).

Adverse Drug reaction (ADR) is an appreciably harmful or unpleasant reaction resulting from an intervention related to the use of medicinal products. ADR is defined by World Health Organisation (WHO) as "any response to a drug, which is noxious, unintended and occurs at a doses used in man for prophylaxis, diagnosis or therapy"(8). Among the anticancer drugs currently in use, the overall magnitude of ADRs, endured by oncology patients are high (9). Most common adverse effect due to cancer chemotherapy is nausea, vomiting, alopecia, myelosuppression, cardiovascular toxicity, mucositis, hemorrhagic cystitis and electrolyte imbalance (10). Most of the patients receiving antineoplastic treatment needed help to prevent and ameliorate adverse events (AEs) produced by them, and with the disease itself (11). Due to narrow therapeutic index of the antineoplastic drugs, early identification of adverse drug

reaction helps in administering ameliorative therapy to counter their toxic effects (12). Toxicity assessment in cancer chemotherapy patients needed special attention and more vigilance particularly in patients receiving poly-chemotherapeutic drug in first few month, as it has a potential role in producing adverse effects (13). It has been considered need of current times to study the nature of ADRs produced by antineoplastic drugs for its proper management. Toxicity amelioration of some commonly associated ADRs are managed by the primary care physicians, however treatment of severe and rare ADRs needs to be explored. Therefore the aim of this study was planned to estimate the assessment and management practice of ADRs due to chemotherapeutic drugs observed in cancer patients in a tertiary care hospital.

2. MATERIAL AND METHODS

2.1 Data collection and study protocol

Sample size for this study was calculated using proportion population formula. Assuming occurrence of at least one adverse effect due to cancer chemotherapy is 80%, relative error (d) 10% at 95% confidence interval, sample size came to 100. Considering 20% non responder or loss to follow up, final sample size was 120. Patients being prescribed chemotherapy drug treatment for the first time attending or referred to the hospital were included in study. Patient excluded from the study are having concurrent medical illnesses, overprescribing, accidental and deliberate over dosage, and history of drug abuse and addiction. Data regarding demographic profile, drugs used and ADRs produced were obtained from the patient and from their in-patient file, using standard case report form. Details of the diagnosis and concomitant drug given and relevant biochemical parameters were also recorded confirmed by the treating physicians.

The severities of reported ADR were assessed using "Modified Hartwig and Siegel" scale (14). The causal relationship between suspected medication(s) and ADRs were assessed using the Naranjo's causality assessment scale (15). According to the Naranjo's algorithm scale, Causality defined on the basis of total score as “Definite reaction $\geq$9”, “Probable reaction 5-8”, “Possible reaction 1-4” and “Doubtful reaction 0” (15). Preventability assessment of noted ADRs were done by using "Schumock and Thronton" Scale. ADRs were classified as "Definitely Preventable", "Probably Preventable" and "Not Preventable" (16).

2.2 Statistical analysis

Data entry, cleaning and analyses were done using SPSS (version 25) software. Descriptive statistics like proportion, frequency distribution were performed for patient demographic profile. Severity (14), Causality (15) and Preventability (16) of reported ADRs were studied. Pearson chi square test were used to evaluate association between occurrence of severity of ADRs and patients characteristics & preventability of ADRs.

3. RESULTS

3.1 Demographic characteristics of patients

A total of 120 samples were included in the study. The mean age of the total patient participated in the study was 46.87 (Standard Deviation SD 10.1), minimum age was found out to be 18 years and maximum age was 75 years. 79(65.8%) patients were categorized in age 18-50 years. Out of 120 patient, gender female were 72(60%) and majority of patient 109(90.8%) were married. Frequencies of occupation were calculated. Most of the patient, 72(42.5%) were homemaker followed by 21(17.5%) laborers (Table1). Breast cancer 28(23%) was found to be the leading site in this study followed by gastric 19(15.8%), colorectal 16 (13.13%), ovarian15 (12.5%), lung 10(8.3%) and other carcinoma 25(20.8%). Details are described in Figure1.

Table1. Demographic characteristics of patient (N=120)

Variables	Frequency (%)
Age (years	
18-50	79 (65.8)
51-<	41 (34.2)
Sex	

Female	72 (60)
Male	48 (40)
Marital status	
Married	109(90.8)
Unmarried	11 (9.2)
Religion	
Hindu	72 (60)
Muslim	48 (40)
Occupation	
Home-maker	51 (42.5)
Labour	21 (17.5)
Business	19 (15.8)
Job	13 (10.8)
Student	7 (5.8)
Elderly	5 (4.2)
Unemployed	4 (3.3)

3.2 Treatment regimens and adverse effect profile of anticancer drugs

Majority of the patient 98 (81.7%) received poly-chemotherapy as their treatment modalities. Most commonly administered chemotherapy regimen were combination of Carboplatin & Paclitaxel 17(14.2%). Administration of Platinum compounds in form of cisplatin, carboplatin and oxaliplatin, mono-therapy or in combination therapy accounts for more than sixty percent of patients received anticancer medication (Table2).

Total of 412 chemotherapy related ADRs were detected from 120 cancer patients. Most common ADR was found out to be nausea & vomiting 73 (17.7%) followed by alopecia and neutropenia (Figure2).

Figure1. Cancer types observed in this study

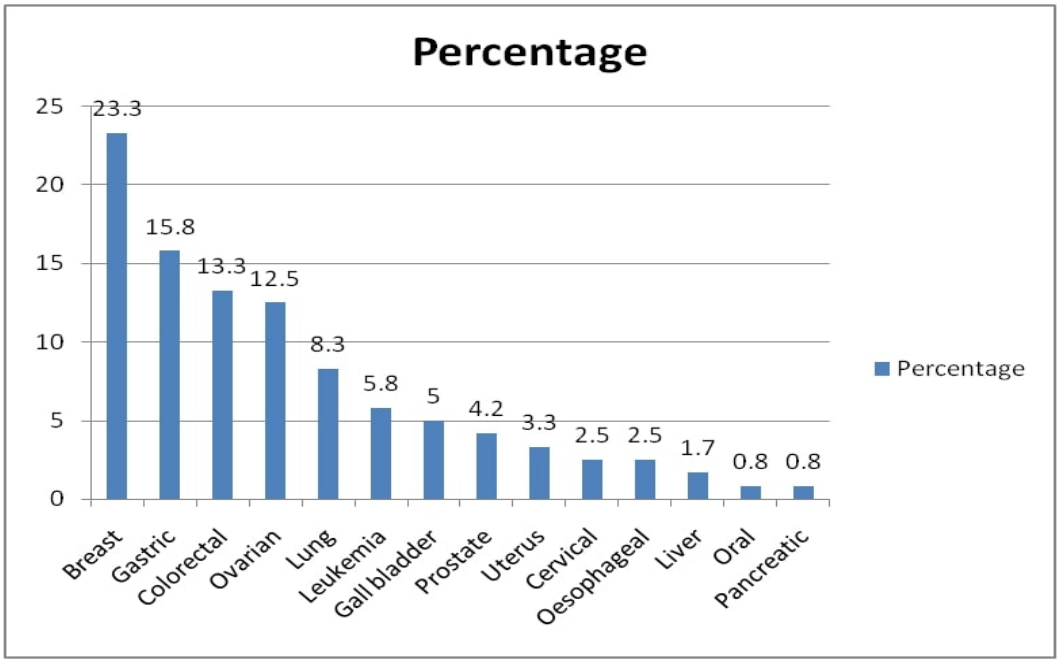

Figure2. Frequency of ADR induced by chemotherapy

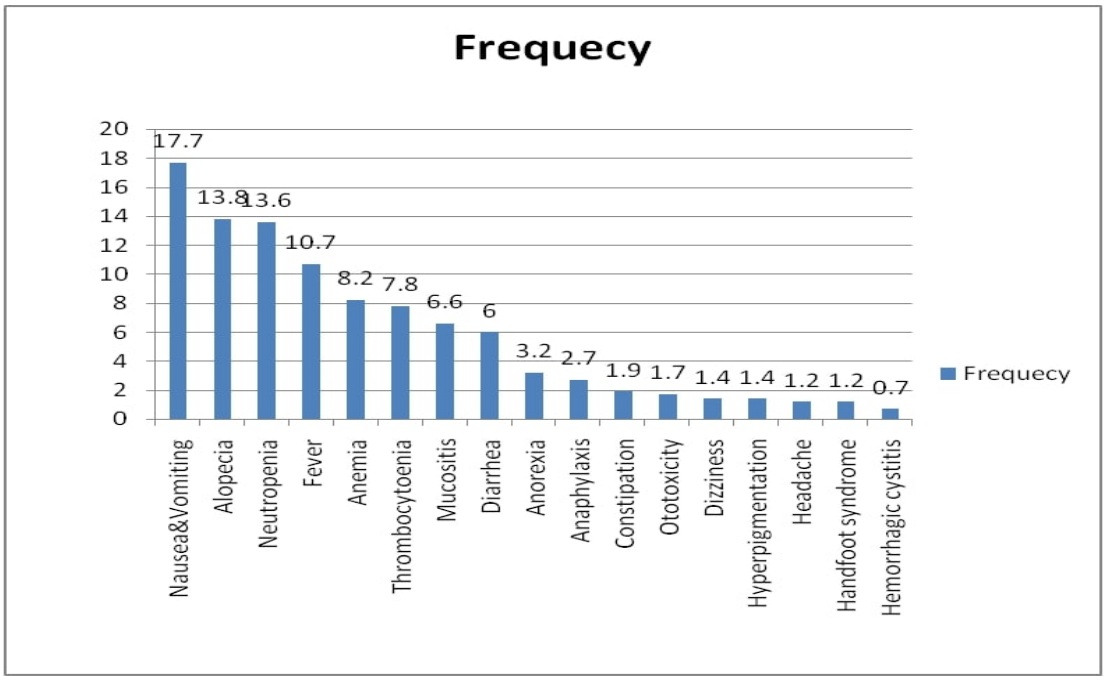

Table2. Chemotherapy regimen used in the study

Chemotherapy regimen	Patients(N=120)	Frequency (%)
Carboplatin+Paclitaxel	17	14.2
Cyclophosphamide+ Adriamycin+5-FU	16	13.3
Cisplatin+Paclitaxel	14	11.7
Cisplatin+5-FU	12	10
Cisplatin	11	9.2
5-FU+Leucovorin+ Oxaliplatin	8	6.7
Gemcitabine+Carboplatin	8	6.7
Paclitaxel+Trastuzumab	7	5.8
Oxaliplatin	4	3.3
Cyclophosphamide+ Mitomycin+5-FU	3	2.5
Cytrabine+Daunorubicin	3	2.5
5-FU+Leucovorin	3	2.5
Vincristine+Prednisone	3	2.5
Adriamycin	2	1.7
Gefitinib	2	1.7
Carboplatin	1	0.8
Cisplatin+Adriamycin+ Tamoxifen	1	0.8
Cytarabine	1	0.8
Epirubicin+Oxaliplatin	1	0.8
5-FU+Leucovorin+ Oxaliplatin	1	0.8

Gefitinib+Carboplatin	1	0.8
Paclitaxel	1	0.8

3.3 Assessment of ADRs due to cancer chemotherapy

All ADRs (412) occurred in total 120 patients received chemotherapy drugs were assessed for severity, causality and preventability. Assessment of severity of the recorded ADRs were performed using modified Hartwig severity scale as "Mild", "Moderate" and "Severe". Maximum number of ADR 150(36.4%) was found to be “Severe” ADR. The Severe grade ADR observed mostly as alopecia (57%) followed by nausea & vomiting (35.6%) (Table3). Causality assessment was done according to Naranjo's algorithmic scale. Out of 412, 281(68%) of the ADRs were analyzed as “Probable”. Alopecia (26.3%) noted as highest "Definite" ADR. (Figure3). Preventability assessment of each ADR was performed by using "Schumock and Thronton" Scale and it was found that 300(73%) ADRs were “Not-Preventable” during the course of chemotherapy (Figure4).

Figure3. Causality assessment (Naranjo's algorithmic scale)

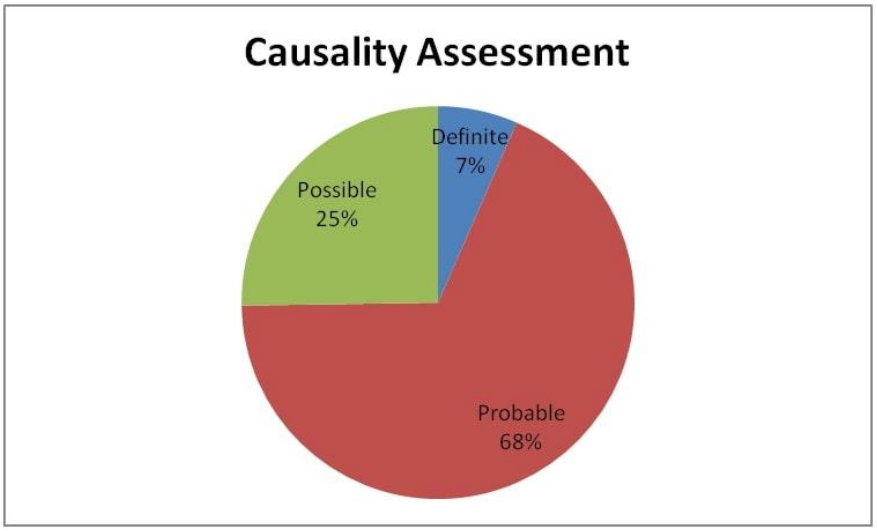

Figure4. Preventability assessment (Modified Schumock and Thronton criteria)

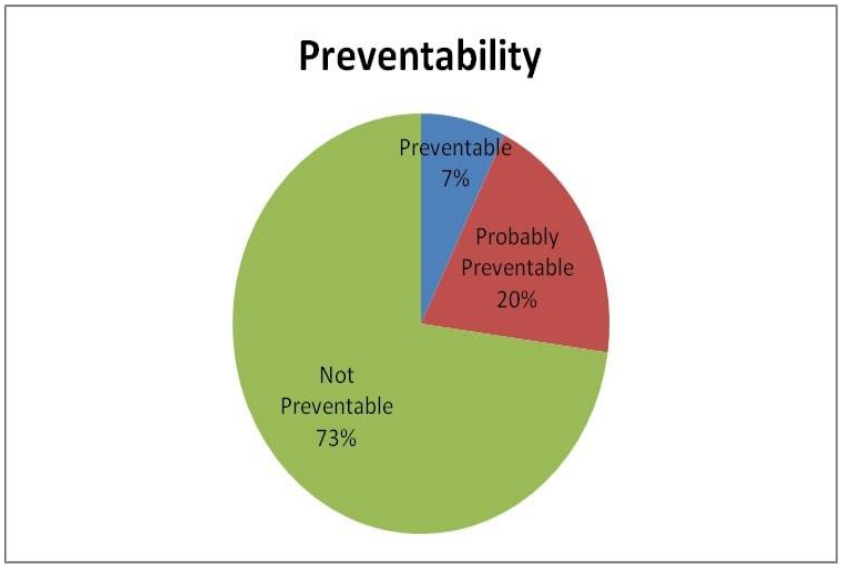

Table3. Assessment of ADRs for Severity (Modified Hartwig Scale)

Type of ADRs	Mild (%)	Moderate (%)	Severe(%)	Total (%)
Nausea&Vomiting	10 (13.7)	37(50.7)	26 (35.6)	73 (17.7)
Alopecia	0	0	57 (100)	57 (13.8)
Neutropenia	11 (19.6)	22 (39.3)	23(41)	56 (13.6)
Fever	27 (61.4)	8 (18.2)	9 (20.4)	44 (10.7)
Anemia	10 (29.4)	14 (41.2)	10(29.4)	34 (8.2)
Thrombocytopenia	7 (21.9)	12 (37.5)	13 (40.6)	32 (7.8)
Mucositis	8 (29.6)	14 (51.9)	5 (18.5)	27 (6.6)
Diarrhea	5 (20)	14 (56)	6 (24)	25 (6)
Anorexia	5 (38.5)	7 (53.8)	1 (7.7)	13 (3.2)
Anaphylaxis	11 (100)	0	0	11 (2.7)
Constipation	7 (87.5)	1 (12.5)	0	8 (1.9)
Ototoxicity	7 (100)	0	0	7 (1.7)
Dizziness	6 (100)	0	0	6 (1.4)
Hyperpigmentation	6 (100)	0	0	6 (1.4)
Headache	2 (40)	3 (60)	0	5 (1.2)
Handfoot syndrome	3 (60)	2 (40)	0	5 (1.2)
Hemorrhagic cystitis	1 (33.3)	2 (66.7)	0	3 (0.7)
Over all	126 (30.6)	136 (33)	150 6.4)	412 (100)

3.4 Ameliorative therapy for management of chemotherapy induced ADRs

Different medications were used for toxicity amelioration in patients received chemotherapeutic drugs. Mostly patients 52(43.3%) administered palonosetron with dexamethasone and pantoprazole combination. Other most common combination noted for toxicity amelioration were the addition of folic acid and vitamin B complex 46(38.3%) (Table4).

3.5 Factors associated with the severity of ADRs

On performing chi square analysis, there is a significant association between occurrence of Severe ADRs and age group, gender & chemotherapy regimen of the patients. Preventability of the ADRs is not statistically significant with the occurrence of Severe ADRs (Table5).

Table4. Ameliorative therapy used in patient receiving chemotherapeutic drugs.

Ameliorative Thearpy	Frequency	Percentage
Palonosetron+ Dexamethasone+Pantoprazole	52	43.3
Palonosetron+ Dexamethasone+B-Complex+Folic Acid	46	38.3
Palonosetron+ Dexamethasone+B-Complex+Folic Acid+Mesna	7	5.8
Palonosetron+ Dexamethasone+B-Complex+Folic Acid+Filgrastim	5	4.2
Palonosetron+ Dexamethasone+B-Complex+Folic Acid+Levamisole	4	3.3
Palonosetron+ Dexamethasone+Pantoprazole+Loperamide	4	3.3
Palonosetron+ Dexamethasone+Pantoprazole+Diphenhydramine	1	0.8
Palonosetron+ Dexamethasone+B-Complex+Folic Acid+Amifostine	1	0.8

Total	120	100

Table 5. Association between cancer patient character and Severity of ADR produced

Variables	ADRs(%)	Mild & Moderate	Severe	*P*-Value
Age group				
18-50	179 (43.4)	124 (69.3)	55 (30.7)	
≥51	233 (56.6)	138 (59.2)	95 (40.8)	.035
Sex				
Male	165 (40)	119 (72.1)	46 (27.9)	
Female	247 (60)	143 (57.9)	104 (42.1)	.003
Number of Chemotherapy				
Monochemotherapy	74 (18)	56 (75.7)	18 (24.3)	
Polychemotherapy	338 (82)	206 (91)	132 (39)	.017
Preventabiltity				
Preventable	112 (27.2)	77 (68.8)	35 (31.2)	
Not Preventable	300 (72.8)	185 (61.7)	115 (38.3)	.18

4. DISCUSSION

Cancer chemotherapeutic drugs used to eradicate tumor cell; causes substantial toxicity and produce number of adverse effect which is needed to treat promptly. Use of these agents must outweigh the risk over benefit (17). Occasionally, ADRs produced by them are the limiting factor in finalizing the end points for treatment protocols because of their non-specificity and its potential to affect most of the rapidly proliferating cells of the body (9). Some of the side effects caused by chemotherapy drug have unpredictable onset and it is needed to identify earliest as they can be life threatening and fatal (18).

In this study, majority of the participant 98(81.7%) were on the poly-chemotherapy. Mostly ADRs 338(82%) occurred in patient received poly-chemotherapy as their treatment modalities. Upon severity assessment using modified Hartwig scale, total of 132(39%) of ADRs were noted as Severe ADR. There is significant association between occurrence of Severe ADRs and chemotherapy regimen (p=0.017). This study corroborate with other studies as poly-pharmacy in current times are more common pattern of chemotherapeutic drug use in elderly patients as compared to younger patients, it could also play a risk factor for more in number and severe ADRs (19). Patients on poly-chemotherapy are more prone to experience ADRs and drug-drug interaction (20).

Most common ADR found in our study were nausea and vomiting. It is also reported by some other studies which states nausea and vomiting are one of the most common chemotherapy induced ADR and classified as acute, delayed or anticipatory (21). The severity of nausea and vomiting depends on the types of specific chemotherapy regimen (22). In this study most common regimen was carboplatin and paclitaxel combination. Other platinum compounds used as chemotherapy were cisplatin and oxaliplatin as mono-therapy or in combination with others. It could be the reason for higher incidence of ADRs in poly-chemotherapy group and also for nausea &vomiting as most common ADR.

Use of corticosteroids with other antiemetic agent have very prominent role in preventing delayed emesis (23). To manage chemotherapy induced nausea and vomiting (CINV) three drug regimens are advocated prior to chemotherapy; 5 Hydroxytryptamine-3 (5HT3) receptor antagonist in combination with dexamethasone and Neurokinin-1 receptor antagonist (NK1) such as aprepitant (24). The higher incidence of CINV in our study may be due to cost and unavailability of the aprepitant one of the important drugs recommended to treat CINV, however most of the patients received dexamethasone for toxicity amelioration.

The next most common ADR associated with

chemotherapy reported in this study are alopecia, neutropenia, fever, anemia and thrombocytopenia. Alopecia is very common in patients receiving doxorubicin and cyclophosphamide in their chemotherapy regimen. Temporary vasoconstriction can be used to reduce blood circulation in scalp to prevent hair loss (25). Our study participant received a various combination of doxorubicin for chemotherapy (Table2). Neutropenia is also reported as one of the most common chemotherapy related adverse effects (26). In this study a total of 13.6 % ADRs were neutropenia, out of which 41% were assessed as severe ADR. Filgrastim a synthetic drug were used to prevent neutropenia in a total of 4.6% patients in this study. Other study also reported to use Granulocyte Colony Stimulating Factor (G-CSF) and Granulocyte macrophage colony Stimulating factor (GM-CSF) to increase the White Blood Count (WBC) (27, 28).

Our study shows occurrence of mucositis (6.6%) and diarrhea (6%) as the fifth ADR observed after hematological toxicity. For their management diphenhydramine and loperamide were used respectively (Table4). Chemotherapeutic drugs may cause mucositis and diarrhea by damaging rapidly dividing cells of gastrointestinal tract (29). Oral mucositis can be prevented by using chlorohexidine mouth wash at bedtime prophylactically. Addition of xylocaine, diphenhydramine and vitamin E as ameliorative therapy are also beneficial. (30). Most common chemotherapy drugs causes diarrhea are 5-Flurouracil (5-FU) and methotrexate. It can be controlled by adding diphenoxylate with scopoloamine combination or by using loperamide (31).

In this study we observed that age group 18-50 years patient produces 30.7% as “Severe” ADR, while patient fall in age group $\geq$51 produces 40.8% as "Severe" ADRs. There is a significant association between occurrence of Severe ADRs and age group (p=0.035). Other study also suggests that aged cancer patients are using more than two drugs for their treatment is having chances of double risk of adverse effects. Ageing and co-morbidities increases the chances of non compliance and non-adherence to therapy especially in elderly and pediatric patients (32).

In our study 60% of the total ADRs were noted in female patient, they mostly experienced "Severe" ADRs (42.1%) which is closed to the finding of other study. There is significant association between occurrence of Severe ADRs and gender was found (p=0.003). The severity of ADRs reported in female were significantly higher, it's may be due to the alteration in hormonal activity at different stages of life (33).

Assessment of causality by Naranjo's scale revealed that most of the ADRs (68%) were “Probable”. Preventability assessment of ADRs explains that 73% of ADRs were "Not Preventable" while 20% and 7% ADRs designated as "Probably Preventable" and "Preventable" respectively. However association between occurrence of Severe ADRs and Preventability are not statistically significant. Report from one study held in All India Institute of Medical Sciences (AIIMS), Rishikesh India also suggests the almost same pattern on Preventability assessment (34).

1. CONCLUSION

This study explained the demographic pattern of patient received cancer chemotherapy drugs. Majority of ADRs occurred due to chemotherapeutic drugs are noted in female patients. Breast cancer was found to be most common cancer among all. Most common ADRs due to cancer chemotherapy were nausea & vomiting followed by alopecia and neutropenia. All ADRs produced due to cancer chemotherapy were assessed for severity, causality assessment and preventability. There is a statistically significant association found between occurrence of Severe ADRs and age group, gender & chemotherapy regimen. Pattern of ameliorative therapy used in each patient after chemotherapy cycles were studied. Association of ADRs and patient characteristics reveals that need of more attention towards detection of chemotherapy induced ADRs and use of ameliorative therapy. By understanding nature of ADRs, proper selection and use of drugs can be advocated for prevention of toxicity for each ADR. Further studies for particular strategies in managing different ADRs with holistic approach may attribute to improve the safety of patients.

ACKNOWLEDGMENT

I would like to acknowledge the support of technical staff of the department.

CONSENT

Written informed consents were taken regarding their willingness for participation in the study and they were told that their participation in the study is voluntary and informed that they can withdraw from the study at any point of time. Detail explanations of the study and its objectives were given to study subjects. Subjects were assured anonymity and confidentiality of data given by them.

ETHICAL APPROVAL

All authors hereby declare that study is approved by Institutional Ethical committee of the institution. IEC-SU/2017/1226(5) and have the therefore been performed in accordance with the ethical standards. This study conducted at the Santosh Medical College and Hospital, Santosh University, situated in Ghaziabad (NCR), India.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. GBD 2016 Cancer Collaborators. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 29 cancer groups, 1990 to 2016: a systematic analysis for the Global Burden of Disease study. JAMA Oncol 2018; published online June 2. DOI:10.1001/ jamaoncol.2018.2706
2. The burden of cancer and their variation across the states of India: the global burden of disease study 1990-2016. India state level disease burden initiative cancer collaborators. Lancet Oncol. 2018 Oct;19(10): 1289-1306
3. Malcolm R Alison. Cancer. London, UK: Imperial College, School of Medicine, encyclopedia of life science: 2001:27-43.
4. Prashant Mathur et al. Cancer Statistics, 2020: Report From National Cancer Registry Programme, India JCO Glob Oncol. 2020 Jul;6:1063-1075.
5. Meyer, U.A. Pharmacogenetics and adverse drug reactions. Lancet 2000, 356, 1667-1671.
6. Lemmelo R et al., Development of a Pharmacogenetic Lab-on-Chip Assay Based on the In-Check Technology to Screen for Genetic Variations Associated to Adverse Drug Reactions to Common Chemotherapeutic Agents Biosensors 2020, 10, 202; doi:10.3390/bios10120202
7. Gandhi TK, Bartel SB, Shulman LN, et al. Medication safety in ambulatory chemotherapy setting. Cancer. 2005;104(11):2477-2483
8. World Health Organization. International Drug Monitoring: The Role of the Hospital. Geneva: World Health Organization; 1996. Technical Report Series, No. 425.
9. Albini A, Donatelli F, Noonan D, D'elios, MM, Prisco D. Bringing new players into the field: onco-pharmacovigilance in the era of cardiooncology. Intern Emerg Med. 2012;7(2):99-101.
10. Lau PM, Stewart TK, Dooley M. The ten most common adverse drug reactions (ADRs) in oncology patients: do they matter to you? Support Care Cancer. 2004;12(9):626-633.
11. Eilers RE Jr, Gandhi M, Patel JD, et al. Dermatologic infections in cancer patients treated with epidermal growth factor receptor inhibitor therapy. J Natl Cancer Inst. 2010;102:47-53.
12. Aranda S, Jefford M, Yates P, et al. Impact of a novel nurse-led pre chemotherapy education intervention on patient distress, symptom burden, and treatment-related information and support needs: results from a randomized, controlled trial. Ann Oncol. 2012;23(1): 222-231.
13. Gita Thanarajasingam, MD et al., Beyond Maximum Grade: Modernizing Adverse Event Assessment and Reporting in Haematologic Malignancies. Lancet Haematol. 2018 November; 5(11): e563-e598.
14. Hartwig SC, Siegel J, Schneider PJ. Preventability and severity assessment in reporting adverse drug reactions. Am J Hosp Pharm 1992;49:2229-32.
15. Naranjo CA, Busto U, Sellers EM, Sandor P, Ruiz I, Roberts EA, *et al*. A method for estimating the probability of

adverse drug reactions. Clin Pharmacol Ther 1981;30:239-45.

16. Schumock GT, Thornton JP. Focusing on the preventability of adverse drug reactions. Hosp Pharm 1992;27:538.
17. Lind MJ. Principles of systemic anticancer therapy. Medicine; systemic therapy, vol 48, issue2, p-90-96 2020.
18. Paolo Baldo etal Pharmacovigilance in oncology, International Journal of Clinical Pharmacy (2018) 40:832-841.
19. Mohile SG, Magnuson A. Comprehensive geriatric assessment in oncology. *Interdiscip Top Gerontol*. 2013;38:85-103
20. Puts MT, Costa-Lima B, Monette J, et al. Medication problems in older, newly diagnosed neoplasm patients in Canada: How common are they? A prospective pilot study. *Drugs Aging*. 2009;26(6):519-536.
21. Mustian KM, Darling TV, Janelsins MC, Jean-Pierre P, Roscoe JA, Morrow GR. Chemotherapy-induced nausea and vomiting. US Oncol. 2008;4(1):19.
22. Schnell FM. Chemotherapy-induced nausea and vomiting: The importance of acute antiemetic control. The Oncologist. 2003;8(2):187-98.
23. Berger AM, Shuster JL, Von Roenn JH. Principles and practice of palliative care and supportive oncology. Lippincott Williams & Wilkins; 2007
24. *Rock EM and Parker LA (2016) Cannabinoids As Potential Treatment for Chemotherapy-Induced Nausea and Vomiting. Front. Pharmacol. 7:221.*
25. Grevelman EG, Breed WP. Prevention of hemotherapy-induced hair loss by scalp cooling. Ann Oncol. 2005;16(3):352-8.
26. Lavan, O'Mahony, Buckley et al. Adverse Drug Reactions in an Oncological Population: Prevalence, Predictability, and Preventability The Oncologist 2019;24:e968-e977
27. Moore DC. Drug-Induced neutropenia: A focus on rituximab-induced late-onset neutropenia. P T. 2016;41(12):765-768.
28. Maryam B. Lustberg, Management of Neutropenia in Cancer Patients. *Clin Adv Hematol Oncol*. 2012 December ; 10(12): 825–826.
29. Aprile G, et al. Treatment-related gastrointestinal toxicities and advanced colorectal or pancreatic cancer: A criticalupdate. World J Gastroenterol. 2015;21 (41):11793-11803.
30. Köstler WJ, et al. Oral Mucositis Complicating Chemotherapy and/or Radiotherapy: Options for Prevention and Treatment. CA Cancer J Clin. 2001;51(5):290-315.
31. McQuade RM, et al. Chemotherapyinduced constipation and diarrhea:Pathophysiology, current and emerging treatments. Front Pharmacol. 2016;7:414-414.
32. Gnjidic D, Hilmer SN, Blyth FM, et al. Polypharmacy cutoff and outcomes: five or more medicines were used to identify community-dwelling older men at risk of different adverse outcomes
33. Belachew S A et al. Pattern of chemotherapy-related adverse effects among adult cancer patients treated at Gondar University Referral Hospital, Ethiopia: a cross-sectional study Drug Healthc Patient Saf 2016 Dec 8;8:83-90
34. Ramasubbu SK, Pasricha RK, Nath UK, Das B.Frequency, nature, severity and preventability of adverse drug reactions arising from cancer chemotherapy in a teaching hospital. J Family Med Prim Care 2020;9:3349-55