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Original Research Article

A prospective observational study on iv compatibility, dose adjustment and ADR of chemotherapy drugs in oncology department at tertiary care hospital

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ABSTRACT

Background: Cancer is the second leading cause of death worldwide. Chemotherapy is a standard modality of cancer treatment that uses chemical agents or drugs to destroy cancer cells in the cell cycles or use chemicals or drugs to inhibit cancerous cells growth and spread. The objective of this study was to assess the IV compatibility of chemotherapy drug in different solution, assess the frequency of ADR, classify ADR according to the class of drug and dose adjustment.
Methods: In this study, cancer patients of either gender (aged 21-90) admitted on the oncology department of Bangalore Baptist Hospital were included in the study. Assessment of IV compatibility was done based on the prescription pattern, dose adjustment was done on the basis of body weight, BSA and hepatic and renal parameters. Adverse reactions reported by the patients, assessed by the doctors and nurses and changes in the laboratory parameters were analysed for the assessment of ADR.
Results: A total of 43 patients met the inclusion criteria; among which 44% were male and 56% were female. The mean age of the study was 57.49. Breast cancer, stomach cancer and lung cancer were more prevalent. In the study 24 chemotherapy drugs were used among them 20 drugs were compatible in 0.9% normal saline and 4 drugs were compatible in 5% dextrose. Dose adjustment were done for 4 drugs which were Carboplatin, Paclitaxel, Trastuzumab and Ifosfamide. The average dose adjusted for Carboplatin, Paclitaxel, Trastuzumab and Ifosfamide were -0.46±3.3, 0.5±10.6, -10±0 and -50±0 respectively. Total of 25 adverse drug reaction were seen where vomiting, gastritis and anemia were more frequently seen. Alkylating agents showed more number of ADRs.
Conclusions: From the study, it can be concluded that most of the chemotherapy drugs were compatible either in 5% dextrose or 0.9% normal saline. Dose adjustments were done on the basis of body weight and BSA. Alkylating agents showed ADR most frequently and least frequent was topoisomerase inhibitor. Vomiting was the most reported ADR.

Keywords: Chemotherapy, Oncology, Adverse effects, Compatibility, Dose adjustment, Cancer

INTRODUCTION

Cancer is a disease caused by the uncontrolled division of abnormal cells in the body, resulting in rapid tissue growth and proliferation.[1] It is the second leading cause of death worldwide, with its incidence and mortality rapidly increasing due to aging populations and socioeconomic factors.[3] Cancer affects men more severely than women, with a higher incidence and mortality rate in men.[4] Treatment options include chemotherapy, radiotherapy, surgery, hormonal therapy, immunotherapy, biologic therapy and cryosurgery.[5] Chemotherapy, using drugs to

inhibit cancer cell growth, can have severe side effects due to its impact on normal cells.[1,2]

Intravenous, oral and intramuscular methods are used to administer these drugs, often in high doses, leading to adverse drug reactions (ADRs) like nausea, vomiting, alopecia and myelosuppression.[8,9] The monitoring and management of ADRs are crucial to improving patient outcomes and reducing hospitalization costs.[10,11]

Primary objective

To study on IV compatibility, dose adjustment and ADR of chemotherapy drugs in oncology department at tertiary care hospital.

Secondary objective

To classify ADRs according to drug class, to assess the frequency of ADRs, to assess the IV compatibility in different solutions, to assess the dose adjustment.

METHODS

Study design

The study was designed as a prospective observational study to assess IV Compatibility, Dose Adjustment and ADR of Chemotherapy Drugs.

Study place

The study was conducted in Oncology Department at Bangalore Baptist Hospital, Bangalore from January 2023 to October 2023.

Study size

A total of 43 patients were included in the study who meet the inclusion criteria and have agreed to participate in the study.

Inclusion criteria

Patients diagnosed with cancer and were undergoing chemotherapy treatment with their consent to participate in the study were included.

Exclusion criteria

Patients under 18 years of age, hemato-oncology patients, pregnant females, patient requiring surgery or radiotherapy and those who were unwilling to participate were excluded from the study.

Source of data and material

Data collection from patient’s case note, treatment chart, medication chart, chemotherapy chart.

Method of collection of data

A prospective observational study was conducted in the oncology department. Patients meeting the criteria were included in the study. Demographic details such as age, sex, weight, body surface area, chemotherapy regimens, treatment onset, IV chemotherapy details, compatibility, drug modifications and adverse drug reactions were collected and documented. Follow-ups were recorded until discharge. Standard references like MICROMEDEX, LEXICOMP and textbooks such as Joseph T. DiPiro's "Textbook of Pharmacotherapy," Herfindal's "Textbook of Pharmacotherapy," and Koda-Kimble's "Applied Therapeutics" were utilized.

Ethical considerations

Informed consent

Participants were provided with detailed information about the study and were required to give written consent.

Confidentiality

Data were anonymized and stored securely to protect participants' privacy.

RESULTS

Socio-demographic characteristics

The study involved 43 patients across various age groups: 4.65% (21-30 years), 11.63% (31-40 years), 9.3% (41-50 years), 27.91% (51-60 years), 34.88% (61-70 years), 9.3% (71-80 years) and 2.33% (81-90 years). The study population consisted of 19 males (44%) and 24 females (56%), indicating a higher participation of females (Table 1).

Distribution of patients by type of cancer

The number of patients affected by different cancers were as follows: breast (8, 18.6%), lung (7, 16.28%), stomach (6, 13.95%), neck (1, 2.33%), esophagus (3, 6.98%), cervix (3, 6.98%), ovary (3, 6.98%), penis (1, 2.33%), pancreas (2, 4.65%), rectum (4, 9.3%), uterus (2, 4.65%), colon (1, 2.33%), caecum/appendix (1, 2.33%) and pre-sacral cancer (1, 2.33%) (Figure 1).

Drug distribution among cancer patients

Among the 43 patients, the drug distribution was as follows: 5-fluorouracil (23.25%), Adriamycin (2.33%), atezolizumab (2.33%), bevacizumab (9.3%), carboplatin (41.86%), cisplatin (11.63%), cyclophosphamide (18.6%), dactinomycin (2.33%), docetaxel (16.28%), doxorubicin (11.63%).

Epirubicin (4.65%), etoposide (4.65%), gemcitabine (11.63%), Ifosfamide (4.65%), irinotecan (6.98%),

methotrexate (2.33%), mitomycin-C (2.33%), nab-paclitaxel (4.65%), oxaliplatin (23.26%), paclitaxel (37.21%), pemetrexed (9.3%), trastuzumab (4.65%), vincristine (4.65%) and vinorelbine (2.33%) (Table 2).

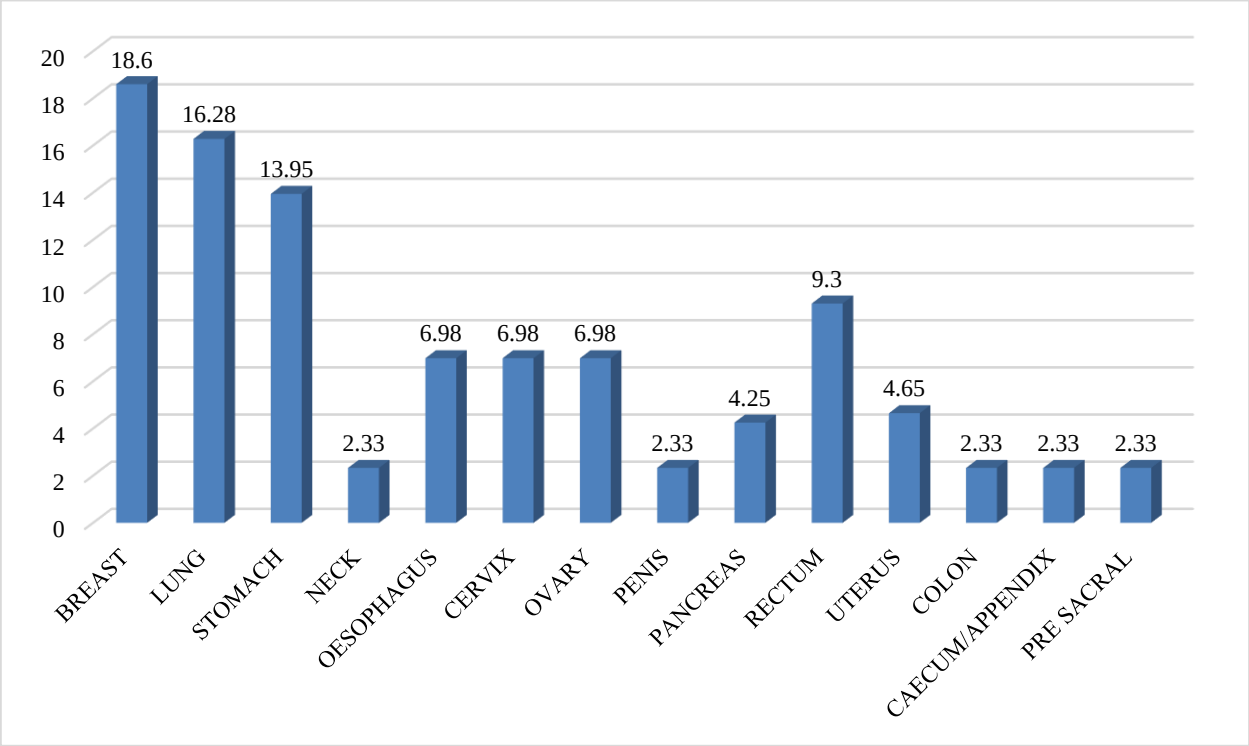

Figure 1: Distribution of patients by type of cancer.

Table 1: Socio-demographic characteristics.

Age Group	No. of patients	%	Mean±SD
21-30	2	4.65	28±0
31-40	5	11.63	36.8±3.35
41-50	4	9.30	46.5±2.38
51-60	12	27.91	57.5±2.58
61-70	15	34.88	64.8±2.39
71-80	4	9.30	75±3.37
81-90	1	2.33	84±0
Gender			
Male	19	44	
Female	24	56	

Drug dilution methods for cancer treatments

Dilution of carboplatin, doxorubicin, irinotecan and oxaliplatin in dextrose was done in 18 (41.86%), 5 (11.63%), 3 (6.98%) and 10 (23.26%) patients, respectively.

Dilution of 5-fluorouracil, Adriamycin, atezolizumab, bevacizumab, cisplatin, cyclophosphamide, dactinomycin, docetaxel, epirubicin, etoposide, gemcitabine, Ifosfamide, methotrexate, mitomycin-C, nab-paclitaxel, paclitaxel, pemetrexed, trastuzumab, vincristine and vinorelbine in normal saline was done in 10 (23.25%), 1 (2.33%), 1 (2.33%), 4 (9.3%), 5 (11.63%), 8 (18.6%), 1 (2.33%), 7 (16.28%), 2 (4.65%), 2 (4.65%), 5 (11.63%), 2 (4.65%), 1 (2.33%), 1 (2.33%), 2 (4.65%), 16 (37.21%), 4 (9.3%), 2 (4.65%), 2 (4.65%) and 1 (2.33%) patients, respectively (Table 3).

Adverse drug reactions by drug class and frequency of specific ADRs

The percentage of adverse drug reactions (ADRs) associated with different drug classes was as follows, alkylating agents (36%), mitotic inhibitors (32%), monoclonal antibodies (4%), antimetabolites (20%) and topoisomerase inhibitors (8%).

Table 2: Drug distribution among cancer patients.

Drugs	No. of patient treated	%
5- Fluorouracil	10	23.25
Adriamycin	1	2.33
Atezolizumab	1	2.33
Bevacizumab	4	9.3
Carboplatin	18	41.86
Cisplatin	5	11.63
Cyclophosphamide	8	18.6
Dactinomycin	1	2.33
Docetaxel	7	16.28
Doxorubicin	5	11.63
Epirubicin	2	4.65
Etoposide	2	4.65
Gemcitabine	5	11.63
Ifosfamide	2	4.65
Irinotecan	3	6.98
Methotrexate	1	2.33
Myticomycin-c	1	2.33
Nab paclitaxel	2	4.65
Oxaliplatin	10	23.26
Paclitaxel	16	37.21
Pemetrexed	4	9.3
Trastuzumab	2	4.65
Vincristine	2	4.65
Vinorelbine	1	2.33

Table 3: Drug dilution methods for cancer treatments.

Drugs	0.9% normal saline (NS)		5% dextrose	
	No. of patients	%	No. of patients	%
5- Fluorouracil	10	23.26		
Adriamycin	1	2.33		
Atezolizumab	1	2.33		
Bevacizumab	4	9.3		
Carboplatin			18	41.86
Cisplatin	5	11.63		
Cyclophosphamide	8	18.6		
Dactinomycin	1	2.33		
Docetaxel	7	16.28		
Doxorubicin			5	11.63
Epirubicin	2	4.65		
Etoposide	2	4.65		
Gemcitabine	5	11.63		
Ifosfamide	2	4.65		
Irinotecan			3	6.98
Methotrexate	1	2.33		
Myticomycin-C	1	2.33		
Nab paclitaxel	2	4.65		
Oxaliplatin			10	23.26
Paclitaxel	16	37.21		
Pemetrexed	4	9.3		
Trastuzumab	2	4.65		
Vincristine	2	4.65		
Vinorelbine	1	2.33		

Table 4: Adverse drug reactions by drug class and frequency of specific ADRs.

	%
Class of anti-cancer drugs	
Alkylating agents	36
Mitotic inhibitors	32
Monoclonal antibodies	4
Antimetabolites	20
Topoisomerase inhibitors	8
ADRs	
Anemia	18.18
Vomiting	36.36
Hypersensitivity reaction	9.09
Leukopenia	9.09
Haematuria	9.09
Gastritis	27.27
Weight loss	9.09
Grade 1 neuropathy	9.09
Pain	18.18
Grade 3 anaphylactic reaction	9.09
Grade 4 febrile neutropenia	9.09
Mucositis	9.09
Low SpO2	9.09
Sweating	9.09

Table 5: Dose adjustment.

Drug	Adjusted in patients (%)	Not adjusted in patients (%)
Carboplatin	6 (33.33)	12 (66.67)
Paclitaxel	6 (37.5)	10 (62.5)
Trastuzumab	1 (50)	1 (50)
Ifosfamide	1 (50)	1 (50)

Table 6: Calculated theoretical dose and difference between actual and theoretical dose.

Drug name	Initial dose	Actual dose	Actual calculated theoretical dose	Difference between actual and theoretical dose	Mean±SD
Carboplatin	420	400	397.2	2.8	-0.46±3.3
	150	130	137.2	-7.2	
	380	340	338.24	1.76	
	530	550	548.7	1.3	
	250	350	349.95	0.05	
	430	400	401.45	-1.45	
Paclitaxel	120	100	117	-7	0.5±10.6
	220	200	187.65	12.35	
	110	100	116.25	-16.25	
	250	230	222.75	7.25	
	220	210	198.45	11.55	
	250	230	234.9	-4.9	
Trastuzumab	650	500	510	-10	-10±0
Ifosfamide	1800	1600	1650	-50	-50±0

The frequency of specific ADRs observed included anemia (18.18%), vomiting (36.36%), hypersensitivity (9.09%), leukopenia (9.09%), gastritis (9.09%), weight loss (27.27%), grade 1 neuropathy (9.09%), pain (9.09%), grade 3 anaphylactic reaction (18.18%), grade 4 febrile neutropenia (9.09%), mucositis (9.09%), low SpO2 (9.09%) and sweating (9.09%) (Table 4).

Dose adjustment

Among the 18 patients treated with carboplatin, 6 (33.33%) had their dose adjusted, while 12 (66.67%) did not. Of the 16 patients treated with paclitaxel, 6 (37.5%) had their dose adjusted and 10 (62.5%) did not. For the 2 patients treated with trastuzumab, 1 (50%) had their dose adjusted and 1 (50%) did not. Similarly, for the 2 patients treated with Ifosfamide, 1 (50%) had their dose adjusted and 1 (50%) did not (Table 5).

Calculated theoretical dose and difference between actual and theoretical dose

The data shows the differences between the actual doses administered and the theoretical doses calculated for four drugs: carboplatin, paclitaxel, trastuzumab and Ifosfamide. For carboplatin, the mean difference was -0.46 with a standard deviation (SD) of 3.3, indicating slight variation around the theoretical dose.

Paclitaxel showed a mean difference of 0.5 with a larger SD of 10.6, reflecting more variability in dosing. Trastuzumab and Ifosfamide had fixed differences of -10 and -50, respectively, with SDs of 0, indicating consistent deviations from the theoretical doses (Table 6).

DISCUSSION

This study, conducted at a tertiary care hospital, thoroughly examined intravenous compatibility, dose adjustments and adverse drug reactions (ADRs) in 43 cancer patients undergoing chemotherapy. The patient age distribution predominantly showed a peak in the 61–70-year range (34.88%), with a higher female prevalence (56%), reflecting a notable trend of increased cancer incidence in women, as supported by previous studies.[1,2] The most common cancers identified were breast, lung and stomach, consistent with global cancer burden data highlighting breast cancer as the most prevalent.[3,4]

Drug compatibility results revealed that 83.33% of the 24 chemotherapy drugs studied were compatible with 0.9% normal saline, while 16.67% required 5% dextrose, with carboplatin being the most frequently used and demonstrating stability in 5% dextrose.[5]

Dose adjustments, essential for optimizing treatment efficacy and minimizing toxicity, were primarily based on body surface area (BSA) for drugs like carboplatin, paclitaxel, trastuzumab and Ifosfamide, aligning with best practices to reduce pharmacokinetic variability and improve patient outcomes.[6,7]

Notably, the most frequent ADRs reported were vomiting (36.36%), gastritis (27.27%) and anemia (18.18%), with alkylating agents and mitotic inhibitors being the primary culprits.[8] These findings underscore the critical importance of precise drug compatibility, careful dose adjustment and vigilant ADR monitoring to enhance treatment efficacy and patient safety in oncology care.

This study faced several limitations, including its confinement to a single center, which may limit the generalizability of the findings across different settings. The study's limited timeframe restricted the volume of data collected and the absence of external funding constrained resources and scope.

Additionally, the relatively small sample size of 43 participants may not provide a sufficiently broad basis for general conclusions. Lastly, the IV solutions used were determined by the prescribing physicians, which did not allow for a detailed evaluation of the selection criteria for these solutions. These factors collectively impact the comprehensiveness and applicability of the study's results.

CONCLUSION

This study investigated IV compatibility, dose adjustment and adverse drug reactions (ADRs) of chemotherapy drugs in an oncology department, including 43 patients, predominantly female, with an age range of 21-90 years and the majority between 61-70 years. It found that most chemotherapy drugs were compatible with 0.9% normal saline (83.33%), compared to 5% dextrose (16.67%). Breast, lung and stomach cancers were the most common among patients.

Dose adjustments were crucial for managing drug tolerability and were notably applied to carboplatin, paclitaxel, trastuzumab and Ifosfamide. ADRs were predominantly caused by alkylating agents and mitotic inhibitors, with vomiting, gastritis and anemia being the most frequent. The study underscores the importance of using 0.9% normal saline for drug compatibility and emphasizes dose adjustment to improve tolerability and effectiveness while recognizing that ADRs, though challenging, can be mitigated through appropriate management strategies.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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