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Original Article

Assessment of Potential Drug–Drug Interactions in an Oncology Unit of a Tertiary Care Teaching Hospital

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Abstract

Context: Drug interactions are more common in cancer patients because they consume several medicines such as hormonal substances, anticancer drugs, and adjuvant drugs to treat comorbidities. **Objectives:** To assess the pattern of potential drug–drug interactions (pDDIs) in an oncology unit of a tertiary care teaching hospital. **Materials and Methods:** A prospective observational study was carried out for 8 months (August 2016 to March 2017). Data on drugs were collected by reviewing the patients' medical records. The drug interactions fact software version such as Micromedex electronic database system, drugs.com interaction checker, and Medscape multidrug interaction checker tool were used to identify and analyze the pattern of pDDIs. **Results:** A total of 180 patients were enrolled during the study period. Among them, 152 study patients had 84.44% of pDDIs. Male predominance (64.4%) was noted over female (35.6%). According to the severity of classification of pDDIs, majority of them were moderate (63.1%) followed by major (26.1%) and minor (10.1%) interactions. The interactions that potentially cause QT interval prolongation and irregular heartbeat were the common outcomes of pDDIs. **Conclusions:** The incidence of pDDIs among cancer patients was 84.44%. The most common interacting drug pair in the study population was found to be dexamethasone + aprepitant [41 (26.9%)] followed by cisplatin + dexamethasone [32 (21.05%)] and other interacting pairs. To avoid harmful effects, screening of pDDIs should take place before administering the therapy.

Keywords: *Antineoplastic agents, chemotherapy, drug interactions*

Introduction

Drug interactions are more common in cancer patients because they consume several medications such as hormonal substances, anticancer drugs, and adjuvant drugs to treat comorbidities.[1,2] The risk of drug–drug interactions (DDIs) increases in elderly patients due to their increased age, physiological changes, and comorbidities.[3] Cytotoxic drugs have narrow therapeutic index, so increases or decreases in the cytotoxic activity result in toxic effect.[4]

Approximately, 60% of the patients undergoing treatment for cancer may develop at least one DDI, of which 30% require medical intervention. QT prolongation, gastrointestinal (GI) toxicity, and central nervous system depression are the most common results of pharmacodynamic DDIs. Most of these potential drug–drug interactions (pDDIs) are left unnoticed or not given proper intervention due to the lack of healthy professional relationship between medical oncologists, pharmacists, and general practitioners.[5]

Before starting chemotherapy, it is necessary to check the pDDIs for the successful usage of drug therapy and to improve the quality of life of the patient. Clinical pharmacists require good knowledge in monitoring DDIs and should advise patients regarding the proper use of drugs. Hence, the present study was aimed to assess the patterns of pDDIs in the oncology unit of a tertiary care teaching hospital.

Materials and Methods

A prospective observational study was carried out for 8-month period (from August 2016 to March 2017) in the inpatient unit of oncology unit at Justice K.S. Hegde Charitable Hospital, Mangaluru. Before starting the study, the study protocol was approved by the Institutional Ethical Committee (Ref no: NIST. EC/EC/65/2016-2017). Either patients of gender with >18 years and diagnosed with

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solid tumor or hematological malignancy were included in the study. Patients who referred to oncology department for consultation, patients who are not willing to participate, pregnant and lactating women were excluded from the study.

The data were collected from patients' treatment chart. Patient medication details were collected on the daily basis and recorded in the drug interactions' documentation form. The pDDIs were those not observed in the patients but they give a signal for the detection of interactions. Micromedex electronic database system, drugs.com interaction checker, and Medscape multidrug interaction checker tool were used to identify the pattern of pDDIs.[6,7] Micromedex contains a separate section on DDIs known as the Drug-REAX System, Denver, Colorado State, US. On entering the drugs one by one, the program lists the possible interactions and categorizes interactions according to their interaction effect, severity (major, moderate, and minor), onset (rapid and delayed), and documentation status (excellent, good and fair). Medscape and drugs.com contain a separate tool for detecting interactions known as the multidrug interaction checker tool. On entering the drugs one by one, the program lists the possible interactions and categorizes interactions according to their interaction effect, severity (major, moderate, and minor), and management. The required guidance to manage particular pDDI was provided to the physician by referring information provided in drug interaction tools.

Statistical analysis

Descriptive statistics were used to describe the demographic characteristic of patients, cancer type, treatment, comorbidities, number of drugs prescribed per patient, and classification of drug interactions. Data analysis was carried out using the Statistical Package for Social Studies (SPSS) version 16 (SPSS Inc., South Asia, Bengaluru).

Results

A total of 180 patients were included during the study period. Among them, 152 study patients had 84.44% of pDDIs. Male predominance (64.4%) was noted over female (35.6%). The mean age of the study population was 53.6 ± 12.4 years. Most of the patients were in the age group of 50–59 years (33.3%) followed by 60–69 years (23.9%). Majority of the patients had no family history of cancer (81.7%) and there was no history of comorbidities (83.8%). Hypertension [11 (7.2%)] was found to be the most common comorbidity observed in cancer patients with pDDIs followed by diabetes mellitus 9 (5.9%).

Out of 180 patients, 18.3% of patients had a history of smoking followed by alcohol and tobacco usage. Majority of the patients were hospitalized for 1–9 days. The median duration of the hospital stay was found to be 9 days. Out of 180 patients, breast cancer [24 (15.7%)] with pDDIs was the most common cancer type in the study population. The median number of medications received by the study population was found to be eight per day. Most of the pDDIs were observed in patients who had undergone 6–10 cycles of chemotherapy [70 (67.3%)], followed by 11–15 cycles [26 (14.4%)]. Patient characteristics and statistical significance of the results are summarized in Table 1.

Among anticancer agents that cause pDDIs, alkylating agent + corticosteroids [32 (21.05%)] were found to be the most common interacting group in cancer patients followed by corticosteroids + mitotic inhibitors [31 (20.3%)], alkylating + mitotic inhibitors [26 (17.1%)] and the other interacting groups are summarized in Table 2. Similarly, in supportive care agents, corticosteroids + aprepitant [34 (22.3%)] were found to be the common interacting pair in cancer patients followed by histamine H2 antagonist + analgesics, 19 (12.5%), and the other interacting groups are described in Table 3.

Out of 152 patients, 659 pDDIs were observed in the study. The most common interacting drug pair in the study population was found to be dexamethasone + aprepitant [41 (26.9%)] followed by cisplatin + dexamethasone [32 (21.05%)] the other interacting pairs are summarized in Tables 4 and 5. QT interval prolongation [62 (40.1%)] was found to be the most common pDDI outcome in cancer patients.

According to the severity of drug interactions, 416 (63.1%) of pDDIs were moderate followed by major [172 (26.1%)] and minor [67 (10.1%)]. Among the 659 interactions, 563 (85.4%) of pDDIs did not specify their onset [23 (3.4%)] were delayed onset, and 73 (11%) were rapid onset. The documentation levels of significance of pDDIs were fair [556 (84.3%)] followed by good [66 (10%)] and rapid [37 (5.6%)].

Discussion

Drug–drug interactions (DDIs) occur when one drug increases or decreases the efficacy of another drug, when both are administered together. When the interaction causes an increase in the effect of one or both of the drugs, that interaction is called synergistic effect. The opposite effect to synergetic effect is termed antagonism.[8]

The current study analyzed the pattern of pDDIs and their assessment among cancer patients. In this study, it was noticed that male (64.4%) patients constituted a major proportion of the study population than females (35.6%). Similar result was shown in the study conducted by Leeuwen *et al*.[9] where it was reported that males (55%) were higher than females (45%). However, contradictory results were shown in the study conducted by Ussai *et al*.,[10] in which female (69%) patients constituted the major proportion of the study population than male patients (31%).

Table 1: Demographics of the study population

Demographic details	Number of patients with pDDIs (*n*=152) (%)	Number of patients without pDDIs (*n*=28) (%)	Total number of patients (*n*=180) (%)
Gender			
Male	101 (66.4)	15 (53.5)	116 (64.4)
Female	51 (33.6)	13 (46.4)	64 (35.6)
Age groups			
18-29	6 (3.9)	2 (7.1)	8 (4.4)
30-39	17 (11.1)	1 (3.6)	18 (10)
40-49	29 (19)	6 (21.4)	35 (19.4)
50-59	51 (33.5)	9 (32.1)	60 (33.3)
60-69	38 (25)	5 (17.8)	43 (23.9)
70-79	10 (6.5)	3 (10.7)	13 (7.2)
>80	1 (0.6)	2 (7.1)	3 (1.7)
Comorbidities			
HTN	11 (7.2)	2 (7.1)	13 (7.2)
Diabetes mellitus	9 (5.9)	1 (3.5)	10 (5.6)
Asthma	2 (1.3)	1 (3.5)	3 (1.7)
Epilepsy	3 (1.9)	2 (7.1)	3 (1.7)
Social habits			
Smoking	30 (19.7)	3 (10.7)	33 (18.3)
Alcohol	22 (14.4)	2 (7.14)	24 (13.3)
Tobacco	18 (11.8)	1 (3.5)	19 (10.5)
Length of hospital stay			
1-9	77 (42.8)	14 (7.8)	91 (50.6)
10-19	29 (16.1)	3 (1.6)	31 (17.2)
20-29	12 (6.7)	4 (2.2)	17 (9.4)
30-39	23 (12.8)	6 (3.3)	29 (16.1)
40-49	5 (2.8)	-	5 (2.8)
50-59	3 (1.6)	-	3 (1.6)
60-69	3 (1.6)	1 (0.6)	4 (2.2)
Solid malignancy			
Breast	24 (15.7)	2 (7.1)	26 (14.4)
Lung	18 (11.8)	5 (17.8)	23 (12.7)
Buccal mucosa	15 (9.8)	4 (14.2)	19 (10.5)
Esophagus	10 (6.5)	2 (7.1)	12 (6.6)
Stomach	13 (8.5)	3 (10.7)	16 (8.8)
Gynecologic	4 (2.6)	5 (17.8)	9 (5)
Gentio-urinary	3 (1.9)	1 (3.5)	4 (2.2)
Others*	47 (30.9)	2 (7.1)	49 (27.2)
Hemato-oncology			
Malignant lymphoma	12 (7.8)	3 (10.7)	15 (8.3)
Leukemia	6 (3.9)	1 (3.5)	7 (3.8)
Number of medications			
1-5	19 (12.5)	18 (64.2)	37 (20.6)
6-10	82 (53.9)	10 (35.7)	92 (51.1)
11-15	39 (25.6)	-	39 (21.7)
16-20	11 (7.2)	-	11 (6.1)

*Carcinoma of nasal cavity, carcinoma of pancrease, carcinoma of oropharynx, osteosarcoma, carcinoma of postcricoid colon, carcinoma of maxilla, carcinoma of anal, carcinoma of gall bladder, carcinoma of hepatocellular, fibrillary astrocytoma, carcinoma of pyriform fossa, plemorphic rhabdomyosarcoma, carcinoma of rectosigmoid colon, microinvassive squamous cell carcinoma, carcinoma of tonsil, carcinoma of voccal cord, carcinoma of supraglotis, carcinoma of tongue, spindle cell sarcoma, carcinoma of buccal mucosa.
pDDIs – Potential drug-drug interactions; HTN – Hypertension

Majority of the pDDIs were seen in patients in the age group of 50–59 years (33.5%) in our study. The study conducted by Riechelmann *et al.*[11] showed the similar results, where the drug interactions were common in the age group of 58 years. Our study results are in contrast to the study conducted by Ko *et al.,*[12] in which the

Table 2: Frequency of potential drug-drug interactions involving anticancer drugs (*n*=152)

Interacting anticancer drug pair	Number of patients (%)
Alkylating agents + corticosteroids	32 (21.05)
Corticosteroids + mitotic inhibitors	31 (20.3)
Alkylating agents + mitotic inhibitors	26 (17.1)
Alkylating agents + anthracycline	22 (14.5)
Alkylating agents + antimetabolite	20 (13.15)
Anthracycline + antiemetic	17 (11.2)
Anthracycline + corticosteroids	13 (8.6)
Alkylating agents + antiemetic	10 (6.6)
Mitotic Inhibitor + NK1 receptor antagonist	10 (6.6)
Anthracycline + NK1 receptor antagonist	7 (4.6)
Anthracycline + antimetabolite	6 (3.9)
Corticosteroids + antimetabolite	5 (3.2)
Histamine H2 antagonist + antimetabolite	4 (2.6)

NK1 – Neurokinin 1

Table 3: Frequency of potential drug-drug interactions involving supportive care drugs (*n*=152)

Interacting supportive care drug pair	Number of patients (%)
Corticosteroids + aprepitant	34 (22.3)
Histamine H2 antagonist + analgesics	19 (12.5)
Antiemetic + opioids	17 (11.2)
Dopamine agonist + histamine H2 antagonist	17 (11.2)
Opioids + opioids	17 (11.2)
Dopamine agonist + histamine H2 antagonist	17 (11.2)
Tricyclic antidepressant + opioids	16 (10.5)
Antiemetic + antibiotic	10 (6.6)
Corticosteroids + anticonvulsant	8 (5.2)
Corticosteroids + antiemetic	7 (4.6)
Antihistamines + opioids	7 (4.6)
Dopamine agonist + antiemetic	7 (4.6)
PPIS + antifungal	6 (3.6)
Corticosteroids + laxative	6 (3.9)
Corticosteroids + antidysrhythmic	6 (3.9)
Corticosteroids + NSAID	5 (3.3)
NSAID + NSAID	5 (3.3)
Hypnotic + opioids	4 (2.6)
Hypnotic + hypnotic	4 (2.6)
Tricyclic antidepressant + antihistamines	4 (2.6)
Antiemetic + antifungal	4 (2.6)
Laxative + antiemetic	4 (2.6)
Opioids + anticonvulsant	4 (2.6)
Corticosteroids + biguanide	3 (1.9)
Corticosteroids + antifungal	3 (1.9)
Antibiotic + anticonvulsant	3 (1.9)
Bronchodilators + opioids	3 (1.9)
Tricyclic antidepressant + antiemetic	3 (1.9)
Antibiotic + laxative	3 (1.9)
Antifungal + opioids	3 (1.9)

PPIs – Proton pump inhibitors; NSAID – Nonsteroidal anti-inflammatory drug

maximum number of drug interactions in the age group was >65 years. This may be because organ dysfunction and comorbid conditions are more likely to be associated with older age. This further increases their risk for developing pDDIs.

In the present study, the most common tumor was found to be breast cancer (14.4%). A comparable result was shown in the study conducted by van Leeuwen *et al*.,[13] where it was found to be 17.2%. However, Mouzon *et al*.[14] concluded that higher incidence was observed with gastrointestinal cancer (27.9%). These findings were contradictory to the current study results.

The median number of medications received per patient in the present study was found to be 8 (range 1–21). A comparable result of median value of 9 in the range of 2–22 drugs was observed in the study conducted by van Leeuwen *et al*.[13] However, comparatively lesser median value of 5 was reported by Riechelmann *et al*.,[11] making it not comparable with the present study results.

In this study, the most frequently prescribed anticancer agents were cisplatin (14.5%) and docetaxel (1.9%). The study results were comparable to the conducted by Mouzon *et al*.,[14] where it was found to be cisplatin (22.1%) and docetaxel (13%).

In the current study, cisplatin [49 (32.2%)] was the most frequently drug involved in pDDIs. A comparable result was found in the study conducted by Mouzon *et al.,*[14] where it was found that cisplatin (22.1%) was the most frequently involved anticancer drug in pDDIs.

Another important finding in the study was the incidence of pDDIs that may result in adverse events which include QT interval prolongation (40.1%) and GI toxicity (9.2%). A comparable result was found in the study conducted by Leeuwen *et al*.,[9] where it was found to be QT interval prolongation (16.1%) and GI toxicity (11.2%).

In the present study, pain related to the cancer was treated with nonsteroidal anti-inflammatory drugs and opioids. These findings were consistent with the study conducted by Espinosa *et al*.[15] and van Leeuwen *et al*.[13]

The incidence of pDDIs in our hospital during the study period was 84.4%. Contradictory results were shown in the study conducted by Riechelmann *et al*.,[11] where it was reported to be 31.34%. This is due to that the patients involved in the study had more comorbidities; therefore, a large number of drugs were administered.

According to the severity of pDDIs, the study showed that 63.1% were moderate followed by major (26.1%) and minor interactions (10.1%). These findings were comparable to the study conducted by Leeuwen *et al*.,[9] where it was reported that most of the interactions were major (33%) followed by moderate (60.3%) and minor (6%).

Table 4: Interacting pair of anticancer drugs with outcome and severity (*n*=152)

PDIs involving anti-cancer drug	Outcome	Severity	Number of patients (%)
Alkylating agents + corticosteroids			
Cisplatin + dexamethasone	Muscle pain	Moderate	32 (21.05)
Corticosteroids + mitotic inhibitors			
Dexamethasone + paclitaxel	Reduces the blood level and effect of paclitaxel	Moderate	16 (10.5)
Dexamethasone + vincristine	Reduces the blood level and effect of vincristine	Moderate	15 (9.8)
Alkylating agents + mitotic inhibitors			
Carboplatin/cisplatin + etoposide	Increases the effect of etoposide	Moderate	6 (3.9)
Cisplatin + paclitaxel	Anemia, bleeding problem and nerve damage	Major	3 (1.9)
Carboplatin + paclitaxel	Nerve damage	Major	13 (8.5)
Carboplatin + docetaxel	Nerve damage	Major	9 (5.9)
Cyclophosphamide + etoposide	Affect bone marrow function	Moderate	1 (0.6)
Alkylating agents + anthracycline			
Cyclophosphamide + doxorubicin	Cardiomyopathy	Major	12 (3.2)
Carboplatin + doxorubicin	Increases doxorubicin exposure	Moderate	1 (0.6)
Ifosfamide + doxorubicin	Affect bone marrow function	Moderate	2 (1.3)
Cisplatin + epirubicin	Affect bone marrow function	Moderate	6 (3.9)
Oxaliplatin + epirubicin	Affect bone marrow function	Moderate	5 (3.2)
Alkylating agents + antimetabolite			
Capecitabine + oxaliplatin	Affect bone marrow function	Moderate	3 (1.9)
Cisplatin + fluorouracil	Affect bone marrow function	Moderate	6 (3.9)
Cyclophosphamide + fluorouracil	Affect bone marrow function	Moderate	1 (0.6)
Gemcitabine + carboplatin	Affect bone marrow function	Moderate	2 (1.3)
Gemcitabine + oxaliplatin	Affect bone marrow function	Moderate	2 (1.3)
Carboplatin + pemetrexed	Affect bone marrow function	Moderate	6 (3.9)
Anthracycline + antiemetic	Affect bone marrow function	Moderate	
Epirubicin/doxorubicin + palonosetron/ondansetron	Irregular heart beat	Moderate	17 (11.2)
Anthracycline + corticosteroids			
Doxorubicin + dexamethasone	Decreases doxorubicin exposure	Major	13 (8.6)
Alkylating agents + antiemetic			
Oxaliplatin + ondansetron	Irregular heart beat	Moderate	1 (0.6)
Oxaliplatin + palonosetron	Irregular heart beat	Moderate	4 (2.6)
Cyclophosphamide + ondansetron	Decreased cyclophosphamide systemic exposure	Moderate	3 (1.9)
Ifosfamide + aprepitant	Increases the blood levels and effect of ifosfamide	Moderate	1 (0.6)
Mitotic inhibitors + NK1 receptor antagonist			
Docetaxel + aprepitant	Increases docetaxel exposure and toxicity	Major	3 (1.9)
Paclitaxel + aprepitant	Decreases blood level and effect of paclitaxel	Moderate	4 (2.6)
Aprepitant + etoposide	Increases blood level and effect of etoposide	Moderate	6 (3.9)
Vincristine + aprepitant	Increases blood level and effect of vincristine	Moderate	3 (1.9)
Anthracycline + NK1 receptor antagonist			
Doxorubicin + aprepitant	Increases doxorubicin exposure	Major	7 (4.6)
Anthracycline + antimetabolite			
Fluorouracil + epirubicin	Affect bone marrow function	Moderate	5 (3.2)
Fluorouracil + doxorubicin	Affect bone marrow function	Moderate	1 (0.6)
Corticosteroids + antimetabolite			
Dexamethasone + methotrexate	Increases blood level	Moderate	5 (3.2)
Histamine H2 antagonist + antimetabolite			
Ranitidine + pemetrexed	Increased blood level and effect of pemetrexed	Moderate	4 (2.6)

NK1 – Neurokinin 1; PDIs – Potential drug interactions

Conclusion

The present study shows that cancer patients are at a high risk of pDDIs. The incidence of pDDIs among cancer patients was 84.44%. The most common interacting drug pair in the study population was found to be dexamethasone + aprepitant [41 (26.9%)] followed by cisplatin + dexamethasone [32 (21.05)] and other interacting pairs. According to the severity of classification of pDDIs,

Table 5: Interacting pair of supportive care drugs with outcome and severity (*n*=152)

PDIs involving supportive care drugs	Outcome	Severity	Number of patients (%)
Corticosteroids + antiemetic			
Dexamethasone + aprepitant	Increase systemic exposure to dexamethasone	Moderate	41 (26.9)
Histamine H2 antagonist+analgesics			
Chlorpheniramine + tramadol	Increased risk of seizures	Major	19 (12.5)
Antiemetic + opioids			
Ondansetron + tramadol	Reduced efficacy of tramadol	Moderate	17 (11.2)
Dopamine agonist + histamine H2 antagonist			
Ranitidine + domperidone	Increased QT interval prolongation	Major	17 (11.2)
Opioids + opioids			
Morphine + tramadol	Increased risk of CNS depression	Major	9 (5.9)
Morphine + morphine	Respiratory depression	Major	8 (5.2)
Tricyclic antidepressant + opioids			
Amitriptyline + tramadol	Increased QT interval prolongation	Major	13 (8.6)
Amitriptyline + morphine	Respiratory depression	Major	3 (1.9)
Antibiotic + antiemetic			
Azithromycin + ondansetron	Increased risk of QT interval prolongation	Major	9 (5.9)
Ciprofloxacin + ondansetron	Increased risk of QT interval prolongation	Major	1 (0.6)
Corticosteroids + anticonvulsant			
Dexamethasone + phenytoin	Decreased dexamethasone effectiveness	Moderate	8 (5.2)
Corticosteroids + antiemetic			
Dexamethasone + ondansetron	Decreases the effect of ondansetron	Moderate	7 (4.6)
Antihistamines + opioids			
Diphenhydramine + tramadol	Increased risk of CNS depression	Major	7 (4.6)
Dopamine agonist + antiemetic			
Domperidone + ondansetron	Increased risk of QT interval prolongation	Major	7 (4.6)
Antifungal + PPIs			
Fluconazole + pantoprazole	Increased concentration of CYP2C19	Moderate	6 (3.6)
Corticosteroids + laxative			
Dexamethasone + magnesium hydroxide/lactulose	Dehydration and hypokalemia	Moderate	6 (3.9)
Corticosteroids + NSAID			
Dexamethasone + diclofenac	Increases GI bleeding	Major	3 (1.9)
Dexamethasone + mefenamic acid	Increases GI bleeding	Major	2 (1.3)
NSAID + NSAID			
Mefenamic acid + diclofenac	Increases GI bleeding	Major	5 (3.3)
Hypnotic + opioids			
Zolpidem + tramadol	Increased risk of CNS depression	Major	4 (2.6)
Hypnotic + hypnotic			
Zolpidem + zopiclone	Increased risk of CNS depression	Major	4 (2.6)
Tricyclic antidepressant + antihistamines			
Amitriptyline + chlorpheniramine	HTN, tachycardia and cardiac arrhythmia	Major	2 (1.3)
Amitriptyline + diphenhydramine	Dry mouth, blurred, vision and drowsiness	Moderate	2 (1.3)
Antiemetic + antifungal			
Fluconazole + ondansetron	Increased risk of QT interval prolongation	Major	4 (2.6)
Laxative + antiemetic			
Magnesium sulfate + ondansetron	Irregular heart beat	Moderate	4 (2.6)
Opioids + anticonvulsant			
Phenytoin + morphine/tramadol	Dizziness, confusion and drowsiness	Moderate	4 (2.6)
Corticosteroids + biguanide			
Dexamethasone + metformin	Reduces the effectiveness of metformin	Moderate	3 (1.9)
Corticosteroids + antifungal			
Dexamethasone + fluconazole	Increased glucocorticoid exposure and risk for toxicity	Moderate	3 (1.9)

Contd...

Table 5: Contd...

PDIs involving supportive care drugs	Outcome	Severity	Number of patients (%)
Antibiotic + anticonvulsant			
Sulfamethoxazole trimethoprim + phenytoin	Increased phenytoin toxicity	Moderate	3 (1.9)
Bronchodilators + opioids			
Theophylline + tramadol	Increases the risk of seizure	Major	3 (1.9)
Tricyclic antidepressant + antiemetic			
Amitriptyline + ondansetron	Increased risk of QT interval prolongation	Major	3 (1.9)
Antibiotic + laxative			
Azithromycin + aluminum hydroxide	Decreases the effect of azithromycin	Moderate	2 (1.3)
Levofloxacin + magnesium hydroxide	Decreases the effect of levofloxacin	Moderate	1 (0.6)

PDIs – Potential drug interactions; PPIs – Proton pump inhibitors; NSAID – Nonsteroidal anti-inflammatory drug; CNS – Central nervous system; HTN – Hypertension; GI – Gastrointestinal

majority of them were moderate (63.1%) followed by major (26.1%) and minor (10.1%) interactions. QT interval prolongation (40.1%) and irregular heartbeat (24.3%) were the most common outcomes of the pDDIs in cancer patients. To avoid harmful effects, screening of pDDIs should take place before administering the therapy. The physician and pharmacist must collaborate for the early detection and prevention of DDIs and their related harmful effects. Screening of pDDIs should take place before starting the therapy to avoid potential drug interactions. Clinical pharmacist in health-care team has a certain role in detecting interactions and making recommendations, to reduce medication-related problem and effective drug therapy to improve the quality of life in these patients.

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Conflicts of interest

There are no conflicts of interest.

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