Symbiosis

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ISSN Online: 2374-8362

Research Article | Palliative Medicine & Care: Open Access | Open Access

Levels of electrolyte in cancer patients; a prospective study focusing on the Variations before and after therapy

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Received: August 07, 2018; Accepted: August 12, 2018; Published: October 15, 2018

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Abstract

Introduction: Electrolyte derangement has been documented during cancer chemotherapy leading to the electrolyte imbalance. So, we conducted this study to evaluate the type and frequency of affected electrolytes.

Objective: To assess frequency of electrolyte imbalances among cancer patients during Chemotherapy.

Material and methods: This was an observational study and samples were collected using non-probability convenient sampling technique, which was conducted in a total duration of 1 year from 1st April 2016 to 30 March 2017 at Jinnah Postgraduate Medical Centre Karachi, Department of Oncology. Informed consent was obtained from patients after approval from ethical review institutional committee. Blood samples were collected for the assessment of the electrolyte levels with the help of analyzer. A total of 256 cancer patients were included, inclusion criteria include age range 18-70 years who received single or combination chemotherapy. Data analysis was done using SPSS version 20. Demographic variables like age, body surface area, weight and height were recorded. Paired t-test was used to assess the significance before and after treatment with p value of <0.05.

Results: The mean age of patients was 43.21±12.85 years while weight was 56.02±11.25 kg. In our study significant difference existed in electrolytes parameters. In our study potassium level before and after the chemotherapy was 3.99±0.25 mg/dl and 3.51±0.76 mg/dl (p<0.001) respectively while sodium level before and after the chemotherapy was 139.66±2.35 mg/dl and 132.23±7.28mg/dl (p<0.001) respectively. Urea level recorded was 19.952±4.46 mg/dl and 27.12±15.29 mg/dl (p<0.001) respectively while recorded creatinine levels before and after chemotherapy was 0.60±0.21 and 0.84±0.44 mg/dl respectively (p<0.001). Sodium, potassium, bicarbonate, magnesium, creatinine and urea levels show significant p values.

Conclusion: Our study demonstrates that electrolyte imbalances are common during chemotherapy and monitoring should be done by medical oncologist so to avoid future morbidity and mortality.

Key words: Electrolyte variations, Cancer patients

Introduction

Cancer patients are usually encountered by number of different issues one of them include electrolyte imbalance (1). Other causes of electrolyte imbalance include para neoplastic syndrome or those associated with chemotherapeutic regimes (2). Life threatening complication has been documented because of these malignant specific electrolyte disorders they may require urgent therapy and correction. Therefore on time proper recognisation and urgent treatment of such patients are overall important (3). Among the electrolyte disorder in malignant patient's hyponatremia is the most common. In one of the study 14% of patients presented were cancer related (4). About half of hyponatremia patients are hospital acquired cases suggesting that proper care and management plan can help to prevent development of hyponatremia (5). Changes in potassium level in cancer patients especially hyperkalemia is attributable to rahabdomylsis, renal injury or tumor lysis syndrome (6). Less

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common causes include adrenal insufficiency associated with drugs or metastatic disease (7). Potassium imbalance especially hypokalemia is the second most common electrolyte imbalance documented in cancer patients (8). These potassium related imbalance can be because of other causes, some medications like as ifosfamide, cisplatin, amphotericin B, and amino glycoside antibiotics are responsible for tubular damage leading to kidney and git losses of potassium leading to hypokalemia (9). Other causes of electrolyte imbalance include use of diuretics which usually alters level of more than one electrolyte causing mainly hypokalemia, hyponatremia and hypomagnesemia. Calcium levels also alter and those having calcium greater than 11mg/dl have more chances of hypokalemia because of diuretics use (11). Another cause of electrolyte disturbance especially calcium is because of tumor meets in bones leading to osteoblastic activity. Hypomagnesemia is usually recorded in cancer patient and this imbalance is usually because of chemotherapy not because of disease (12). So the purpose of this study is to evaluate the electrolyte disturbances in cancer patients who are on chemotherapy so that effective management of such patients can be done accurately on time.

Methodology

This is an observational study and samples were collected using non-probability convenient sampling technique, which was conducted in a total duration of 1 year from 1st April 2016 to 30 March 2017 at Jinnah Postgraduate Medical Centre Karachi, Department of Oncology. Blood samples were taken for the assessment of the electrolytes with the help of analyzer. Informed consent has been obtained from patients and approval from ethical review institutional committee has been obtained. A total of 256 cancer patients were included, inclusion criteria include patients who were diagnosed as a case of cancer on histopathological basis with the age range of 18-70 years who received single or combination chemotherapy. Patients who were on total parentral nutrition due to poor performance status on chemotherapy were excluded from the study. Single or combination of chemotherapy regime that were used included taxotere, cisplatin and fluorouracil, oxaliplatin, leucovorin, adriamycin cyclophosphamide, gemcitabine, carboplatin, paclitaxel etoposide, daunorubicin, vincristine, prednisone, L-asparaginase, daunorubicin and cytarabine, hydroxydaunorubicin, oncovin, bleomycin, vinblastine and dacarbazine

Data analysis was done using SPSS version 20. The demographic variables like age, body surface area, weight and height were recorded. Independent variables included sodium, chloride, potassium and magnesium. Significant P-value was consider when it is less than 0.05

Results

256 patients were included in the study. The mean age of patients was 43.21±12.85 years while weight was 56.02±11.25 kg. The mean height was 158.38±10.55cm and the mean body surface area was found to be 1.55± 0.17m2. In our study significant difference exists in electrolytes parameters. Potassium level before and after the chemotherapy was 3.99±0.25 mg/dl and 3.51±0.76 mg/dl respectively while sodium level before and after the chemotherapy was 139.66±2.35 mg/dl and 132.23±7.28mg/dl respectively. Urea level recorded was 19.952±4.46 mg/dl and 27.12±15.29 mg/dl respectively while recorded creatinine levels before and after chemotherapy was 0.60±0.21 and 0.84±0.44 mg/dl respectively. Sodium, potassium, bicarbonate, magnesium, creatinine and urea levels show significant p values. The days for chemotherapy were 5.98±2.36 days. The most common group of cancer patient was acute myeloid leukemia, number of patients was about 58(23%), 35(14%) were of acute lymphoblastic leukemia and 30(12%) patients has cancer of ovary and lungs.

Table 1:- Basic demographic variables

	Mean	Std. Deviation
Age (years)	43.21	12.85
Weight (kg)	56.02	11.25
Height (cm)	158.38	10.55
Body Surface area (m2)	1.55	0.17
Chemotherapy (Days)	5.98	2.36

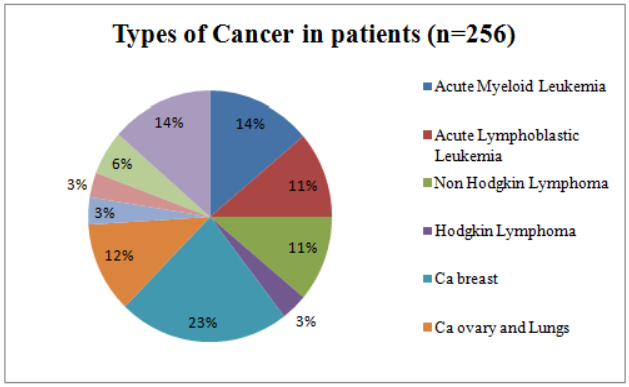

Figure 1: Type of cancer in patient under treatment

Table 2: Different electrolyte levels before and after treatment.

n=256		Mean	Standard Deviation	Std. Error Mean	P-Value
Sodium	Before	139.66	2.35	0.14	<0.001
	After	132.23	7.28	0.45	
Potassium	Before	3.99	0.25	0.01	<0.001
	After	3.51	0.76	0.04	
Magnesium	Before	2.03	0.23	0.14	<0.001
	After	1.86	0.31	0.1	
Chloride	Before	102.69	1.96	0.12	<0.001
	After	99.35	7.32	0.45	
Urea	Before	19.52	4.46	0.27	<0.001
	After	27.12	15.29	0.95	
Creatinine	Before	0.6	0.21	0.01	<0.001
	After	0.84	0.44	0.02	

Discussion

Data was collected from 256 patients undergoing chemotherapy. Overall there is a drop of sodium level below normal in our study after chemotherapy and the mean recorded sodium level is 132.23±7.28mg/dl with significant p value. There is a drop in potassium level from 3.99±0.25 to 3.51±0.76 mg/dl but the levels remain within the normal range with significant p value. All patients in our study before the start of chemotherapy had normal chloride and magnesium levels and after chemotherapy there levels remain normal with significant p value.

The incidence of hyponatremia has stretched from as low as 4 % to about 47 %. (13,14). In one of the study conducted by Verbalis JG et al., is proportionate to the hyponatremia prevalence rates of 15%–30% which has been reported for general medicine admissions. (15). According to study conducted by Hutchison FN et al; stated recorded that poor hospitalization management accounts for 14% cases of hyponatremia (16). While another study conducted by Castillo JJ et al., noted that metabolic derangement is responsible for hyponatremia in 46-54% of cases (17). Reported the prevalence of hypokalemia in 43 to 64% patients (18). Another study conducted by Alexandraki KIet al., documented that one of the cancer specific causes of hypokalemia was tumor that are responsible for secreting ectopic (ACTH) such as such as SCLC, thyroid medullary carcinoma, thymus or bronchial carcinoid, or neuroendocrine tumours. Although it is uncommon but has been documented that tumor stimulate renal potassium wasting via release of cortical excessively which in response activate mineral-corticoid pathway. Because of this there is a profound potassium losses and require replacement aggressively (19). For treatment of hypokalemia same management plan is carried out as it's for non-cancer patients; but in cancer patient i.v dosing is preferred over oral and it should be considered if patient is having symptoms of nausea, mucositis etc (20). If hypomagnesemia remains uncorrected, the treatment of hypokalemia is also ineffective; it is because of disregulatory mechanism in distal nephron tubular cells which do loses of potassium by renal medullary K1 channels (ROMK) (21). Decrease intake or due to magnesium wasting from kidney can cause low magnesium. The active site for re absorption of magnesium in nephron is distal nephron and it is the site for chemotherapy medicated injury (22). The hyponatremia in patients receiving platinum-based chemotherapy is reported to be 43% (23). In our study almost all the patients had normal potassium, magnesium and chloride levels before and after the start of chemotherapy regime.

The overall findings in the studies mentioned above clearly state a wide range of electrolyte imbalance in different chemotherapeutic combinations which are consistent with findings in our study. The quantitative and qualitative approach of our study has assured that we have assessed the range of electrolyte imbalances in cancer patients. However, the study might not be immune from selection and observer bias. Considering the views of our observations and to what extent they are consistent with the different chemotherapeutic regimens would be revealing to discover more facts about the electrolyte imbalances in patients receiving chemotherapy. The serum electrolytes including sodium, magnesium, potassium, chloride, blood urea nitrogen (BUN) and creatinine levels were calculated before and after the chemotherapy. With the help of these electrolytes parameters we can assess the degree of renal injury and Nephrotoxicity.

Conclusion

It is observed that there are variations in electrolytes parameters in patients receiving chemotherapy. Our study showed that patients during chemotherapy develop electrolyte imbalances mainly in sodium, potassium, magnesium and chloride levels. Therefore, it is recommended to focus on electrolyte imbalance in patients receiving chemotherapy, so that the appropriate chemotherapeutic plan can be devised to manage the patients accordingly. This may help to decrease mortality and morbidity in future.

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