Introduction

Human kidneys are weighing about 115 grams each in normal person and located in either side of spine, they filter around 200 liters of blood daily to remove the excess water and remove the waste. The most useful test that available to detect the kidney abnormalities is the urinalysis and blood test. Kidney function assessment in cancer patient is very necessary factor in outlining the survival risk, defining a patient eligibility for clinical trials and to determine the proper dose of the chemotherapy drugs. Accurate evaluation of kidney function is advisable to minimize variability in decision making and ultimately the clinical benefits and therapeutic outcome of toxicity. Both underestimation and overestimation of kidney function could affect on the treatment outcome and efficacy.

A variety of treatments for malignant diseases including drugs, antibiotics and chemotherapy are nephrotoxic and lead to renal disease and electrolyte disorder, so it is need dose modification or medical interruption to avoid renal injury. Nephrologist must make a major contribution in the management and identification of renal dysfunction in cancer patients. The collaboration between nephrologist and oncologist is very important to manage the patient optimally. Dysfunction of the kidney is common in malignant patients and usually some kidney functions lost during or after cancer therapy. This dysfunction leads to failure, which affects the immune system performance, and this can lead to immunodeficiency that can increase mortality rate among patients with kidney-failure. Our recent studies among untreated cancer patients in Taif city have detected leukocytosis, hypoproteinemia, vitamin D deficiency, and anemia were common.

This study aimed to evaluate renal functions in untreated cancer patients before initiating cancer therapy.
Materials and Methods

Study design
This study was approved by the directorate of health affairs in Taif city for the period 2020 to 2021, a consent form was provided prior using of data. The study sample of this research is 167 patients and 44 healthy controls to reach total of 211 contributors.

Sample analysis
A 3 mL of peripheral blood was collected into plain tube, examined directly by ROCHE COBAS ® platform e501. Both groups of participants were asked to fast for 10 hours prior collecting of blood.

Statistical analysis
In this study, Microsoft excel for office was used for data analysis and most of statistical calculations. As our data were not normally distributed, Pearson's chi-square test was used to detect any significant frequency in a single category. Moreover, Un-Paired t-test was used to compare between mean levels among the healthy and the patients. For odds ratio (OR), and 95% confidence interval (95% CI) medcalc-website were used (www.medcalc.org), results when $P$ value < 0.05 were considered significant.

Results

Demographic analysis
The total number of the study sample was 211, divided between 167 and 44 healthy controls (Table 1).

Types of cancer
There were five types of cancer in this study, 17 patients with respiratory tract cancer were all male, 49 with breast cancer, 45 with gastrointestinal tract cancer, 39 with gynecological cancer, and 17 with head and neck cancer (Table 2).

Breast cancer
Analysis of kidneys function profile in breast cancer patients have shown the following, 21 (42.85%) patients have normal levels of blood urea, the same percentage do low levels of blood urea, and 7 (14.28%) do high levels of blood urea ($P = 0.0183$, OR 59.95% CI 3.4 to 1039). For creatinine, 31 (63.26%) patients have shown normal levels, 10 (20.4%) have low levels, and 8 (16.3%) do shown high levels ($P < 0.0001$, OR 1.5 95% CI 1.5 to 461). Majority of patients have normal levels of Na in 44 (89.8%) patients, and 5 (10.2%) have low levels of Na. For K levels, 37 (75.5%) have normal levels, 8 (16.3%) do high levels, and 4 (8.3%) do low levels ($P$ value < 0.0001). Chloride level was normal in 30 (61.2%), low in 10 (20.4%), and high in 9 (18.4%) of the patients ($P = 0.0002$), moreover, the mean levels of patients was significantly higher than normal controls ($P = 0.0003$, OR 28.7 95% CI 1.65 to 502). (Table 3)

Gynecological tumors
Analysis of kidneys function profile in gynecological tumors patients have shown the following (Table 4), 26 (66.67%) patients have normal levels of blood urea, low levels of blood urea in 8 (20.51%), and 5 (12.82%) have high levels of blood urea ($P < 0.0001$, OR 23 95% CI 1.3 to 407). For creatinine, 26 (66.67%) of patients have shown normal levels, 7 (17.94%) do low levels, and 6 (15.38%) do high levels ($P < 0.001$, OR 23 95% CI...
1.3 to 407). Majority of patients have normal levels of Na in 34 (87.18%) patients, and 5 (12.82%) have low levels of Na. For K levels, 31 (79.48%) have normal levels, 6 (15.39%) do high levels, and 2 (5.12%) do low levels (P value < 0.0001). Chloride level was normal in 32 (82.05%), low in 3 (7.74%), and high in 4 (10.25%) of the patients (P < 0.0001), moreover, the mean levels of patients was significantly higher than normal controls (P < 0.0001).

### Head and neck cancer

Analysis of kidneys function profile in patients with head and neck cancer have shown the following (Table 5). Creatinine levels in 26 (69.23%) patients have shown normal levels, 8 (21.62%) do low levels, and only one patient do show high level (P = 0.0183), moreover, mean levels of patients was significantly higher than healthy controls (P < 0.0001). For K, 9 (25.71%) patients have shown normal levels, 3 (8.61%) do high levels, and 4 (11.43%) do low levels (P < 0.0001), moreover, mean levels of patients was significantly higher than healthy controls (P = 0.0035, OR 40 95% CI 2.1 to 770). For Na, K, and Chloride, most patients have shown normal levels (P < 0.0001), and mean levels of Na, K and chloride were significantly higher in patients than healthy controls.

### Gastrointestinal tract cancer

Analysis of kidneys function profile in patients with gastrointestinal tract cancer have shown the following (Table 7). Most of the female patients have normal blood urea, Na, K, and chloride (P = 0.0076, <0.0001, 0.0119, 0.0003, respectively). Na (P = 0.01, OR 0.5 95% CI 0.3 to 0.7), K (P = 0.0081, OR 6.1 95% CI 3.0 to 11.5), and

#### Table 3 Kidneys function profile in breast cancer patients

| Characteristics | Patients mean ± SD | Healthy mean ± SD | Odds Ratio OR 95% CI | P value |
|-----------------|--------------------|-------------------|----------------------|---------|
| Blood Urea      | 29.04 ± 25         | 26.7 ± 5.2        | 0.0183               |         |
| Creatinine      | 0.7 ± 0.3          | 0.6 ± 0.06        | <0.0001              |         |
| Na              | 139.4 ± 3.8        | 138.4 ± 1.3       | <0.0001              |         |
| K               | 4.3 ± 0.75         | 4.1 ± 0.14        | <0.0001              |         |
| Chloride        | 103 ± 4.9          | 101.7 ± 0.9       | 0.0002               |         |

#### Table 4 Kidneys function profile in gynecological tumors patients

| Characteristics | Patients mean ± SD | Healthy mean ± SD | Odds Ratio OR 95% CI | P value |
|-----------------|--------------------|-------------------|----------------------|---------|
| Blood Urea Males| 31.8 ± 17          | 26.7 ± 5.2        | 0.0183               |         |
| Females         | 30.6 ± 18          | 0.6 ± 0.06        | <0.0001              |         |
| Creatinine Males| 0.9 ± 1.07         | 0.6 ± 0.06        | <0.0001              |         |
| Females         | 0.66 ± 0.19        | 0.6 ± 0.06        | <0.0001              |         |
| Na Males        | 139.2 ± 3.6        | 138.4 ± 1.3       | <0.0001              |         |
| Females         | 4.3 ± 0.56         | 4.1 ± 0.14        | <0.0001              |         |
| Chloride Males  | 102.5 ± 5.4        | 101.7 ± 0.9       | 0.0002               |         |

#### Table 5 Kidneys function profile in head and neck cancer patients

| Characteristics | Patients mean ± SD | Healthy mean ± SD | Odds Ratio OR 95% CI | P value |
|-----------------|--------------------|-------------------|----------------------|---------|
| Blood Urea Males| 27.5 ± 14          | 23.01 ± 1.01      | 0.173                |         |
| Females         | 30.6 ± 18          | 26.7 ± 5.2        | 0.367                |         |
| Creatinine Males| 0.75 ± 0.26        | 0.9 ± 0.27        | <0.0001              |         |
| Females         | 0.66 ± 0.19        | 0.6 ± 0.06        | <0.0001              |         |
| Na Males        | 134 ± 4.3          | 138.5 ± 0.6       | <0.0001              |         |
| Females         | 141.3 ± 5          | 138.4 ± 1.3       | <0.0001              |         |
| K Males         | 4.6 ± 0.23         | 4.2 ± 0.4         | <0.0001              |         |
| Females         | 4.18 ± 0.56        | 4.1 ± 0.14        | <0.0001              |         |
| Chloride Males  | 100.38 ± 6.1       | 102.1 ± 0.2       | 0.018                |         |
| Females         | 104 ± 4.8          | 101.7 ± 0.9       | 0.016                |         |
Renal functions in cancer patients

Chloride (P = 0.0088, OR 15.4 95% CI 0.8 to 247) were all higher in patients than healthy controls.

Discussion

The number of participants in this study were 211 in which 44 healthy controls and 167 untreated cancer patients. Most of the participants are from 40 to 64-year-old and females 59.24% of total study group, and their mean age was 53.8±6.9-year-old. About 27% of the patients were females suffering from invasive ductal carcinoma. All the patients in this study were from Taif city, which is a high-altitude city. Previous studies have detected electrolytes imbalance due to dehydration and living in high-altitude\textsuperscript{10}, therefore, were have focused in kidneys functions in untreated cancer patients to detect any risk factors developed due to cancer, like electrolyte imbalance\textsuperscript{11}.

In our study, chloride was higher in most of our study group compared to healthy control. The main function of potassium is regulation of muscle and nerves excitability. We found in this study the potassium levels in some cancer patients were higher than the normal people and statistically significant (P < 0.05) when it compared to the normal healthy controls. Hyperkalemia could results due to several reasons for example breakdown of the tumor cells that may exacerbated by development of renal failure (uremia), chemotherapeutic drugs or by some hormone that released from the tumor which lead to high level of potassium in the blood\textsuperscript{11}. Some antileukemic drugs could lead to increase of potassium and that is mean if we want to destruct the leukemic cells, we should expect increase of the potassium level\textsuperscript{12}.

Studies showed that patients when exposed to radiotherapy or chemotherapy lead to alterations in serum biochemical parameters, those studies compared to the results before and after the therapy. The rapid increase in the blood potassium could lead to severe arrhythmias and sudden death\textsuperscript{13}.

Urea should be measured before and after therapy to determine the difference in every series of therapy, any increase of urea level after the therapy would be an indicator of renal dysfunction. Some studies suggest that impairment in the regulation in the urea level could be a cancer marker\textsuperscript{14, 15}.

In this study the creatinine level was higher in cancer patients compared to the normal people. The creatine

| Characteristics | Patients | Healthy | Odds Ratio |
|-----------------|---------|---------|------------|
|                 | mean ± SD | mean ± SD | P value | mean ± SD | P value | OR 95% CI | P value |
| Blood Urea      | Males 30.8 ± 16 | 23.01 ± 1.01 | 0.001 | 49 (2.7 to 918) | 0.009 |
|                 | Females 28.75 ± 14 | 26.7 ± 5.2 | 0.007 | 40 (2.1 to 770) | 0.014 |
| Creatinine      | Males 0.83 ± 0.37 | 0.9 ± 0.27 | 0.049 | 43 (92.5 to 751) | 0.009 |
|                 | Females 1.2 ± 2.7 | 0.6 ± 0.06 | 0.038 | 43 (92.5 to 751) | 0.009 |
| Na              | Males 141.76 ± 3.6 | 138.4 ± 0.6 | 0.049 | 0.5 (0.009 to 25) | 0.729 |
|                 | Females 139 ± 3.8 | 138.4 ± 0.6 | 0.049 | 0.5 (0.009 to 25) | 0.729 |
| K               | Males 4.26 ± 0.5 | 4.2 ± 0.4 | 0.001 | 6.1 (0.3 to 115) | 0.226 |
|                 | Females 4.3 ± 0.56 | 4.1 ± 0.14 | 0.001 | 6.1 (0.3 to 115) | 0.226 |
| Chloride        | Males 104.7 ± 5 | 102.1 ± 0.2 | 0.013 | 15.4 (0.8 to 278) | 0.063 |
|                 | Females 103 ± 4 | 101.7 ± 0.9 | 0.001 | 15.4 (0.8 to 278) | 0.063 |
and creatinine metabolism play a very important role in energy production of muscle cells and also linked to cancer progression and carcinogenesis. Creatine is an energy source of ATP. The creatinine is the waste product of metabolism of creatine. The creatine is utilized quickly by cancer cell as an energy resource so the creatinine level will be increased as a waste product. So when the level of creatine increased it could be associated with highly active tumor\(^{16}\). It is necessary to check the creatinine level before, during and after the chemotherapy to avoid any risk of kidney failure. Kidney function failure is particularly known as cardiovascular mortality\(^{16}\). Chloride usually secreted in the sweat, stomach and urine. In this study Chloride level was significantly higher in most of cancer patients. However, chloride could be secreted from 10–20% of tumors\(^{12}\).

**Conclusion**

The electrolytes imbalance is additional risk factor for cancer patients. Therefore, the continuous monitoring of electrolytes before and after the therapy is essential. The balance between preservation of renal functions and cancer therapy will help the clinicians in prognosis of disease and monitor the cancer patients from any other problems that is life threatening.

**Conflict of interest:** None.

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