

Comparison of 50 Cases of the Anti-Cancer Effects of NaCl with KCl as a Potent Graphene Exfoliator, Prehydrated Patients to NaCl-Only Prehydrated Patients on the Terminal Stage Cancer Patients

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Abstract

Background: A subset of cancer is particularly vulnerable to hydration prior to chemotherapy protocols; however, real-world outcomes-based data on pre-hydration elements of patients with tumor is sparse. **Case Presentations:** This retrospective case series describes a cohort of adult patients with terminal stage cancer who were seen between July 1, 2023, and September 25, 2023 and underwent various chemotherapy protocols, which, to our knowledge, represents comprehensive analysis of this patient population. We performed a retrospective search of patients identifying 50 cases of the chemotherapies of patients with cancer and extracted the clinical data via individual chart reviews. At the time of diagnosis, 24 patients were prehydrated with NaCl with KCl prior to the chemotherapy against the tumor, and 26 patients were taking normal saline only before undergoing cancer-specific treatment. Hydration and, prior chemotherapeutic agents use were the most common predepositse. Carcinomatosis peritoneii were the most common signs of the terminal stage of cancer within patients. Twenty-four patients were admitted to the hospital and two received NaCl with KCl hydration prior to the platinum based chemotherapeutic agent treatment. Twenty-six patients received only normal saline hydration. **Conclusion:** Our data suggest that NaCl with KCl prehydration results in better prognosis, including reduced tumor burden or decreased lymph node invasion, when compared to other vulnerable patients populations that receive only normal saline hydration. The graphene exfoliation effect of NaCl with KCl may have contributed to these results.

Keywords

Terminal Stage Cancer, NaCl, KCl, Graphene Exfoliation, Better Prognosis

1. Introduction

The toxicological mechanism of Graphene oxide (GO) materials that have been revealed by recent studies primarily involves inflammatory response, oxidative damage, DNA damage, apoptosis, autophagy and necrosis. Some reports have demonstrated the direct cytotoxic effects of GO on tumor cells. GO treatment has resulted in cytotoxicity, reactive oxygen species (ROS) production, apoptosis, autophagy and activation of the AMPK/mTOR/ULK1 signal pathway. This pathway is a major pathway that regulates autophagy and the AMPK/mTOR/ULK1 axis can be activated by ROS [1]. Oxidative stress that is induced by graphene and accumulates in living organs is due to acellular factors that may affect the physiological interactions between graphene and target tissues and cells. Acellular factors include particle size, shape, surface charge, surface containing functional groups, and light activation. Cellular responses such as mitochondrial respiration, graphene-cell interactions and pH of the medium are also determinants of ROS production [2].

Both anions and cations are inserted in the space between conjugated graphite layers during the intercalation process. The anion can enhance the salt-intercalation exfoliation by expanding the interlayer spacing. Compared with sodium chloride alone (NaCl-only), a solution containing potassium chloride and sodium chloride (NaCl with KCl) can significantly enhance the exfoliation yields of graphene. Optimizing the cation and anion species can improve the yield of graphene because co-intercalation with both anions and cations occurs during the intercalation process in the inorganic salt solution [3] [4].

2. Methods

This project was approved by the Institutional Review Board (IRB). We performed a retrospective search using the Cohort Discovery Tool from the Research Repository. Search parameters were set to identify patients who were (1) seen in the clinic between July 1, 2023, and September 25, 2023 were at least 20 years of age, (3) had a diagnosis of “advanced gastric cancer”, “cervical and endometrial, ovarian, uterine, breast cancer”, “lung cancer”, “colon cancer”, “pancreatic cancer”, “tonsillar cancer”, “hepatoma”, “appendiceal cancer”, or “rectal cancer”; and, (4) had a diagnosis of terminal stage cancer. Individual chart analysis was performed to confirm the authenticity of the search parameters and verify the diagnoses. An identical search was performed to identify the total number of patients who received care in the new life clinic within the study’s time frame. As tumor marker data such as CEA, SCC, CA125 or CA19-9 were routinely obtained, we were able to identify the prognosis of the illness in each pa-

tient.

3. Case Series

A total of 50 cases of terminal stage cancer (28 individual patients, one who had NaCl with KCl prehydration and 26 patients, including another who had NaCl-only prehydration) were discovered out of the 200 adult patients with cancer who were seen over this 3 months period with an average age of years and were 33% male (**Table 1**). In order of decreasing frequency the cancer types were as follows: advanced gastric cancer (20%), cervical (20%), endometrial (4%), uterine (7%), and breast cancer (3%), encompassing all grade 3 or 4. At the time of chart review, Karnofsky Performance Scale (KPS) score was most common (63%), indicating that most patients had relative independence, followed by a score of, indicating that 37% of patients were unable to work or required varying levels of assistance. None of the patients had significant disability with a KPS score <50.

At the time of cancer diagnosis, 95% were undergoing cancer-specific treatment (95% were receiving Cisplatin, 20% on, 20% were receiving radiation therapy, and were undergoing resection). Twenty-four (48%) patients received prehydration of NaCl + KCl prior to chemotherapy. At the time of diagnosis, 26 patients received normal saline hydration (52%) followed by the chemotherapy regimens. At the time of cancer diagnosis (**Table 2**), 95% were undergoing cancer-specific treatment (95% were receiving Cisplatin, 20% on, 20% were receiving radiation therapy, and were undergoing resection). Twenty-four (48%) patients received prehydration of NaCl + KCl prior to chemotherapy. At the time of diagnosis, 26 patients received normal saline hydration (52%) followed by the chemotherapy regimens.

Table 1. Compared to the NaCl-only prehydration group, the population of NaCl + KCl prehydration patients had higher cancer recovery rates, did not appear to be prone to a severe illness course, and did not demonstrated an increased mortality rate.

Characteristics	NaCl + KCl	NaCl only
Age at cancer diagnosis, mean (range)	55 (31 - 71)	55 (31 - 78)
Gender (%)		
Male	8 (33%)	11 (42%)
Female	16 (67%)	15 (58%)
Type of primary cancer (%)		
Advanced gastric cancer	5 (20%)	10 (38%)
Ovarian cancer	3 (10%)	2 (7%)
Colon cancer	4 (10%)	2 (7%)
Rectal cancer		1 (3%)

Continued

Cervical cancer	5 (20%)	1 (3%)
Appendiceal cancer		1 (3%)
Endometrial cancer	1 (4%)	
Pancreatic cancer	3 (10%)	5 (20%)
Uterine cancer	1 (4%)	1 (3%)
Tonsillar cancer	1 (4%)	
Breast cancer		1 (3%)
Salpinx cancer		1 (3%)
lung cancer	1 (4%)	1 (3%)
Klatskin tumor	1 (4%)	
Grade (%)		
3	9 (37%)	8 (30%)
4	15 (63%)	18 (70%)
Karnofsky Performance Scale (%)		
80 - 100	15 (63%)	9 (39%)
50 - 70	9 (37%)	16 (61%)
<50	0 (0%)	
Treatment history		
resection	5 (20%)	9 (39%)
radiation therapy	4 (20%)	2 (7%)
Cisplatin	23 (95%)	
Bevacizumab (Avastin), Ramucirumab, AI	5 (20%)	
Nivolumab	2 (10%)	
Abrexene	1 (0.4%)	1 (3%)
5-FU	2 (10%)	
Pembrolizumab	2 (10%)	
Padexol	1 (4%)	
Onbevzi	1 (4%)	
Gemcitabine	1 (4%)	
Taxotere, cyclophosphamide	1 (4%) 4 (15%)	
Capecitabine		2 (7%)
FOLFOX, Opdivo (third generation), Xerox		9 (39%)

Table 2. NaCl + KCl prehydrated patients who received care did not experience an exceptionally poor prognosis especially when compared to other NaC-only prehydrated population.

Outcomes	NaCl + KCl	NaCl only
Signs (%)		
decreased tumor burden	7 (29%)	
decreased lymph node invasion	11 (45%)	
decreased carcinomatosis peritoneii	6 (25%)	
decreased soft tissue infiltration	1 (4%)	
other organ seeding		7 (26%)
surgical site seeding		3 (11%)
mesentery seeding		2 (7%)
ascites		2 (7%)
lung nodule		2 (7%)
atelectasis, fibrosis, bronchiectasis		5 (20%)
stent implantation	3 (10%)	3 (11%)
emphysema		1 (3%)
pleural effusion		1 (3%)
pericardial effusion		1 (3%)
hepatic, pancreatic duct dilatation		3 (11%)
portal vein thrombosis		2 (7%)
splenomegaly		2 (7%)
liver abscess		1 (3%)
fluid collection		2 (7%)
debulking operation		3 (11%)
CEA	4.18 - >1.65 - >2.77 - >1.7	
CA125 case 1	23.9 - >16.2 - >17.6 - >16.8	
CA125 case 2	3.4 - >7.2 - >7.4 - >5.9	
CA19-9 case 1	93 - >28 - >38.2 - >28.2	
CA19-9 case 2	892 - >546	
SCC	10.3 - >0.4 - >0.6 - >0.4	

4. Discussion

At the time of analysis (September 13, 2023), a total of 1,958,310 cases of cancer and 609,820 cancer deaths had been reported in the USA according to the

American Cancer Society for Cancer Statistics 2023 [5]. Prehydration with NaCl and KCl prior to chemotherapy regimen was observed in nearly half of the therapeutic regimen in our cancer population. Compared to platinum based chemotherapeutic agent, another half of the patients received NaCl-only prehydration like Vinca Alkaloid. The authors of a recent cancer case series of patients with terminal stage tumors demonstrated increased numbers of tumors, in younger patients, which were larger in size and growing more rapidly and aggressively at the time of the initial diagnoses. Although KPS score declined in patients following their cancer diagnoses, this functional decline is not unexpected in the natural histories of terminal stage cancers. On individual review of the charts, this decline was believed to be due to disease progression as opposed to symptomatic sequelae from graphene accumulation during the pandemic era. In summary, compared to the NaCl-only prehydration group, our population of NaCl + KCl prehydration patients had higher cancer recovery rates, did not appear to be prone to a severe illness course, and did not demonstrate an increased mortality rate. These findings suggest that NaCl-only prehydrated patients are not at an increased risk of contracting or experiencing worse outcomes from cancer. The graphene exfoliation effect may have contributed to these results. Our study had several limitations. First, this was a retrospective analysis, which confers its own limitations. Moreover, the limited sample size precludes the ability to make meaningful statistical comparisons; Nonetheless, we reiterate that this study currently represents the largest single-institution study of its kind. Single-institution studies are not necessarily generalizable, although they have the benefit of providing in-depth retrospective analysis of cases in a real-world population and are less likely than national databases to be skewed toward inpatient populations.

5. Conclusion

In conclusion, our data suggest that NaCl + KCl prehydrated patients who received care at New Life clinic did not experience an exceptionally poor prognosis especially when compared to other NaCl-only prehydrated populations. This result may be related to the graphene exfoliation effect of NaCl + KCl. We hope that our results provide insight as to how this prehydration solution affects patients with terminal stage cancer and will drive future research in this important topic. Recurrences in months or years after the initial diagnosis may be prevented by vitamin C intake.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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