ORIGINAL ARTICLE

Urine Radon Levels among Various Cancers Other than Lung Cancer: A Cross-sectional Study

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Objective: To evaluate if urine radon can be a potential marker for cancers other than lung cancer.

Materials and Methods: This was a cross-sectional study with the inclusion criteria were adult patients diagnosed as non-lung cancer or healthy control subjects and agreed to participate in the study. Urine Radon, an outcome of the study, was measured with the RAD 7 and compared between the groups of cancers other than lung cancer versus control group.

Results: There were 144 patients participating in the present study. Of those, 56 patients (38.19%) were control patients, 42 patients (29.17%) had gastrointestinal cancer, 8 patients (5.56%) had breast cancer, 12 patients (8.33%) had gynecological cancer, 13 patients (9.03%) had hematological cancer, and 14 patients (9.72%) had otolaryngology cancer. There were comparable results on age, body mass index, urine pH including urine radon among six groups. The median urine radon was highest in the control group and gynecological cancer group at 402 Bq/m^3 (p=0.222).

Conclusion: Urine radon levels among various cancers other than lung cancer were not different from the control group. Further studies are required to confirm the results of the present study due to the small sample size.

Keywords: RAD7; Radon; healthy

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Radon, a colorless and odorless gas from Uranium and Radium, has been shown to be one of the major risk factors of lung cancer[1]. Other than occupational exposure of Radon in miners, residential radon was associated with lung cancer shown by a systematic review and a case-control study[2-4]. A previous systematic review showed that radon exposure increased risk of lung cancer by 1.29 times with 95% confidence interval of 1.10 to1.51[2]. A recent review also reported that radon exposure is associated with other cancers including skin cancer with a hazard ratio of 1.16 or gastric cancer with a hazard ratio of 10.8[1].

Serum radon may be used to be a marker for lung cancer. A study from Iraq found that serum radon was higher in patients with lung cancer than control group at 19.22 vs. 1.78 Bq/m^3[5]. Urine radon is a non-invasive diagnostic test which has a good correlation with serum radon. A study conducted in smokers found that average urine and serum radon levels were comparable at 11.96 vs. 11.82 Bq/m^3[6]. As there is limited data if urine radon can be a potential marker for cancers other than lung cancer, the present study aimed to evaluate this possibility.

Materials and Methods

This was a cross-sectional study conducted at Cancer center, Khon Kaen Hospital, a referral hospital in northeast Thailand. The inclusion criteria were adult patients diagnosed as non-lung cancer or healthy control subjects and agreed to participate in the study. The control group was those without cancer. The present study was approve

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Eligible patients were evaluated for age, sex, body mass index, and urine examination. The urine examination included urine salinity (ppt), urine temperature (°C), urine electrical conductivity (µs/cm), urine total dissolved solids (ppm), urine pH, and urine radon (Bq/m^3). Urine radon, an outcome of the study, was measured with the RAD7, the most multipurpose radon detector that professionals and researchers use globally[7].

Statistical analysis

Patients were categorized into six groups: control group and five non-lung cancer groups. Descriptive statistics were used to compute baseline characteristics and urine variables of both groups. Numerical variables were shown as median (range), while categorical variables were reported as number (percentage). The differences of each variable among groups were compared by using one-way analysis of variance (ANOVA) test for numerical variables, and Fisher Exact test for categorical variable. Bonferroni test was used to calculate a pairwise comparison in significant numerical variables. The statistical analyses were performed using STATA software version 18.0 (College Station, Texas, USA).

Results

There were 144 patients participating in the study. Of those, 56 patients (38.19%) were control patients, 42 patients (29.17%) had gastrointestinal cancer, 8 patients (5.56%) had breast cancer, 12 patients (8.33%) had gynecological cancer, 13 patients (9.03%) had hematological cancer, and 14 patients (9.72%) had otolaryngology cancer. Regarding age, sex, and basic urine examination, there were comparable results on age, body mass index, and urine pH among six groups (Table 1). The median age was highest at 58 years in breast cancer group, gynecological cancer group and otolaryngology cancer group (p=0.247). There were significant different in a proportion of sex (p<0.001), and medians of urine salinity (p<0.001), urine temperature (p<0.001), urine electrical conductivity (p=0.031), and urine total dissolved solids (p=0.001) as shown in Table 1. Urine salinity was significantly different between control group and gastrointestinal cancer group (p=0.024), breast cancer group (p=0.004), gynecological group (p=0.040), and ENT cancer group (p=0.038) as shown in Table 2. For urine temperature, there was a significant difference between control group and all cancer groups (Table 2). Urine electrical conductivity had no significant difference between groups, while the urine total dissolved solids had significant difference between control group and breast cancer group (p=0.010) and ENT cancer group (p=0.001).

There was no significant difference of urine radon among the six groups of patients (Table 1). The median

Table 1. Baseline characteristics, urine properties, and urine radon in control subjects and patients with various cancers

Factors	Control, (n=56)	Gastrointestinal, (n=42)	Breast, (n=8)	Gynecological, (n=12)	Hematological, (n=13)	ENT, (n=14)	p value
Age, years	50 (30 to 81)	56 (38 to 73)	58 (42-67)	58 (32 to 70)	55 (25 to 69)	58 (19 to 73)	0.247
Male sex, n (%)	25 (45.45)	24 (57.14)	0	0	7 (53.85)	11 (78.57)	<0.001
Body mass index, kg/m^2	22.71 (13.84 to 35.55)	21.75 (14.36 to 28.35)	21.92 (13.31-30.30)	21.87 (15.14)	22.60 (13.00 to 35.00)	19.85 (15.77 to 26.72)	0.148
Urine salinity, ppt	8.04 (1.27 to 18.40)	5.98 (0.22 to 13.80)	3.81 (1.75-5.43)	5.24 (1.08 to 8.32)	5.68 (1.52 to 8.92)	4.77 (1.40 to 11.20)	<0.001
Urine temperature, °C	17.5 (6.3 to 28.4)	11.4 (5.7 to 19.7)	11.9 (8.4-13.8)	8.8 (5.2 to 24.0)	11.5 (6.6 to 21.2)	11.6 (6.1 to 17.3)	<0.001
Urine EC, µs/cm	49 (1 to 137)	51 (4 to 126)	77 (54-109)	98 (9 to 130)	85 (10 to 133)	88 (11 to 131)	0.028
Urine TDS, ppm	5,180 (1,887 to 12,310)	4,850 (210 to 8,580)	2670 (1495-4130)	4,085 (1,028 to 7,270)	4,570 (1,609 to 7,100)	3,915 (1,213 to 5,870)	0.001
Urine pH	6.45 (4.90 to 8.86)	6.42 (3.25 to 9.31)	6.12 (5.52-7.58)	6.37 (5.40 to 7.46)	6.11 (5.50 to 6.95)	6.86 (5.54 to 7.39)	0.511
Urine radon, Bq/m^3	402 (0 to 1,210)	202 (0 to 1,010)	202 (0-403)	402 (0 to 605)	202 (0 to 605)	302 (0 to 806)	0.222

Data presented as median (range).

EC=electrical conductivity; TDS=total dissolved solids

Table 2. Pairwise comparison between various cancer groups versus control group in four urine variables

Factors	Gastrointestinal n=42	Breast n=8	Gynecological n=12	Hematological n=13	ENT n=14	p value
Urine salinity, ppt	0.024	0.004	0.040	0.087	0.038	<0.001
Urine temperature, oC	<0.001	0.009	<0.001	0.006	<0.001	<0.001
Urine EC, µs/cm	0.999	0.999	0.799	0.999	0.999	0.028
Urine TDS, ppm	0.631	0.010	0.377	0.764	0.047	0.001

Data showed a p-value for a comparison with control group by Bonferroni test

EC=electrical conductivity; TDS=total dissolved solids

urine radon by the RAD7 was highest in the control group and gynecological cancer group at 402 Bq/m^3 (p=0.222). There was no statistical significance of urine radon among groups in female patients (p=0.174) and male patients (p=0.620).

Discussion

The present study found that urine radon was not statistically significant between subjects in the control group and patients of five cancers other than lung cancer. Even though radon has been shown to be associated with lung cancer, a systematic review did not declare statistically significant between radon and cancers other than lung cancers[8]. Note that it had a positive correlation with almost significance between radon and melanoma mortality (p=0.07), liver cancer mortality (p=0.06), and gastrointestinal cancer (p=0.06). The explanation for the non-significant results in this study and the previous systematic review may be due to natural history of radon exposure[8].

Radon is a radioactive gas originating from the ground and entering the human body via breathing even with low level but long term exposure of radon[9,10]. Previously, several reports showed that miners exposed to radon were at risk for lung cancer. A previous study found that miners had 40% of lung cancer deaths and 70% of lung cancer deaths in non-smokers related to radon exposure[11], while a study from Germany showed a linear correlation between long-term radon exposure of low radon level and lung cancer mortality in miners with the excess relative risk per working level months at 0.013 with 95% confidence interval of 0.007 to 0.021[9]. Recently, a systematic review also found that residential radon was associated with lung cancer as well with pooled odds ratio of 1.48; 95% confidence interval of 1.26 to 1.73[12]. As radon exposure via respiratory system, it may not be associated with cancers other than lungs. Additionally, there is limited data of urine radon measurement in patients with cancers other than lung cancer. A previous study showed that residential radon level over 100 Bq/m^3 may increase the risk of lung cancer by 11%, but not the urine radon level[12].

There are some limitations in the present study. First, measurement of residential radon of each patient was not performed. The present study may not imply on the association of residential radon exposure and cancers. Second, the sample size in this study was quite small. Further large study may be needed. Finally, cytological diagnosis or cell types of the cancers were not evaluated.

In conclusion, urine radon levels among various cancers other than lung cancer were not different from the control group. Further studies are required to confirm the results of the present study due to the small sample size.

What is already known on this topic?

Radon exposure is associated with lung cancer. Serum radon level was higher in patients with lung cancer than control group.

What this study adds?

Urine radon in patients with cancers other than lung cancer was comparable with urine radon in non-cancer control subjects.

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Conflicts of interest

The authors declare no conflict of interest.

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