醫工學會誌 : 第11卷, 第1號, 1990
J. of KOSOMBE : Vol. 11, No. 1

研 究 論 文
90- 1 -02

The Study of Possibility of Cancer Diagnosis by the Spectral Analysis of Excretion of Human Urine*

Yong Jin Kim

-Abstract-

A simple diffraction grating spectrometer is successfully utilized to distinguish the similar red colored sediments obstained from both of cancer and non-cancer urine reactions caused by the the previous developed reagent for the cancer diagnosis by examining their spectral absorption bands in order to improve its sentitivity and specficity. It is found that the cancer and non-cancer absorption band regions lie between 4250 A and 4750 A and between 5250 A and 5400 A, respectively.

1. Introduction

It has been reported that the four aromatic proton NMR signals[1] with a relatively higher and broader area between 7.00 ppm and 8. 00 ppm which are identified as a phenolic compound (or hydroxy bezene) are much more often appear in cancer urine than in normal and other diseased urine (See Appendix). It has also pointed out that the excretion substance is regarded as a cancer marker[1-3] which can practically be used for a differential diagnosis between cancer and non-cancer urine. Here the noncancer urine stands for the normal and other diseased one for simplicity.

In place of the above NMR method for the diagnosis, a very effective reagent[2] has been developed for a spot cancer diagnosis by detecting the substance excreted in the urine. It is found that the reagent sensitivity and specificity are 70% on an average which is much less than 80%. This is because of the occasional excretion of the substance even in the noncancer urine. Furthermore it is found that almost similar red colored sediments caused by the reaction of the reagent on the substance are formed in both of the cancer and noncancer urine, which leads to false diagnoses and eventually yields the lower sensitivity and specificity.

In this study an attempt has been made to possibly minimize the false diagnoses by examining their spectral absorption bands by an appropriate diffraction grating spectrometer**. The result of the attempt shows that the cancer and non-cancer bands are quite different from each other.

〈접수 : 1989년 12월 2일〉

Department of Physics, Hanyang University, Seoul 133-791, Korea

* This work was supported by the 1989 Hanyang University reseach fund.

** The results of the spectral absorption bands obtained by the spectrometer were first reported at the 1988 KOSOMBE Meeting held at Jang Ki Won Memorial Hall of Yonsei University, Autumn, 1988.

*** The urine samples are furnished by The Central Laboratory of Samil Pharmaceutical Co., Ltd., Seoul.

2. Experimental Arrangements and Procedures

Fig. 1 shows a block diagram of the experimental arrangements of obtaining the spectral absorption bands of the cancer and non-cancer urine sediments. A tungsten light bulb of KODAK 760HK SLIDE PROJECTOR is used for the light source (LS). A convex lens(L) is used for ray convergence to the sample tube (T) with 1. 2 cm in diameter. The distances of d_1 and d_2 shown in the figure are 8 cm and 13 cm, respectively. S and E in the CENCO diffraction grating spectrometer drawn represent slit and eyeiece, respectively. G is the CENCO Rowland's grating 14,500 lines to the inch and the numerals in the spectrometer represent the wavelengths in angstrom(A).

0.15 c. c. of the reagent[1] is added to 3 c. c. of urine in the sample tube(T) to obtain the urine color reaction sediments. The sample tube is placed in front of the slit (S) to observe the absorption bands through the eyepiece (E) distanced from the grating(G).

3. Results and Discussion

The results of the cancer and non-cancer urine color reactions are listed in Table 1. In the table the urine numbers, #3 and #5, are falsely diagnosed. That is, they must show the white (W) rather than the red. Likewise #14 through #18 are falsely diagnosed. On the other hand, #10 of the stomach cancer urine shows the white reaction (W) rather than the red (R), which is obviously a false diagnosis, however, as emphasized in the introductory section, only the red colored reactions sediments between the cancer and non-cancer patients urine are concerned to examine theire spectral absorption band differences in order to possibly remove the false diagnoses obtained by misjudging their slimilar colors which occationally occur in the reactions of the two largely classified patients urine.

Fig. 2 shows a graph illustrating the results of the spectral absorption bands of the red sediments obtained from the cancer and non-cancer reactions. From the figure it is noticed that the cancer

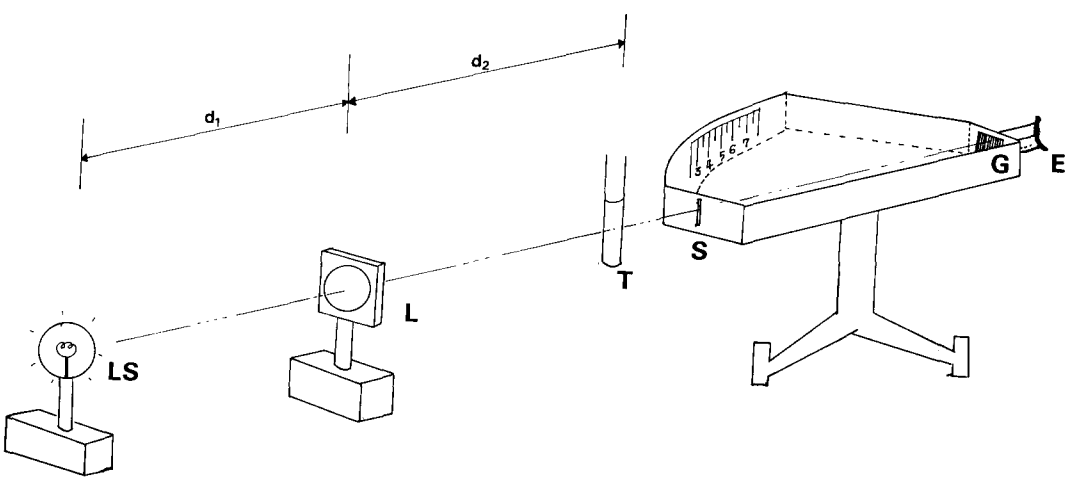

Fig. 1 Block diagram of experimental arrangements with the diffraction grating spectrometer.

Table 1 Results of cancer and non-cancer urine color reactions.

Urine number	Kind of urine***	Urine color reaction	Remarks
1	Hepatitis	W	
2	Hepatitis	W	W : White
3	Hepatitis	R	sediment
4	Normal	W	(normal or
5	Normal	R	non-cancer)
6	Stomach cancer	R	
7	Stomach cancer	R	R : Red sediment
8	Stomach cancer	R	(cancer)
9	Stomach cancer	R	
10	Stomach cancer	W	
11	Hepatoma	R	
12	Hepatoma	R	
13	Hepatoma	R	
14	Normal	R	
15	Normal	R	
16	Heart disease	R	
17	Diabetic mellitus	R	
18	GI-bleeding	R	

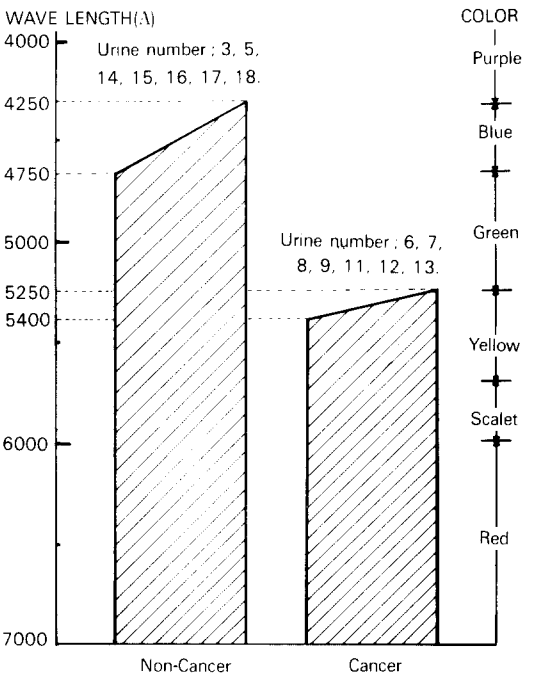

Fig. 2 Results of the spectral absorption bands of red colored sediments obtained from cancer and non-cancer urine reactions. The cancer absorption bands lie between 5250 A and 5400 A and the non-cancer ones between 4250 A and 4750 A.

and non-cancer spectral absorption bands lie respectively between 5250 A and 5400 A and 4250 A and 4750 A. This means that the absorption of the non-cancer urine reaction sediments occurs less than the one of the cancer urine sediments. And this is also because of the former sediments are relatively sparser than the latter ones. Hence the majority of the visible lights with longer wave lengths go through the non-cancer urine reaction sediments. On the other hand, since the cancer urine reaction sediments are relatively denser than the non-cancer ones, the majority of the lights with shorter wave lengths are absorbed in the sediments. It must be noted that the white sediments shown in the table allow the most visible lights to go through them. This is because of the visible lights are mostly reflected on the white sediment particles and moreover because of the white sediments are much sparser than the red ones obtained from the non-cancer urine reactions.

Without owing the results of Fig. 2, the reagent sensitivity and specificity strictly calculated from the results of the table listed are 7/8=87. 5% and 3/10=30%, respectively, but recorrecting the two by using the results of Fig. 2, the former and latter turn out to be 7/8=87. 5% and 10/10=100 %, respectively.

In conclusion the method employed for distingushing the similar red sediments formed between the cancer and non-cancer reactions caused

by the reagent by the diffraction grating spectrometer seems very good as well as the one by a sophiscated and commercialized spectrometer such as a spectrophotometer.

Rererence

1) Yong Jin Kim and Dong Jun Yoon, The Possible Reagent for a Cancer Diagnosis by a Urine Color Reaction, J. KOSOMBE, **4** , 145 (1987).
2) Yong Jin Kim, Jong Hwa Lee and Hee J. Lee, The Possible Discovery of a Reagent for Cancer Diagnosis by Urine NMR Analysis, J. KOSOMBE, **9** , 149 (1988).
3) Yong Jin Kim, The Study of Possibility of Finding a Reagent for Cancer Diagnosis by Urine NMR Measurement, J. KOSOMBE. **7** , 35 (1986).

Appendix

The following figures of Fig. I to III are the exemplarly proton NMR signal disributions of two normal and healthy persons' urine(non-cancer urine) and one stomach cancer urine. In Fig. I no NMR signals corresponding to the phenolic compoud appear between 7.00 ppm and 8.00 ppm. But it is noticed that the signals appear in Fig. II between the scales. The area (which is proportional to the concentrations of the sustance) under the NMR signals are relatively smaller than the one shown in Fig. III which represents the distribution of the NMR signals of the stomach cancer urine. Furthermore in Fig. III the signals are much sharper and higher than the ones appeared in Fig. II so that in comparison with the signal areas the cancer diagnosis can be made instead of using the reagents.[2] But this method takes a lot of times. Here it must be noted that the reagent equally and effectively reacts on the excretions between 7.00 ppm and 8.00 ppm in both of Fig. II and III, which leads to the false diagnoses mentioned in the introductory remarks.

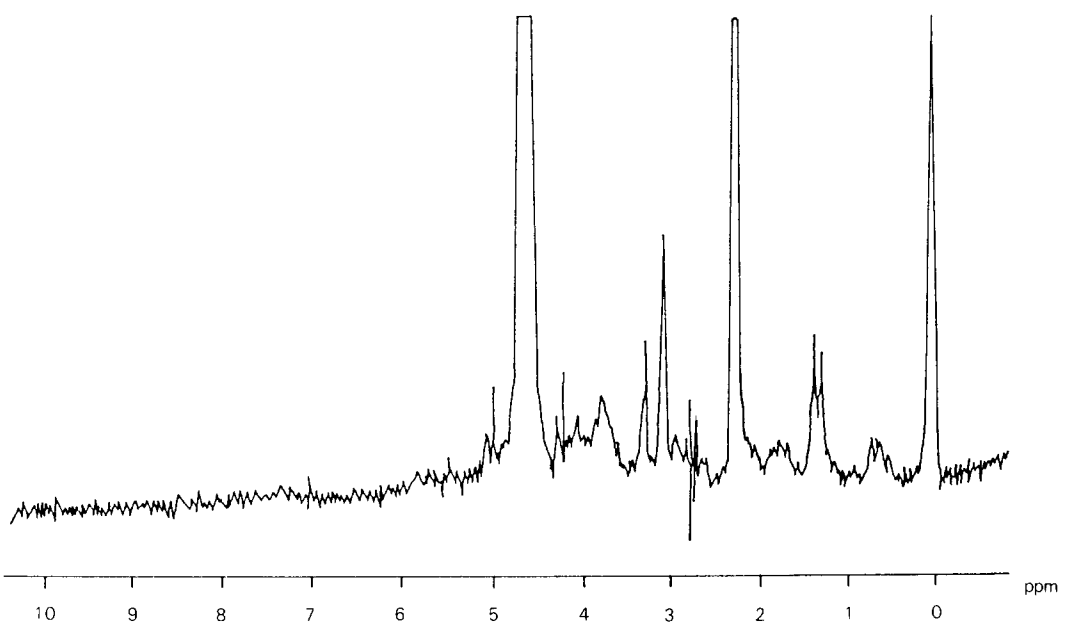

Fig. I . Observed proton NMR signal distribution of a non-cancer urine in ppm measured at room temperature.

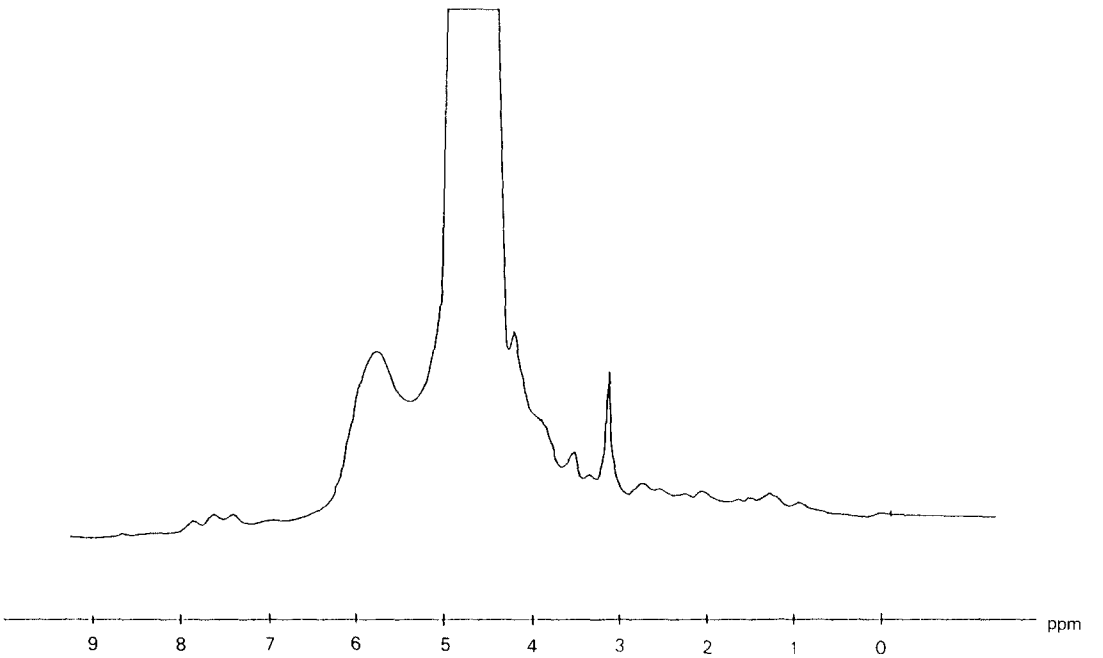

Fig. Ⅱ. Observed proton NMR signal distribution of a non-cancer urine in ppm measured at room temperature.

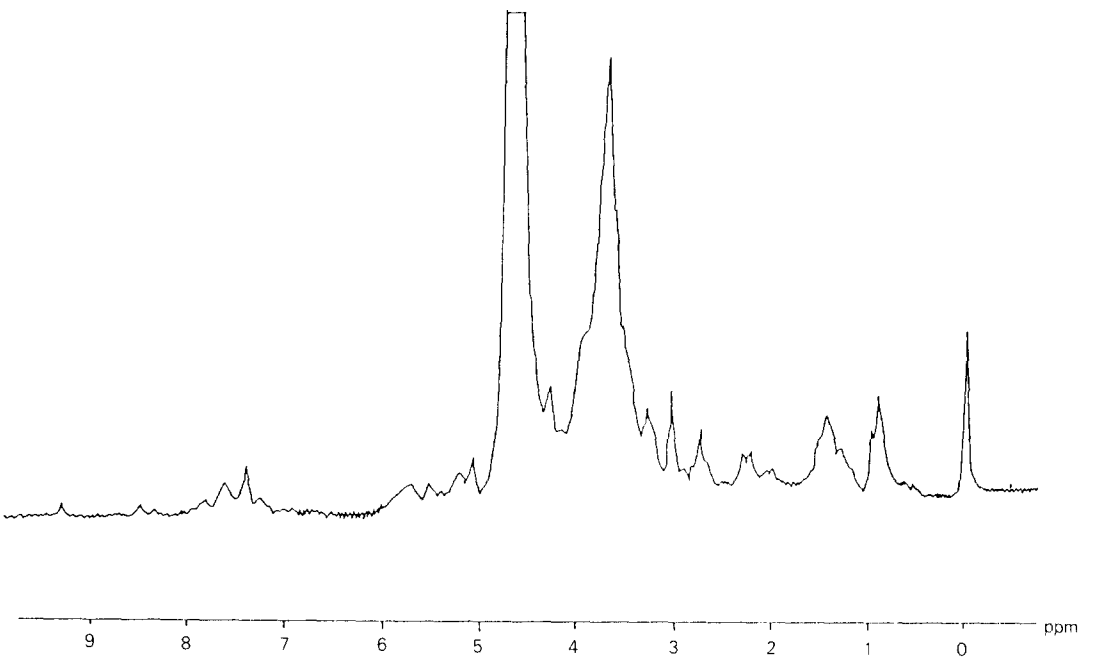

Fig. Ⅲ. Observed proton NMR signal distribution of a stomach cancer patient's urine in ppm measured at room temperature.