NOTE

¹³N-Head Activity following Rectal Administration of ¹³N-ammonia as a Porta-systemic Shunt Index[†]

Nobuo FUKUDA, Yukio TATENO, Tomoyuki RIKITAKE,
Nobuko SAWARA, Mitsuhiro KUCHIKI, Hirofumi KOEN*,
Hirotaka MUSA* and Kunio OKUDA*

National Institute of Radiological Sciences, Anagawa, Chiba-shi 280, Japan

* Department of Medicine, Chiba University School of Medicine,
Inohana-cho, Chiba-shi 280, Japan

Received September 16, 1977

Rectal administration of ammonium salt as done in the rectal ammonia tolerance test, is followed by rapid absorption of ammonia, which is cleared in the normal liver in a single passage. Therefore, ammonia concentration should not rise appreciably in the hepatic vein and systemic arteries.

In the presence of porta-systemic collaterals, some of the absorbed ammonia will bypass the hepatic cells through intra-and/or extrahepatic shunts and go into systemic circulation, thus resulting in a elevation of arterial concentration of ammonia. In such a case the intake of ammonium salts or food substances able to produce ammonia would induce the syndrome of hepatic coma. We expected that measurement of ¹³N-head activity following rectal administration of cyclotron produced short lived ($T_{1/2}=10$ min) ¹³N-ammonia would be of diagnostic value for prediction of hepatic coma associated with porta-systemic shunt in liver cirrhosis.

1. Materials and Methods

Fifteen~thirty mCi of ¹³N-ammonia dissolved in 10 ml of a solution buffered at pH

8.1¹⁾ was administered via a catheter into the rectum of the patients previously cleaned by enema. ¹³N-head and leg activity were recorded by the detectors for renography with rate meters (TOSHIBA, RDU-501) and 2-channel recorders (YOKOGAWA TYPE-3047) positioned over the left temporal region and left leg of the patient respectively. Rectangular collimator and lead-shield was used for the leg measurement but not for the head.

2. Results and Discussion

The control group consisting of a patient with essential tremor, a patient with essential hypertension, and 3 patients with chronic hepatitis, as well as 5 patients with liver cirrhosis and a patient with portal hypertension were studied (Table 1). In the almost every subject, ¹³N-radioactivity appeared in the head and leg in about 1 min after rectal administration, and increased linearly up to 30 min. Hence, the head/leg ratio of ¹³N-activity as well as the ¹³N-head activity/mCi at 30 min itself were tabulated in Table 1 with the other data.

While conclusive comment is not yet in order because of inadequate case studies in the present work, the accumulation of ¹³N-ammonia in the head of the patient with liver cirrhosis was found to be much higher than that in the control with a normal liver. It may represent accumulation of ¹³N-ammo-

[†] 門脈-大循環シャント指数としての ¹³N-アンモニア経直腸投与後の¹³N-頭部放射能。福田信男, 館野之男, 力武知之, 佐原伸子, 朽木満弘, 高圓博文*, 武者広隆*, 奥田邦雄*: 放射線医学総合研究所 280 千葉市穴川4-7-1, * 千葉大学医学部第一内科, 280 千葉市亥鼻町1-8-1.

Table 1 Wedged hepatic venous pressure (WHVP), portal venous pressure (PVP), percentage retention of indocyanine green 15 min after i.v. injection ($\text{ICG}_{(R15)}$), the head/leg ratio of ^{13}N -activity 30 min after rectal administration of ^{13}N -ammonia (H/L_{30}), and the ^{13}N -head activity at 30 min (H_{30})

Name	Sex	Age	Clinical diagnosis	Grade of varices	Ascites	serum γ -globulin (%)	WHVP (mm H_2O)	PVP (mm H_2O)	$\text{ICG}_{(R15)}$ (%)	H/L_{30}	H_{30} (kcps/mCi)
T. O.	F	68	Essential tremor	(-)	(-)	11.6				8.0	3.0
F. T.	M	35	Essential hypertension	(-)	(-)					5.2	2.7
T. I.	F	46	Chronic active hepatitis	(-)	(-)	18.0			5.0	10.0	5.95
I. S.	M	59	"	(-)	(-)	24.0			17.0	10.9	4.65
Y. S.	M	44	Chronic hepatitis	(-)	(-)	19.8			14.5	7.4	3.4
T. N.	M	43	Liver cirrhosis	(+)	(+)		370		40.5	23.2	11.65
Y. N.	M	33	"	(+)	(+)	28.7	120	290	48.5	10.3	6.65
S. H.	M	42	"	(+)	(-)	21.6	280		34.0	8.7	7.0
H. T.	M	49	"	(+)	(±)	33.0	380	402	21.0	17.4	8.5
T. Y.	F	46	"		(+)	35.2	400		59.0	13.5	7.1
T. H.	M	35	Portal hypertension	(+++)	(-)	17.9	130	410	8.0	25.8	8.3

nia bypassing the hepatocytes in the liver with cirrhosis to reach the brain which is known to take up ammonia actively²⁾. This bypassing may be attributed to porta-systemic collateral circulation and decreased effective intrahepatic portal vascularity, as well as to reduced number of functioning hepatocytes in liver cirrhosis. ^{13}N -head activity following rectal administration of ^{13}N -ammonia seems to serve in differentiating between control and the cirrhosis or portal hypertension group.

^{13}N -head/leg ratio may overcome difficulties associated with variations in dosage and absorption in each patient. Accumulation of ^{13}N -ammonia in the leg muscle, however,

affect the ^{13}N -head/leg ratio and decreases the efficiency of discrimination of the cirrhosis group from the control.

The present method is commendable for its non-invasiveness, quick radiation decay, and rapidity in having the results.

References

- 1) N. Fukuda, et al.: Consistence Positron Imaging of the Liver and Heart following Rectal Administration of ^{13}N -ammonia in Liver Cirrhosis. *Radioisotopes*, **12**, 872 (1977)
- 2) Phelps, M.E., Hoffman, E.J., et al.: *J. Nucl. Med.*, **17**, 603-12, (1976)