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Introduction

Recently radionuclide techniques have significantly contributed to the non-invasive diagnosis. Especially positron computed tomography provides a unique capability comparable to in vivo tissue counting. For accurate measurements of myocardial blood flow, labeled microspheres are used but this technique is highly invasive. Therefore, use of diffusible indicators is preferable for noninvasive measurement of myocardial blood flow. Nitrogen-13 ammonia has been used as a flow indicator. We investigated in this work about the value of N-13 ammonia as a flow indicator under conditions of fasting and clarified that the myocardial uptake of N-13 ammonia increased under fasting state.

Materials and Methods

Nitrogen-13 ammonia was produced in the cyclotron by bombarding water with 18-Mev proton producing the $^{16}\text{O}(p,a)^{13}\text{N}$ nuclear reaction, followed by reduction of the N-13 compounds to ammonia with Devarda's alloy. Experimental groups of young male Donryu rats (weighed 130 to 150 g) were fasted for 0, 12, 24, 36 and 48 hours each. Appropriate doses of N-13 ammonia were injected intravenously through a lateral tail vein. They were killed by cervical dislocation at 5 min after injection, and then heart was removed, bottled, weighed and counted in an automated NaI well-counter and the radioactivity data were corrected for physical decay. Eight rats were used for each data point. Secondly, six rats were, weighing 120-140 g, used after free access to water only for 24 hours prior to experiments. Six rats were fed ad libitum and they were used as control. Thallium-201 was injected intravenously, then N-13 ammonia was injected at 15 min after Tl-201 injection. They were killed at 5 min after N-13 ammonia injection, then blood and heart were removed and counted. To normalize for differences in animal weights, tissue concentrations were expressed as gram-dose per gram tissue (g-dose/g tissue).

Results

Effects of fasting on myocardial uptake of N-13 ammonia were studied. The results were presented in Fig. 1. The uptakes by the heart increased with increasing the fasting time from 2.75 ± 0.75 to 5.79 ± 0.68 . Increase of the myocardial uptakes was statistically significant after 24 hours fasting. Myocardial uptakes of N-13 ammonia and Tl-201 were shown in Table 1. In the case of Tl-201, the

difference of the myocardial uptake between control and fasting animals was not statistically significant. The activity of the blood remained relatively unchanged.

Discussion

Recently, N-13 ammonia has been highly evaluated as a flow indicator. We studied in this work whether the myocardial uptake of N-13 ammonia was modified by metabolic alterations. We investigated the myocardial uptake of F-18 labeled 2-deoxyglucose (F-18 FDG) under fasting condition and clarified that the uptake of F-18 FDG decreased by fasting. Therefore myocardial metabolic alterations were apparently induced by fasting. Systemic changes of metabolism may also be induced by fasting. Intracoronary administration of N-13 ammonia is appropriate to evaluate it as a flow indicator, but in practical clinical use, noninvasive assessment of myocardial blood flow is desirable. Therefore, N-13 ammonia was administered intravenously in our study. Myocardial uptake of N-13 ammonia increased under fasting state in our present study. The uptake of Tl-201 by the heart may be changed under fasting condition, but in our present experiments, it was not observed. Nevertheless the uptake of N-13 ammonia increased in our present study. Early after administration, the distribution of Tl-201 in myocardium parallels closely myocardial blood flow. We interpreted these results as myocardial metabolic alterations rather than increase of blood flow. That is to say, these results suggested the possibility that the uptake of N-13 ammonia into myocardium is not a mere function of blood flow. The uptake may also be modified by metabolic alteration. Further investigations may be needed to clarify the effects of fasting on myocardial N-13 ammonia uptake.

References

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Table 1. Myocardial Uptakes of N-13 Ammonia and Thallium-201

	g-dose/g tissue*			
	N-13 ammonia		Thallium-201	
	Blood	Heart	Blood	Heart
ad libitum fed rats	0.31±0.01	2.61±0.39	0.11±0.01	4.74±0.22
24 hrs fasted rats	0.32±0.02	4.22±0.59**	0.10±0.01	4.45±0.30 [!]

* Mean SD for six rats per point

** Statistically significant P<0.001

! not significant

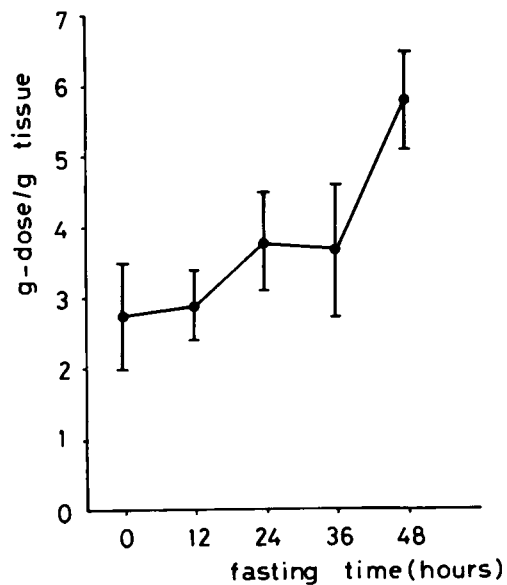


Fig. 1. Effects of fasting on myocardial uptake of N-13 ammonia. The uptake by the heart increased with the fasting time. Each point represents the Mean±SD of eight rats.