MethodsX 3 (2016) 289–296

Contents lists available at ScienceDirect

MethodsX

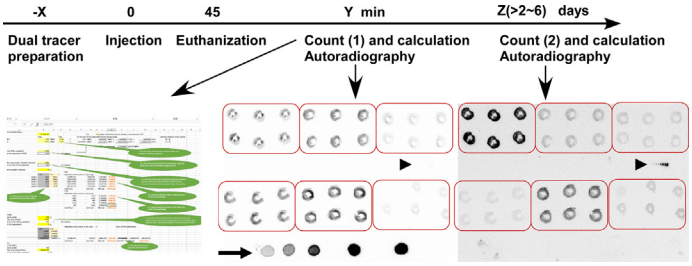
journal homepage: www.elsevier.com/locate/mex

A data sheet for the simultaneous assessment of dual radioactive tracer uptake in the heart

Takao Kato

Department of Cardiovascular Medicine, Graduate School of Medicine, Kyoto University, 54 Shogoin Kawahara-cho, Sakyo-ku, Kyoto 606-8507, Japan

GRAPHICAL ABSTRACT



ABSTRACT

The myocardium takes up two major substrates: glucose and fatty acids, and various methods have been used to evaluate this uptake. Despite extensive study of radiotracer uptake-based methods, however, an easily applicable datasheet has not previously been provided. In this manuscript, an example of a method involving an easily modified data sheet based on dual tracer methods is presented.

This method, with its data sheet:

- Is applicable to all radiotracers, regardless of decay time
- Is useful, simple, and modifiable; and
- Is applicable to small animal studies.

ARTICLE INFO

Method name: A data sheet for a dual radioactive tracer method
Keywords: Myocardium, Radiotracer, Data sheet, Dual tracer method, Uptake, Small animal studies
Article history: Received 8 January 2016; Accepted 30 March 2016; Available online 2 April 2016

E-mail address: tkato75@kuhp.kyoto-u.ac.jp (T. Kato).

http://dx.doi.org/10.1016/j.mex.2016.03.015

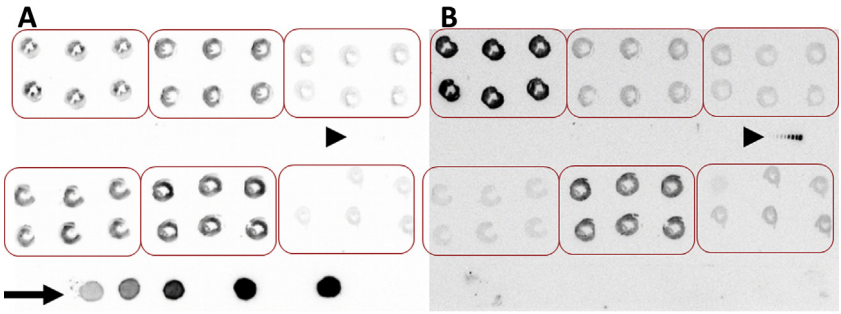


Fig. 1. (A) Autoradiography of ^{18}F-fluorodeoxyglucose (^{18}FDG) at the first analysis. (B) Autoradiography of ^{125}I-iodophenyl 9-methylpentadecanoic acid (^{125}I-9MPA) at the second analysis.
When ^{18}FDG images were acquired (A), graded standards of both ^{18}FDG which consisted ^{18}FDG only and ^{125}I-9MPA which consisted ^{125}I-9MPA olny as described in second method in the section 2 in Measurement of radioisotope activity were placed on the sheet. When ^{125}I-9MPA images were acquired 9 days after the first experiment (B), the same sheet was exposed; note that the ^{18}FDG standards had completely decayed. The respective ^{18}FDG and ^{125}I-9MPA doses per rat were 436 μCi (16.1 MBq) and 11.6 μCi (0.43 MBq). The arrow indicates graded ^{18}FDG standards. Arrowheads indicate graded ^{125}I-9MPA standards.

Methods details

Overview

In this methodological study, myocardial glucose and fatty acid uptake were measured using ^{18}F-fluorodeoxyglucose (^{18}FDG) and ^{125}I-labeled fatty acid tracer, respectively [1,2]. The fatty acid tracers comprise ^{125}I-iodophenyl 9-methylpentadecanoic acid (^{125}I-9MPA) which is incorporated and rapidly metabolized to iodophenyl-3-methylnonanoic acid by beta-oxidation and retained in the myocardium [3] and ^{125}I-BMIPP, 15-(*p*-iodophenyl)-3-*R*,S-methylpentadecanoic acid, which is another fatty acid tracer and metabolized by β oxidation and retained in the myocardium [4]. The radioactive half-lives of ^{18}FDG and ^{125}I-labeled fatty acid tracer are 110 min and 60 days, respectively. The dual tracer methods utilize the difference in decay times, the energy peaks, and the doses injected of two tracers. For example, rats were fasted overnight, simultaneously injected with about 0.5–1 mCi of ^{18}FDG and about 10–20 μCi of ^{125}I-lrabeled fatty acid tracer, and euthanized by decapitation 45 min

Table 1
Advantages and disadvantages of radioactive and stable tracers.

	Advantages	Disadvantages
Radioactive	In vivo imaging available by PET or SPECT; relatively easy clinical application Autoradiography	Some tracers have a very short decay time
	systems and activity counters widely available for ex vivo analysis	Some tracers are trapped, and only substrate uptake is analyzed
	Dual-tracer methods utilize different decay times, energy peaks, and dosages	Limited information available about intermediate metabolites
Non-radioactive (Stable tracers)	Fluxome analysis of intermediate metabolites from tracers using nuclear magnetic resonance (NMR) or gas chromatography mass spectrometry (GC–MS)	Difficulties with in vivo analysis
	Complex metabolic networks can be analyzed	Expensive tracers and equipment
	Do not decay or emit radiation	Natural abundance of a given isotope (and presence of multiple other isotopes) must be low
		Amounts should be sufficiently large to account for when calculating a metabolic rate