Perfusion imaging using rubidium-82 ((82)Rb) PET in rats with myocardial infarction

First small animal cardiac (82)Rb-PET

Clemmensen, Andreas Ettrup; Ghotbi, Adam Ali; Bodholdt, Rasmus Poul; Hag, Anne Mette Fisker; Hasbak, Philip; Ripa, Rasmus Sejersten; Kjaer, Andreas

Published in:
Journal of Nuclear Cardiology

DOI:
10.1007/s12350-016-0564-6

Publication date:
2017

Document version
Publisher's PDF, also known as Version of record

Document license:
CC BY

Citation for published version (APA):
Clemmensen, A. E., Ghotbi, A. A., Bodholdt, R. P., Hag, A. M. F., Hasbak, P., Ripa, R. S., & Kjaer, A. (2017). Perfusion imaging using rubidium-82 ((82)Rb) PET in rats with myocardial infarction: First small animal cardiac (82)Rb-PET. Journal of Nuclear Cardiology, 24(2), 750-752. https://doi.org/10.1007/s12350-016-0564-6

Download date: 03. apr. 2022
Perfusion imaging using rubidium-82 ($^{82}$Rb) PET in rats with myocardial infarction: First small animal cardiac $^{82}$Rb-PET

Andreas Ettrup Clemmensen, MSc, Adam Ali Ghotbi, MD, Rasmus Poul Bodholdt, MSc, Anne Mette Fisker Hag, PhD, Philip Hasbak, MD, Rasmus Sejersten Ripa, MD, DMSc, and Andreas Kjaer, MD, PhD, DMSc

Departments of Clinical Physiology, Nuclear Medicine & PET and Cluster for Molecular Imaging, Rigshospitalet and University of Copenhagen, Copenhagen, Denmark

Received May 11, 2016; accepted May 21, 2016
doi:10.1007/s12350-016-0564-6

INTRODUCTION

Assessing myocardial perfusion using $^{82}$Rb-PET is emerging as a valuable clinical tool. The rapid decay ($T_1/2 = 76$ s) allows for absolute quantification of both rest and stress perfusion within 30 minutes. In addition to evaluation of epicardial disease with perfusion defects, also evaluation of balanced coronary and small vessel disease is possible. For further evaluation of how $^{82}$Rb-PET can be used clinically, pre-clinical application of the method would be valuable. However, so far no data on the use of $^{82}$Rb-PET in small animals have been published nor has the use of $^{82}$Rb-PET, to the best of our knowledge, been successfully tried. Therefore, we wanted to develop and test the applicability of the method in rats, despite the high positron range of $^{82}$Rb. To do so, we adapted the clinical method and tested it in rats with experimentally induced myocardial infarction.

CASE SUMMARY

A male Sprague-Dawley rat underwent $^{82}$Rb-PET/CT as described in Figure 1; after the baseline scan, the animal was subjected to myocardial infarction; a thoracotomy was performed, and LAD was ligated proximally. After closure, the animal recovered under anesthesia for 45 minutes, before being scanned again following the same protocol. Figure 2 shows the perfusion images, demonstrating clear uptake in the myocardium. On the post-infarction images, the perfusion defect is identified. The anterolateral location of the myocardial infarct was similar to that seen in humans when the culprit lesion is in the LAD. This despite anatomical differences between rats and humans. The myocardial infarct was subsequently confirmed by ex vivo autoradiography.
Despite the challenge of high energy of the positron emitted by $^{82}$Rb, the infarcted area could be identified on the in vivo images.

CONCLUSION

For the first time, feasibility of $^{82}$Rb-PET in small animal cardiac imaging has been demonstrated. The method could delineate an infarcted area of a rat heart in vivo. These encouraging data stimulate for further development of the method.
Pre-infarct | Post-infarct | Autoradiography
---|---|---
Basal slice | ant | lat | sep
Apical slice | inf | * | sep lat

**Figure 2.** $^{82}$Rb-PET short axis images of the heart before (left column) and after (middle column) LAD ligation. The reconstructed scan was imported into pMod software (v 3.3, pMod Technologies Ltd, Zürich, Switzerland) and reoriented to short axis view. After the second PET/CT scan, the animal was injected with 40-50 MBq of $^{99m}$Tc-Sestamibi and after 10 minutes the animal was euthanized by decapitation. The heart was rapidly excised and snap-frozen in liquid nitrogen. The frozen heart was casted in Tissue-Tek (Sakura, NL) and 20 slides (8 μm thick) were made, 240 μm apart, covering the infarcted area. The slides were exposed to a radiosensitive phosphor film and developed in a phosphor imager (Cyclone Plus, PerkinElmer Inc., US). The right panels show the resulting ex vivo autoradiography images of histological slices corresponding to the PET images. The infarcted area is marked by an arrow on both the $^{82}$Rb-PET and the autoradiography. The star (*) denotes a slicing artifact.

**Open Access**

This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.

**References**

1. Saraste A, Kajander S, Han C, Nesterov SV, Knutti J. PET: Is myocardial flow quantification a clinical reality? J Nucl Cardiol 2012;19(5):1044–59.
2. Flotats A, Knutti J, Guterlet M, Marcassa C, Bengel FM, Kaufmann PA et al. Hybrid cardiac imaging: SPECT/CT and PET/CT. A joint position statement by the European Association of Nuclear Medicine (EANM), the European Society of Cardiac Radiology (ESCR) and the European Council of Nuclear Cardiology (ECNC). Eur J Nucl Med Mol Imaging 2011;38(1):201–12.
3. Anderson PG, Bishop SP, Peterson JT. Chapter 26—Cardiovascular Research A2—Suckow, Mark A. In: Weisbroth SH, Franklin CL, editors. The Laboratory Rat. 2nd ed. Burlington: Academic Press; 2006. p. 773–802.