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Novel Functional Renal PET Imaging With ^{18}F-FDS in Human Subjects

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Abstract: The novel PET probe 2-deoxy-2-^{18}F-fluoro-D-sorbitol (^{18}F-FDS) has demonstrated favorable renal kinetics in animals. We aimed to elucidate its imaging properties in 2 human volunteers. ^{18}F-FDS was produced by a simple 1-step reduction from ^{18}F-FDG. On dynamic renal PET, the cortex was delineated and activity gradually transited in the parenchyma, followed by radiotracer excretion. No adverse effects were reported. Given the higher spatiotemporal resolution of PET relative to conventional scintigraphy, ^{18}F-FDS PET offers a more thorough evaluation of human renal kinetics. Due to its simple production from ^{18}F-FDG, ^{18}F-FDS is virtually available at any PET facility with radiochemistry infrastructure.

Key Words: 2-deoxy-2-^{18}F-fluoro-D-sorbitol, ^{18}F-FDS, renal imaging, PET, split renal function, kidney

(*Clin Nucl Med* 2019;44: 410–411)

Received for publication November 27, 2018.
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Conflicts of interest and sources of funding: This work was supported by the Competence Network of Heart Failure funded by the Integrated Research and Treatment Center of the Federal Ministry of Education and Research, NIH R01-HL131829, and German Research Council (DFG grant HI 1789/3-3). This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement no. 701983. None declared to all authors.
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ISSN: 0363-9762/19/4405–0410
DOI: 10.1097/RLU.0000000000002494

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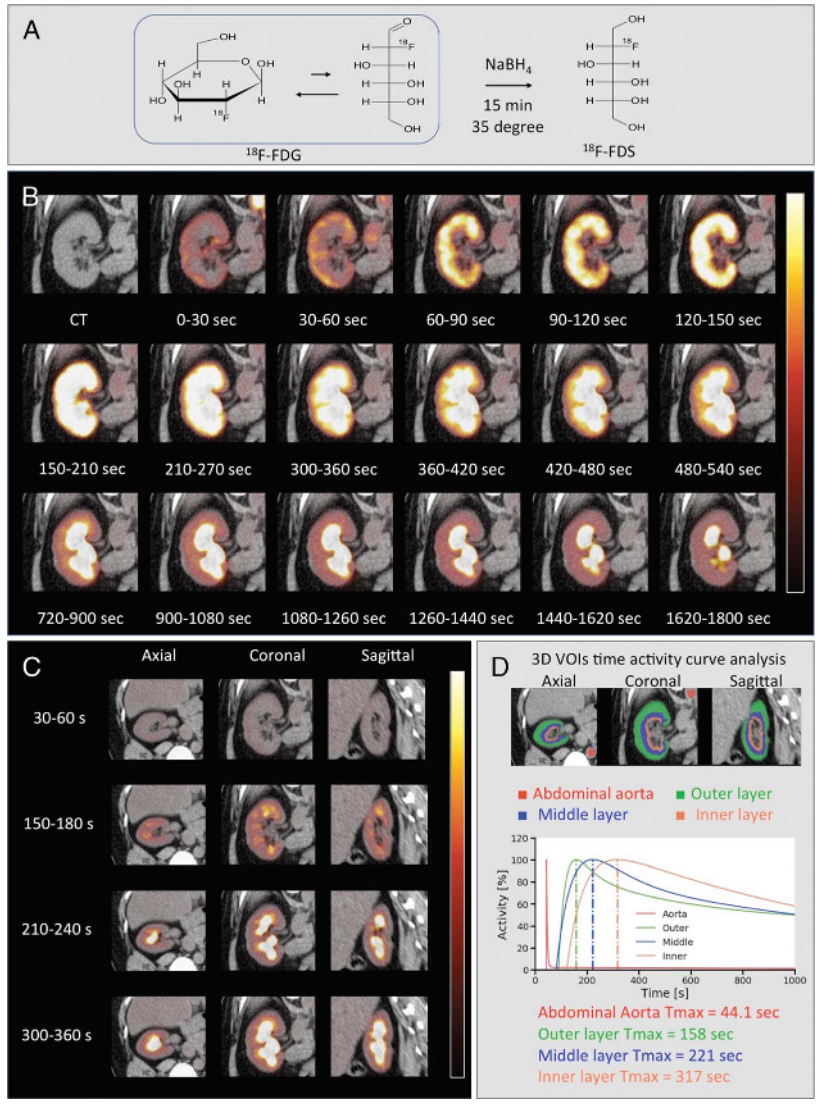

FIGURE 1. Due to its underlying sorbitol structure that shares kinetic properties to the criterion standard inulin (sorbitol-to-inulin clearance ratio, 1.01),[1] the novel renal PET imaging agent 2-deoxy-2-^{18}F-fluoro-D-sorbitol (^{18}F-FDS) demonstrated promising properties for renal imaging in preclinical experiments.[2,3] Furthermore, ^{18}F-FDS can be easily produced by a simple 1-step reduction of 2-deoxy-2-^{18}F-fluoro-D-glucose (^{18}F-FDG).[4,5] We aimed to elucidate its imaging properties in human. ^{18}F-FDS was produced by a simple 1-step reduction from ^{18}F-FDG (**A**). Two volunteers underwent dynamic ^{18}F-FDS PET/CT, and standard and blood urine tests were normal at the time of the scan (serum creatinine, <1.2 mg/dL; estimated GFR, >60 mL/min/1.73m^2). Volumes of interest (outer layer covering the renal cortex and middle/inner layer covering the renal medulla) were placed on the left and right kidneys. **B** to **D** displays the right kidney of a 48-year-old woman. After rapid clearance of the circulation system, the radiotracer was excreted through the urinary system and finally transited into the collecting systems. In a dynamic PET acquisition centered on the kidneys, only the renal cortex was delineated 60 seconds after injection of the radiotracer, reflecting blood flow (**B**). Thereafter, activity gradually accumulated in the renal parenchyma and reached the pelvicalyceal system after 210 seconds (**C**), followed by radiotracer excretion. Finally, retention in the kidneys diminished completely. Three-dimensional volumes of interest placed on the outer (cortical) and middle/inner (medullary) layers of the kidneys confirmed ^{18}F-FDS transit from the renal cortex through the medulla toward the pelvis (**D**). For the second volunteer, similar results on renal PET imaging were recorded. Given the higher spatiotemporal resolution of PET technologies relative to conventional 2D scintigraphy, ^{18}F-FDS PET may offer a more thorough evaluation of human renal kinetics. Notably, ^{18}F-FDS can be easily produced from the most commonly used PET radiotracer ^{18}F-FDG, providing access for virtually any PET facility with radiochemistry infrastructure. Moreover, due to the long half-life (109.4 minutes), delivery from central cyclotron facilities to smaller hospitals can be envisaged,[6] which has been proven to be cost-effective for oncology imaging with ^{18}F-FDG.[7] ^{18}F-FDS PET has the major advantage of lower positron energy along with higher positron yield, and therefore, the increased count rates offer the opportunity to inject a considerably lower amount of activity. Hence, ^{18}F-FDS PET could significantly lower radiation exposure to children without sacrificing imaging quality.[8] Thus, ^{18}F-FDS could also be applied to pediatric indications, for example, to identify structural abnormalities with significant functional obstruction.[9]