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Conf-820666--7

BNL--31713

BNL-31713

DE82 020526

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SHORT-LIVED POSITRON EMITTER LABELED RADIOTRACERS - PRESENT STATUS

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Widespread interest in the application of positron emission transaxial tomography (PETT) and organic molecules labeled with short-lived positron (β^+) emitting nuclides to the study of physiological processes in the living human body (1,2,3) has been brought about largely by the demonstration that one of the elegant methods of neurochemical autoradiography (4), namely the ^{14}C-2-deoxyglucose (^{14}C-2DG) method (5), could be extended to humans by using these techniques. For example, by using 2-deoxy-2 [^{18}F]fluoro-D-glucose (^{18}FDG), a β^+ emitter labeled analog of 2DG, it has been possible to correlate regional brain glucose metabolism with functional activity in humans during normal circumstances (6-8), under conditions of somatosensory stimulation (9-12) and in psychiatric conditions (13-16). This characterization of the metabolic activity of the functioning human brain and other organs such as the heart (17) depends on the use of positron emission transaxial tomography (PETT), a method of detection which gives an image of the distribution of the labeled tracer in a transverse section of the body (18-22) allowing the quantitation of radioactivity in a discrete volume of tissue. By applying PETT, the appropriate labeled tracers and mathematical models (3) to problems in the biomedical sciences it has been possible for the first time to obtain regional metabolic information in the living human body at little or no risk. Such studies are truly multidisciplinary and require a coordination of efforts in cyclotron (accelerator) technology, nuclide and labeled compound preparation, PETT and computer science and research in biology and medicine. Today, many coordinated cyclotron-PETT centers, dedicated solely to applying this powerful new technique to a variety of problems, are emerging.

This chapter will describe some of the problems and progress in the synthesis of short-lived β^+ emitter (^{11}C, ^{18}F, ^{13}N) labeled tracers for PETT within the context of their application to problems in the biomedical sciences. For a comprehensive treatment of the subject of rapid synthesis of organic molecules labeled with carbon-11, fluorine-18 and nitrogen-13 the reader is referred to a recent monograph on the subject (23).

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