

Design and Synthesis of 2-Deoxy-2-[¹⁸F]fluoro-D-glucose (¹⁸FDG)

Joanna S. Fowler and Tatsuo Ido

Chemistry Department, Brookhaven National Laboratory, Upton NY 11973

Tohoku University, Sendai, Japan

THE FIRST SYNTHESIS of 2-deoxy-2-[¹⁸F]fluoro-D-glucose (¹⁸FDG) for human studies took place in 1976 the result of a collaboration between scientists at the National Institutes of Health, the University of Pennsylvania and Brookhaven National Laboratory which had begun three years earlier. ¹⁸FDG was developed for the specific purpose of mapping glucose metabolism in the living human brain thereby serving as a tool in the basic human neurosciences (Ido et al, 1978; Reivich et al, 1979). With ¹⁸FDG it was possible for the first time to translate the [¹⁴C]2-DG autoradiographic method (Sokoloff, 1979) to the clinical arena. Around the same time that ¹⁸FDG was developed, preclinical studies suggested the utility of ¹⁸FDG for studies of myocardial metabolism (Gallagher et al, 1977) and for tumor metabolism (Som et al, 1980).

In the first human studies and many that followed, ¹⁸FDG was synthesized at Brookhaven National Laboratory on Long Island and sent by small plane to Philadelphia Airport and then transported to the Hospital of the University of Pennsylvania where the first images of a human volunteer were made (Figure 1). In spite of the 110 minute half-life of fluorine-18 and the relatively low yields of ¹⁸FDG, this remote supply of ¹⁸FDG served to demonstrate its unique properties and its utility as a scientific tool for basic research and clinical diagnosis. In the next few years BNL supplied ¹⁸FDG to the Hospital of the University of Pennsylvania and also to the National Institutes of Health. Soon, however, most of the major institutions having a cyclotron produced ¹⁸FDG for their own use. It is remarkable that 25 years later, the production of ¹⁸FDG