The production of PET tracers utilizing small accelerators

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The goal of positron emission tomographic (PET) studies is to utilize radiotracers to provide fundamental information that will lead to a better understanding of the physiology in both diseased and healthy tissue. In order for PET to become a viable clinical modality, these tracers must be produced reliably and efficiently. Work has concentrated on developing a cyclotron laboratory dedicated to the efficient production of the most commonly used PET tracers. Considerable effort has been directed towards understanding the subtleties of all of the subprocedures involved. As a result of this work, the success rate of delivering radiopharmaceuticals on demand to the nuclear medicine clinic is now above 95%.

In order to further facilitate performing PET studies with minimal professional support, a time-of-flight detector system has been developed to noninvasively measure input functions that are required in applying compartmental models to the data. Its potential utility has been demonstrated with phantoms; testing and evaluation is currently being studied in human patients.

The feasibility of producing PET tracers in a manner consistent with the operation of a clinical PET center has been demonstrated. Since FDG is the tracer in highest demand (over 50% of all studies), the effort has concentrated on the production of this model compound. As a result of this work, the amount of FDG that may be produced in a single synthesis at the University of Wisconsin-Madison has increased by a factor of 25 in the last five years. During the same period, the number of man-hours needed to perform a FDG synthesis has decreased by a factor of 10 and the radiation dose received by the chemist per mCi of starting material has decreased by a factor of 100. In addition to these advances, the number of successful syntheses between failures has increased by a factor of 20. This improvement has been made possible by a thorough understanding of all aspects of the production of PET tracers and by intelligent monitoring of the parameters that have the greatest effect on the outcome of the synthesis.