

Radiation Environment in Medical Cyclotron Facility & Optimization of Synthesis Parameters of Flouro-Deoxy Glucose

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ABSTRACT OF Ph.D. THESIS

“RADIATION ENVIRONMENT IN MEDICAL CYCLOTRON FACILITY & OPTIMIZATION OF SYNTHESIS PARAMETERS OF FLOURO-DEOXY GLUCOSE”

INTRODUCTION:

Positron Emission Tomography is a nuclear imaging modality of nuclear medicine department that has rapidly gained favor. PET is powerful imaging modalities, which are mainly used for oncological, cardiological and neurological patients. Most important application of PET is in the staging and management of cancers. PET accurately determines the extent of the spread of disease in a cancer patient. PET scanning is a simple, non-invasive procedure. For undertaking a whole body PET scan, a small intravenous injection of the radiopharmaceutical injected (i.e. Flouro-Deoxy Glucose).

For production of Flouro-Deoxy Glucose, we need F-18 which is radioactive in nature. This F-18 produced on-site in a special machine called medical cyclotron. During production of F-18 we checked any radiation leakage is found or not. On the same time we also monitored the irradiation parameters of the medical cyclotron. During this monitoring we optimized the working principle of medical cyclotron and irradiation parameters. After production of F-18 it was transferred in to the Radiochemistry module Explora FDG4. Where actually Flouro-Deoxy Glucose synthesized.

This work includes the radiation safety of the patients, patient attendants and radiation safety personals, Radiation environment of the medical cyclotron Facility. Radiation safety personal include the staff working at the site. Which include Nuclear

Medicine Physicians, Medical Physicist, Radiation Safety Officer, Nuclear Medicine Technologist, Nurse and Nursing attendant. In this study on Radiochemistry module Explora FDG4 synthesis parameter optimized.

OBJECTIVE OF RESEARCH

This was carried out in the Department of PET Scan and medical cyclotron Facility, where actually cyclotron was installed. Basically three major equipments were involved in this study. Those were medical cyclotron, Radiochemistry Explora FDG4 Module and PET scanner. The cyclotron is the most widely used particle accelerator for producing medically important radio nuclides. The name of this cyclotron is Eclipse RDS111 from Siemens Limited, Germany. Many medical centers in India have installed compact medical cyclotrons for on-site production of short-lived positron-emitting radio nuclides. The energy of the medical cyclotron was 11 MeV. This means the charge particle will rotate about by this speed. The maximum target current of this cyclotron was 40 μ A.

A mandatory requirement for cyclotron installation is radiation control permit from AERB. Cyclotron radiation survey is an integral part of the overall radiation safety in the cyclotron facility.

Since this is a very new modality in the India. So the motivation behind this work is to understand the processes which start with cyclotron start and up to patient's scan.

The purpose of this work is to optimize the working principle of medical cyclotron and synthesis of parameters of FDG. In this study the knowledge of

Physics, Nuclear Physics, Chemistry and Radiochemistry and Nuclear Medicine involved. This work was basically related with Nuclear PET Radiopharmacy

In summary, the following work has been carried out:

1. To optimize the working principle of medical cyclotron
2. To optimize the irradiation parameters of medical cyclotron for maximum yield
3. To study the radiation safety aspects in medical cyclotron, Radiochemistry lab and Quality Control area
4. To study to minimization of radiation dose to staff and attendant of the patients minimize in PET scan.
5. To optimize the synthesis parameters of Positron Emitting Flouro-Deoxy Glucose in Cyclotron Facility

The present work is organized into following five chapters:

Chapter-1 It is include the introduction of the study. Its deals with the basics of PET Pharmacy and medical cyclotron. Importance of irradiation in the field of Nuclear Science is explained. In this chapter also discussed about aims of the study. A review of literature on present experimental work on the medical cyclotron and FDG is carried out. The objectives and future scope of the present work have been given at the ending of this chapter.

Chapter-2 Gives the information about the material used and experimental technique used in present work. This chapter gives the information about the medical cyclotron, FDG and Radiation safety aspects. In this chapter optimize the working principle of

medical cyclotron and optimize the irradiation parameters of medical cyclotron for maximum yield also mentioned.

Chapter-3 This chapter includes the comprehensive studies of synthesis of FDG and its quality control and optimization of parameters of Synthesis of. The effect of optimization of FDG parameters also mentioned. The advantage of optimization includes Yield, Chemical consumed and Time. It consumed lesser chemicals, lesser time and maximized the yield of FDG by new method. Further, all quality control was done of produced FDG and showing excellent results.

Chapter-4 In this chapter the radiation level of the deferent points of the medical cyclotron, Radiochemistry synthesis area and Quality Control areas were tabulated and analyzed. In cyclotron area radiation monitoring was done before bombardment, during bombard and after bombardment. In case radiochemistry area, it was done before synthesis, during synthesis and after synthesis. In quality control area radiation exposure level was noted before and during quality control. It also tells us about the layout of the radiation surveillance. Deferent point were recognized for radiation monitoring

Chapter-5 This chapter concludes the findings of this research work and presents a discussion of their implications in the context of present and future effects of medical cyclotron and FDG. The future scope of the present work has also been presented.