PRODUCTION OF RADIOPHARMACEUTICALS BY CYCLOTRONS

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During these last ten years, the radiopharmaceuticals producers' community has experienced tremendous changes. Historically, this occurred mainly because of

- hardware improvements : cyclotron, targets, radiochemistry
- involvement of the regulatory affairs and large extension of medical use
- use of new radioisotopes or new radioisotopes production techniques

Companies specialized in the development and installation of accelerator-based systems dedicated to the medical applications brought on the market cyclotrons well fitted to the requests of the industrial community or universities and so covering every segment of the market (table1). These machines are fully automatic, and need reduced maintenance; they are highly specialized for defined tasks. They can produce high beam intensity and realize dual beam irradiation. Also the prices are reducing considerably. The targets and the automatic system follow the same trend. Unfortunately, the flexibility of these devices for new area of research and development has been dramatically reduced.

The growing number of PET cameras has increased the popularity of PET tracers used for nuclear imaging. Consequently, there is a growing demand for these radiopharmaceuticals compounds labeled with short-lived radioisotopes for clinical applications. From a research and development tool in the eighties, PET has now grown up to a clinical tool. Moreover, depending of the social welfare, reimbursement of some PET examinations is granted, which accelerates the trend for an extended use of PET tracers. Regulatory affairs try to establish and standardize the control on these radiopharmaceutical compounds produced in a growing number of local radiopharmacies owning a baby cyclotron. On the other hand, the attention of equipment

suppliers was brought in the setting up of a total quality control follow up. These efforts were successively achieved by getting for instance the ISO 9001 certificate.

The third factor of major changes in the cyclotron technology relates to attempts of transferring to cyclotron facilities the production of radioisotopes previously generated in nuclear reactors. This is the case, for instance for palladium-103 used in brachytherapy.

Improvement of cyclotrons, successful development of local radiopharmacy dedicated to PET tracer production have contributed to an increase of production facility owning a cyclotron and radioisotopes produced by these accelerators.

References

IAEA-dcrp/cd

Table 1 : General basic characteristics of cyclotrons available on the market.

Beam energy (MeV)	Particles	Typical beam intensity on beam stop (μA)	Typical production
3	D^+	80	^{15}O
10-13 p-5	H^- option D^-	100	^{15}O, ^{11}C, ^{13}N, ^{18}F
16-19 p-, 8-10	H^- option D^-	150	^{15}O, ^{11}C, ^{13}N, ^{18}F, ^{124}I, ^{86}Y…
14-19	H^+ or H^-	2000	^{103}Pd
15-30	H^-	1000	^{123}I, ^{201}Tl, ^{67}Ga, …