MICROFLUIDIC CIRCUIT APPLIED TO THE CONCENTRATION OF 18F FOR THE PRODUCTION OF RADIOPHARMACEUTICALS

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Introduction: Microfluidics is becoming a promising technology for synthesizing [^{18}F]-labeled radiopharmaceuticals, reducing costs, reagents, and increasing activity [1]. Conversely, current commercial production of such radiopharmaceuticals for clinical diagnosis by positron emission tomography (PET) imaging requires dedicated and expensive equipment, only available in specialized facilities to produce only one type of ^{18}F radiopharmaceutical [2]. So, as the demand for PET increases, the use of microfluidics becomes essential for this commercial production, and, in this sense, this work presents the results of a developed "micro-cartridge" microfluidic chip applied to the ^{18}F retention and elution process that can improve all the production aspects.
Methodology: The micro-cartridge was machined in borosilicate optical glass – BK7 using the ultrashort pulse laser ablation technique. After micromachining, the micro-cartridge is filled with the same resin used in the conventional anionic synthesis cartridge (Waters Accel Plus QMA Light cartridge). Both are later submitted to comparative performance tests to evaluate the radiochemical efficiency in the ^{18}F retention and elution phase between them.
Results and discussion: Four comparative tests were performed for both phases (first stage of synthesis of radiopharmaceuticals labeled with ^{18}F), with activities (55.5 ± 11.1 Mbq and 9.2 ± 0.4 Gbq; n = 2). The results showed that the micro-cartridge is equivalent to the conventional cartridge (QMA Plus Light) in the retention phase, presenting a radiochemical efficiency of 99.3% ± 0.7 vs 99.6% ± 0.3, respectively. However, in the ^{18}F elution phase, the micro-cartridge showed a radiochemical efficiency of 93% ± 0.2, and the conventional cartridge had a maximum of 77.4% ± 15.5, showing the great advantage of the micro-cartridge. The hypothesis that supports the superiority of the results of micro-cartridge efficiencies in the elution phase is the high surface-volume ratio, which leads to the prevalence of surface phenomena such as mass transfers and faster reaction syntheses, which occur in microfluidic systems. Although the microfluidic systems studied for radiopharmaceuticals have existed for almost 20 years, the use of the ultrashort pulse laser technique and the type of material used in the micro-cartridge development are not commonly reported.
Conclusions: Integrating an anion exchange micro-cartridge on a chip with the ultrashort pulse laser ablation technique opens the door to smaller, and more efficient radiopharmacy chips for producing ^{18}F radiopharmaceuticals. The first unprecedented experimental results in Brazil demonstrate that the initial stages of production of ready-to-use doses for humans (pre-concentration of fluorine) can be carried out with greater efficiency in the elution parameters of ^{18}F compared to synthesis with a conventional cartridge.

References:

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