
Carbon-11- and fluorine-18-labeled choline derivatives are commonly used in prostate cancer imaging in the clinical setting for staging and re-staging of prostate cancer. Due to a limited detection rate of established positron emission tomography (PET) tracers, there is a clinical need for innovative tumor-specific PET compounds addressing new imaging targets. The aim of this study was to compare the properties of [(18)F]Bombesin (BAY 86-4367) as an innovative biomarker for prostate cancer imaging targeting the gastrin-releasing peptide receptor and [(11)C]Choline ([(11)C]CHO) in a human prostate tumor mouse xenograft model by small animal PET/X-ray computed tomography (CT). We carried out a dual-tracer small animal PET/CT study comparing [(18)F]Bombesin and [(11)C]CHO. The androgen-independent human prostate tumor cell line PC-3 was implanted subcutaneously in the flanks of nu/nu NMRI mice (n = 10) (PET/CT measurements of two [(11)C]Choline mice could not be analyzed due to technical reasons). [(18)F]Bombesin and [(11)C]CHO PET/CT imaging was performed about
3-4 weeks after the implantation of PC-3 cells on two separate days. After the intravenous tail vein injection of 14 MBq [(18)F]Bombesin and 37 MBq [(11)C]CHO, respectively, a dynamic study over 60 min was acquired in list mode using an Inveon animal PET/CT scanner (Siemens Medical Solutions). The sequence of [(18)F]Bombesin and [(11)C]CHO was randomized. Image analysis was performed using summed images as well as dynamic data. To calculate static and dynamic tumor-to-muscle (T/M), tumor-to-blood (T/B), liver-to-blood (L/B), and kidney-to-blood (K/B) ratios, 4 × 4 × 4 mm(3) volumes of interest (VOIs) of tumor, muscle (thigh), liver, kidney, and blood derived from transversal slices were used. The mean T/M ratio of [(18)F]Bombesin and [(11)C]CHO was 6.54 ± 2.49 and 1.35 ± 0.30, respectively. The mean T/B ratio was 1.83 ± 0.79 for [(18)F]Bombesin and 0.55 ± 0.10 for [(11)C]CHO. The T/M ratio as well as the T/B ratio for [(18)F]Bombesin were significantly higher compared to those for [(11)C]CHO (p< 0.001, respectively). Kidney and liver uptake was statistically significantly lower for [(18)F]Bombesin (K/B 3.41 ± 0.81, L/B 1.99 ± 0.38) compared to [(11)C]CHO (K/B 7.91 ± 1.85 (p< 0.001), L/B 6.27 ± 1.99 (p< 0.001)). The magnitudes of the time course of T/M and T/B ratios (T/M and T/B dyn ratios) were statistically significantly different (showing a higher uptake of [(18)F]Bombesin compared to [(11)C]CHO); additionally, also the change of the T/M and T/B ratios over time was significantly different between both tracers in the dynamic analysis (p< 0.001, respectively). Furthermore, there was a statistically significantly different change of the K/B and L/B ratios over time between the two tracers in the dynamic analysis (p = 0.026 and p< 0.001, respectively). [(18)F]Bombesin (BAY 86-4367) visually and semi-quantitatively outperforms [(11)C]CHO in the PC-3 prostate cancer xenograft model. [(18)F]Bombesin tumor uptake was significantly higher compared to [(11)C]CHO. [(18)F]Bombesin showed better imaging properties compared to the clinically utilized [(11)C]CHO due to a higher tumor uptake as well as a lower liver and kidney uptake.