

An intra-operative positron probe with background rejection capability for FDG-guided surgery

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For radio-guided surgery on tumors using F-18-FDG, detection of annihilation gamma photons emanating from other parts of the body produces background radiation counts and limits its use in clinical situations. To overcome this limitation, we have developed an intra-operative positron probe with background-rejection capability. The positron probe uses a phoswich detector composed of a plastic scintillator and a bismuth germinate (BGO). A positron from a positron emitter such as F-18 is detected by the plastic scintillator and emits annihilation photons. The BGO detects one of the annihilation photons while a photo-multiplier tube (PMT) detects scintillation photons from both scintillators. The decay time differences of these two scintillators are used to distinguish whether the event is a true event where a positron and a following annihilation photon are detected simultaneously, or a background event. In this configuration, only positrons can be selectively detected, even in an environment of high background gamma photon flux. Spatial resolution was 11-mm full width at half maximum (FWHM) 5 mm from the detector surface. Measured sensitivity for the F-18 point source was 2.6 cps/kBq 5 mm from the detector surface. The background count rate was less than 0.5 cps for a 20-cm diameter cylindrical phantom containing 37 MBq of F-18 solution measured on the phantom surface, while the positron count rate was almost linear over a range of approximately 6 kcps. These results indicate that our developed intra-operative positron probe is valuable for radio-guided surgery on tumors using F-18-FDG in a high flux of background annihilation gamma photons.

Key words: positron, intra-operative probe, background, FDG