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Intra-arterial administration of PSMA-targeted radiopharmaceuticals for brain tumors: is the era of interventional theranostics next?

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Abstract

In recent years, prostate-specific membrane antigen (PSMA), a transmembrane glycoprotein, has emerged as a promising biomarker for theranostics, integrating diagnosis and therapy. PSMA's overexpression in various tumors, including brain metastases and high-grade gliomas, suggests its potential in neuro-oncology. Pruis et al. conducted a proof-of-concept study comparing intra-arterial (IA) and intravenous (IV) administration of ^{68}Ga-PSMA-11 in brain tumor patients, aiming to enhance radioligand therapy (RLT) outcomes. Ten patients underwent IV and super-selective IA (ssIA) tracer administration, showing higher tumor uptake and more favorable biodistribution after ssIA administration on positron emission tomography (PET). Dosimetry modeling on the basis of PET data resulted in median absorbed radiation doses per tumor per cycle notably higher with ssIA with respect to IV administration, indicating its potential for RLT optimization. Challenges persist, notably in penetrating intact blood-brain barriers and targeting tumor cells effectively. To overcome these limitations, novel approaches like convection-enhanced delivery and focused ultrasound warrant exploration. Safety concerns, though minimal in this study, underscore the need for larger trials and AI-assisted procedures. PSMA's role in neuro-oncological theranostics is promising, but future research must address specificity and compare it with emerging targets.

Keywords: Glioblastoma; PET/CT; interventional radiology; molecular imaging; prostate specific membrane antigen; theranostics.