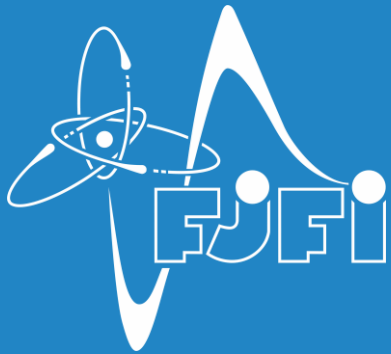


In-vitro comparison of alpha and beta therapeutic radionuclides' impact on tissue and tumour cell lines



Lukáš Ondrák¹, Martin Vlk¹, Ján Kozempel¹,
Marie Davídková², Jana Vachelová²



¹Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering,
Department of Nuclear Chemistry, Břehová 7, 115 19 Prague 1, Czech Republic

²Department of Radiation Dosimetry, Institute of Nuclear Physics of the CAS,
180 00 Prague 8, Czech Republic

Introduction

- Nuclear medicine
 - Radiodiagnostics
 - SPECT
 - PET
 - Radiotherapy
 - Beta therapy
 - Conventional
 - ^{177}Lu , ^{90}Y , ^{131}I , ^{153}Sm or ^{186}Re
 - Alpha therapy – rapidly evolving

Introduction

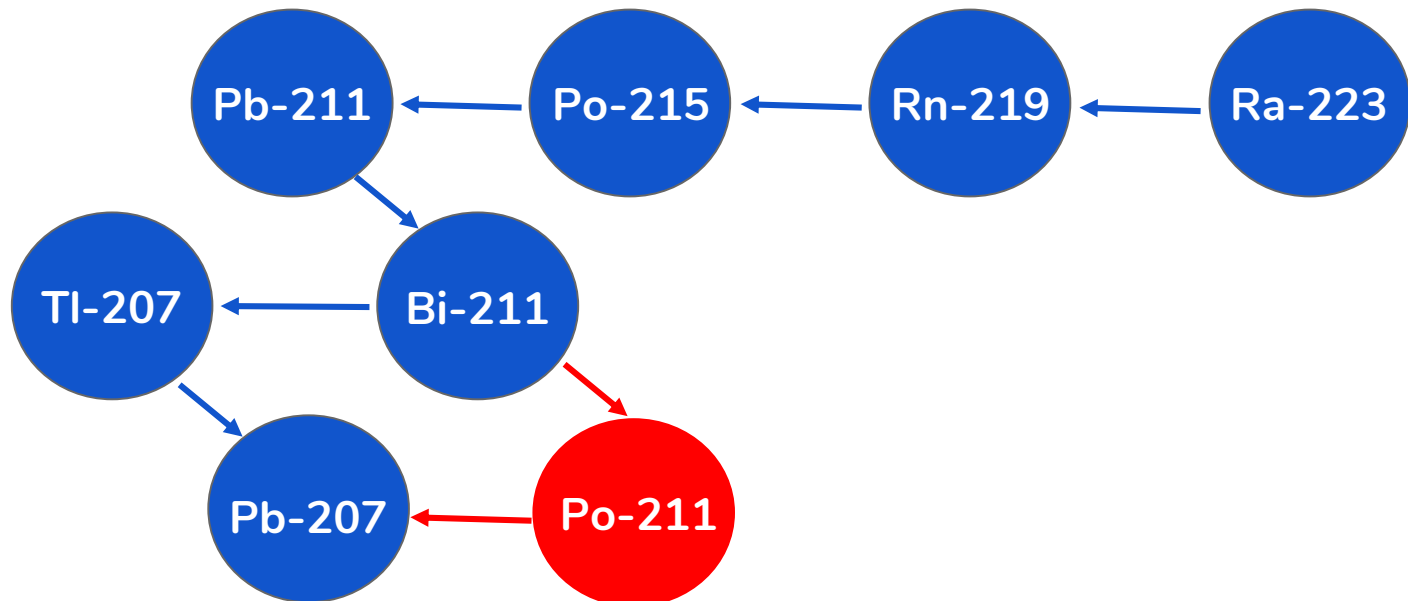
- Advantages of alpha therapy
 - Higher energy of emitted particles
 - Higher charge of emitted particles → shorter range in tissue
→ higher values of LET
 - Production of double strand breaks
 - Irradiation of small volume in tissue

Introduction

- Xofigo[®]
 - $^{223}\text{RaCl}_2$
 - The first clinically used radiopharmaceutical in TAT
 - Castration-resistant prostate cancer with bone metastases

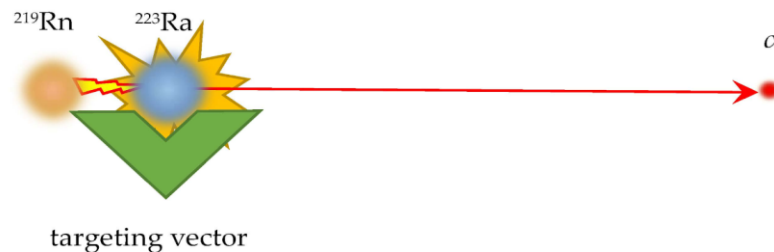
Introduction

- Ra-223
 - Half-life 11.43 days
 - Eluted from $^{227}\text{Ac}/^{227}\text{Th}/^{223}\text{Ra}$ generator



Introduction

- Disadvantages of alpha therapy
 - Nuclear recoil \longrightarrow release of radionuclide \longrightarrow irradiation of the surrounding tissue



- Insufficient dosimetry at cellular and subcellular levels

The aims of the study

- Determination of the survival curves of the selected cell lines exposed to alpha and beta therapeutic radionuclides
- Comparison of the effects of alpha and beta therapeutic radionuclides on the selected cell lines
- Verifying the applicability of the chosen methodology on the selected cell lines

Materials and Methods

- Selected cell lines
 - V79
 - U87
 - DU145
- Model radionuclides
 - Ra-223 – RaCl₂ (Xofigo[®])
 - Sm-153 – complex with EDTMP (Quadramet[®])
 - Re-186 – complex with HEDP (Re-Bone[®])

Materials and Methods

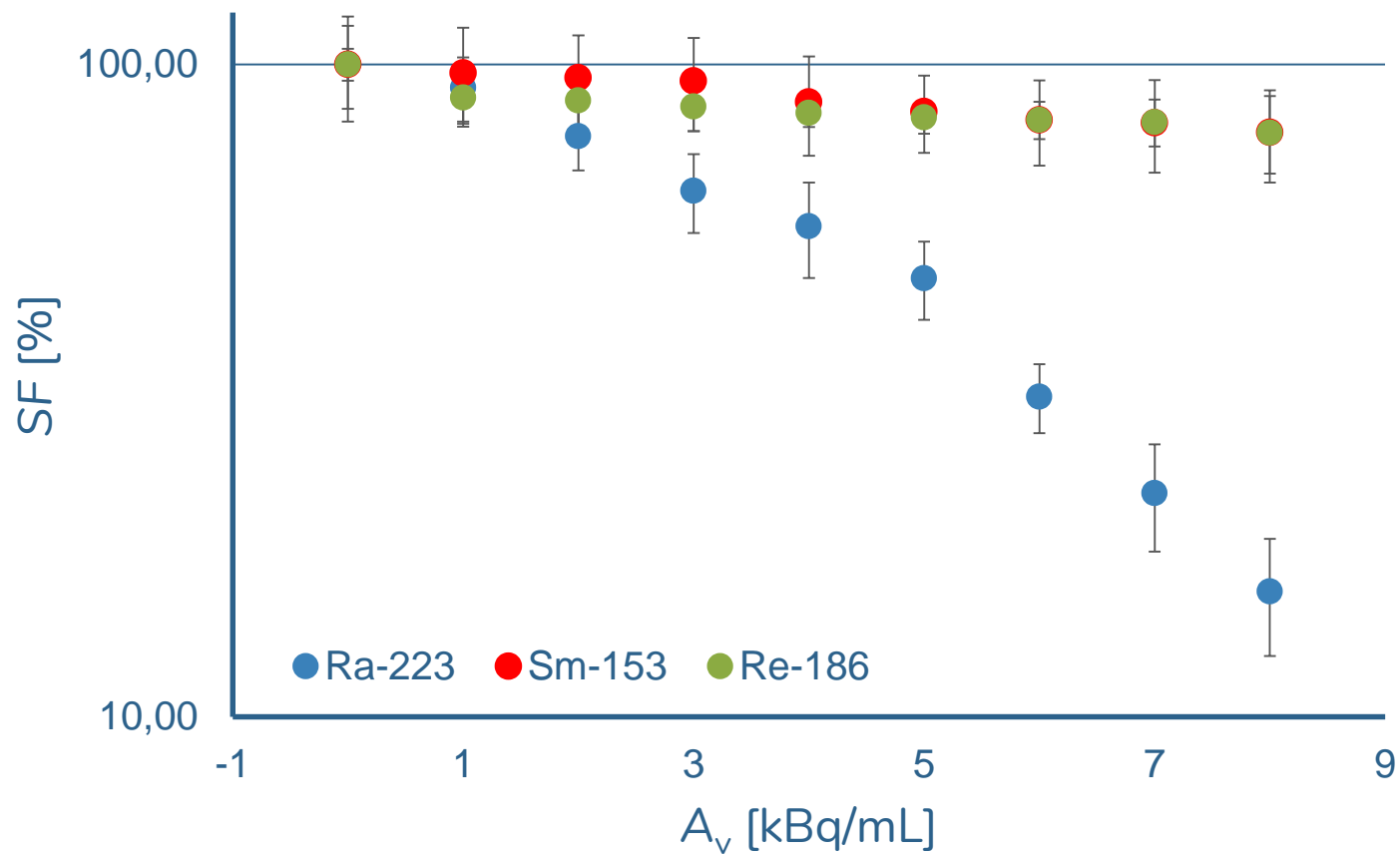
- Cultivation at 37 °C, 5 % CO₂
- Cultivation media:

Cell line	Medium	Supplementation
V79	Dulbecco's Modified Eagle's Medium	10 % Fetal Bovine Serum 1 % Penicillin-Streptomycin
U87, DU145	Eagle's minimum essential medium	10 % Fetal Bovine Serum 1 % Penicillin-Streptomycin, L-glutamine, nonessential amino acids, pyruvate

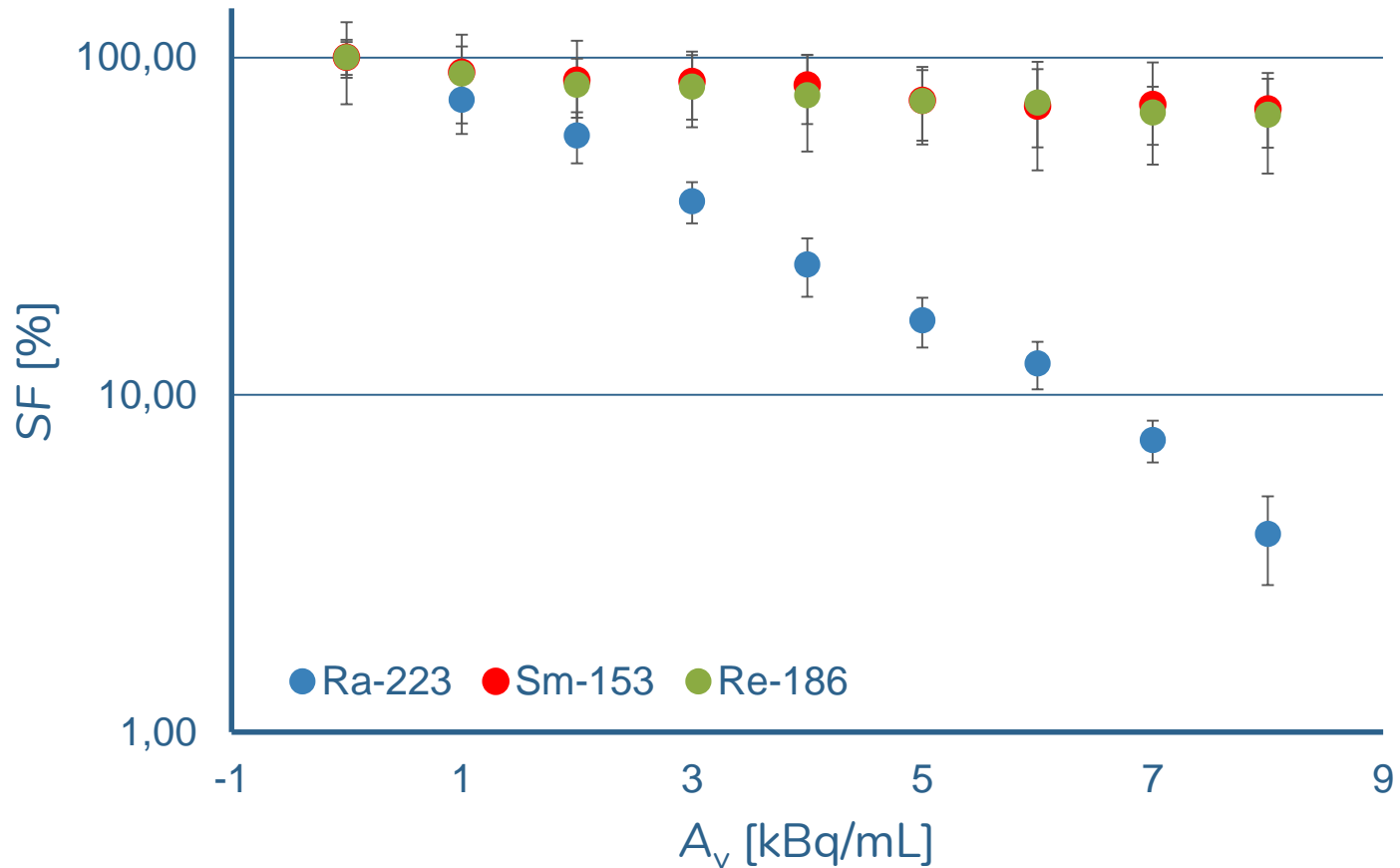
Materials and Methods

- Tissue Culture Flasks
 - 25 cm² bottom area
 - 5 mL cultivation media
- Cultivation with the radionuclide 24 hours
- Volume activity range 0-8 kBq/mL
- Cytometric cell counting
- Clonogenic assay

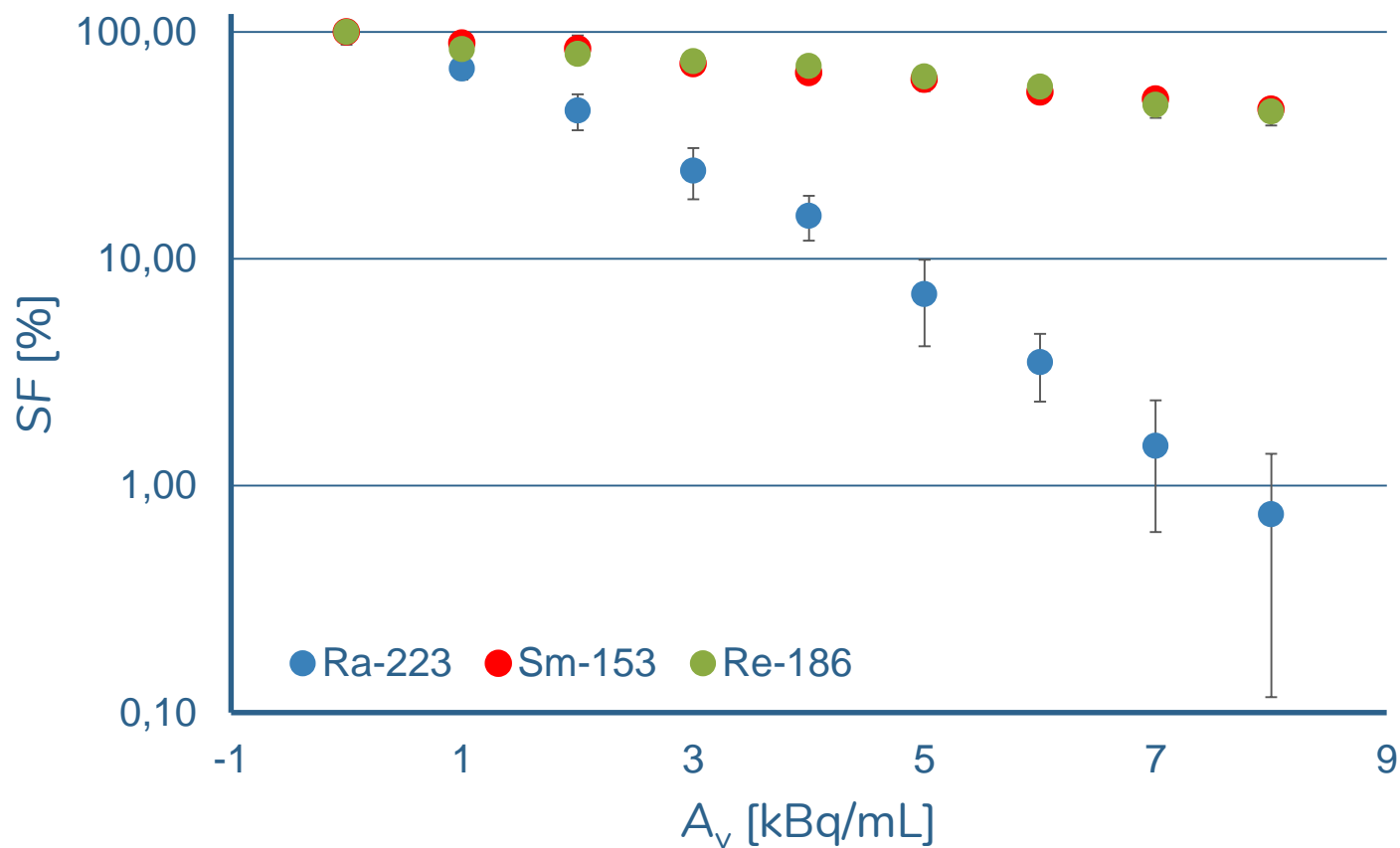
Results - V79



Results - DU145



Results - U87



Conclusion

- All survival curves correspond to a linearly-quadratic model
- The sensitivity of DU145 and U87 to the effects of alpha or beta radiation is higher compared to the V79
- The sensitivity of all cell lines is higher to the effect of alpha treatment in comparison with beta treatment
- The applied methodology is applicable for the study of TAT dosimetry

Thank you for your attention.

This work was supported by the Health Research Agency of the Czech Republic (grant No. NV16-30544A), Technology Agency of the Czech Republic (grant No. TJ01000334) and by the Czech Technical University in Prague (grant No. SGS19/194/OHK4/3T/14).