Successful application of nuclear technologies for the therapy of eye tumors at Moscow Helmholtz Research Institute of Eye Diseases

RAS corresponding member, prof. Neroev V.V.  
prof. Saakyan S.V.

Moscow Helmholtz Research Institute of Eye Diseases.

19–20 September 2017
IAEA Scientific Forum
Nuclear Techniques in Human Health
Prevention, Diagnosis, Treatment
The most common primary malignant intraocular tumors

**Uveal melanoma**
- Adults
- 6 – 8 patients per 1 million adults per year (WHO - 1-23)
- 50% of patients die due to the metastatic disease in 10 years after initial diagnosis

**Retinoblastoma**
- Children
- Incidence varies from 1 per 15000-20000 newborns with a tendency to increase over the last years.
- Monolateral – 60%, bilateral – 40% and is due to hereditary factors
An idea of UM contact irradiation belongs to P. Moore (1930)

1960-1978 yrs - cobalt ophthalmic applicators (OA) ($^{60}$Co) L. Stallard, R. Ellsworth

1973 – strontium OA ($^{90}$Sr + $^{90}$Y) G. D. Zarubey, A. F. Brovkina (Russia)

1974 – rhutenium OA ($^{106}$Ru + $^{106}$Rh) P. Lommatch

1980 – iodine OA ($^{125}$I) R. Seedly, H. Burret

For many years, the main method of malignant intraocular tumors treatment was the enucleation of the affected eye.
Surgical steps of plaque application

OA irradiation dose decrease (in %) depending on **biological tissue thickness** (in mm)

Surface dose percent

Biological tissue thickness (mm)

Russian plaques (Obninsk)
More than 5600 patients with intraocular tumors (uveal melanoma and retinoblastoma) have been treated in Moscow Helmholtz Research Institute of Eye Diseases by the year 2017. Head – RAS corresponding member, prof. Neroev V.V.

- A unique group of ophthalmic applicators (plaques) for intraocular tumors and tumors of the anterior eye segment irradiation with isotopes Rh-106 and Sr-90 is developed and produced in Russia (I.I. Leypunsky Institute of Physics and Power Engineering, Obninsk city)
Uveal melanoma regression after brachytherapy

Before treatment.
7.0 x 13.6 mm

6 months after treatment
5.2 x 10.1 mm

12 months after treatment
No signs of tumor

UM patients survival rate

<table>
<thead>
<tr>
<th>Follow-up period</th>
<th>Survival rate %</th>
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<tbody>
<tr>
<td></td>
<td>Enucleation</td>
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<tr>
<td>5 years</td>
<td>83.5</td>
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<tr>
<td>10 years</td>
<td>42</td>
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Results of retinoblastoma combined treatment:

- Eye-preserving treatment was successful in 85 – 95% of children depending on the tumor stage;
- Visual functions are preserved in 70% of children;
- 5-year survival rate is 92 – 95% depending on the tumor stage.
We use ophthalmic applicators with isotope Sr90+Y90 for anterior segment tumors brachytherapy (G.D. Zarubey, A.F. Brovkina 1973)

More than 1570 patients with malignant eye lids and conjunctival tumors were treated over a period of 2001 – 2016

Complete resorption in
Epithelial tumors- 92.8%,
Lymphoma- 98%
Skin and mucosal melanoma- 67%

before after
The future perspective is:

**For anterior segment and eye lids:**

- With isotopes $^{90}\text{Sr} + ^{90}\text{Y}$ and $^{106}\text{Ru} + ^{106}\text{Rh}$
- Irradiation rate- 90-110 cGy/min.
- New OA shapes and sizes

**For intraocular tumors:**

- With isotopes $^{90}\text{Sr} + ^{90}\text{Y}$, $^{106}\text{Ru}$ + $^{106}\text{Rh}$ and $^{125}\text{J}$
- Irradiation rate - 1000-2300 cGy/hour.

Brachytherapy allows to preserve life, the eye and visual functions.
It improves patient's quality of life.
Thank you!