

RADIATION PROTECTION ON SIRT

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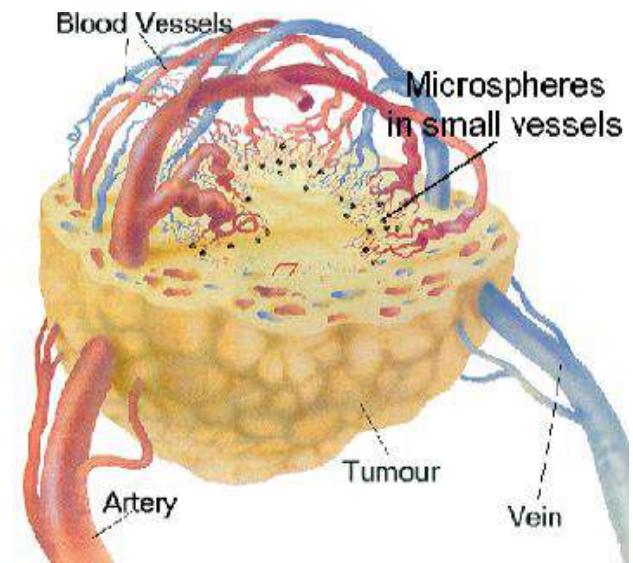
Yttrium Y-90

- Pure β emitter
 - T1 /2: 64 hrs (2.7 days)
 - Maximum energy: 2.28 MeV
 - Mean energy: 0.93 MeV
 - Travelling range
 - Max: 11 mm, Mean: 2.5 mm in water/tissue
 - Inherent safety
 - Minimal penetration depth
 - Relative short half-life



What happen to the Y-90 microspheres?

- 35 microns resin microspheres
- Microspheres lodge in the micro-vascular network of the tumor
- The radiation from Y-90 is largely confined to a tissue depth of 2 - 3 mm



General RP Principles

- ▣ Time
- ▣ Distance
 - Use long forceps to handle radioactive substance
 - Stay away from radioactive substance
- ▣ Shielding
 - β radiation
 - Perspex or acrylic syringe shield and v-vial holder
 - Bremsstrahlung X-ray:
 - Concrete, Lead
 - Mobile lead screen or concrete wall



Exposure from patient

For a 2 GBq SIRT,

		Trunk mSv (mrem)	Lens of Eye mSv (mrem)	Hands mSv (mrem)
Pharmacist	Shallow Dose (0.07mm)	0.027 (2.7)	0.026 (2.6)	0.35 (35)
	Deep dose (10mm)	0.003 (0.3)	0.004 (0.4)	
Physician	Shallow Dose (0.07mm)	0.038 (3.8)	0.12 (12)	0.32 (32)
	Deep dose (10mm)	0.004 (0.4)	0.054 (5.4)	
Radiation Safety Officer	Shallow Dose (0.07mm)	<0.02 (<2)	0.04 (4)	0.2 (20)
	Deep dose (10mm)	0.01 (1)	0.017 (1.7)	

*Physician and Institution Information for SIR-Spheres

For example,
1 SIRT → 0.01mSv
2000 SIRTs → 20mSv (Annual dose limit)

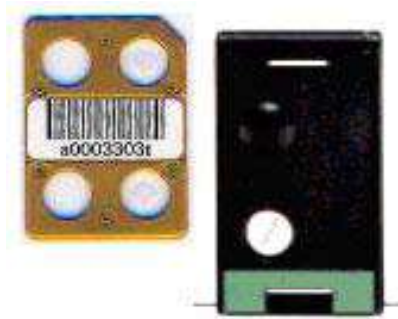
□ External dose rate from a 2GBq patient,

0.25m	18.8 $\mu\text{Sv/hr}$ (microSieverts/hour)
0.5m	9.2 $\mu\text{Sv/hr}$
1m	1.5 $\mu\text{Sv/hr}$
2m	0.4 $\mu\text{Sv/hr}$
4m	<0.1 $\mu\text{Sv/hr}$

□ General public are unlikely receive 1mSv from Y-90 patient

Instrumentation

- ▣ TLD badge
- ▣ Ring TLD
- ▣ Personal pocket dosimeter
- ▣ Radiation survey monitor



Radiation survey

- Activity
 - SIR-Spheres (50Bq), TheraSphere (2500Bq)
- External radiation
 - Area survey
 - Patient release
 - Ionization chambers or Geiger-Muller (GM) counter
- Area contamination
 - Class III($>30\text{Bqcm}^{-2}$) (COP 2011, HA)
 - Wipe test
 - Scintillation counter

Preparation of SIR-Spheres

- Y-90 should be handled with forceps
- Safety cabinet should be used in the dose preparation area
- Staff should wear PPE
- Aware of positive pressure from the v-vial



Implementation of SIR-Spheres

- During the injection:
 - All Staff should wear PPE
 - Floor should be covered with water absorbing drapes
 - All staff should wear personal dosimeter
- After the procedures,
 - Stay away the patient when surveying
 - Survey all the personnel before leaving the procedure room
 - Contaminated items should be labelled as radioactive substance and stored in a Perspex container

Response to the spills or contamination

- Use towels to absorb the liquid and trap the microspheres
- Foaming product is not advised to use
- Adhesive tape can be used to capture the microspheres
- Cover the area with 1 cm low Z material if removal is not possible

Patient care

- Patient should stay in the radiation ward
- Patient is covered by a lead sheet over the implantation area
- $1 \mu\text{Sv/hr}$ is detected at 1 m from the patient



Radioactive waste

- Urine
 - 20-50 kBq / 24 hrs
 - Patient may use the toilet and flush twice
 - Urine bags are discharged into the sluice and flush twice
- Blood / tissue samples
 - Clearly labelled before send to the laboratory
- Contaminated items
 - Decay and dispose method is used
(400 kBq per 0.1 m³ as ordinary refuse)
 - Monitored by survey meter
 - Put in the black plastic bag inside a Perspex container box
 - Clearly labelled and stored for decay

Patient Discharge

- $^{90}\text{Y} \geq 1.5 \text{ GBq}$
 - ▣ Patient needs to stay in the radiation ward
- $^{90}\text{Y} < 1.5 \text{ GBq}$
 - ▣ Patient can be discharged and return home
- ▣ No restriction when decay to 200 MBq (COP 2011, HA)

Half life ($T_{1/2}$)	Day(s)	Activity (MBq)
0	Day 0	3000
1	Day 2.7	1500
2	Day 5.4	750
3	Day 8.1	375
4	Day 10.8	187.5
5	Day 13.5	93.75
6	Day 16.2	46.88
7	Day 18.9	23.44
8	Day 21.6	11.72

Guideline for healthcare professionals

- Within the first 2 weeks after treatment:
 - Patient stays in radiation ward until the Y-90 activity below 1.5 GBq
 - Wear disposable gloves when nursing the patient (changing urinary bags or taking blood samples)
 - Wash the hands thoroughly after nursing
 - Contaminated items should be monitored and handled properly
 - Pregnant staff should not nurse the patient
 - Visitors maybe allowed for 30 minutes
(Avoid pregnant women & children under 5)
 - No restriction when decay to 200 MBq
(12 days after 1.5 GBq)

Patient Instructions

- Female patient should stop breast-feeding for 3 months after treatment.
- Female patient should avoid pregnancy for 1 month after the treatment and seek medical advice before getting pregnancy.
- Within the first week after treatment:
 - avoid journeys on public transport for more than 1 hour.
- Within the first 2 weeks after treatment:
 - Present this card to healthcare professionals during re-admission or follow-up.
 - Flush toilet twice after use and wash hands with soap in running water.
 - Avoid going to crowded places.
 - Avoid sexual activity.
 - Avoid prolonged close contact with children under 5 or pregnant women.

Radioactive waste storage

- Residual Y-90 microspheres present in transfer tubing, containers
- Placed in beta shielded container
- Decays until background and follows licencing condition
- 10 half-life decay (27 days)
- Disposal record should be kept