2nd PANHELLENIC CONGRESS OF MEDICAL PHYSICS
4-6 OCTOBER 2024| EUGENIDES FOUNDATION

Radiation protection during Y-90 Selective Internal Radiation Therapy of a hemodialysis patient: A case report.

Zarros[1] C, Manios[1] GE, Georgakopoulos[2] A, Stefanogiannis[1] AP, Papanikita[2] K, Miliou[1] K, Armeniakos[2] I, Chatzioannou[2] S, Efstathopoulos[1] E

[1] 2nd Department of Radiology, Medical Physics Unit, Attikon University Hospital, Athens, Greece

[2] Department of Nuclear Medicine and Molecular Imaging, Attikon University Hospital, Athens, Greece

1. Background-Aim

Radioembolization

- Selective Internal Radiation Therapy (SIRT)
- Yttrium-90 (Y-90) microspheres are implanted into hepatic tumors by injection into the hepatic artery using a catheter to treat unresectable liver tumors.
- According to literature the total excreted activity post implantation is very low.
  - ➢ Grosser et al.: The mean accumulated urinary excretion of 90-Y over a 48h was 0.018% (range: 0.012–0.061%) of the injected activity.

Physical Features

- Y-90 emits beta particles with a maximum energy 2.27 MeV and a mean 0.93 MeV with a half-time $T_{1/2}$ = 64.1h

Hemodialysis

- It is a process of cleaning the blood of accumulated waste products. It is used for patients with renal failure.

- It is typically required to be carried out three times per week.

❖ **This study summarizes our experience, in terms of radiation protection, of a hemodialysis patient who has undergone SIRT at our institution.**

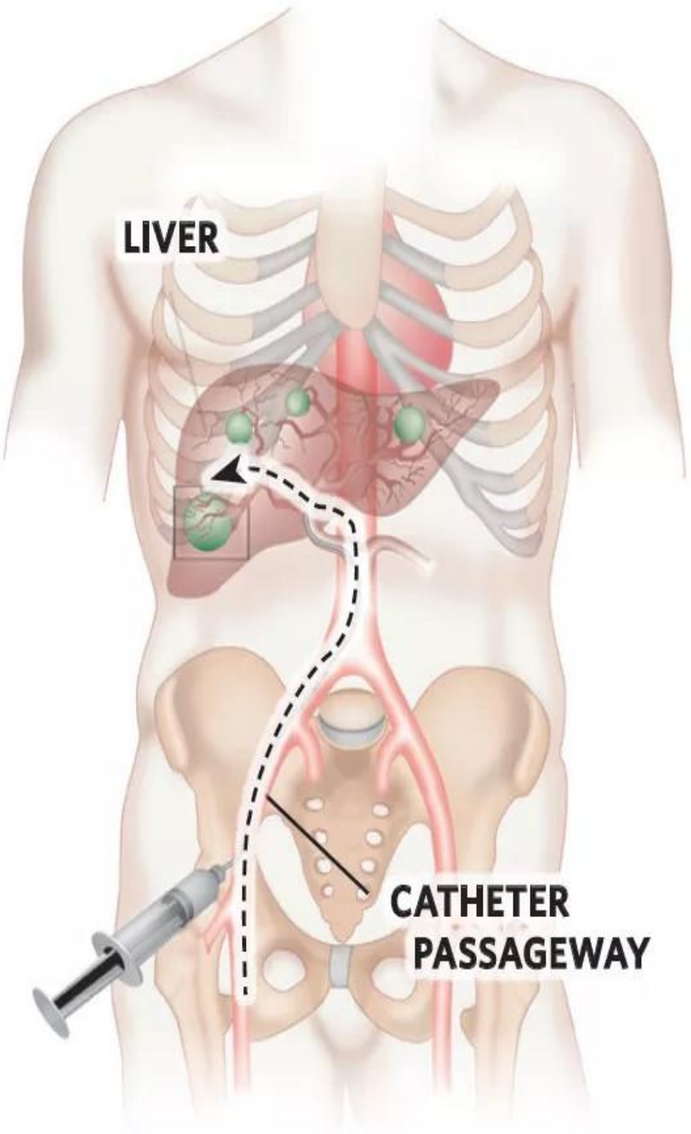


Image: https://uihc.org/y90-radioembolization-liver-tumors

2. Materials & Methods

- A female hemodialysis patient with chronic kidney disease was referred to our hospital for Y-90 SIRT.
- Secondary tumors in the right liver lobe.

Pre-treatment – Treatment Simulation

Angiographic planning determined the arterial branches via which actual therapy will be performed.

- A dose of 2 mCi Technetium macroaggregated albumin (99mTc-MAA) was delivered intra-arterially;
- It was conducted calculation of Lung shunt, of the doses to the tumor, lungs and liver parenchyma and administered activity of Y-90 microspheres.

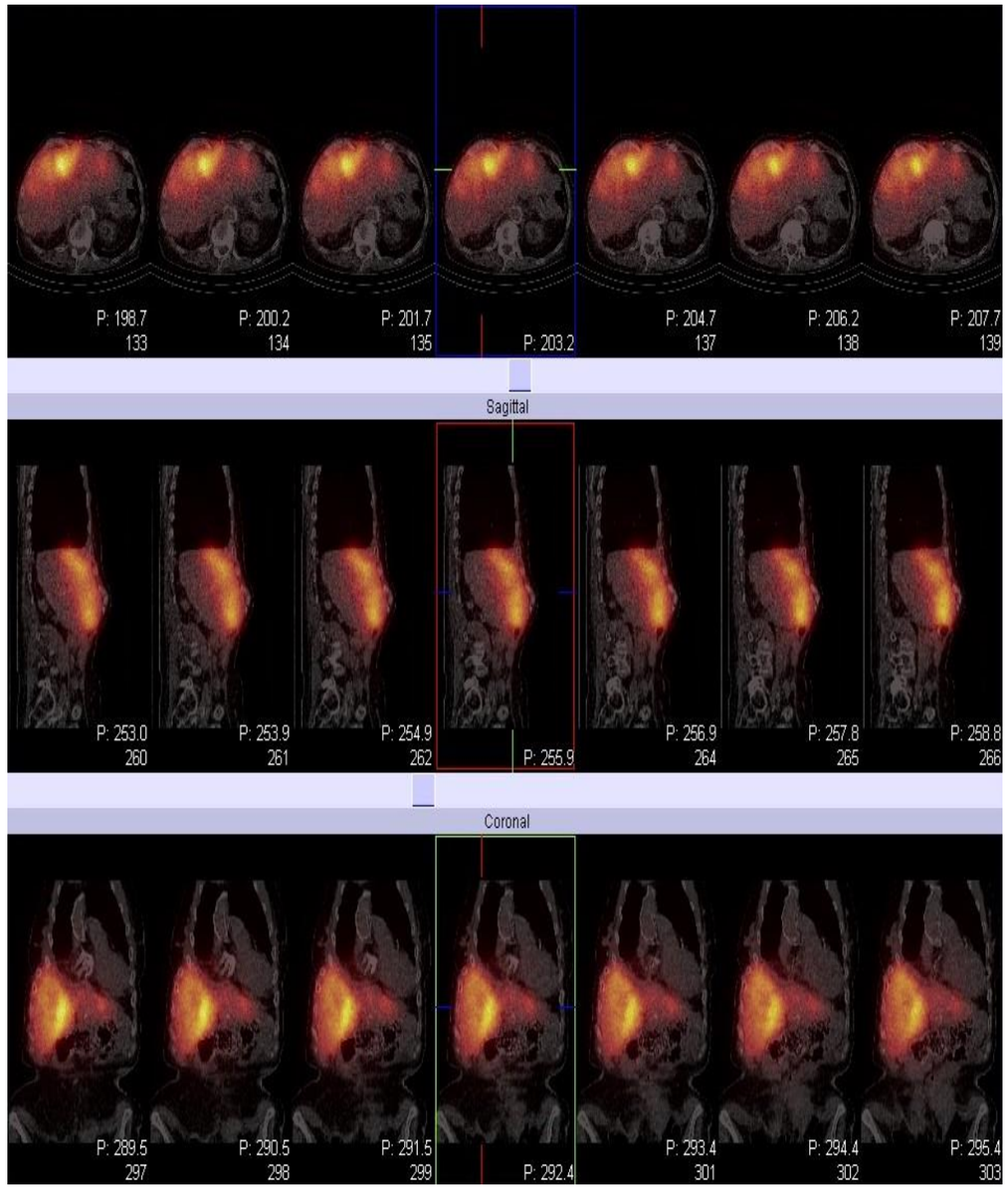
Treatment Procedure

Activity 27 mCi Y-90 microspheres was administrated via hepatic artery using a catheter.

Radiation Protection Procedures

Using an area radiation survey were measured :

- Dose rates at 0.5m (DRs-0.5) from the patient, at the level of the upper abdomen, 24h and 48h post Y-90 implantation;
- The dose rate at the surface (DR-S) of the container (waste) was measured.



Post-treatment patient imaging - 24h after Y-90 microspheres implantation

3. Results

- The only protection measure for the pre-treatment procedure was to be given a guideline that the next hemodialysis should be performed 24 hours after the administration of 2 mCi ^{99m}Tc-MAA.

- The treatment schedule was adjusted based on radiation protection of the patients and the hemodialysis unit personnel.
  - Guidelines had been issued, hemodialysis should be performed 24 hours before the Y-90 treatment for radiation protection reasons, and the next hemodialysis should be performed after 48 hours of therapy administration.
  - Guidelines had been given to hemodialysis unit staff about their radiation protection.

- The **DR-0.5** at 24 and 48 hours post implementation, were measured **2.1 μSv/h** and **1.6 μSv/h** respectively.

- The **DR-S** of the waste container was measured at **0.3 μSv/h**

- The hemodialysis nurse was occupied less than **15min** at a mean distance of **0.5m** from the patient during the hemodialysis procedure.

DR-0.5=1.6 μSv/h

Hemodialysis nurse dose < 0.4 μSv

4. Conclusions

- Y-90 SIRT can be performed safely on hemodialysis patients without the need of particular radiation protection measures for the staff and the patients of the dialysis unit.
  - It is recommended, when it is feasible, hemodialysis to be conducted at least 24 hours after the implantation of Y-90 microspheres, for the radiation protection optimization.
  - A reduction of the time spent by hemodialysis unit staff close to the patient.
- The waste after the hemodialysis, may be disposed as common hospital waste.
  - It is recommended the DR-S is measured before the disposal.

5. References

- Grosser OS, Juri R, Pethe A, Kupitz D, Wissel H, Benckert C, et al. Urinary Excretion of Yttrium-90 after Radioembolization with Yttrium-90-Labeled Resin-based Microspheres. *Health Phys*. 2018;114(1):58-63.

- SIR-Spheres Y-90 resin microspheres. SIRTeX. https://www.sirtex.com/us/products/sir-spheres/sir-spheres-y-90-resin-microspheres/about-sir-spheres.

- Y90 Radioembolization for Liver Tumors. IOWA HEALTH CARE. Y90 Radioembolization for Liver Tumors | University of Iowa Health Care (uihc.org).

- Sarafidis P, Faitatzidou D, Papagianni A. Benefits and risks of frequent or longer haemodialysis: weighing the evidence. *Nephrology Dialysis Transplantation*. 2021; 36(7):1168-1176.

- Law 1958B/2014, Article 3 – 4, Government Gazette, July 18, 2014