



Factsheet for the Press (Physics)

NORMAL TISSUE REACTION OF THE LIVER AFTER STEREOTACTIC RADIOTHERAPY (SBRT) DETERMINED BY 18-FLUORODEOXYGALACTOSE AND PET/CT-SCANNING

by Morten Høyer, Aarhus University Hospital, Denmark

Context: Patients with a few, small or medium sized malignant liver tumors may be treated by high precision stereotactic radiotherapy. By this method, 5-8 radiation beams are directed against each tumour in the liver. Normal liver tissue receives a substantial radiation dose and radiation to the liver is the major limiting factor in radiotherapy for liver tumours. The radiation effects are especially of concern in patients with hepatitis or cirrhosis. Severe reactions and even a few deaths have been observed, but we have only limited knowledge on the livers radiation tolerance.

Purpose: We have developed a method to determine the function of the liver in 3-dimensional images. The method is based on intravenous infusion of a radioactive tracer (galactose) with low activity to the patient who are subsequently scanned with a PET/CT scanner. Early studies on pigs showed that the method is precise and that function of liver cells varies throughout the liver. We are now conducting a clinical study in patients treated with stereotactic radiation therapy for liver metastases. In these patients we determine the liver function by galactose PET/CT before and after stereotactic radiotherapy. The study shows that radiation reduces the liver function which reaches a minimum at 1 month after treatment. The effect is dose-dependant and the higher the radiation dose, the greater is the observed depression in liver function. After 1 month the liver slowly starts to recover.

Findings:

1. There is great variability of function throughout the liver. However, the function and variability of function are constant with time in untreated liver.
2. Following radiation, there is a time and dose-dependant depression in function. However, the liver regenerates within months after treatment.
3. When information from galactose PET/CT is used in planning of stereotactic radiotherapy of liver tumours, it may be possible to spare parts of the best functioning liver.



Impact: First of all we wish to use this method for investigation of radiation related side effects in patients treated for liver tumours with stereotactic radiotherapy. Patients with hepatitis and cirrhosis are of special concern for radiation related adverse effects and they will now be investigated.

Furthermore, we will use this method for selection of patients with liver tumours in whom stereotactic radiotherapy can safely be performed.

Finally, we are testing if the method can be used directly in functional planning of radiation therapy. By functional radiotherapy planning the radiation is directed to the tumour based on information from a galactose PET/CT in a way where the beams follows corridors of liver with low function. This method will spare the best functioning liver tissue.

Indicative of a bigger trend in oncology? The main issues in radiotherapy is to deliver precise radiation to tumours and spare the normal tissues resulting in the highest possible probability of cure with the lowest risk of complications. Methods allowing us to measure function of normal organs may play a key role in the work to fulfil these aims. A number methods for 3-dimentional measurements of organ function in a variety of organs are studied. So far, we have preliminary results of studies on lung, liver, brain and salivary glands.

"Stereotactic radiotherapy is form of treatment that will allow a shift from an invasive approach, by surgery, towards a non-invasive approach by irradiation.[...] Even when metastases are present median survival has increased from 6 months to more than 2 years."

Ass. Prof. Johan Bussink, Radboud University Nijmegen Medical Center, Nijmegen, The Netherlands