APPROACH METHODS FOR BIOMEDICAL IMAGE PROCESSING USING DOSE BK Y90

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Abstract

Along with the rapid development of diagnostic imaging equipment in Nuclear Medicine, software for biomedical image processing has played an important role in helping. Doctors and Medical Physics to reach accurate calculate dose. DOSE BK Y90 is a multipurpose software based on Matlab programming language which features registration, 2D visualization, fusion SPECT/CT, raw ROI, and calculation dose 90Y, it is used for processing biomedical images (SPECT & CT) obtained from commonly used imaging equipment. This paper introduces some concrete approach methods for biomedical image processing using the software DOSE BK Y90 to facilitate and enhance either practice training of biomedical image processing or flexible manipulation in clinical practice of Nuclear Medicine.

1. Introduction

SIRT (Selective Internal Radiation Therapy) for liver cancer therapy is a method which isdeliveringmillions of microspheres SIR-Spheres Yttrium-90 directly to liver tumors via the hepatic artery. In this treatment, millions of tiny radioactive beads are injected directly into the arteries that supply blood to the tumor. These beads will stay in the blood vessels around the tumors. This allows a very strong radiation to reach the tumors directly [1]. There is a very little effect on healthy parts of the liver or other tissues in the area such as intestines

or skin. The treatment dose is limited less than the Maximum Treatment Activity (MTA) in order that the absorbed doses do not exceed 80Gy in patients with normal liver, 25Gy in lung and 70Gy in patients with cirrhosis [2].

The patient who is selected to treat by SIRT will be checked for general health, including any signs of disease (such as lumps or weight loss) or anything else that seems unusual. The doctor will also take a history of health including past illnesses and treatments and will ask about patient's symptoms (about patient's illness, egg, tiredness, loss of appetite). Liver tumors can be diagnosed using a combination of blood tests and other diagnostic tests. Blood tests look at liver function and levels of tumor markers (certain substances which are linked to specific types of cancer). Liver tumors will often be shown on an ultrasound scan but full assessment requires a CT scan [3]. The patient will usually have a number of tests including an angiogram, a scintigraphy scan (called a lung-shunting or MAA scan) and possibly, a special CT scan called a CT-hepatic angiogram. There are two methods for calculating the activity of SIR-Spheres microspheres to implant Empiric method (or BSA Method) and Partition model method. The main tasks of Medical Physics areto calculate the percent lung-shunting by SPECT/CT image (Tc99m-MAA) and to select-the calculating method (BSA or Partition Model). These are the content of software DOSE BK Y90.

2. Dose BK Y90-software description
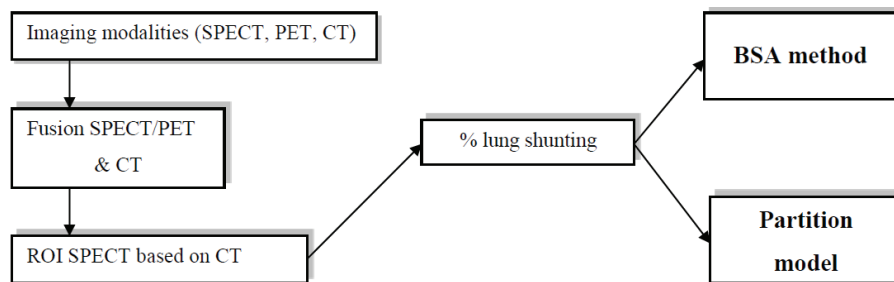
Approach

Fig. 1: *DOSE BK Y90 Framework*

Programmed in Matlab 7.7, DOSE BK Y90 (Fig.1) has been supported by the following Mathworks toolboxes: Graphical User Interface Toolbox; Image Acquisition Toolbox 3.2 and Image Processing Toolbox 6.2.

The software is divided into 4 main modules: patient information, image registration, % lung shunting and dose method calculation. After programming

process is completed, the software is tested and then packaged in an installation file by using Matlab Compiler tool.
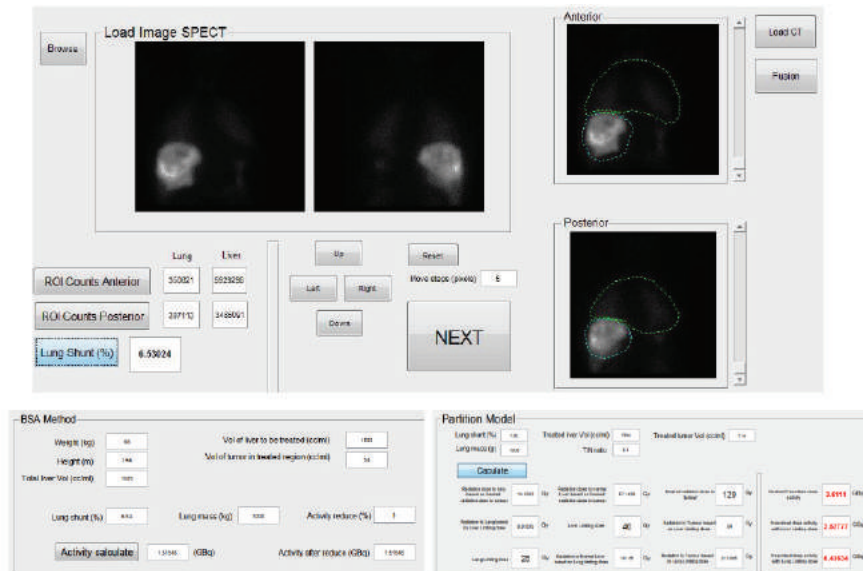

Fig. 2: *User interfaces of DOSE BK Y90 modules*

2. Functions

- Registration: Fusion: manual mode *(translate, rotate, resize an image by a hand)*; Subtraction to analyze temporal evolution or detect differences: manual mode; Multi-image Registration.
- Drawing the ROI (Region of Interest): drawing an ROI SPECT with CT background.
- Calculation % lung shunting: Automatic collect ROI data and show the result %LSF.
- Calculation dose ^{90}Y injection: input data and automatic calculate activity 90Y and absorbed dose at each organ.

3. Selective Applications

Example

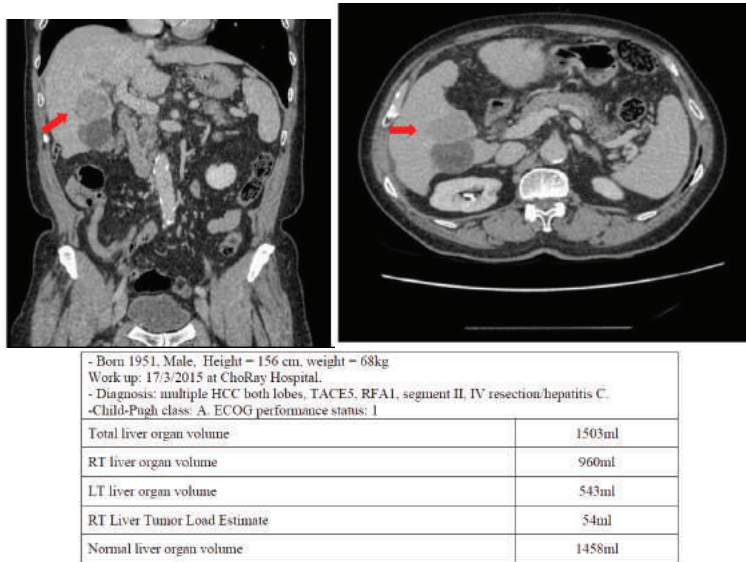| - Born 1951, Male, Height = 156 cm, weight = 68kg Work up: 17/3/2015 at ChoRay Hospital. - Diagnosis: multiple HCC both lobes, TACE5, RFA1, segment II, IV resection/hepatitis C. -Child-Pugh class: A. ECOG performance status: 1	
Total liver organ volume	1503ml
RT liver organ volume	960ml
LT liver organ volume	543ml
RT Liver Tumor Load Estimate	54ml
Normal liver organ volume	1458ml

Fig.3: Typical volume and distribution of a metastatic liver tumor. Resin microsphere radiation activity planning can be performed via BSA methods recommended by the manufacturer.
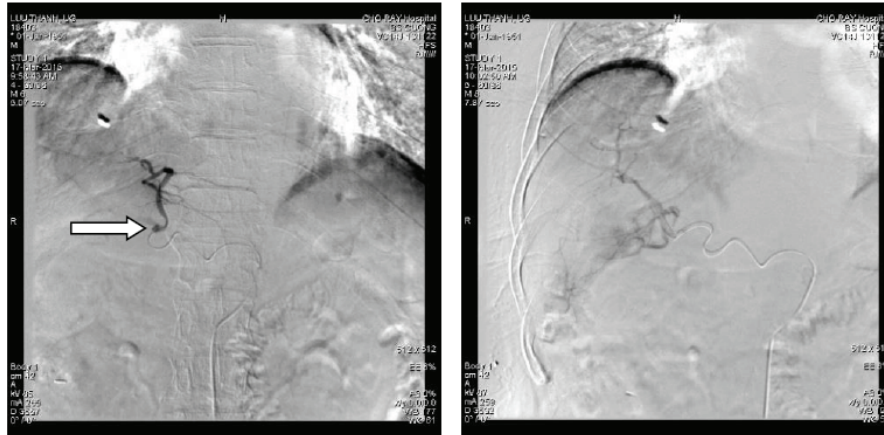

Fig. 4: Following coil embolization of the origin of the left hepatic artery from the left gastric artery(arrowhead), there is immediate opacification of the whole liver from the common hepatic artery allowing for whole liver treatment from a single injection site.
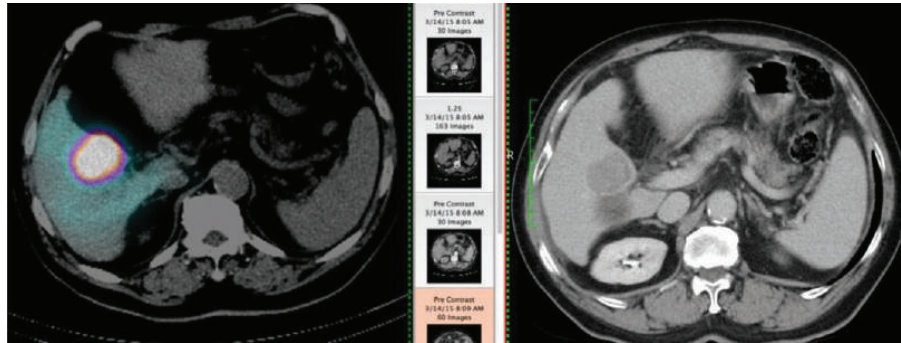
Fig. 5: SPECT/CT image (a) and Contrast CT image (b) at largest diameter of liver tumor. The combination of SPECT/CT images shows the accurate location of the liver tumor and the distinction between the liver tumor and liver follicle. Contrast CT image (b) at (1) is the shadow and can be mistaken with liver follicle below.
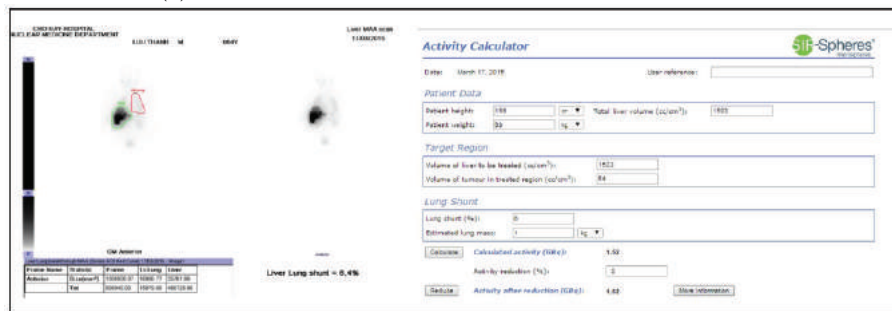

Fig.6: Original method. Medical Physics had drawn the ROI on image SPECT which did not have anunclear organ border(estimated by the eyes). % LSF = 6.4 1.73. Then they used another program to calculate the activity of 90Yinjection. All process took about 20-30minutes.
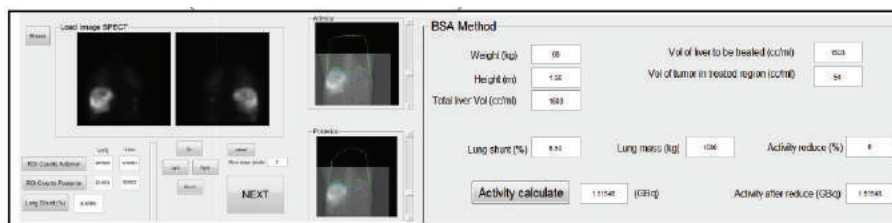

Fig.7: New method. User-drawn ROI SPECTbased on CT image (clearorgan border). %LSF= 6.53 0.02. The standard division was better than the original method. All process was about only 5-10 minutes.
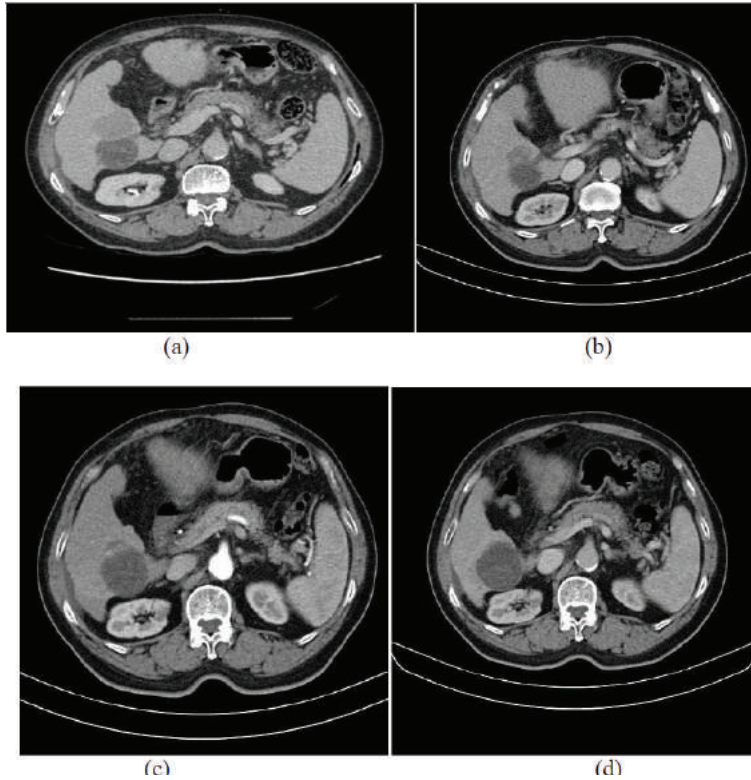
Fig 8. Treatment process with 90Y, the liver tumor volume is 53 cm3 bigger than the follicle below. (b) CT-Image of 6 weeks after treated with 90Y, the tumor volume is reduced significantly to 34cm3. (c) CT Image after 2 months, the tumor volume is 8cm3. (d) CT image after 1 year, the tumor is nolonger existing on CT-image. Patient general health is good. The treatment process is completed, the result is very good.

4. Conclusion

The effectiveness of the program is assessed on the following standard:

Versatility/ Multifunction: The program is highly versatile due to the ability to combine simultaneously image processing and dosing measurement modules. Users do not have to either work on image processing computer or dosing computer. Besides, the ability to analyze many images formats (JPG, BMP, GIF, PNG, TIF, DICOM, DICOMDIR. In addition, the image was formally processed in terms of visual or sensory. Nowadays, combined with the SPECT and CT images will result in higher accuracy.

User-friendliness: The program interface is scientifically designed and in-

tuitive, hence, easier usage and more convenient. By the way of splitting the group of program functions into blocks based on the processing progress that helps the user to follow up functions and operations quickly.

Flexibility: The SPECT/CT machine in Nuclear medicine department has only one workstation, meanwhile the number of users is huge that why they have to "queue up" to process the image. Using the above program, users can operate on their personal computer anywhere and anytime. In addition, the program is very convenient during the consultation; by the way of attaching the projector to a personal computer, doctors and physicists can diagnose difficult cases and optimize the dose.

Biomedical image processing is an important tool in diagnosis. Using DOSE BK Y90 some approach methods has been reviewed. The software is written in Matlab language which is familiar with Medical Physics and researchers in the technological field. The aim of the software is providing to doctor and Medical Physics a useful tool and fundamental knowledge to develop into professional software that could be used in Vietnamese hospitals and Nuclear Medicine centers in the near future.

References

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[2] Sirtex SIR-Spheres Pty Ltd., *SIR-Spheres and microspheres Training Program for Physicians and Institutions,* Sirtex Medical Training Manual, (2014), 33-34.

[3] R. J. W. Blanchard, *Treatment of liver tumours with yttrium-90 microspheres,* Canadian Journal of Surgery, vol. **26** (5), (1983), 442-443.