Beth Israel plugin : A new free software tool for metabolic tumor volume calculation on PET/CT

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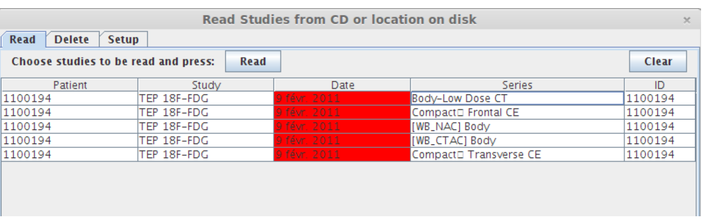
Objective: The project was to build a new free software tool to simplify the calculation of whole-body metabolic tumor volume (MTV) calculation

Materials and Methods

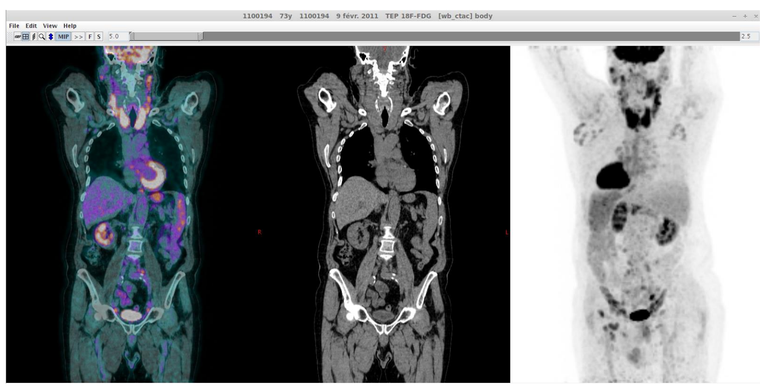
ImageJ is a public domain image processing program developed at the NIH and available for Windows, Mac OS and Linux. The software developed at Beth Israel Deaconess Medical Center is an Image J plugin which offers MPR (Multiplanar reconstruction) and MIP (Maximum Intensity Projection) display of PET/CT images. For MTV calculation, the software handles absolute SUV and relative SUVmax threshold. The software allows drawing of irregular and overlapped ROIs. The SUVmax position and the selected voxels for MTV can be displayed for visual control. The accuracy of the MTV results was controlled using phantom images and in a dataset of 59 patients with a baseline PET/CT for Hodgkin lymphoma. We compared the MTV values, area under ROC curves and prognosis value of our software with Keosys software (using 41% SUVmax threshold).

The Beth Israel plugin

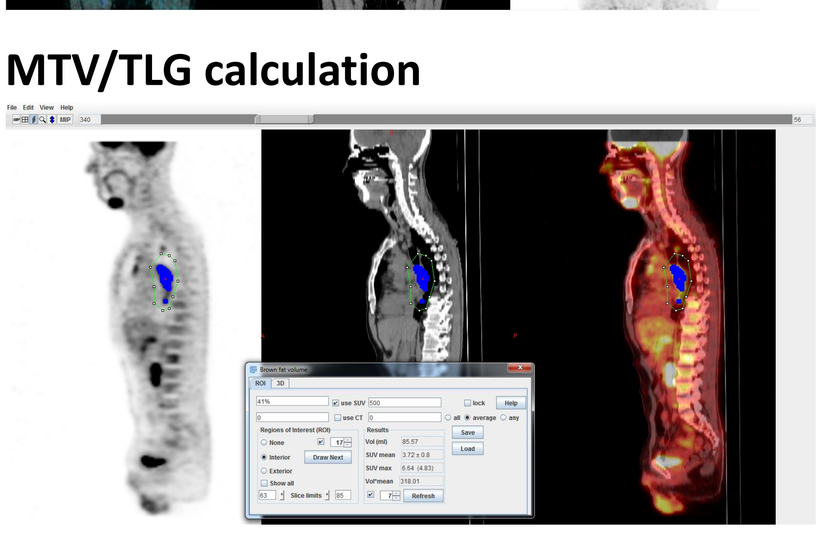
Read from CD function



PET/CT display



MTV/TLG calculation

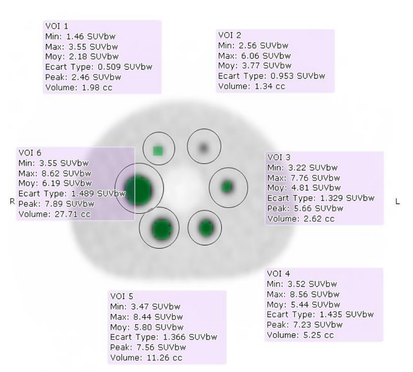


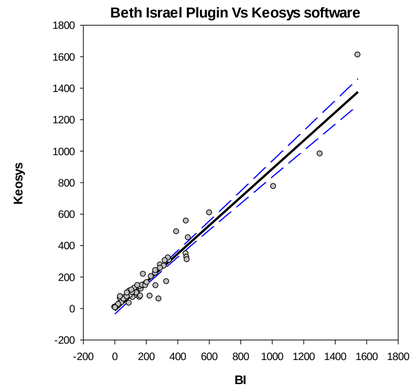
CSV export functionality

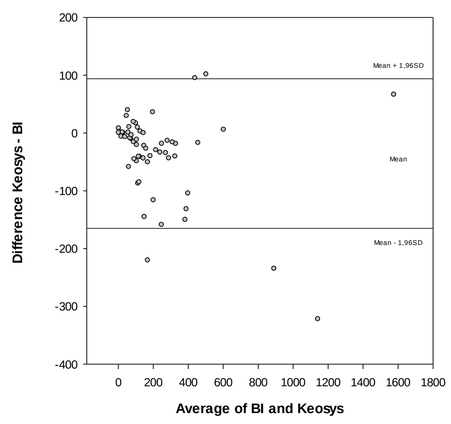
	A	B	C	D	E	F	G	H	I	J
1	ROI	type	Vol(ml)	Vol*mean	SUVMean	SD	SUVMax	MeanMax	axial	
2	1	1	12.86	42.48	3.3	0.64	5.29	3.8		
3	2	1	2.56	7.58	2.96	0.38	3.86	3.28		
4	3	1	0.0	0.0	0.0	0.0	0.0	0.0		
5	4	1	58.94	225.22	3.82	1.24	7.83	5.34		
6	sum	1	74.37	275.28	3.7	1.16	7.83	4.36		
7										
8	Number of ROIs = 4									
9	1	24	46	num points = 6	59 57	51 53	44 57	50 67	59 66	62 60
10	1	48	58	num points = 5	60 62	51 59	49 65	57 71	60 66	
11	1	167	177	num points = 4	88 94	85 90	79 93	83 97		
12	1	183	199	num points = 6	79 41	66 39	57 42	57 52	72 54	79 52
13	SUVlo	SUVhi	CTlo	CThi	useSUV	useCT	CtRadio			
14	2.5	500	-50	1000	1	0	1			

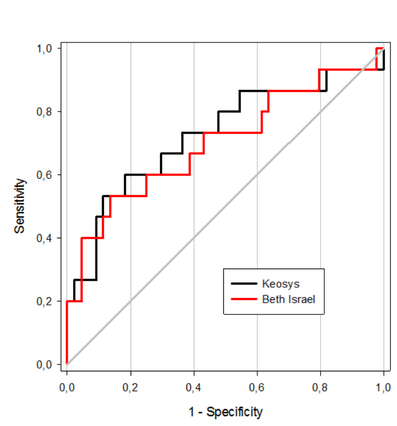
Results

With BI plugin, the MTV calculation on the phantom images shows the same value of MTV, SUVmax and SUVmean as the Keosys software (0% difference).









Software validation :
Phantom validation (A) showed exactly same values between Keosys and Beth Israel Plugin. Validation using the dataset of patients, correlation (B), Bland-Altman analysis (C) and ROC curves (D).

In the patients database: the mean MTV value was significantly higher with BI than Keosys (243 vs 207 ml [16.4–54.9] p<0.001). Pearson correlation coefficient was r=0,96, p<0,0001.The ROC analysis showed no significant differences between the two packages (AUC=0.711 for Keosys and 0.692 for BI, p=0.64). The optimal MTV cut-off to predict patient outcomes was 225ml for Keosys and 313ml for Beth Israel. Both MTV value using Keosys or BI were predictive of disease specific survival (HR=4.98 [1.4-17.7] p=0.0015 and HR=4.11[1.1-15.2] p<0.005 respectively).

Conclusion

Beth Israel software provides the first free, handy and validated software for MTV calculation. This software is open for further developments.

What can I do with Beth Israel Plugin ?

Beth Israel plugin is a software solution for nuclear medicine applications.
You will find a complete software solution to display and analyze PET/CT examinations. The software handles all usual function to display (PET/CT fusion, MPR, MIP, screen capture) and analyze (SUV quantification, MTV, TLG) PET images.
Based on FIJI (ImageJ distribution) you can also use all ImageJ functionalities for image processing (filtering, segmentation….)

How can I get it ?

Beth Israel is completely free and can be used over all operating systems (Windows, Mac OsX, GNU/Linux).

Go to Fiji website (http://fiji.sc/) to download and install FIJI, an ImageJ distribution.

Open Fiji, go to “Help” menu. Click on “update” then “manage update site”. In the list check “PET-CT” and click “apply change”.
You’re done, once installed Beth Israel plugin will auto update itself for each new release.

To get all those informations just scan this flashcode:

http://fiji.sc/User:Ilan

How can I support ?

Beth Israel Plugin is open source and in a continuous development cycle.

You can contribute by sharing your ideas for improvement and your needs for your projects.

If you face problem using Beth Israel, your reports will contribute to debug and improve the software.

If you use Beth Israel for publications, please mention that Beth Israel software is shareware from the Beth Israel Deaconess Medical Center, Division of Nuclear Medicine and Molecular Imaging, available at
http://sourceforge.net/projects/bifijiplugins/