Biomedical
Image Quantification

PMOD Technologies Ltd
Sumatrastrasse 25
8006 Zürich Switzerland

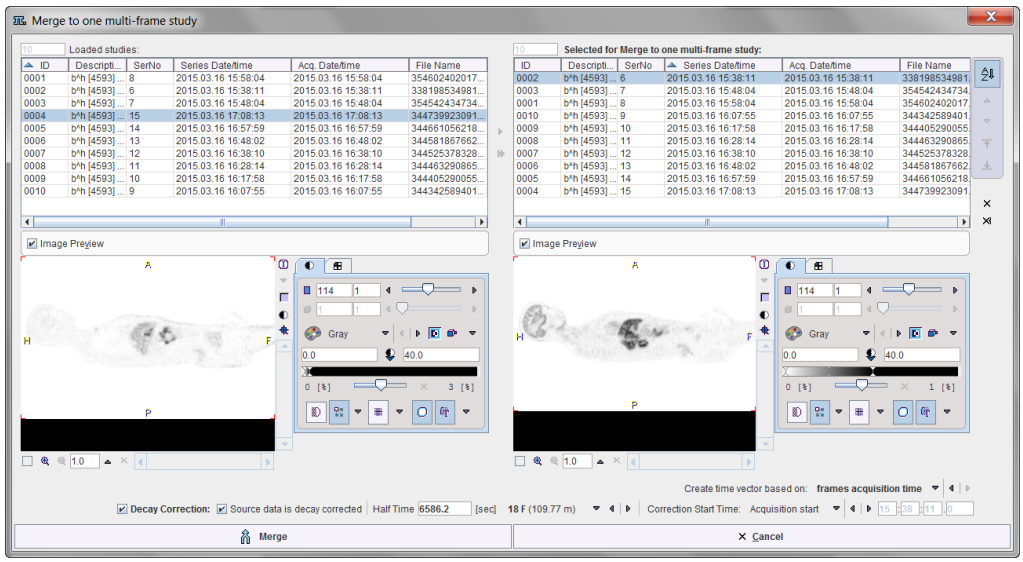
T +41 44 350 46 00
F +41 44 350 46 01
info@pmod.com pmod.com

PMOD Workflow for Dosimetry Pre-processing

The estimation of the internal radiation dose in nuclear medicine is a common requirement for the characterization of novel radiotracers. The total number of disintegrations (cumulated activity, or “residence time” in OLINDA/EXM) in the organs during the presence of the radionuclide in the body is required. PMOD supports a tailored workflow of preprocessing steps to arrive at reliable dosimetry input data from a set of sequential image acquisitions, using the base tool PBAS and the kinetic modeling tool PKIN.

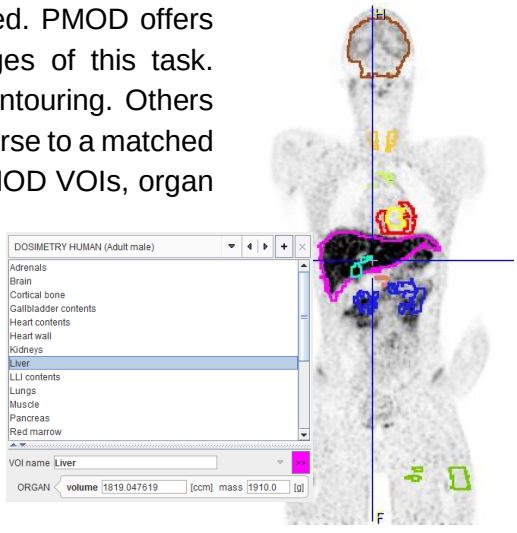
Data Preparation in PBAS

The images of multiple studies may be separated by hours or even days depending on the half-life of the isotope in question. The first task is to combine those images into a consistent dynamic series. A crucial element during data merging is the proper handling of decay correction for independently acquired series. PMOD’s Merge tool can derive the series timing directly from the image headers and offers decay correction at the individual image and dynamic series levels.



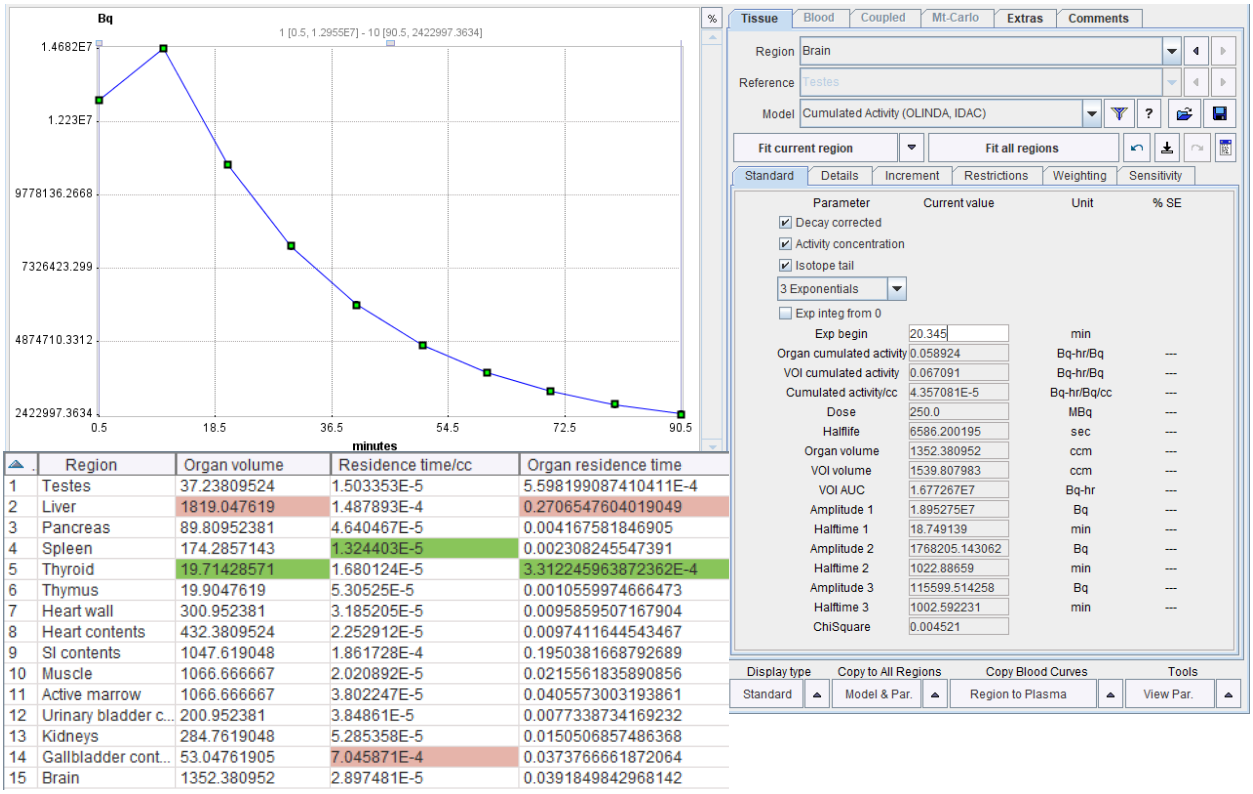
Organ Outlining in PBAS

As a next step organ outlines (VOIs) need to be defined. PMOD offers various flexible approaches to overcome the challenges of this task. Organs with clear uptake can be addressed via iso-contouring. Others may require manual or semi-automatic outlining, or recourse to a matched anatomical data set. Thanks to the 4D-capabilites of PMOD VOIs, organ position and even shape changes between sequential acquisitions can be precisely tracked. Finally, using a drop-down list, each VOI can easily be assigned to an organ with properties corresponding to a particular dosimetry phantom anatomy.



Cumulated Activity Calculation in PKIN

The radioactivity in each organ VOI is then averaged and transferred to PKIN, PMOD's kinetic modeling tool, as a time-activity curve (TAC). The TACs may feature time shifts to account for acquisitions with multiple bed positions. Before the actual number of disintegrations in the organs can be estimated, decay correction – if applied – has to be undone, and activity concentration data needs to be converted into total organ uptake. PMOD's workflow, including predefined VOI properties for dosimetry phantom organs, allows this process to be automated. Several integration approaches can be applied to the count rate curves generated: Discrete rectangular or trapezoidal integration followed by isotope decay, fitting of the declining part of the data with exponentials and algebraic integration, or a combination of both.



	Region	Organ volume	Residence time/cc	Organ residence time
1	Testes	37.23809524	1.503353E-5	5.598199087410411E-4
2	Liver	1819.047619	1.487893E-4	0.2706547604019049
3	Pancreas	89.80952381	4.640467E-5	0.004167581846905
4	Spleen	174.2857143	1.324403E-5	0.002308245547391
5	Thyroid	19.71428571	1.680124E-5	3.312245963872362E-4
6	Thymus	19.9047619	5.30525E-5	0.0010559974666473
7	Heart wall	300.952381	3.185205E-5	0.0095859507167904
8	Heart contents	432.3809524	2.252912E-5	0.0097411644543467
9	SI contents	1047.619048	1.861728E-4	0.1950381668792689
10	Muscle	1066.666667	2.020892E-5	0.0215561835890856
11	Active marrow	1066.666667	3.802247E-5	0.0405573003193861
12	Urinary bladder c...	200.952381	3.84861E-5	0.0077338734169232
13	Kidneys	284.7619048	5.285358E-5	0.0150506857486368
14	Gallbladder cont...	53.04761905	7.045871E-4	0.0373766661872064
15	Brain	1352.380952	2.897481E-5	0.0391849842968142

Compatibility with OLINDA/EXM and IDAC

Using a dedicated facility in PKIN, the resulting cumulated activities may be directly exported into an OLINDA/EXM case file or and IDAC2.1 .idac file. The corresponding dose calculation tools can then be started, the data retrieved, and the doses readily calculated.