Title: Co-registration and Quantification of OPT and MR images of Pancreatic islets

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Introduction: Quantification of total pancreatic islets (PIs) mass has great value in monitoring the onset of diabetes. High resolution optical projection tomography (OPT) allows ex vivo global evaluation of pancreatic constituent whereas MRI provides non-invasive imaging approach to monitor PIs in vivo. However, the quantification of PIs in MR images is always challenging due to false positive signal from other sources of hypo-intensity (blood vessels etc.). Thus, we have demonstrated here a method to co-localize PIs using OPT and MR images, and cross-validating the MRI contrast by extracting information obtained from the high-resolution and specific OPT.

Methods: Pancreatic islets were isolated from mice and labeled with micron-sized iron oxide (MPIOs) particles (ME04F, diameter 1-1.99 μm, BangsLab). Labeled islets were injected into a freshly isolated mouse pancreas. Pancreas were fixed and mounted in agarose prior to OPT scanning.

OPT and MRI scanning: OPT scanning were performed on a Biophtonic 3001 OPT scanner (Bioptonics), iso-surface reconstruction of labeled islets were generated by Volocity Version 4.3.2 (Improvision). MRI images were obtained on 9.4T Biospec small animal MRI scanner (Bruker Biospec, Germany).

OPT/MRI co-registration: Co-registration was accomplished by an in-house developed tool (Mirit) using MeVisLab. High-resolution 3D OPT tissue images were spatially normalized to its corresponding 3D MR images using [1]. After manual re-orientation and initialization, a 12-parameter affine transformation (translation, rotation, scaling and skewing) was determined automatically by maximizing mutual information between MR and OPT tissue images. OPT iso-surface reconstruction of PIs images were resampled to the MRI space. Pancreatic islets in MR images were shown as hypo-intense spots after segmentation and intensity threshold.

MRI quantification: Another in-house tool (Qmop) developed in MeVisLab was used to verify the accuracy of OPT/MRI co-registration and quantify PIs in MRI. Clusters of segmented hypo-intense spots in MRI were manually labeled by adding markers in Qmop. Number of PIs in MR images was compared with OPT images.

Results and Discussion: Figure shows OPT/MRI co-registration (left) and MRI quantification (right). Quantification of overlap between signals from OPT with MRI showed an 82.6% agreement of OPT signals with corresponding MRI signals. Approximately 36% of MRI signals did not overlap with an OPT signal, indicating false positive PIs. In conclusion, successful co-registration of PIs from MRI and OPT images allowed cross-validation of MR images, confirming its suitability for in vivo PI imaging.

![OPT/MRI co-registration, MRI quantification](image)

Left: OPT/MRI co-registration, PIs in OPT images were labeled in green, MRI contrast were shown in grey scale. Right: MRI quantification using Qmop, OPT signals were labeled in yellow, MRI hypo-intense signals were labeled with red square.
References:

Topic:
- [ ] Cancer imaging
- [ ] Central nervous system imaging
- [ ] Molecular imaging of cardiovascular diseases
- [ ] Inflammation
- [x] Molecular imaging technology
- [ ] Other imaging modalities