Development of a Tumor Model for Augmented Reality

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Background

The objectives were to develop a new model of laparoscopic experimental tumor and to evaluate it with the use of Augmented Reality.

Methods

We did a prospective, experimental study on ex vivo porcine kidneys. To determine the optimal pseudotumor agent to use, various substances were injected. Ideally, a tumor model should be easy to create and implant, biocompatible, safe and durable, visible on several imaging modalities at and the macroscopic scale, and comparable in texture to real tumor tissue. We finally used Alginate, because it has many advantages. Alginate was injected into the parenchyma and easily allowed us to create 4-10mm pseudotumors. Kidneys were then imaged by MRI (T1-weighted) in three planes. We improved MRI settings (0.4mm resolution, and slide thickness 1.5 mm) and pseudotumors were easily identified.

Results

Augmented Reality (AR) is a technology that allows a surgeon to see sub-surface structures in an endoscopic video. In our technique, three phases are necessary: Phase 1: segmentation phase; using the MRI images, the kidneys and pseudotumors' surface are segmented to construct a 3D mesh model. Phase 2: the intra-operative shape on the kidney is determined. Phase 3: fusion phase; the pre-operative and intra-operative models are fused with the laparoscopic view. This blending gives the impression that the kidney is semi-transparent and the surgeon can see the location of the tumors inside it. On this 2D images, to improve the depth localization of the tumors the AR software allows one to display in real-time the kidneys' surface meshes in addition to tumors meshes. Our software also allows us to display the resection margins defined preoperatively by the surgeon (5mm margins in our model).

Conclusions

The simple and minimally invasive method for lesion creation, the robust imaging capabilities make this proposed Alginate model for tumor creation very valuable for further studies.