3D-Modeling and Printing of Pancreatic Tumors: A New Personalized Diagnostic Approach

Christelle De Vico

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Currently, patients with pancreatic adenocarcinoma have an extremely low life expectancy, that is due to late diagnosis and aggressive tumor behavior. At 5 years follow-up, survival of affected persons is below 5% and surgery remain the only curative treatment. When pancreatic adenocarcinoma is diagnosed, a minority of patients show a resectable lesion (< 20%), and the majority of them already show metastatic lesions (> 50%). However, in approximately 30% of these patients the tumor is locally advanced, but without any distant metastases. The possibility of a surgical resection is mainly limited by the invasion of important blood vessels, such as the superior mesenteric artery, the coeliac trunk, sometimes the portal vein or the superior mesenteric vein with thrombosis. Due to a limited radiological prevision what concerns such vascular infiltrations, they are often detected only during surgical exploration. In cases with not a feasible surgical resection at exploration, recovery after surgery may substantially delay the initiation of chemo- and/or radiotherapy. Neuroendocrine tumors of the pancreas (pNETs) are originating from pancreatic islet cells. The fiveyear survival rate in patients with complete resection of non-metastatic pNETs is > 90%. Surgery remains the most favorable treatment option and localization of such tumors is of high importance in order to allow complete removal and also minimizing resection of non-affected pancreatic tissue. In order to improve the prediction of surgical resectability of pancreatic tumors, we try to establish anatomic 3D-imaging and -printing as a new tool with the aim to evaluate whether this new approach may help to improve planning of the treatment strategy and operative management. For patients with pancreatic adenocarcinoma, the aim was to analyze a potential vascular invasion of locally advanced tumors by 3D-printing in order to avoid unnecessary surgical exploration. For patients with pNET's, the aim of anatomical 3D-printing was to evaluate the exact localization of tumors being able to obtain a more precise operative (tissue-sparing) planning. We selected three patients in order to evaluate this new method in a first pilot study at the HFR. There were 2 patients with locally advanced adenocarcinoma of the pancreatic head and one with a pNET. The patients presenting adenocarcinomas had been operated on, the patient with a pNET was in the preoperative work-up. The pre-operative images were processed for 3D-segmentation, followed by the 3Dprinting. In the first patient with pancreatic adenocarcinoma, the invasion of the superior mesenteric vein could not be seen by the conventional pre-operative radiological work-up (CT-scan, MRI). However, vascular invasion was suspected by the radiologist who performed the 3D-modeling. Based on these first 3 cases of 3D-modeling and -printing of pancreatic tumors, it appears that this new method of pre-operative work-up is able to add important information, such as the prediction of vascular involvement of major vessels as well as the more precise location of tumors (pNET's).

Director: Prof. Dr. Med. Bernhard Egger, HFR Fribourg