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ABSTRACTS

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Advances in CT Imaging of GI Malignancies

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Introduction and Overview: CT has always played a major role in the detection, staging and management of patients with a wide range of GI malignancies. With the most recent advances in both CT hardware and software new opportunities for even a greater impact on patient care is possible. In this presentation I will highlight some of these changes and their impact on the detection and staging of GI malignancies. Due to the 20 minute time limitation, I will focus on some of the newer aspects of CT that have the greatest impact on lesion detection, lesion identification and staging.

With the advent of 64 MDCT in 2004 we were able to acquire datasets of the abdomen in around 10 seconds or less while being able to obtain routinely true isotrophic datasets. Subsequent scanner hardware advances to 256 MDCT and Dual Source scanners have allowed us to scan even faster with ever higher resolution so that current Dual Source scanner can scan the abdomen in under a second with under .4 mm spatial resolution. The fast scan time allow for closer coupling of iodinated contrast delivery and data acquisition allowing for optimal acquisition of scan data in either arterial or venous phase or the ability to acquire multiple phases of acquisition. The isotrophic datasets provide the ability to display images in any plane or perspective with a similar resolution to the axial protocols. This is critical when multiplanar images (MPR) are acquired in the coronal or saggital display, as well as 3D mapping using either volume rendering (VRT) or maximum intensity projection (MIP) is used. Similarly when 3D techniques are used for virtual colonoscopy or virtual endoscopy isotrophic datasets are critical.

Scanning protocols for GI Oncologic imaging also require careful patient preparation with the use of oral and IV contrast material. While positive contrast has long been the standard for CT imaging and still remains a commonly used agent for routine follow-up of malignancies like colon cancer and lymphoma, water is becoming the new standard in many cases. Water is a neutral agent, which distends the bowel but does not limit the analysis of the enhancement pattern of bowel and often allows detection of smaller tumors especially when they are vascular. In select cases of evaluation of the small bowel and occasionally the stomach a different agent, VolLumen is used. These cases are typically those classified as CT Enterography. Intravenous contrast is routinely used and is an iodinated contrast agent. We routinely use Omnipque-350 or Visipaque-320 depending on the clinical history and the patient's renal function. Contrast is injected at 4-5 cc/sec usually for a volume of 90-120 cc depending in part on the study performed and the patient's body habitus.

Depending on the clinical application images are usually acquired in the arterial phase (25-30 seconds after start of injection) and portal venous phase (60-70 seconds after start of the injection. Delayed phase images (3-5 minutes after start of injection) are not routinely obtained but are in select cases for further lesion characterization. All study protocols are designed with ALARA principles in mind for lowest radiation dose possible while maintaining good image quality. Once the data sets are acquired images are usually

reconstructed with .75 mm slice thickness at .5 mm intervals. Further details on study protocols as well as other information including case studies can be accessed on line at no charge at www.ctisus.com.

Data Display: Once the data is reconstructed at the scanner, the image files are sent to a freestanding workstation where the data analysis is performed. The techniques use interactive rendering and the post processing is done by the radiologist to optimize image display and interpretation. Images generated are sent to the referring physician and can also be accessed through the PACs system and now via thin client on Apple iPads or iPhones.

Representative Applications

Pancreas Imaging: The use of dual phase imaging is critical for both lesion detection and staging across a range of pancreatic tumors. While adenocarcinoma of the pancreas is often best seen on venous phase images correct staging requires vascular maps of both the arterial (celiac including hepatic and splenic arteries as well as the SMA) and venous phase images (portal vein and SMV). The vascular maps are ideally displayed with a combination of MPR and 3D mapping. On the other hand neuroendocrine tumors and their metastases (i.e. liver) are best seen and may be only seen on the arterial phase images. On venous phase images the primary mass as well as liver metastases may become isodense to the adjacent organ.

Hepatic Imaging: Detection of liver lesions is but one step in their analysis and evaluation. Liver masses commonly exhibit characteristic signatures that allow identification. Cysts usually are the easiest to define but other lesions like hemangioma (peripheral puddling and lesion filling in over 10-15 minutes), focal nodular hyperplasia (vascular lesion as bright as the IVC with homogeneous enhance, and a central scar which fill in) to hepatic adenoma (evidence of mass effect and recent bleed and/or vascular mass) to hepatoma (vascular lesion with neovascularity often in a cirrhotic liver.

3D mapping often helps with lesion identification as well as with helping determine the optional therapy for the patient (i.e. surgery vs embolization). Newest applications like perfusion CT may help with defining tumor angiogenesis as well as response to therapy.

Small Bowel Imaging: Detection of small bowel tumors has always been a challenge when lesions are small and do not cause bowel obstruction. It is little surprise that from presentation to diagnosis it is often been quoted in the past as 12-18 months till a small bowel lesion is detected. Today with dedicated CT of the bowel using a neutral contrast agent we can detect ever-smaller tumors by either mass enhancement or perfusion changes in the bowel. Tumors within the bowel wall or in the mesentery can be detected with dual phase imaging. Whether a lesion is an adenocarcinoma, GIST tumor or a carcinoid tumor our detection rates surely improve by using dual phase imaging and 3D mapping. The accurate detection of metastases to the liver can also be done with arterial phase imaging in the patient with a vascular primary like a carcinoid tumor.

Conclusion: I have presented a brief overview of some of the principles and techniques used in CT of the GI tract today. Applications like virtual colonoscopy or endoscopy are also important and are increasing in importance. Dual energy techniques may also have promise in GI imaging. CT imaging of the esophagus, stomach and spleen can also be useful when performed correctly. This talk highlighted many of technical parts of the study to help define where state of the art is in CT of GI Malignancies and some of the direction we need to explore further.