Three dimensional (3D) CT reconstruction in cancer imaging

The article by Zhang et al. in this issue highlights the power of 3D CT, especially in operable breast cancer. Conservative breast surgery is becoming an important treatment option. Precise edge detection is an important prerequisite for adequate surgery. The authors have studied 3D CT reconstruction and thin slice reformatted image using dedicated software. They have compared their observations against the gold standard surgical specimen and have found that thin slice 3D reconstruction was closest to the actual specimen. This adds to the armamentarium of the surgeon to get adequate image guidance. The complex architecture of breast is only partly unraveled by mammography. Digital breast tomosynthesis with 2D and 3D reconstruction is poised to improve the detectability of lesion. On phantom studies, 3D study acquired with variable dose approach has shown lesser noise. The success of breast reconstruction is limited by the inability to objectively assess breast volume and shape; 3D imaging helps largely to bridge this limitation. Partial breast irradiation for the post-operative breast with high dose rate brachytherapy is best achieved by 3D CT based pre implant definition. CT based 3D RT planning system ensure exact planning target volume, which is likely to improve outcome.

Sentinel lymph node imaging has been strengthened by addition of real time virtual sonography systems which display multiplanar reconstruction images obtained from 3D CT-lymphography that significantly improve preoperative detection of sentinel lymph nodes. Amongst the other uses in oncology, 3D PET/CT flythrough post processing has provided more accurate targeting for mediastinoscopy.

For presurgical evaluation several 3D fusion anatomical and morphological techniques have been proven to be of help. Using 3D CT/SPECT quantitative uptake and distribution of $^{99m}$Tc Galactosyl Human Serum Albumin has been estimated in patients with chronic liver disease, thereby measuring functional liver parameters or index. Feasibility of precise local resection of hepatocellular carcinoma according to the anatomy and vessels using preoperative 3D CT analysis has also been demonstrated.

In addition to oncology 3D reconstruction has been found to be extremely useful in several other clinical situations such as trauma and reconstructive surgeries. Imaging and modelling of skeletal fracture with 3D CT and 3D models to 2D CT have led to significant improvements in sensitivity and in the diagnosis and treatment planning. Better inter-observer agreement has been noted with 3D reconstructed images. Besides fractures of long bones, evaluation and management of maxillofacial bone fractures have significantly benefitted. The accuracy of 3D reconstruction images using multidetector CT and cone beam CT has been effectively demonstrated and used in skeletal lesions especially the skull. HYBRID IMAGING (SPECT/CT) combining 3D CT and single photon emission computerized tomography (SPECT) provides functional 3D information and have been used to normalize orthopaedic SPECT/CT data that enable standardized quantitative measurements.

Thus, advances in imaging have contributed greatly to patient management - diagnosis, planning of surgical and reconstructive techniques or radiotherapy planning. This has largely been due to clearer depiction of disease morphology including better edge detection which has been brought about by the advent of 3D CT, the indications and use of which are undoubtedly on the rise.

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References


