Indian J Med Res 136, January 2013, pp 10-11

Commentary

Three dimensional (3D) CT reconstruction in cancer imaging

The article by Zhang *et al*[1] 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[2]. 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[3]. 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[4].

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[5]. Amongst the other uses in oncology, 3D PET/CT flythrough post processing has provided more accurate targeting for mediastinoscopy[6].

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[7]. Feasibility of precise local resection of hepatocellular carcinoma according to the anatomy and vessels using preoperative 3D CT analysis has also been demonstrated[8].

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[9]. 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[10]. 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[11].

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.

V. Rangarajan
Department of Nuclear Medicine
& Molecular Imaging
Tata Memorial Centre
Mumbai 400 012, India
drvrangarajan@gmail.com

References

1. Zhang Y, Zhou Y, Yang X, Tang P, Qiu Q, Liang Y, *et al*. Thin slice three dimentional (3D) reconstruction versus CT 3D reconstruction of human breast cancer. *Indian J Med Res* 2013; *137* : 57-62.
2. Vuong T, Parker W, Patrocinio HJ, Fava P, Parmar D, Evans MD, *et al*. An alternative mantle irradiation technique using 3D CT- based treatment planning for female patients with Hodgkin's disease. *Int J Radiat Oncol Biol Phys* 2000; *47* : 739-48.
3. Tepper OM, Karp NS, Small K, Unger J, Rudolph L, Pritchard A, *et al*. Three-dimensional imaging provides valuable clinical data to aid in unilateral tissue expander-implant-breast reconstruction. *Breast J* 2008; *14* : 543-50.
4. Aristei C, Tarducci R, Palumbo I, Cavalli A, Corazzi F, Rulli A, *et al*. Computed tomography for excision cavity localization and 3D-treatment planning in partial breast irradiation with high-dose-rate interstitial brachytherapy. *Radiother Oncol* 2009; *90* : 43-7.
5. Yamamoto S, Maeda N, Tamesa M, Nagashima Y, Yoshimura K, Oka M. Prospective ultrasonographic prediction of sentinel lymph node metastasis by real-time virtual sonography constructed with three-dimensional computed tomography-lymphography in breast cancer patients. *Breast Cancer* 2012; *19* : 77-82.
6. Siepel FJ, de Bruin WI, van Duyn EB, Steenvoorde P, Wagenaar NR, Slump CH, *et al*. Targeted lymph node biopsy in mediastinoscopy using 3D FDG-PET/CT movies: a feasibility study. *Nucl Med Commun* 2012; *33* : 439-44.
7. Yoshida M, Shiraishi S, Sakaguchi F, Utsunomiya D, Tashiro K, Tomiguchi S, *et al*. A quantitative index measured on 99m Tc GSA SPECT/CT 3D fused images to evaluate severe fibrosis in patients with chronic liver disease. *Jpn J Radiol 30* : 435-41.
8. Wang Y, Zhang Y, Peitgen HO, Schenk A, Yuan L, Wei G, *et al*. Precise local resection for hepatocellular carcinoma based on tumor-surrounding vascular anatomy revealed by 3D analysis. *Dig Surg* 2012; *29* : 99-106.
9. Brouwer KM, Lindenhovius AL, Dyer GS, Zurakowski D, Mudgal CS, Ring D. Diagnostic accuracy of 2- and 3-dimensional imaging and modeling of distal humerus fractures. *J Shoulder Elbow Surg* 2012; *21* : 772-6.
10. Kim M, Huh KH, Yi WJ, Heo MS, Lee SS, Choi SC. Evaluation of accuracy of 3D reconstruction images using multi-detector CT and cone-beam CT. *Imaging Sci Dent* 2012; *42* : 25-33.
11. Hirschmann MT, Wagner CR, Rasch H, Henckel J. Standardized volumetric 3D-analysis of SPECT/CT imaging in orthopaedics: overcoming the limitations of qualitative 2D analysis. *BMC Med Imaging* 2012; *12* : 5.