Original Article

Pulmonary Nodules

MDCT at LUMHS: Detection of the Small Pulmonary Nodules by Use of Maximum Intensity Projection Images

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ABSTRACT

Objective: To assess the benefit of computed tomography by using Maximum Intensity Projection (MIP) compare to Volume Rendering (VR) reconstructions to study pulmonary metastases.
Study Design: Observational / descriptive study.
Place and Duration of Study: This study was conducted at Radiology Department of Liaquat Medical University Hospital Hyderabad from July 2015 to April 2016.
Materials and Methods: Computed tomography studies of 30 pulmonary metastatic cases were reviewed retrospectively. Images were evaluated as number of the nodules. Two viewers on VR & MIP reconstructions on axial-source images assessed these parameters. Independent evaluation of the MIP & VR images was done by well experienced chest radiologist. In the course of independent image assessment, each pulmonary nodule was indicated by an arrow as well as recorded in the Performa.
Results: A total of 30 cases were integrated in our study. The mean age of the cases was *52.12 ± 7.33* years. Out of 30 cases male were in majority 24(80%). Total 334 nodules were detected by MIP images, while out of them 276 were detected by VR images and 58 were missed, therefore MIP images is the significantly more detectable technique for pulmonary nodules detection. P= value 0.001. Following by central 253 nodules were detected by MIP images, out of them 40 nodules missed by VR images and 113 were detected, with significant difference P value = 0.001. Similarly all the peripheral nodules were also significantly more detected by MIP images, as compare to VR images. P value = 0.001
Conclusion: Maximum intensity projection is more useful and best technique, to detect the small pulmonary nodules especially in central lung.
Key Words: Small pulmonary nodules, MIP, VR

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INTRODUCTION

Lungs are important organs of the body for survival of human beings. The lungs may suffer from many fatal diseases. In radiology, it is a general clinical issue to detect pulmonary nodules through computed tomography in the assessment of cases with suspected malignancy of metastases to the lung as well as to detect tiny nodules as part of a CT-based lung cancer screening program. [1] In order to detect the nodule, Helical CT is an alternative technique;[2,3] though, failure of both helical CT to depict and the reviewer to detect small (< 6-7 mm in diameter) lesions is well known. Overall sensitivity is only 47-69% for such small nodules in clinical practice, even though viewing conditions and specific CT methods differ widely in the published studies. [4,5]

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Lung cancer screening failures also occur; half of the carcinomas detected on helical CT in one screening program have been existing in retrospect on a preceding screening assessment.[6] Both technical parameters (nodule depiction) and interobserver variability (nodule detection) are important determinants of overall CT sensitivity, although the relative importance of each factor is not well understood. Multidetector computed tomography (MDCT) enables concurrent increased *z*-axis exposure & thinner segment collimation in contrast to single-row-scanner helical computed tomography. Thin segments improve resolution as well as lower the volume averaging from segment-to-segment and must lead to further accurate depiction of small nodules. However, two major factors limit the observer for the detection of such nodules: substantial quantity of axial images is generated, which results in reviewer fatigue whilst interpretation; and, on each thin slice, normal vessels are imitated by nodules in cross-section and vice versa particularly in the central lung zones. [7,8] These contemplations limit apprehension of the real potential of MDCT in detecting the nodules in the lung. New computer-based image processing means can facilitate the full application of substantial volumetric multidetector CT data sets. One example is maximum-

intensity-projection (MIP) imaging, originally expressed by Napel & associates.[9] This tool applies ray projection methods via a mass of predefined axial images; the maximum density point met by the ray passing through the stack is pitched onto the ultimate image. MIP processing keeps a number of benefits: vascular structures come into view as noticeably branching & tubular structures instead of discreet nodules; the MIP piece conserves the resolution intrinsic to the axial images via which it is produced; and quantity of images are markedly decreased in comparison to the axial image set. In numerous earlier studies, researchers have exhibited that the nodules exposure rates of lung via post processing methods for example VR & MIP are higher to those accomplished via traditional transverse section analysis. [10,11] On other hand Peloschek et al. established VR to be better than MIP.[12] Therefore aim of our study was to assess the experience of CT by using MIP compare to VR reconstructions to study small lung nodules on multidetector CT data sets.

MATERIALS AND METHODS

This prospective study was conducted at radiology department of Liaquat medical University Hospital Hyderabad, and mostly cases were referred from medical department with the duration of time from July 2015 to April 2016. All the cases between ages of 20 to 60 years, either genders were selected for the study and all the cases less than 20 years and more than 60 years of the age and having coexisting lung disorder (e.g., interstitial lung disorder, consolidations) and those who were not agree to participate in the study were excluded. 30 patients with having pulmonary metastatic disease were retrospectively identified. Two senior reviewers interpreted all images on a workstation. Contrast agent was IV administrated in all selected cases. The scanning was started when CT decreases in the rising aorta assessed as 120 HU. Individual evaluation of the MIP and VR images was done by well experienced chest radiologist. While individual image evaluation, each pulmonary nodule was manifested via an arrow as well as was recorded on the Performa.

RESULTS

A total of 30 cases were integrated in our study. The mean age of the cases was *52.12 ± 7.33* years. Out of 30 cases male were in majority 24(80%), and 06(20%) were female with male to female ratio was 1:4 as shown in table 1.

Total 334 nodules were detected out of them 276 were detected by VR images and 58 were missed, while no missed nodules were noted by MIP images, therefore MIP images is the significantly more detectable technique for pulmonary nodules detection. P= value 0.001 table2.

Furthermore central nodules were 253 and totally were detected by MIP images, while 40 nodules missed by VR images and 113 were detected, with significant difference P value = 0.001 table 2.

Similarly all the peripheral nodules were also significantly more detected by MIP images, as compare to VR images, as: out of 181 nodules 163 were detected and 18 were missed. P value = 0.001 table 2.

Table. No.1. Demographic traits of cases (n=30)

Variables	Number of patients /(%)
AGE (mean+SD)	52.12 ± 7.33 years
Age groups	
20-40	02(6.66%)
41-60	28(93.34%)
GENDER	
Male	24(58%)
Female	06(42%)

Table No.2: distribution of pulmonary nodules *according to VR and MIP images (n=30)*

Pulmonary nodules	No. of patients /(%)		
	VR images	MIP images	P-value
All nodules			
Detected	276(82.63%)	334(100%)	0.001
Missed	58(17.37%)	00	
Central nodules			
Detected	113(33.83%)	153(45.80%)	0.001
Missed	40(11.97%)	00	
Peripheral nodules			
Detected	163(48.80%)	181(100%)	0.001
Missed	18(5.38%)	00	

DISCUSSION

At a workstation, viewing image stacks of computed tomographic assessments through a constant series rather than reading particular images on hard copies was an untimely most important technologic progression. Though, application of post processing methods, for instance MIP or VR, has been exhibited to enhance pulmonary nodules detection rates in contrast to cine viewing of non post processed axial images.[10-11,13]

In this study the mean age of the cases was *52.12 ± 7.33* years. Out of 30 cases male were in majority 24(80%), and 06(20%) were female. Similarly Peloschek P et al[12]

reported that from selected 20 cases (8 were females & 12 were males and mean age was 56±16 years). In another study of Kawe N et al[14] also found similar findings as from 8 8 case (55males, 33 females; mean age 59 yrs & age ranging from 18 to 81yrs).

In this study total 334 nodules were detected by MIP images out of them 276 were detected by VR images and 58 were missed, therefore MIP images is the significantly more detectable technique for pulmonary nodules detection. P= value 0.001. As well as in numerous preceding studies, researchers have exhibited that the diagnostic rates for lung nodules by the application of post-processing methods for instance VR & MIP are better to those accomplished via typical transverse section examining.[15,16] Diederich et al.[17] contrasted, among others, 15mm & 30mm MIP and established 15mm MIP to be somewhat better. Nonetheless, MIP images were restructured via CT record sets along 5mm &10mm collimation. Peloschek et al.[10] contrasted MIP & VR for just single fixed slice of thickness of 7 mm. As well as Yoneda et al.[12] assessed MIP & VR with a slab of 15 mm of thickness. Gruden et al.[15] contrasted 10mm MIP & 3.75mm axial images since the outcomes of their preceding examinations produced the postulation that 10mm MIP is better than 5 &30mm MIP.

253 central nodules were detected by MIP images, out of them 40 nodules missed by VR images and 113 were detected, with significant difference P value = 0.001. Similarly all the peripheral nodules were also significantly more detected by MIP images, as compare to VR images, P value = 0.001. Similarly Kawe N et al[14] reported that pulmonary nodules sensitivity was better in MIP images as well as MIP was significantly superior to the sensitivities of each further tested methods for both interpreters ($p < 0.001$ each) regardless of nodule size & localization. A greater sensitivity was accomplished via MIP contrasted with VR. P value 0.001.

CONCLUSION

Maximum intensity projection is more useful, less time consuming and best technique, to detect the small pulmonary nodules especially in central lung. Hence MIP reconstructions is most sensitive to detect tiny pulmonary nodules. More studies with big sample size are required to more accurate findings.

Conflict of Interest: The study has no conflict of interest to declare by any author.

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