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Novel Use of Augmented Fluoroscopy using the LungVision System to Access Peripheral Pulmonary Nodules - A Feasibility Study

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Abstract:

Background: Multiple modalities exist for the bronchoscopic access of peripheral pulmonary nodules (PPN); each vary in equipment, cost, and required skillset inherent to that modality. LungVision (Body Vision Medical Ltd, Israel) is a new modality that enables augmented bronchoscopic navigation to PPNs. The system integrates information from pre-procedural CT imaging into augmented fluoroscopic images, presenting real-time visualization of the airways and localization of the nodule during transbronchial navigation and biopsy. During the LungVision procedure, anatomic and external landmarks are used to fuse multiplanar fluoroscopic images with CT modeling to create an augmented fluoroscopic overlay of the airways leading to the nodule, and an overlay of the nodule itself such that biopsy localization can be achieved. LungVision has potential advantages in that it uses readily available equipment that users have familiarity with. This feasibility study evaluates LungVision's performance during concurrent use of electromagnetic navigation bronchoscopy (ENB) in access and biopsy of PPNs.

Methods: Patients with PPNs in which biopsy was needed to determine further management plans were enrolled. All patients were intended to have an ENB (SuperDimension, Medtronic, USA) with concurrent LungVision augmented fluoroscopy. ROSE was used in all cases. After patients were anesthetized, LungVision registration using multiplanar fluoroscopy imaging was performed, producing augmented fluoroscopic imaging (see photo). ENB was then performed in usual fashion with simultaneous LungVision-enabled augmented fluoroscopy imaging. All procedures

used peripheral EBUS (pEBUS) for localization verification. When ENB and LungVision imaging disagreed, the modality which attained pEBUS verification was used for biopsy localization; in situations where neither attained verification, LungVision localization was used first, and if ROSE was non-diagnostic, then ENB localization was used.

Results: 34 patients with 36 peripheral nodules were enrolled into the study. LungVision was used for all nodules. In 4 patients ENB could not be performed and only LungVision was used for navigation. Average nodule size was 19. 6mm (+/- 10. 1mm); 25 (69%) were <20mm. 21 (58. 3%) were in upper lobe nodules. Localization success (pEBUS confirmation and/or definitive biopsy) occurred in 31 (86%) of nodules. 27 (75%) nodules received a definitive diagnosis. Navigation agreement between ENB and LungVision occurred in 22 (68%); in cases of disagreement, definitive diagnosis occurred in 7 (70%), and all resulted by using LungVision imaging for localization.

Conclusions: In this feasibility study, LungVision showed acceptable navigational agreement with ENB, and in several cases of disagreement it enhanced localization and diagnostic yield. Further studies are warranted to further evaluate its performance as a primary navigation modality.

Novel Use of Augmented Fluoroscopy using the LungVision System To Access Peripheral Pulmonary Nodules - A Feasibility Study

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INTRODUCTION

Multiple modalities exist for the bronchoscopic access of peripheral pulmonary nodules (PPN); each vary in equipment, cost, and required skillset inherent to that modality. LungVision (Body Vision Medical LTD, Israel) is a new modality that enables augmented bronchoscopic navigation to PPNs. The system integrates information from pre-procedural CT imaging into augmented fluoroscopic images, presenting real-time visualization of the airways and localization of the nodule during transbronchial navigation and biopsy. During the LungVision procedure, anatomic and external landmarks are used to fuse multiplanar fluoroscopic images with CT modeling to create an augmented fluoroscopic overlay of the airways leading to the nodule, and an overlay of the nodule itself such that biopsy localization can be achieved. LungVision has potential advantages in that it uses readily available equipment that users have familiarity with. This feasibility study evaluates LungVision's performance during concurrent use of electromagnetic navigation bronchoscopy (ENB) in access and biopsy of PPNs.

METHODS

Patients with PPNs in which biopsy was needed to determine further management plans were enrolled. All patients were intended to have an ENB (SuperDimension, Medtronic, USA) with concurrent LungVision augmented fluoroscopy. ROSE was used in all cases. After patients were anesthetized, LungVision registration using multiplanar fluoroscopy imaging was performed, producing augmented fluoroscopic imaging. ENB was then performed in a usual fashion with simultaneous LungVision-enabled augmented fluoroscopy imaging. All procedures used peripheral EBUS (pEBUS) for localization verification. When ENB and LungVision imaging disagreed, the modality which attained pEBUS verification was used for biopsy localization; in situations where neither attained verification, LungVision localization was used first, and if ROSE was non-diagnostic, then ENB localization was used.

TABLE 1 : PATIENTS DEMOGRAPHICS

CHARACTERISTIC	LUNGVISION , (n=34)
Age, Years, mean ± SD	68.9 ± 9.7
Male : Female sex, n (%)	12 (35%) : 22 (65%)
Used tobacco, n (%)	29 (85%)
Size of nodule or mass, n (%) **≤20 mm** **>20 mm**	25 (69%) 11 (31%)
Upper lobe location of target nodules, n (%)	21 (58.3%)

FIGURE : A GRAPHIC DESCRIPTION OF THE LUNGVISION SYSTEM

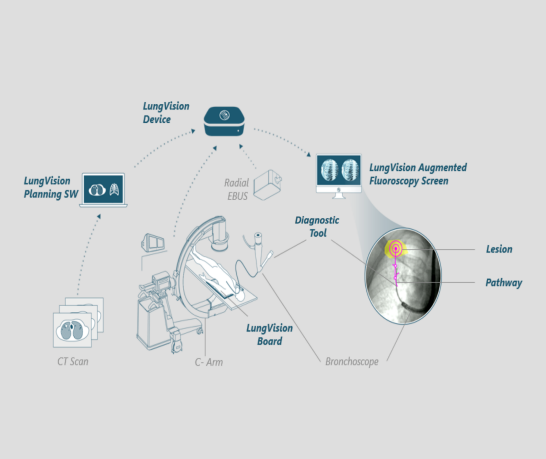
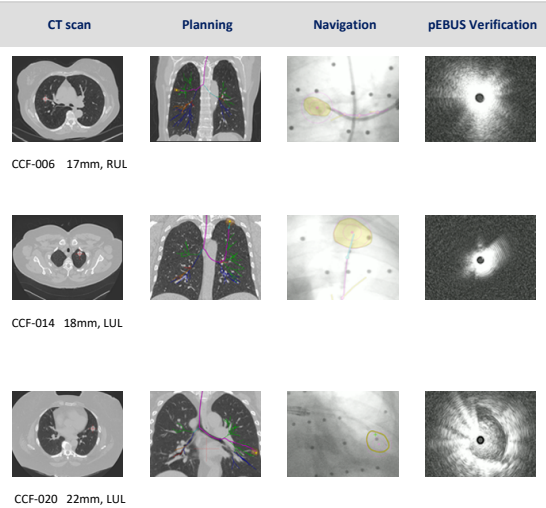


FIGURE : LUNGVISION PROCEDURES



RESULTS

34 patients with 36 peripheral nodules were enrolled into the study. LungVision was used for all nodules. In 4 patients ENB could not be performed and only LungVision was used for navigation. Average nodule size was 19.6 mm (± 10.1 mm); 25 nodules (69%) were <20mm. 21 nodules (58.3%) were located in the upper lobe. Localization success (pEBUS confirmation and/or definitive biopsy) occurred in 31 (86%) of the nodules. 27 (75%) nodules received a definitive diagnosis. Navigation agreement between ENB and LungVision occurred in 22 procedures (68%); in cases of disagreement, definitive diagnosis occurred in 7 (70%), and all resulted by using LungVision imaging for localization.

DISCUSSION

In this feasibility study, LungVision showed acceptable navigational agreement with ENB, and in several cases of disagreement it enhanced localization and diagnostic yield. Further studies are warranted to further evaluate its performance as a primary navigation modality.

TABLE 2 : STUDY RESULTS

Number of Patients	34 patients
Number of nodules aimed to access	36 nodules
Average nodule size ± SD (mm)	19.6 ± 10.1
Average procedure time (min)	57.20
Localization by LungVision confirmed with pEBUS	31 confirmations; 86%
Localization by both LungVision and SuperDimension confirmed by pEBUS	22 confirmation; 68%
Definitive diagnosis when both LungVision and SuperDimension agreed on biopsy location	18 cases; 81.8%
Definitive diagnosis when LungVision and SuperDimension didn't agree on biopsy location. Biopsy was performed using LungVision imaging for localization	7 cases; 70%
Diagnostic yield	**27 cases; 75%**