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The Study of Radiation Exposure During Bronchoscopic Procedure Guided by LungVision, Novel Endobronchial Navigation and Guidance System

Dr. Krish Bhadra, CHI Memorial Hospital, Chattanooga, USA

Abstract:

Background: Early detection of lung cancer relies on accurate identification and diagnosis of small pulmonary nodules. LungVision is a novel system (LungVision, Body Vision Ltd, Israel) that enables augmented endobronchial navigation and guidance of standard endoscopic biopsy tools towards small peripheral lung nodules (PLNs) and guided transbronchial biopsy. The system is capable of integrating information from existing imaging devices in the operating space into an upgraded fluoroscopic image and to present real-time visualization and localization of the airways and nodule during navigation and biopsy. In this study, we show that the radiation exposure from fluoroscopy during LungVision guided bronchoscopic procedure of both the patient and physician is comparable or lower than current practice and no additional procedure risk is being introduced.

Methods: Patients with PLNs referred for bronchoscopy were offered to participate in the study. CT scans were imported into the LungVision planning software, where the physician identified the targeted nodule and selected the desired pathway. LungVision system was used for real-time localization of the airways and nodule and for directional guidance and assistance during biopsy. Radiation exposure parameters were recorded during 25 consecutive bronchoscopies with fluoroscopic guidance with a mobile C-arm fluoroscopy system. The patient's and physician's radiation exposure doses were measured.

Results: 17 patients were recruited to the study. Average age was 69.2 ± 9.9 ; 70.6% were male. Average lesion size was 28mm, and 53% of the nodules were located in the upper lobes. The mean effective dose of patient's radiation exposure during bronchoscopy with LungVision was 2.76 ± 2.19 milli-Sieverts (mSv). The estimated effective radiation dose to the physician was 0.03 mSv.

No peri-procedural adverse events were reported. Successful navigation to the PLN, according to LungVision display, was achieved in all cases. PLN location displayed real time by the LungVision system was verified successfully by r-EBUS in 16 out of the 17 (94.1%) cases. Tissue samples were successfully acquired.

Conclusion: This study demonstrates that patients are exposed to comparable or lower radiation doses (2.76 ± 2.19 mSv mean) during LungVision-guided bronchoscopy in comparison to CT-guided lung biopsy (14.5 mSv) while having a notable clinical benefits and higher diagnostic yield. The physician exposure was negligible with adequate standard shielding.

Augmented endobronchial fluoroscopic navigation is proven to be safe, feasible and accurate. The system's ability to show real time nodule localization and support guided transbronchial biopsy with a low dose radiation exposure presents LungVision as a potential method of choice for the image-guided biopsy of PLNs.

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INTRODUCTION

Early detection of lung cancer relies on accurate identification and diagnosis of small pulmonary nodules. LungVision is a novel system (LungVision, Body Vision Ltd, Israel) that enables augmented endobronchial navigation and guidance of standard endoscopic biopsy tools towards small peripheral lung nodules (PLNs) and guided transbronchial biopsy. The system is capable of integrating information from existing imaging devices in the operating space into an upgraded fluoroscopic image and to present real-time visualization and localization of the airways and nodule during navigation and biopsy. In this study, we show that the radiation exposure from fluoroscopy during LungVision guided bronchoscopic procedure of both the patient and physician is comparable or lower than current practice and no additional procedure risk is being introduced.

METHODS

Patients with PLNs referred for bronchoscopy were offered to participate in the study. CT scans were imported into the LungVision planning software, where the physician identified the targeted nodule and selected the desired pathway. LungVision system was used for real-time localization of the airways and nodule and for directional guidance and assistance during biopsy. Radiation exposure parameters were recorded during 17 consecutive bronchoscopies with fluoroscopic guidance with a mobile C-arm fluoroscopy system. The patient's and physician's radiation exposure doses were measured.

TABLE 1: PATIENT DEMOGRAPHICS

| | |
|------------------------------------|------------------------|
| Age, Years, mean ± SD | 69.2 ± 9.9 |
| Male : Female, n (%) | 12 (70.6%) : 5 (29.4%) |
| Nodule median size | 28 mm |
| Nodule location, upper lobe, n (%) | 9 (53%) |

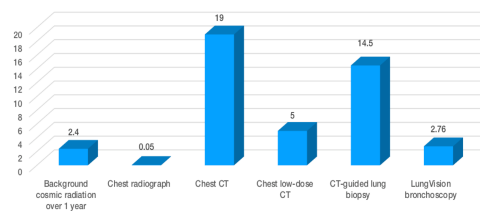
FIGURE 1: LUNGVISION PROCEDURE FLOW

- CT scans are imported to LungVision planning software
- Nodule and pathway are marked on CT
- Pre procedure CT to procedure registration is done
- Real-time navigation to nodule
- Biopsy

TABLE 2: EFFECTIVE RADIATION DOSE

| | |
|--------------------------------|-----------------|
| Mean fluoroscopy time ± SD | 1.5 ± 1.34 |
| Radiation dose to physician | 0.03 mSv |
| Mean radiation to patient ± SD | 2.76 ± 2.19 mSv |

FIGURE 2: EFFECTIVE RADIATION DOSES FROM DIFFERENT SOURCES (mSv)



RESULTS

17 patients were recruited to the study. Average age was 69.2± 9.9; 70.6% were male. Median nodule size was 28mm, and 53% of the nodules were located in the upper lobes. The mean effective dose of patient's radiation exposure during bronchoscopy with LungVision was 2.76 ± 2.19 milli-Sieverts (mSv). The estimated effective radiation dose to the physician was 0.03 mSv. The mean fluoroscopy screening time was 1.5 ± 1.34 min.

No adverse events were reported. Successful navigation to PPNs, according to LungVision display, was achieved in all cases. Nodule location displayed real time by the LungVision system was verified successfully by r-EBUS in 16 out of the 17 (94.1%) cases. Tissue samples were successfully acquired.

DISCUSSION

This study demonstrates that patients are exposed to comparable or lower radiation doses (mean 2.76 mSv) during LungVision-guided bronchoscopy in comparison to CT-guided lung biopsy (14.5 mSv)⁽¹⁾ while having a notable clinical and safety benefits. The physician exposure was negligible with adequate standard shielding.

Augmented endobronchial fluoroscopic navigation is proven to be safe, feasible and accurate. The system's ability to show real time nodule localization and support guided transbronchial biopsy with a low dose radiation exposure presents LungVision as a potential method of choice for the image-guided biopsy of PLNs.

REFERENCE

⁽¹⁾ Comparison of cone-beam CT-guided and CT fluoroscopy-guided transthoracic needle biopsy of lung nodules. Rotolo et al.; Eur Radial. 2016 Feb;26(2):381-9