Operative Techniques in Thoracic and Cardiovascular Surgery

Electromagnetic Navigation–Assisted Bronchoscopy

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Introduction

There are 2 types of computer-assisted navigation. The first is electromagnetic navigation bronchoscopy (ENB); this technology uses a "location board" or box in proximity to the chest. The board emits low-frequency electromagnetic waves that couples the Digital Imaging and Communications in Medicine (DICOM) data obtained from a computed tomography (CT) scan to data obtained from a "locatable guide" (sensor in the airway). This coupling allows for precise tracking of both position and orientation throughout the electromagnetic field. The second form uses virtual bronchoscopic (VB) simulation of the airway to provide real-time path navigation within the lungs, the navigation pairs real-time and virtual images throughout procedure. The system reconstructs airways and major vessels from DICOM data on the CT scan. Then during bronchoscopy, the system simultaneously overlays the live view, virtual view, and the path to the target lesion.

A meta-analysis published in CHEST found the pooled diagnostic yield to be 70%. The yield increased as the lesion size increased. The rate of occurrence of pneumothorax was 1.5%, which is significantly lesser than that reported for transthoracic needle aspiration. Pneumothorax develops in 11%-24% of patients after transthoracic needle aspiration, and 5%-14% require insertion of a chest tube. Owing to its ability to reach small peripheral nodules with a high degree of accuracy, navigational bronchoscopy has also become a useful tool for placing fiducial markers to guide stereotactic radiotherapy and to aid in localization for resection of small nodules during video-assisted thoracic surgery.

ENB using the iLogic System (superDimension, Inc, Minneapolis, MN) consists of 4 components: a disposable extended working channel that extends beyond the reach of the bronchoscope and becomes a conduit for endobronchial tools; a steerable locatable guide that contains a location sensor in the distal tip that is tracked by the software and to allow steerability through the bronchial tree; planning and navigation software that provides a reconstruction of the bronchial airways; and hardware, including a localization system, computer and monitor, that provides the physician with real-time catheter positioning within the lungs (Figs. 1-11).

List of computer-assisted navigational bronchoscopy systems

- iLogic (superDimension, Inc, Minneapolis, MN)—ENB system
- SPiN Drive system (Veran Medical, St. Louis, MO)—ENB system
- LungPoint virtual bronchoscopic navigation (VPN) system (Broncus Technologies, Mountain View, CA)—VB system
- The bf-NAVI virtual bronchoscopic navigation (VPN) system (Emergo Group, Austin, TX)—VB system

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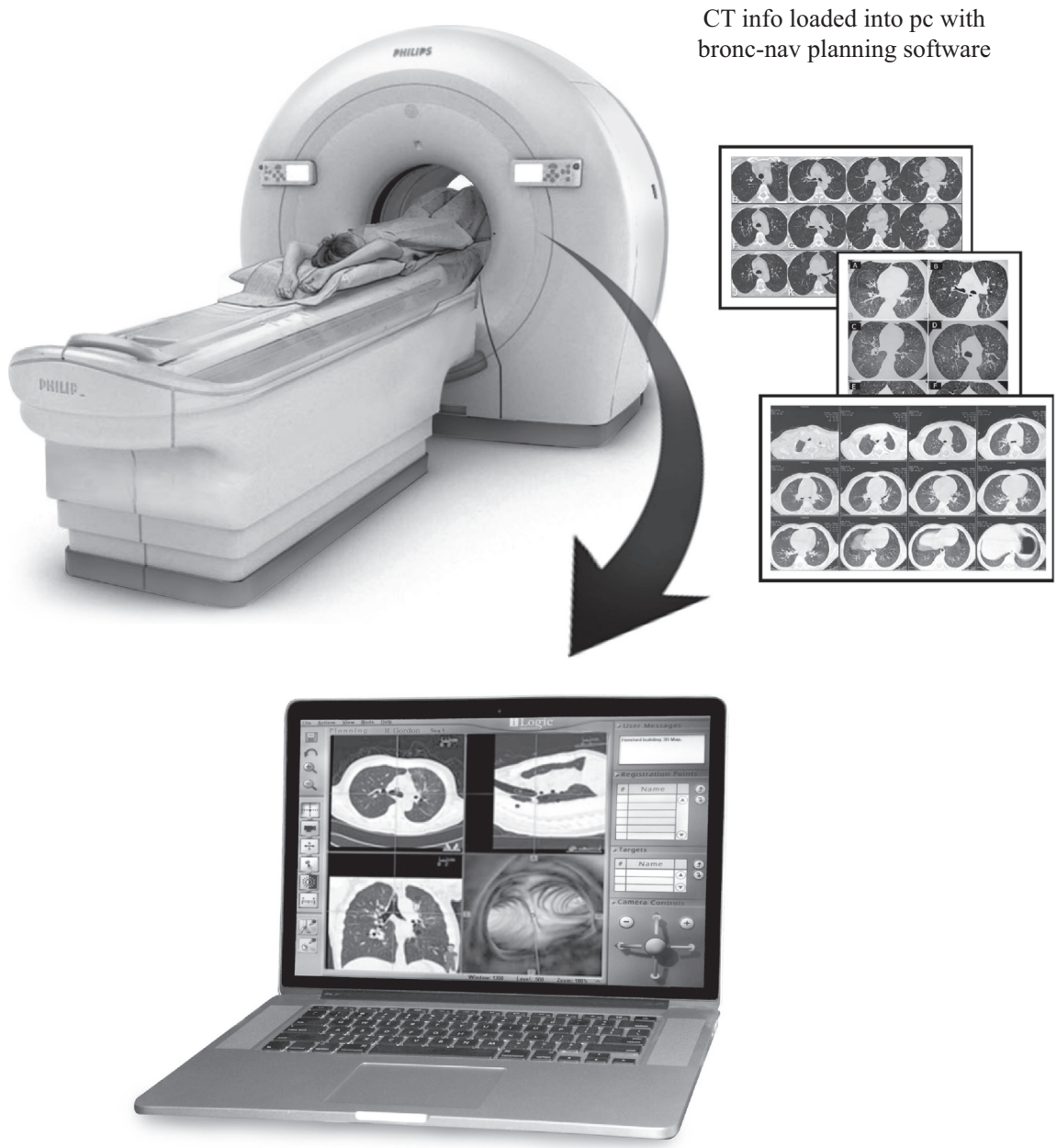

Figure 1 Obtain chest CT in supine position, while patient is immobile and during a full inspiratory breath hold. A 16-slice detector scanner or better is preferred for the best images. No matter the manufacturer, the image resolution must be 512 × 512 pixels, the field of view must include at least 1 cm of trachea and the entire lung volume, the overlap of images should be 20%-50%, and there must be <620 images in the data set. A 3D airway map generation has been optimized for use with manufacturer-specific reconstruction parameters (Thickness, Interval, Kernel and Filter), which may vary slightly by manufacturer. 3D, 3-dimensional.

Image resolution	512 × 512 Pixels				
Field of view	At least 1 cm of trachea and entire lung volume				
Overlap	20%-50%	Overlap % = (Thickness − Interval)/Thickness			
Maximum images	620				
Manufacturer-specific recommendations					
	Manufacturer	Thickness (mm)	Interval (mm)	Kernel	Filter
	GE	1.25	1	Standard	Body
	Philips	1	0.8	C	0
	Siemens	1	0.8	B31f	
	Toshiba	1	0.8	FC05	

The DICOM data from the CT must now be loaded onto the planning laptop. The data can be loaded by having the CT facility burn a CD, push the data from the scanner over the network to the planning laptop, or pull the data from a PACS system using the planning software interface.