Radiology Case Reports 15 (2020) 702–704

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/radcr

Case Report

Dynamic chest radiography: Novel and less-invasive imaging approach for preoperative assessments of pleural invasion and adhesion

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ARTICLE INFO

Article history:
Received 21 January 2020
Revised 17 February 2020
Accepted 20 February 2020

Keywords:
Dynamic chest radiography
Tumor invasion/adhesion
Flat-panel detector (FPD)-based functional X-ray imaging

ABSTRACT

Here, we report a case of lung cancer with preoperatively predicted invasion to the parietal pleura on dynamic chest radiography (DCR). An 82-year-old patient was referred for staging of a right lung tumor. Preoperative DCR revealed invasion or adhesion of the tumor to the chest wall, and intraoperative findings revealed invasion of the tumor to the parietal pleura. DCR provides objective and quantifiable information, including diaphragmatic movement, pulmonary ventilation, and circulation, as well as tumor invasion or adhesion and is less invasive compared to 3-dimensional chest computed tomography or cine magnetic resonance imaging. This study was our initial attempt at performing a quantitative assessment using DCR.

Introduction

Dynamic chest radiography (DCR) is a flat-panel detector-based functional X-ray imaging modality that provides pulmonary ventilation and circulation findings. Except for the breathing pattern, imaging is performed in the same way as the conventional chest examination. The total patient dose is adjustable based on changes in the imaging time, imaging rate, and source-to-image distance, and can be less than 1.9 mGy, which is the dose limit for 2 projections recommended by the International Atomic Energy Agency. The first clinical report of this technique was published by the author's group [1]. Although lung cancer invasion of the chest wall or aorta has been investigated in studies using cine magnetic resonance imaging or combined inspiratory and expiratory chest computed tomography (CT) [2–6], these are not the mainstream diagnostic modalities and are still considered to be experimental. Here, we report the usefulness of DCR for predicting tumor invasion or adhesion preoperatively.

Abbreviations: DCR, dynamic chest radiographys; 3D-CT, 3-dimentional computed tomography; MR, cine-magnetic resonance; FPD, flat-panel detector.

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https://doi.org/10.1016/j.radcr.2020.02.019

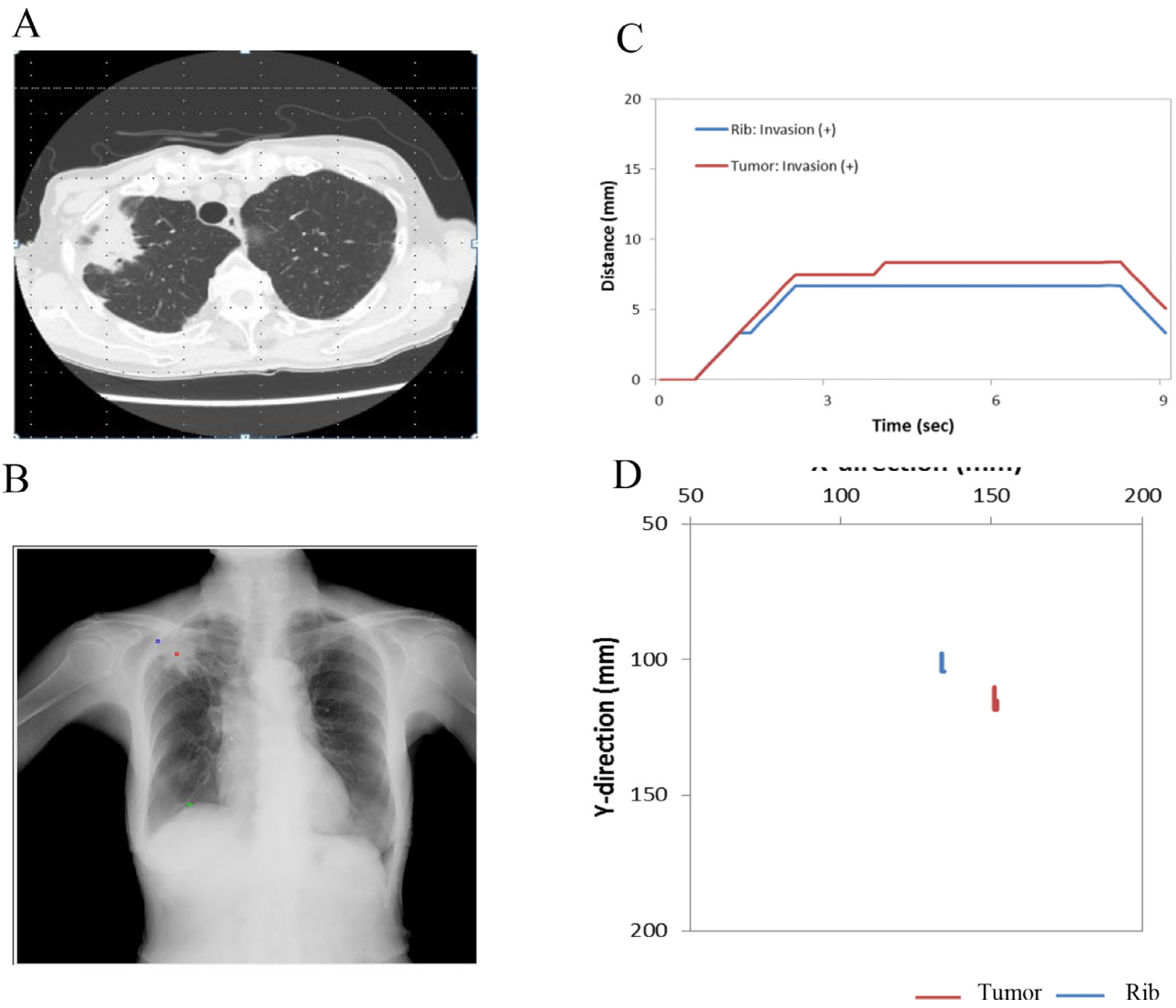

Fig. 1 – (A) Chest CT findings. (B) Video showed DCR findings. (C) The distance of the two points. One point was placed in the center of the lung tumor (red). The other point was the rib adjacent to the tumor (blue). (D) Movement of the two points.

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An 82-year-old patient was referred for staging of a right lung tumor (Fig. 1A, arrow). Fig. 1B (video) shows the DCR findings. Two points were placed for measurements on the inspiratory frame of the dynamic ventilation: one at the center of the targeted lung tumor (red point) and the other at the rib adjacent to the tumor (blue point). The software automatically tracked these 2 measuring points (tumor and rib), and coordinates were recorded. Distance between the 2 points (Fig. 1C) and movement in 2 directions (Fig. 1D) almost coincided, suggesting invasion or adhesion of the tumor to the chest wall. Thoracotomy was performed, and intraoperative findings showed invasion of the tumor to the parietal pleura. The frozen-section diagnosis was adenocarcinoma. Right upper lobe lobectomy with lymph node dissection and chest wall resection with reconstruction were performed.

Discussion

DCR provides objective and quantifiable information, including diaphragmatic movement, pulmonary ventilation, and circulation, and is reasonable for detecting tumor invasion or adhesion. Prior to surgical resection, invasion and/or adhesion of peripheral lung cancers to the parietal pleura should be assessed. This information can help thoracic surgeons prepare for longer operating times, anticipate greater blood loss, and guide appropriate informed consent. This study was our initial attempt at performing quantitative assessment using DCR. We focused on changes in the distance moved from a single frame and total movement distance.

Several recent studies have identified parietal pleura invasion/adhesion, including conventional methods, such as static chest CT, cine magnetic resonance imaging, and preoperative ultrasound [7], as well as newer methods, such as 4-dimensional dynamic-ventilation CT.

Sakuma et al [8] reported that dynamic-ventilation CT can be utilized as a novel imaging modality for preoperative assessments of pleural invasion and adhesion. The total radiation exposure in dynamic-ventilation CT ranged from 4.2 to 6.1 mSv. The total patient dose in DCR was 0.23 mSv, which was approximately double that of conventional chest radiography [1]. DCR is acceptable owing to the increased yield of information, low radiation exposure, and a simple and rapid procedure of functional imaging. Since chest X-ray is routinely performed in the standard preoperative assessment of patients with lung cancer, we currently believe that the addition of DCR to conventional chest X-ray is reasonable for obtaining the diagnosis of tumor invasion or adhesion of the parietal pleura. A prospective study including a large sample size is underway.

In conclusion, DCR can be utilized as a novel and less-invasive imaging modality for preoperative assessments of pleural invasion and adhesion.

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