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# Computed tomography detection of stapled interlobar fissure facilitates diagnosing postoperative lobar torsion: A case report



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## ABSTRACT

**INTRODUCTION:** Atelectasis of the right middle lobe following right upper lobectomy may result from lobar torsion, bronchial kink, or impacted mucus plug. Although clinical consequence of lobar torsion could be serious, differentiating it from bronchial kink is occasionally challenging.

**PRESENTATION OF CASE:** A 39-year old man with non-small cell lung cancer of cT1aN0M0 stage IA underwent right upper lobectomy. On postoperative day 1, we identified middle lobe atelectasis on the chest X-ray and performed bronchoscopy, which showed an obstruction of the right middle lobe bronchus without mucoid impaction. We injected air using a bronchoscope to the middle lobe, which re-expanded it. However, on postoperative day 2, chest X-ray showed a slightly collapsed and opacified middle lobe. Although enhanced computed tomography showed a patent middle lobe pulmonary artery, we noticed that a staple placed in the horizontal fissure was in contact with the lower lobe, implying the possibility of lobar torsion. Rethoracotomy on postoperative day 2 revealed a 240° clockwise rotation of the congested middle lobe. Therefore, we performed simple detorsion. The patient was discharged 10 days after rethoracotomy without further adverse events.

**DISCUSSION:** In our case, patency of the pulmonary artery and temporary improvement of the atelectasis using a bronchoscopic aeration maneuver could not rule out the possibility of lobar torsion.

**CONCLUSION:** The position of the staple placed on the interlobar fissure should be evaluated using computed tomography in postoperative middle lobe atelectasis. If the aeration maneuver for middle lobe atelectasis using bronchoscope fails, rethoracotomy should be considered.

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## 1. Introduction

Atelectasis of the right middle lobe (ML) following right upper lobectomy may result from lobar torsion (LT), bronchial kink (BK), or impacted mucus plug. While BK can occur with substantial frequency [1], LT is rare, but has serious clinical consequences [2]. It can be challenging to differentiate LT from BK [2]. We report a successfully treated case of LT-induced right ML atelectasis. The position of a surgical staple on computed tomography triggered clinical suspicion of LT and rethoracotomy. The work has been reported in line with the SCARE criteria [3].

## 2. Presentation of case

A 39-year old man with no medical history had a 15 mm nodule in the right upper lobe; he was diagnosed as having non-small cell lung cancer cT1aN0M0 stage IA. We performed a right upper lobec-

tomy and mediastinal lymph node dissection via a video-assisted approach with an 8-cm access window and three surgical ports. For an incomplete lobulation, we divided the lung parenchyma using a surgical stapler (EndoGIA Tri-staple, Medtronic, Japan) on both the oblique and horizontal fissures.

On postoperative day (POD) 1, although his general condition was stable, a chest X-ray showed complete atelectasis of the right ML (Fig. 1a). Bronchoscopy revealed that the right segmental bronchi of the ML (B4, B5) were obstructed with mucosal redness; there was no mucoid impaction and the spur of B4/B5 was visible (Fig. 1b). We considered the possibility that BK occurred in the periphery of the segmental bronchus. To improve the atelectasis, we wedged the tip of the bronchoscope to the middle lobar bronchus and injected air 5 times using a 50-mL syringe. Chest X-ray performed after the bronchoscopy showed re-expansion of the ML (Fig. 1c). Since we were concerned about the LT, enhanced computed tomography (CT) was undergone after the bronchoscopy, which indicated a patent ML pulmonary artery.

On POD 2, a chest X-ray showed increased opacification in the collapsed ML (Fig. 2a). We rechecked the CT and found that the staple placed in the horizontal fissure was in contact with the right

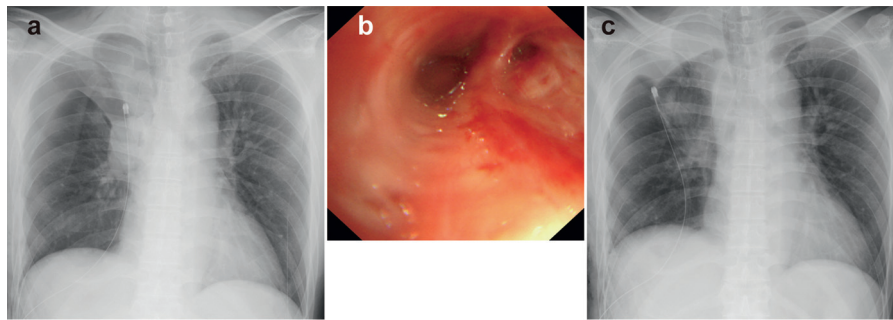
Abbreviations: ML, Middle lobe; LT, lobar torsion; BK, Bronchial kink.

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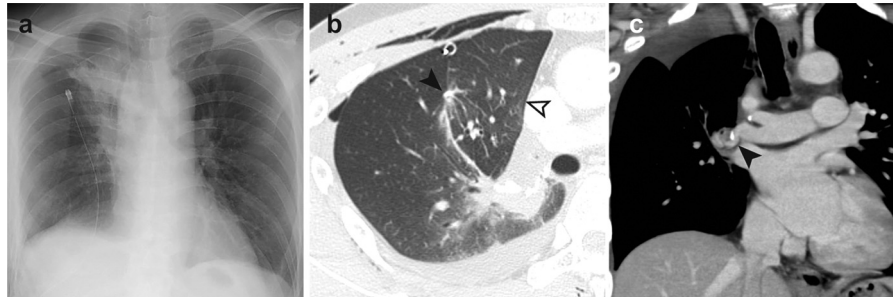
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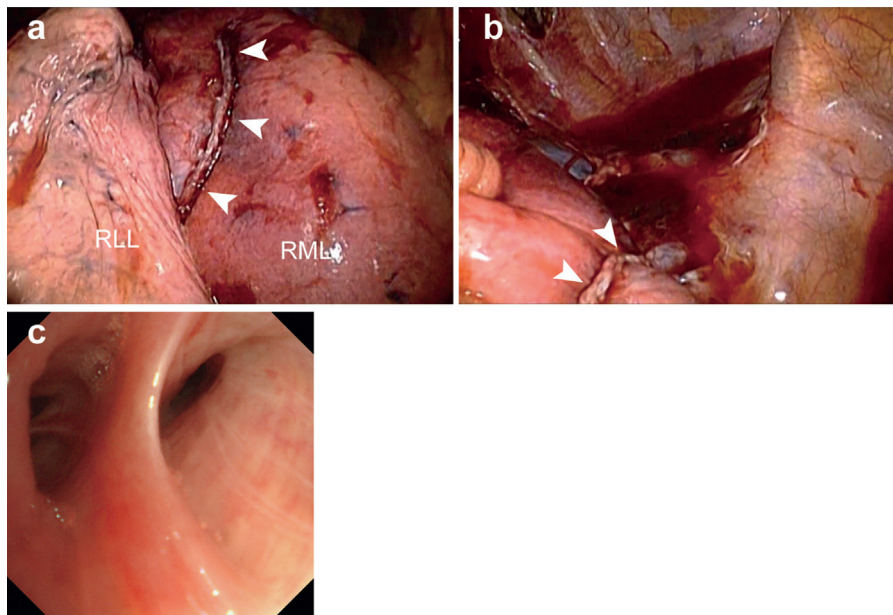
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**Fig. 1.** a: Chest X-ray on postoperative day (POD) 1 shows complete atelectasis of the right middle lobe. b: Bronchoscopic image shows a slit-like obstruction in the segmental bronchi of the middle lobe. c: Chest X-ray after bronchoscopy shows an improvement in atelectasis.



**Fig. 2.** a: Chest X-Ray on POD2 shows increased opacification in the collapsed middle lobe (ML). b: Enhanced computed tomography (CT) shows the surgical staple placed in the horizontal fissure in contact with the right lower lobe (arrow head). It should be on the opposite side (outlined arrow head). c: The frontal plane of the enhanced CT shows an abnormal course of the pulmonary artery of the ML (arrow head).



**Fig. 3.** a: Intraoperative photo shows that the staple of the middle lobe (ML) fired on the horizontal fissure (arrow heads) is in contact with the right lower lobe. RLL: right lower lobe, RML: right middle lobe. b: Intraoperative photo after detorsion shows that the staple (arrow heads) was restored to the normal location, specifically the cranial surface of the ML. c: Bronchoscopic image taken after rethoracotomy shows patent segmental bronchi of the ML.

lower lobe (Fig. 2b). Since the staple should be located ventrally and not in contact with the lower lobe, we considered the possibility of LT and performed rethoracotomy using the same incisions. The ML was slightly inflated by the injected air and twisted clockwise by 240°; it was reddish in appearance, but not necrotic (Fig. 3a). Therefore, we decided to perform simple detorsion (operative finding shown in Video 1 in Supplementary file). Prior to the procedure, we asked the anesthesiologist to pay attention to possible arrhyth-

mia and increase in airway secretion and subsequently rotated the ML counterclockwise 240° (Fig. 3b). This improved the color of the ML without any complication. To prevent recurrence, we secured the ML to the lower lobe by ligating and applying fibrin glue to the interlobar pleura.

Postoperative bronchoscope showed patent ML segmental bronchi (Fig. 3c). He was discharged 10 days after rethoracotomy without further adverse events.

### 3. Discussion

We present a case of ML atelectasis resulting from LT. In the present case, we could not identify vascular malposition on enhanced CT prior to rethoracotomy. Since the degree and direction of torsion vary in each case, anatomical malposition of the vessels/bronchi on CT can be varied, which contributes to difficulty and/or delay of diagnosis [2]. We reviewed the CT in more detail after reoperation and found an abnormal J-shaped course of the ML pulmonary artery in the frontal plane (Fig. 2c). In simple BK, the pulmonary artery of the ML should run on the cranial side directly. If the ML rotated 120° counterclockwise, a staple fired on the horizontal fissure could also be located in contact with the right lower lobe. In that case, we think that the staple would be mostly in contact with the superior segment of the lower lobe (S6) and the traveling path of the middle lobar pulmonary artery cannot form a J-shape. While we did not consider the direction of torsion before rethoracotomy, the staple shown in Fig. 2b was in contact with the anterior basal segment of the lower lobe (S8), which may imply that the ML rotated 240° clockwise. Although three-dimensional reconstruction by CT might be helpful and important, it is much easier to confirm the position of the staple compared to finding vessel malposition. In addition, as shown in Fig. 2b, since the staple placed in the horizontal fissure was separate from the pulmonary hilum, it was not difficult to distinguish it from the staple placed in the bronchus and pulmonary vessels.

Masuda et al. reported that BK occurring at the level of the lobar bronchus resulted in invisibility of the spur of B4/B5 [4]. If it is unlikely that BK occurs more at the periphery of the segmental bronchus, our finding may be an important clue to identify LT. When we injected air to the collapsed ML, respiratory exacerbation due to ventilation-perfusion imbalance was not apparent. Although it is inconclusive whether injecting air to a twisted lobe is beneficial or harmful, we believe that aeration of the ML facilitated the finding of the abnormal position of the staple in our case.

During the rethoracotomy, we fixed the ML and the lower lobe by ligation as a preventive measure known as pneumopexy. During the initial operation, we noted that the oblique fissure between the ML and the lower lobe was incompletely divided, and we speculated that this would prevent lobar torsion as natural pneumopexy. Although our speculation was not correct in this case, we performed the preventive pneumopexy after the right upper lobectomy in only selected patients.

With regard to detorsion, we chose and preferred the mini-thoracotomy approach with direct vision, whereas some may use the video-assisted approach. Direct vision allows more distant view for more reliable and accurate intraoperative findings. In addition, we decided on the position of the fixation for pneumopexy under sufficiently inflated lobes. We believe that this is more appropriate compared to that determined under collapsed lobes, and this is possible under direct vision, but not under thoracoscopic vision.

### 4. Conclusions

The position of staples placed in the interlobar fissure should be additionally evaluated using diagnostic CT for postoperative

ML atelectasis. Patency of the pulmonary artery and temporary improvement of the atelectasis using a bronchoscopic aeration maneuver could not rule out the possibility of lobar torsion. If the aeration maneuver for ML atelectasis using a bronchoscope fails, rethoracotomy should be considered.

### Consent

We obtained written informed consent from the patient for publication of this case report and accompanying images.

### Contributors

TY and HI wrote the manuscript. TY, KK, and HI performed the surgery and cared for the patient. YS comprehensively supervised this case report. All authors have read and approved the final manuscript.

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### Ethical approval

None.

### Guarantor

Hideo Ichimura.

### Conflict of interests

The authors declare that they have no conflicts of interest.

### Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.ijscr.2017.10.013>.

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