# Utility of virtual bronchoscopy in congenital tracheomalacia

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**Utility of virtual bronchoscopy was evaluated in a case of congenital tracheomalacia by comparing virtual bronchoscopic images with those of fiberoptic bronchoscopy. Results indicate that virtual bronchoscopy is useful in diagnosing stationary lesions. However, its diagnostic value is inferior to that of fiberoptic bronchoscopy for mobile lesions, in that virtual bronchoscopy does not permit dynamic images. We recommend that the institutions, where fiberoptic bronchoscopy is available, should perform virtual bronchoscopy in parallel to explore its utility.**

**Key words: Virtual bronchoscopy, fiberoptic bronchoscopy, congenital tracheomalacia.**

## INTRODUCTION

A number of studies have been presented at the meetings of the Japanese Society of Pediatric Pulmonology, reporting the usefulness of fiberoptic bronchoscopy (FB). However, it is also true that FB is used at a limited number of institutions because the technique and image interpretation of FB are unique and require specialty. A survey by the Japanese Society of Pediatric Pulmonology reported that as of June, 2006, pediatric FB is available at 58 institutions throughout Japan [1].

Virtual bronchoscopy (VB) is an imaging technique in which a view point is positioned inside the lumen of three-dimensional images of the bronchus, and view field angles are set the same as those for FB. With the view point positioned within the lumen of the air way, VB allows images that simulate those of FB [2]. Recently, reports on VB are increasing, and basic studies [2-4] as well as its clinical applications on air way stenosis of infants [5-7] have appeared in Japan.

In the present study, we generated VB images in a case previously diagnosed with congenital bronchomalacia and, by comparing them with FB images obtained from the same patient, evaluated the usefulness for the diagnosis of the case.

## PATIENTS AND METHODS

### Case

A six-year old girl with a previous history of congenital esophageal obstruction (Gross-C) diagnosed at birth and of having undergone radical surgery for duodenal obstruction. At the age of 5 months, the girl was brought to our department for detailed examinations of wheezing. Expiratory wheezing was noted, and plain chest radiography revealed that the marking of the intratracheal air was unclear in the frontal radiograph and narrow in the side radiograph (Fig. 1). At the age of two years, FB was performed under systemic anesthesia, which led to the diagnosis of congenital bronchomalacia, and aortoprexy was performed. In the present study, FB was performed to follow up the case.

### Methods

Data were acquired using LightSpeed Ultra (GE Healthcare, Milwaukee, WI, U.S.A.) and analyzed on an image analysis work station, Ziosoft M900 Quadra (AMIN, Ltd.). Conditions for data acquisition included helical thickness of 1.25 mm and slice pitch of 1.675 mm. No pre-examination preparation was necessary. FB was performed using BF-N20 (Olympus, Tokyo, Japan) under systemic anesthesia with a laryngeal mask, and still images were prepared from video recording.

## RESULTS

Figure 2 and 3 show FB images at the age of two years and VB images at the age of six years, respectively. The FB images clearly show that the bronchial lumen was markedly narrowed upon expiration in the posterior-to-anterior direction. The VB images confirmed, as a follow-up evaluation of aortoprexy, that the bronchial lumen was maintained upon expiration.

## DISCUSSION

Recent reports described that VB and FB have comparable diagnostic capacities for air way lesions of

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infants [8, 9]. We point out that VB has the following advantages and disadvantages over FB.

**Advantages**

1. Examinations are possible without anesthesia: In VB, sedation may be necessary for young and noncooperative children. The risk, however, is less than that for FB performed under systemic anesthesia.
2. Examination time is extremely short: Although it depends on the performance of CT equipment, LightSpeed Ultra of GE Healthcare employed in the present study has eight rows of CT detectors, and the examination time for the present case was approximately 15 seconds. By contrast, FB required at least a few minutes.
3. Physician's technical proficiency is not involved: Accurate FB findings are made possible by technically proficient physicians, whereas VB does not require physician's technical proficiency.
4. No direct invasion of the air way occurs: FB is associated with risks of such complications as physical irritation of the air way mucosal membranes, hypoxemia and the lower air way infections. VB is absolutely noninvasive.

**Disadvantages**

1. Dynamic images are not available: FB is commonly performed under spontaneous respiration, and findings can be evaluated repeatedly on video recording of images. In contrast, VB only provides still images because VB first constructs three-dimensional images and, inside the air way of these images, detects areas where CT values change drastically from the air layer to the tracheal wall and creates images. Thus, its diagnostic capacity for stenoses with respiration-associated changes is inferior to those of FB.
2. Evaluation of lesions in the mucosal membrane is difficult: On VB images, examiners can modulate at will the color tone of the mucosal membrane. Thus, apart from apparently rugged lesions in the mucosal membrane, findings such as flares of the mucosal membrane cannot be obtained.
3. Radiation exposure cannot be avoided: Recently, pediatric FB is often performed without intubation, lessening its invasiveness. In contrast, radiation exposure cannot be avoided in VB.

Thus, VB is useful in diagnosing stationary bronchostenosis, whereas its utility in diagnosing air way stenosis with respiration-associated changes, such as the present case, needs further evaluation.

## CONCLUSION

The value of VB in diagnosing congenital bronchomalacia is inferior to that of FB, in that dynamic images are not available with VB. On the other hand, VB is noninvasive, can be performed without systemic anesthesia and requires no expertise of the physician, thus, can be a powerful tool to examine for stationary air way lesions. It is important to explore the usefulness of VB through simultaneous use of VB and FB at institutions equipped with FB.

## ACKNOWLEDGMENTS

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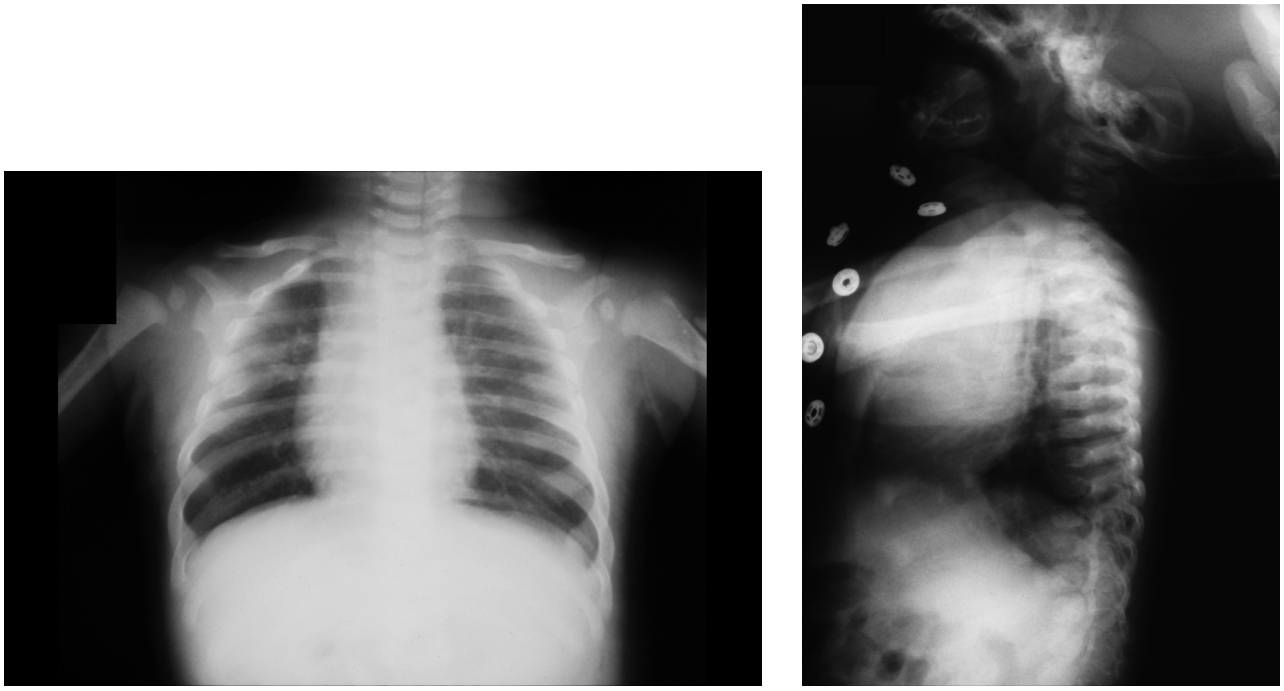

**Fig. 1** Chest radiography
Plain chest radiographs taken 5 months after birth. Marking of the intratracheal air is not clear in the frontal radiograph taken in the anteroposterior direction (a) and appears narrow in the side radiograph (b).

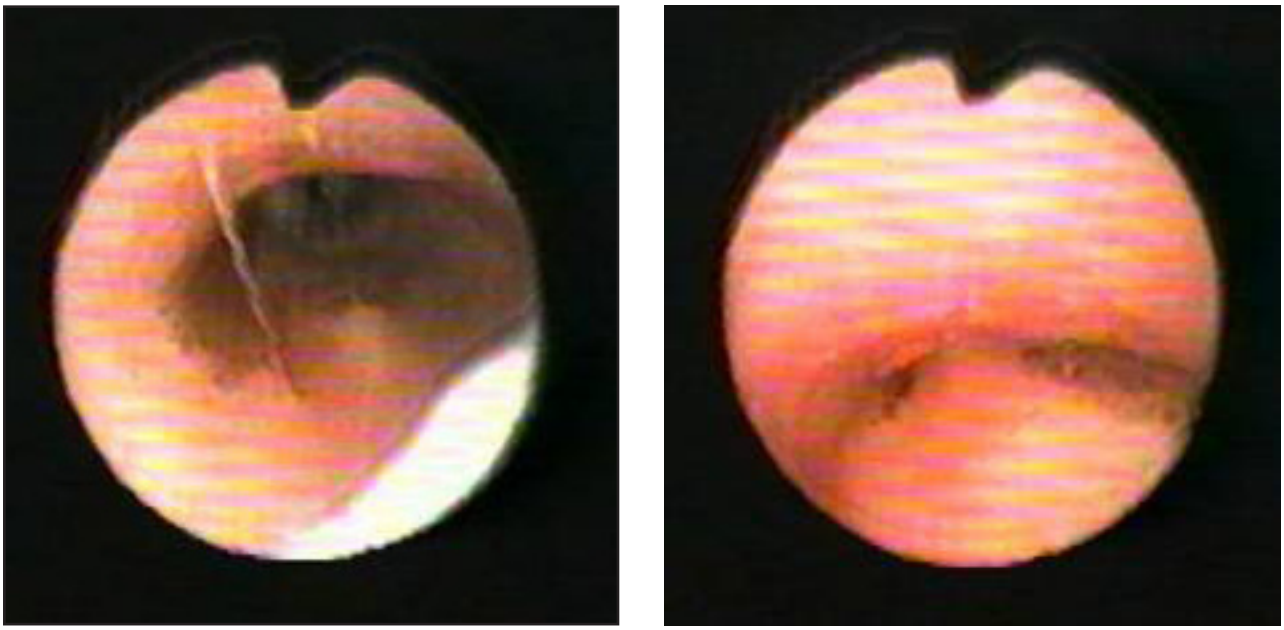

**Fig. 2** Fiberoptic bronchoscopy
FB images on inspiration (a) and expiration (b) at the age of 2 years. FB was performed under systemic anesthesia with tracheal intubation. The ratio of the cartilage area to membrane area was approximately 2:1. Despite the detained intubing, the tracheal lumen is narrowed on expiration in the back-to-forth direction.

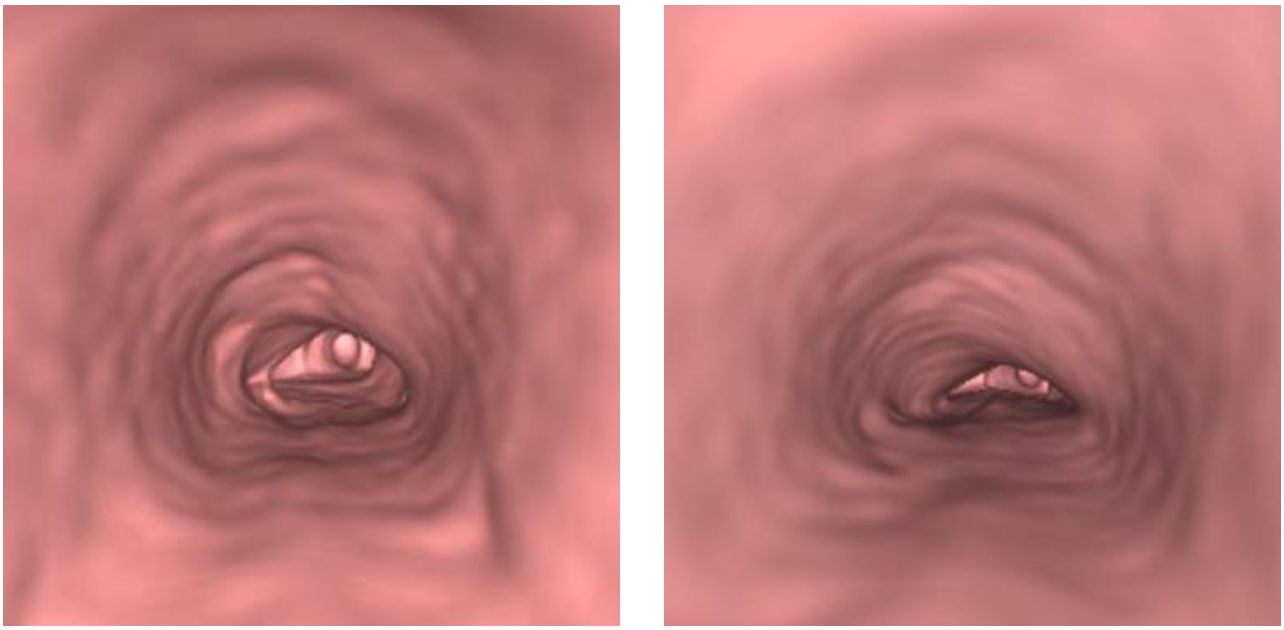

**Fig. 3** Virtual bronchoscopy
VB images on inspiration (a) and expiration (b) at the age of 6 years. For postoperative evaluation of aortopexy, the tracheal lumen was confirmed to be maintained.

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