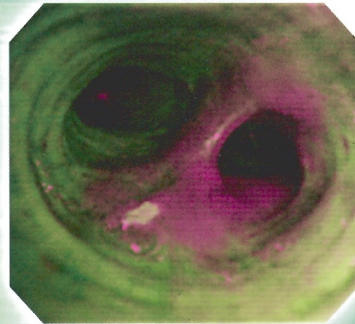


Introduction of Special Light Imaging Clinical Cases

AFI

Auto Fluorescence Imaging

AFI



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# AFI

## Auto Fluorescence Imaging

This technology exploits the fact that different wavelengths of light can be used to highlight the distinction between tumorous lesions and normal tissues. AFI produces diagnostic images using light that is affected by the blood constituents, as well as auto fluorescence.



### What is AFI?

Autofluorescence is generated when blue light excites cells in the sub-epithelial layer. AFI is an imaging technique that uses autofluorescence to contrast tumors with healthy tissue using the difference in fluorescence intensity or color

tone. This helps facilitate detection and diagnosis of lung cancer at an early stage.

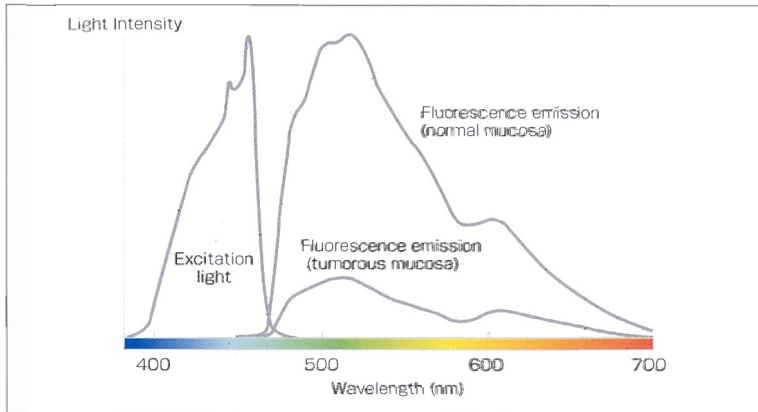


### Attenuation of Autofluorescence

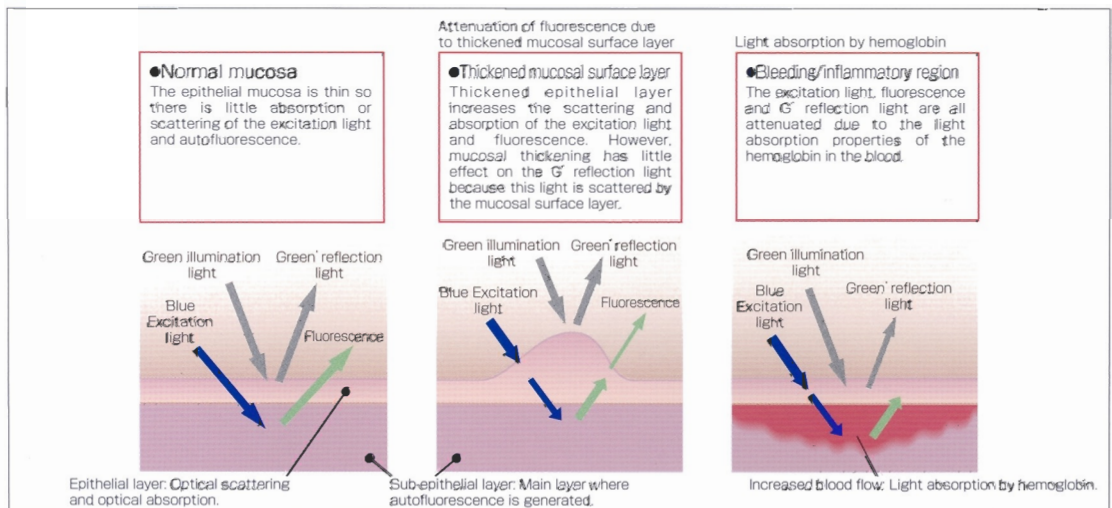
One of the factors that attenuates autofluorescence is the absorption and scattering of light in the thickened epithelial layer of tumorous tissues. When the mucosa thickens, the amount of blue excitation light reaching the fluorescent substances in the sub-epithelial layer is reduced. The autofluorescence emitted is further attenuated by absorption and scattering in the epithelial layer. Another

important factor is the light absorbed by hemoglobin, which strongly absorbs blue light. Absorption of the excitation light by blood results in further attenuation of the autofluorescence. With conventional autofluorescence imaging, all of these factors combine to make the autofluorescence so weak that even inflammatory lesions are difficult to visualize and detect.

### Difference in fluorescence intensity depending on mucosal surfaces



### Mechanism of fluorescence attenuation



## Features and Principles of AFI

### <Features>

●The high-resolution imaging of the CCD at the distal end of the EVIS LUCERA BF-F260 bronchovideoscope offers clear, bright fluorescence images. One touch of a button on the scope allows easy switching between normal light observation and AFI.

●Normal tissues are displayed in green and tumorous lesions (where autofluorescence is attenuated due to mucosal thickening) in magenta. The different color tones

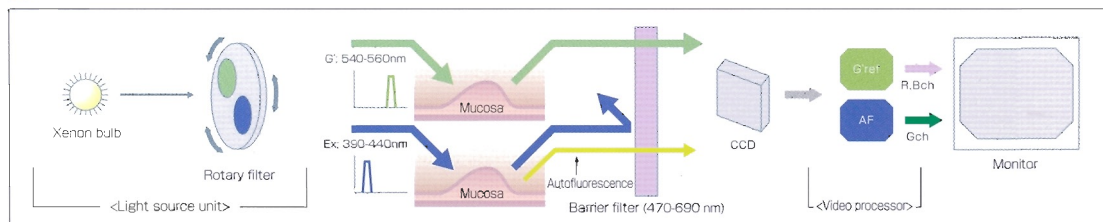
### <Principles>

In addition to blue excitation light, AFI uses green light that is strongly absorbed by hemoglobin. Both types of light are emitted from the AFI-dedicated rotary filter installed in front of the light source bulb. The blue excitation light causes autofluorescence to be generated from the living tissue, while the green illumination light produces green light that is reflected by the hemoglobin contained in the living tissue. These two kinds of light are captured by the CCD at the

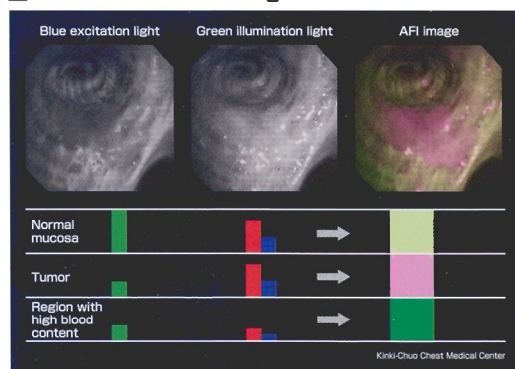
distal end of the scope and converted into electrical signals. At this time, the barrier filter installed in front of the CCD cuts excessive blue excitation light to detect weak autofluorescence. In the video processor, the autofluorescence light signal is converted into green data and the green reflected light signal is converted into red and blue data. The data is then synthesized into the AFI color image data that is displayed on the monitor.

●In addition to blue excitation light, AFI uses green reflection light that is easily absorbed by hemoglobin. This is expected to improve tumor identification in regions with high blood content as well as to enhance the distinction between bleeding sites or blood vessels and tumorous lesions.

### ■AFI System Configuration

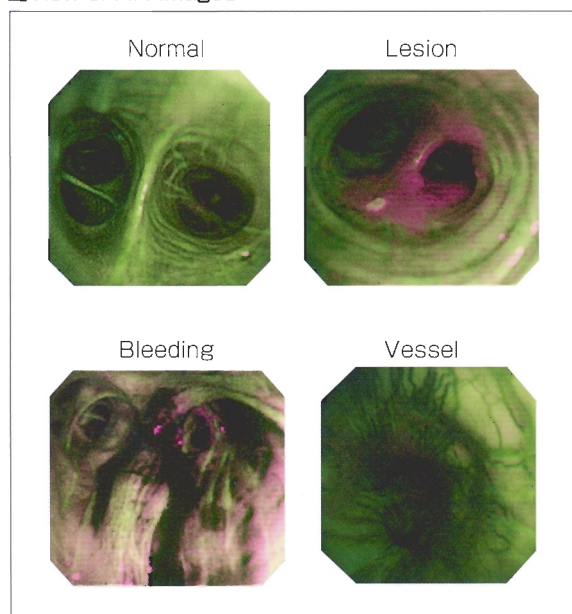


### ■AFI Color Tone Setting

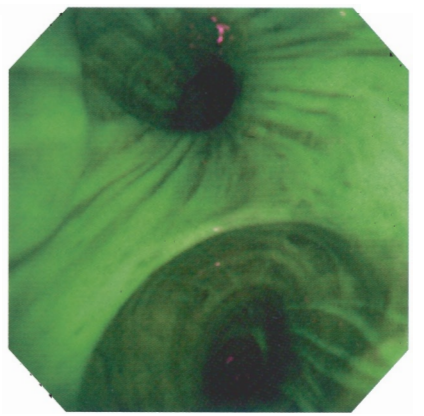
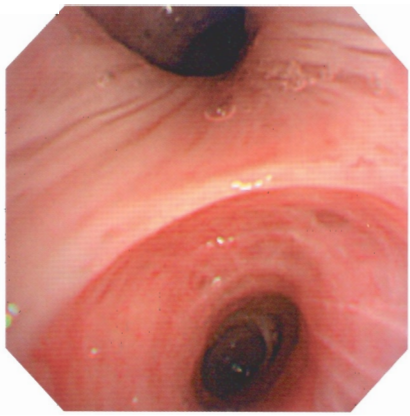
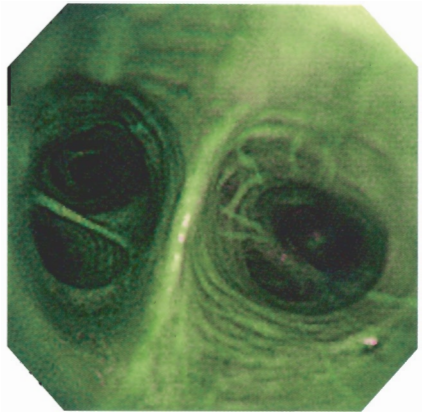
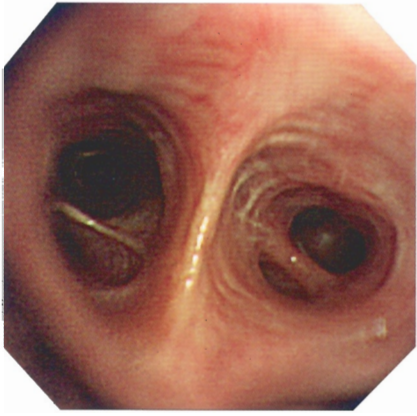


The autofluorescence and green reflection light vary depending on the condition of the mucosa. With normal mucosa, neither the autofluorescence nor green reflection light is attenuated so the AFI color image looks bluish. With tumorous lesions, the autofluorescence is significantly attenuated, but there is less attenuation of the green reflection light so the AFI color image is displayed in magenta. In regions with high blood content or blood vessels, the autofluorescence is attenuated, but the attenuation of the green reflection light is much greater, so the AFI color image is displayed in green.

### ■View of AFI images



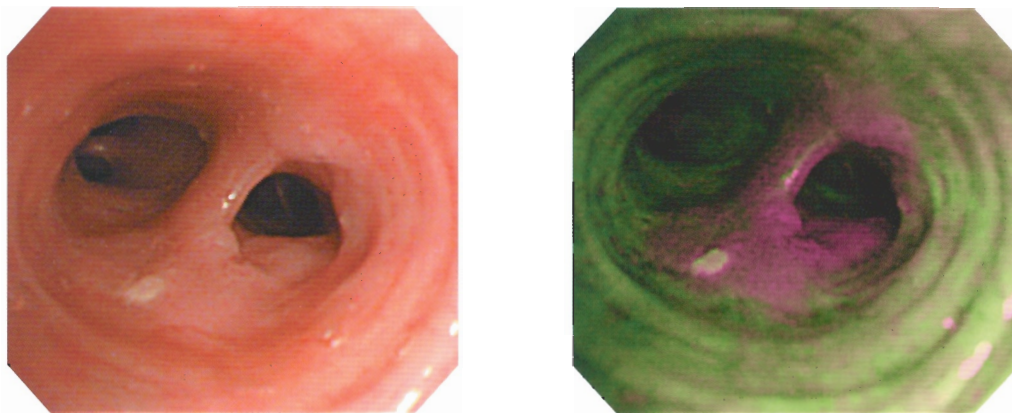
Normal



Miyagi Cancer Center

Comparison of conventional light images and AFI images. Normal tissues are displayed in greenish tones.

## Early central lung cancer



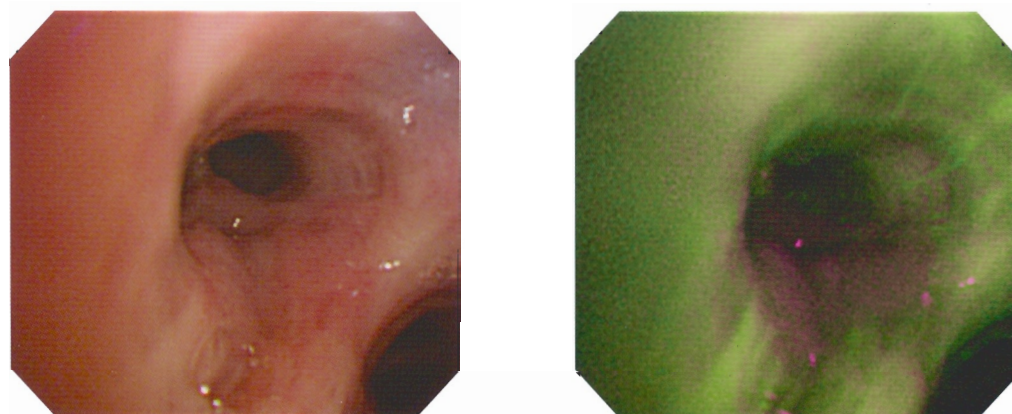
Chiba University

Male aged 65, community health checkup, E in sputum cytology.

In white light examination, irregularities and prominence of mucosa are observed around the bifurcation between B<sup>4</sup> and B<sup>5</sup> in the right middle lobe, but the evolution area is unclear. AFI displays this region in sharp magenta and shows the infiltration area clearly.

As this case also presented large cell neuroendocrine carcinoma (LCNEC) in the right lower lobe, it was subjected to open surgery. The bronchial wall infiltration of the tumor did not reach the cartilage.

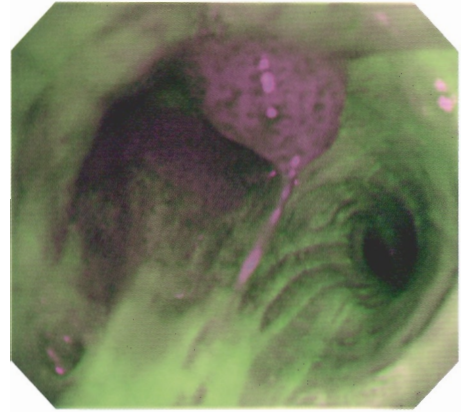
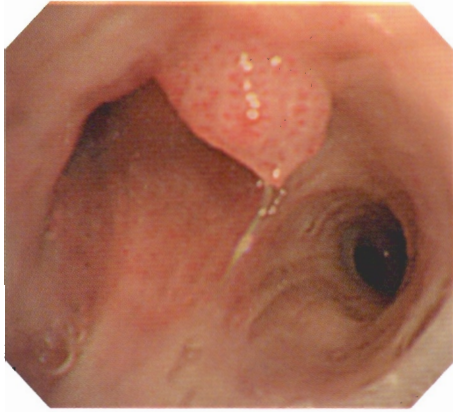
## Early central lung cancer



Miyagi Cancer Center

- 1) Region: Left superior segment.
- 2) Endoscopic findings: Conventional light observation apparently showed edema and constriction at the entrance of left B<sup>3</sup>a clearly. Additional AFI showed that the extent of the lesion was larger than expected and made it possible to identify the irradiation area for PDT.
- 3) Pathological examination: Early invasive cancer (squamous cell carcinoma).
- 4) Clinical information: CR was achieved after PDT.
- 5) Comment: AFI prevented us from overlooking the full extent of the lesion that we might otherwise have ignored based on first impressions or the simple relief obtained from discovering the lesion itself.

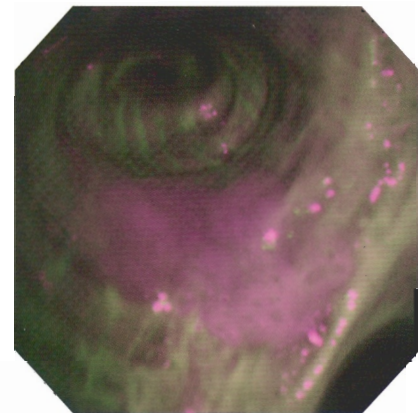
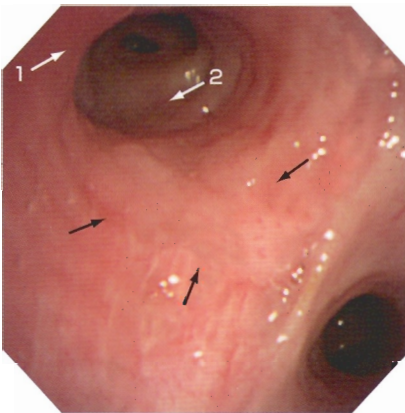
## Early central lung cancer



Miyagi Cancer Center

- 1) Region: Left superior segment.
- 2) Endoscopic findings: A polyp type tumor with vascularization was recognized. Flare was recognized at the B<sup>1+2</sup> entrance on the peripheral side of the tissue, but the verge was not clearly observed in conventional light observation. Additional use of AFI made it possible to capture the extension of the lesion easily.
- 3) Pathological examination: Early invasive cancer (squamous cell carcinoma).
- 4) Clinical information: CR was achieved after stereotactic radiotherapy.
- 5) Comment: Initial attention was caught by the closer lesion, but AFI helped with identification of the lesion behind it.

## Early central lung cancer



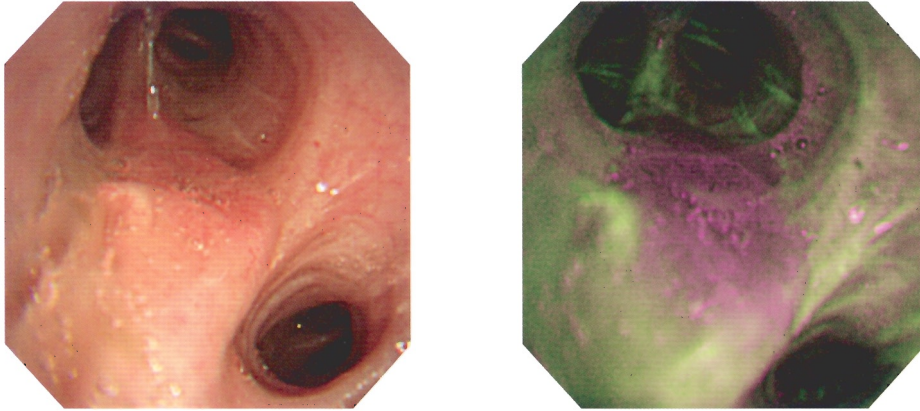
Kinki-Chuo Chest Medical Center

Male aged 62, heavy smoker, positive in sputum cytology, normal in chest X-ray examination.

Whight light observation: Lesion that seemed to be a thickened squamous cell carcinoma was observed at the orifice of the left superior segment (black arrows). As the circular folds on the superior wall were unclear and flare was observed (white arrow 1), circular infiltration was suspected. In addition, loss of definition of longitudinal folds toward the peripheral tertiary bifurcation was also suspected (white arrow 2).

AFI: The thickened part has a longitudinal diameter of about 10 mm and the limited lines look clear magenta. The superior wall is normal, the peripheral longitudinal folds were also found to be normal, and the invasion area of cancer was confirmed. This case was improved with PDT.

## Early central lung cancer

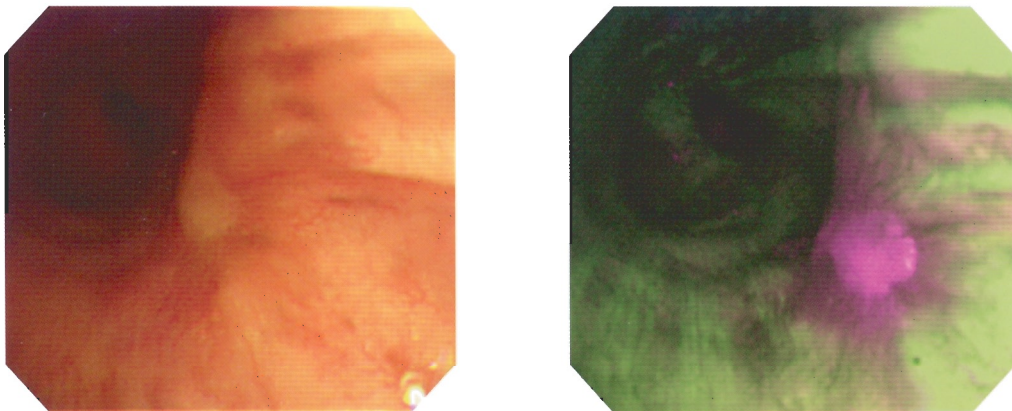


Chiba University

Male aged 65, community health  
checkup, E in sputum cytology.

An elevated lesion was observed at the entrance of the left superior segment. AFI displays this lesion in magenta. The lesion was diagnosed as a squamous cell carcinoma by histological examination. CR was achieved after PDT using Laserphyrin.<sup>®</sup>

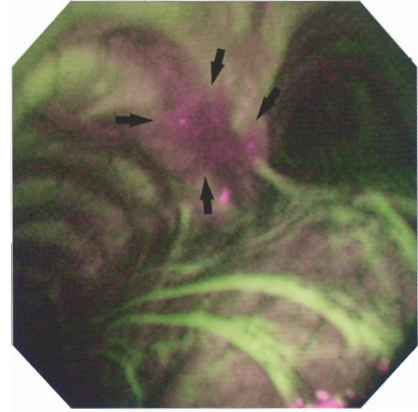
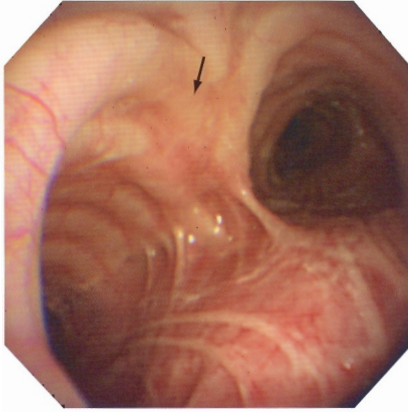
## CIS



Miyagi Cancer Center

- 1) Region: Left main bronchus.
- 2) Endoscopic findings: A flat lesion was observed in the left main bronchus.
- 3) Pathological examination: Squamous cell carcinoma (carcinoma in situ).
- 4) CR was achieved after PDT.
- 5) Comment: The lesion was hardly recognized in conventional light observation but identified clearly with AFI. Even a bronchoscopist with little experience in diagnosis of early cancer lesions will not overlook lesions when using AFI.

## CIS



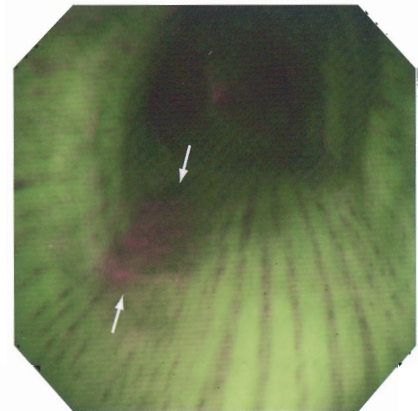
Kinki-Chuo Chest Medical Center

Male aged 62, heavy smoker, positive in sputum cytology, normal in chest X-ray examination.

White light observation: Slight thickening was observed between the tracheal bifurcation and the first cartilage ring at the left main entrance (arrow). CIS was suspected but the invasion area was unclear.

AFI: Magenta colors were observed only in dented sections between the first cartilage ring (thick arrows), and the area was about 10 mm. Very minute invasion was observed at the tracheal bifurcation. The lesion was diagnosed to be CIS of squamous cell carcinoma. CR was achieved by PDT.

## CIS



Kinki-Chuo Chest Medical Center

Male aged 67, heavy smoker, positive in sputum cytology, normal in chest X-ray examination.

White light observation: The trachea looked almost normal.

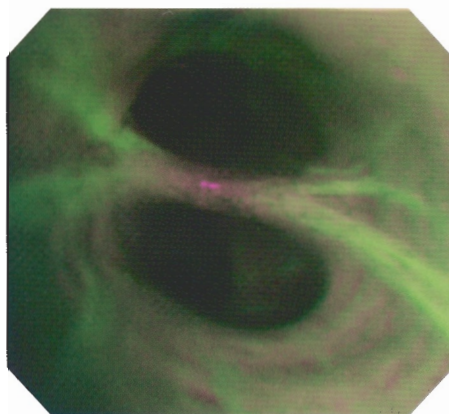
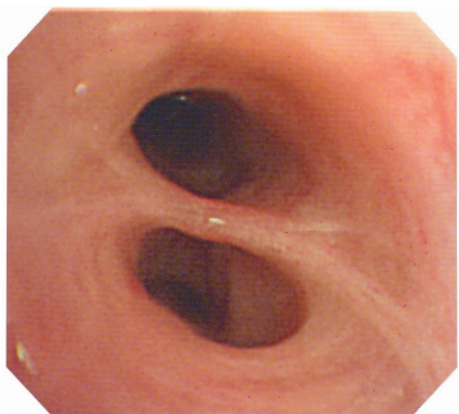
AFI: A magenta-colored lesion was found on the cartilage-membranous area boundary at the level between the second and fifth cartilage rings counted from the tracheal bifurcation toward the center (arrows). The longitudinal diameter of the lesion was about 15 mm.

Histological diagnosis concluded that it was the CIS of squamous cell carcinoma, which was cured with PDT.

The localization and invasion area of this case would not be possible if only white light observation was used.



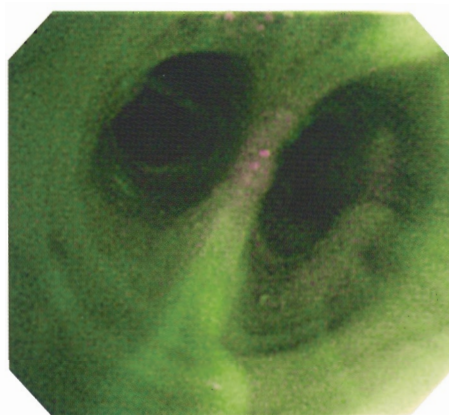
## Dysplasia



Miyagi Cancer Center

- 1) Region: Right B<sup>2</sup>a/b
- 2) Endoscopic findings: Slight vascularization and thickened mucosa were observed on right B<sup>2</sup>a/b.
- 3) Pathological examination: Moderate dysplasia.
- 4) Clinical information: Progress was being observed but canceration was not observed. The lesion still exists.
- 5) Comment: Some dysplasia could also be identified in conventional light observation.

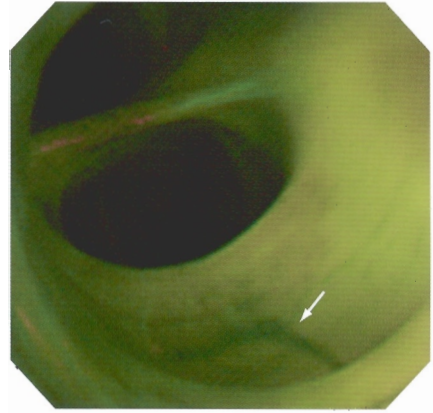
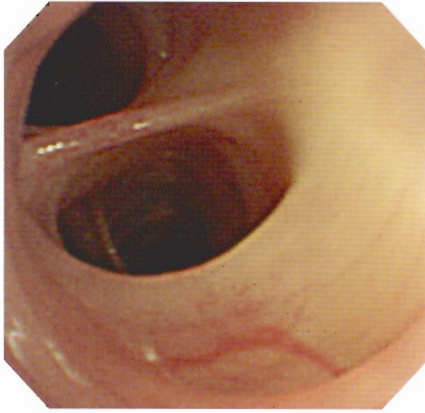
## Dysplasia



Miyagi Cancer Center

- 1) Region: Right B<sup>2</sup>a/b
- 2) Endoscopic findings: This lesion was not detected at the initial observation with conventional light observation. It was detected with AFI.
- 3) Pathological examination: Mild to moderate dysplasia.
- 4) Clinical information: Smoking was prohibited during observation of progress. No suspicious cell were detected in later cytologic examinations. Endoscopic observation of progress is planned shortly.
- 5) Comment: The dysplasia was discovered with AFI even though it was not observed with conventional light observation.

## Dysplasia



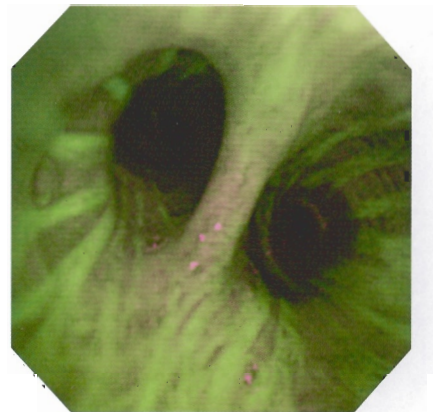
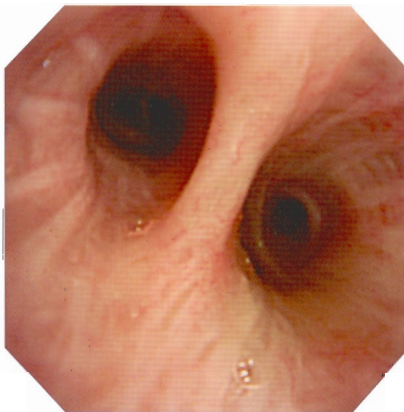
Osaka Medical Center for Cancer and Cardiovascular Diseases

Male aged 76, heavy smoker, pseudo-positive in sputum cytology, normal in chest X-ray examination.

White light observation: The bifurcation of the tertiary bronchus of right B<sup>3</sup>b is lightly thickened and light flare was observed. Dysplasia was suspected in white light observation.

AFI: Pink tone was observed in the bifurcation, and mild dysplasia was identified in histological diagnosis. The image also showed the blood vessel before the bifurcation in green (arrow).

## Dysplasia



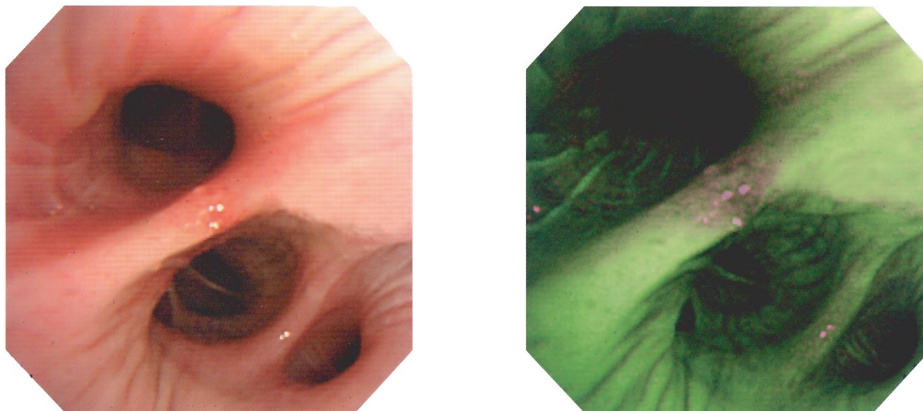
Chiba University

Male aged 58, community health checkup, C in sputum cytology.

Squamous dysplasia (severe):

Bronchoscopy was performed because bloody sputum was observed. The bifurcation between right B<sup>7</sup> and 8, 9, 10 was found to be slightly swelled in normal light observation. AFI image shows as magenta. The lesion was pathohistologically diagnosed as a severe dysplasia. Additional bronchoscopy for observation of progress is scheduled.

## Dysplasia

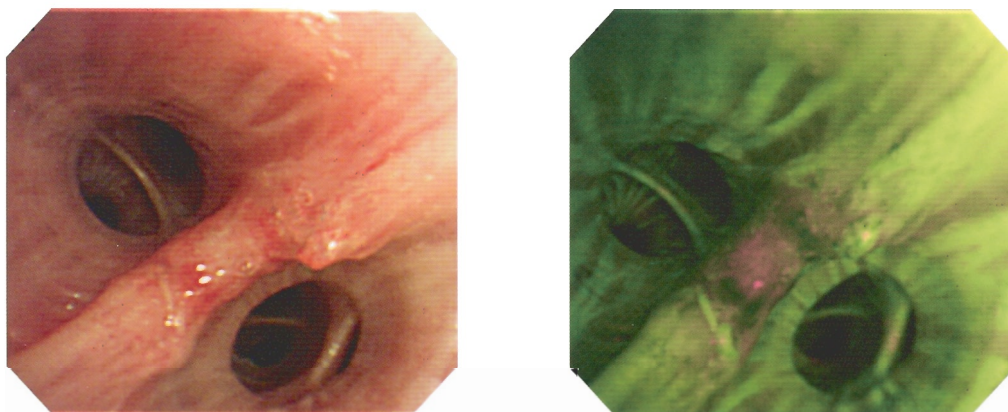


Chiba University

Male aged 66, progress of COPD being observed by a nearby clinic, atypical cells were observed in sputum cytology.

Under white light examination, redness was observed at the bifurcation of right middle and lower lobe bronchus and AFI displayed the same region in magenta. The results of a biopsy proved that it was a moderate dysplasia.

## Scar from biopsy



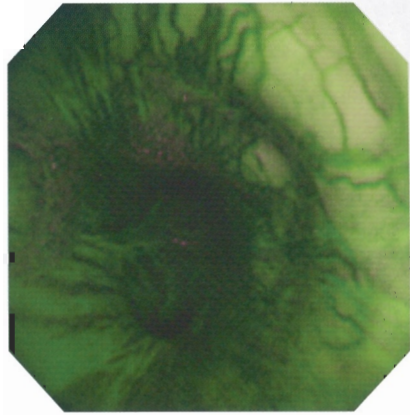
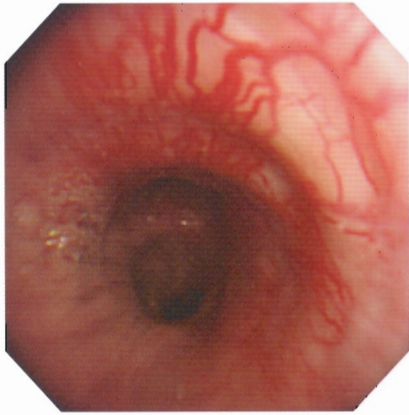
Kinki-Chuo Chest Medical Center

Male aged 57, heavy smoker, suspected positive in sputum cytology, normal in chest X-ray examination.

White light observation: In the bifurcation between right B<sup>9</sup> and B<sup>10</sup>, the region that looks like irregular thickening is the scar due to a biopsy performed because of suspected CIS in the thickened bifurcation.

AFI: The region was displayed in magenta, but this was because the normal layer containing fluorescent substances was peeled off due to biopsy as well as reactions to it. The sub-epithelial bleeding region in the surroundings was displayed in dark green.

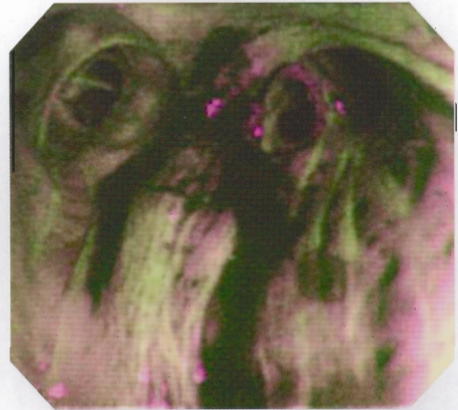
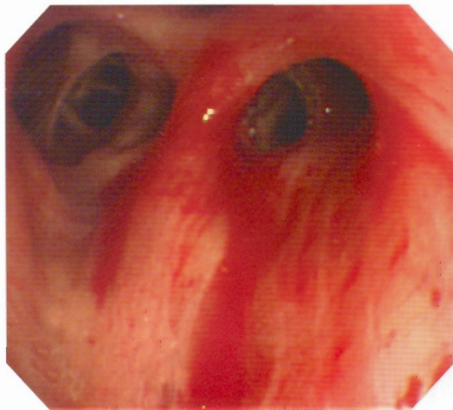
## Blood vessels



Miyagi Cancer Center

Due to the use of green reflection light that is affected easily by blood constituents, AFI depicts blood vessels in dark green tones.

## Bleeding



Chiba University

AFI depicts bleeding regions in dark green tones.

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