OBSERVATION OF THE LASER EXCITED FLUORESCENCE
AT THE GASTROINTESTINAL TRACT (THIRD REPORT)
— A BASAL STUDY TO MEASURE THE SPECTRUM OF
THE ARGON LASER EXCITED FLUORESCENCE —

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We have taken photographs of the Argon laser excited fluorescence of various lesions at the gastrointestinal tract(1). On this method it is able to take the whole image of the fluorescence of the lesion, but its hue is affected by the latitude of the film and the photographing condition as the picture is taken on the color film. Therefore it is necessary to measure the Argon laser excited emission spectrum at the lesions of the gastrointestinal tract, not only to estimate it objectively but also to analyze the factors of the fluorescence. But it is in doubt whether we can obtain a constant emission spectrum during endoscopy, because the fluorescent intensity differs according to a distance between the tip of the optical fiber and the material or its angle with a vertical line. Then this paper reports the study on the basal conditions necessary to obtain a constant emission spectrum during endoscopy.

Methods and Results

We measured the Argon laser excited emission spectrum under several conditions, using the system for real time measurement of emission spectrum during endoscopy developed by Nishisaka et al.(2). Fig.1 is the block diagram of this system. The optical fiber for measurement has a coaxial arrangement. The quartz fiber for laser irradiation lies in the center and the glass fibers for detection of the emission surround it.

As previously reported by Yonekawa et al.(3), the light induced by the electric discharge is intermingled with the laser beam(Fig.2). Then this exerts a marked influence on the emission spectrum(Fig.3, lower), but it is eliminated by interposing a suitable band pass filter between a laser oscillator and a fiber for laser irradiation(Fig.3,upper).

Figure 1

Figure 2

Figure 3

Figure 4

a) Mucosal damage by laser irradiation

The coaxial optical fiber was placed in a vertical position to the resected, non-fixed gastric mucosa in close contact or for a distance of 5mm. The laser irradiation time for measurement was very short, about 0.5sec. When the tip power of the optical fiber was 50, 100 and 300mW, the mucosal damage was not detected macroscopically for each distance of 0 or 5mm. Fig.4 shows the Ar laser(488nm,300mW) excited emission spectra measured for four consecutive times in close contact with the same point of the resected, non-fixed gastric mucosa. Until three times the spectra were almost similar and the mucosal damage was not detected macroscopically.

b) Distance and angle between the optical fiber and the material

The Ar laser(488nm,200mW) excited emission spectrum through cut filter Y-52 was measured on many sheets of white paper and on a resected, non-fixed stomach. The coaxial optical fiber was placed in a vertical position to the material and its emission spectrum was recorded for a distance of 0 to 7mm at 1mm intervals(Fig.5). The spectra for a distance of 0 to 2mm were almost similar, while the intensity of spectrum decreased significantly for a distance of 3mm or more. The angle formed by the optical fiber and the vertical line exerts a marked influence on the intensity of emission spectrum(Fig.6), therefore the optical fiber must be placed in a vertical position.

c) Influence by the broken optical fibers

The emission spectrum measured through the broken optical fibers for detection(Fig.7,upper) is intermingled with other light besides true emission(Fig.7,lower).

Summary

- 1) Because the light induced by the electric discharge of the Argon laser oscillator intermingles with an emission spectrum, it is necessary to eliminate it by interposing a suitable band pass filter between a laser oscillator and a fiber for laser irradiation.
- 2) The almost same emission spectrum is obtained when the coaxial optical fiber is placed in a vertical position to the material and for a distance of 0 to 2mm between its tip and the material.
- 3) The emission spectra are almost similar which are measured for three consecutive times in close contact with a same point of the resected, non-fixed gastric mucosa, and its noise is considerably eliminated by integrating them.
- 4) The difference of the fluorescent intensity between two points is never significant unless it is 30% and more.
- 5) The emission spectrum measured through the broken optical fibers for detection is intermingled with other light besides true emission.

References

1. HOSHIHARA, Y. et al. J. Jpn Society for Laser Medicine 3:449, 1982
2. NISHISAKA, T. et al. Gastroenterological Endoscopy 25:810, 1983
3. YONEKAWA, M. et al. J. Jpn Society for Laser Medicine 3:77, 1982

Figure 5 (white paper) Figure 6 (resected stomach)

Figure 7