3-Dimensional Determination of the Gastric Lesion by Laser Endoscopy

Masayuki Yamaguchi, Yukinori Okazaki, Tatsuo Ohtani, Yoshito Ohshita,
Shigemi Ariyama and Tadayoshi Takemoto

The 1st. Dept. Int. Med., Yamaguchi Univ. Sch. Med., Ube Yamaguchi Japan

We developed a new method to determine the size of the gastric lesion endoscopically, not only the diameter, the area, but the height and depth of the lesion.

The system consists of an endoscope, low power argon laser, transmission diffraction grating made of glass fiber and microcomputer for graphic processing (Figure 1).

The fiber grating is made of a single layer of uniformly directed glass fibers. When two layers of fiber grating were piled up with a right angle crossing to each other, and laser beam made enter the grating, two dimension array of diffracted beam was gained. Determination of the gastric lesion was possible when the grating was put into the top of the endoscope, and the pattern of the diffracted beams projected on the lesion was processed by computer.

A cubic model was determined in vitro. The height measured by the system was 10.7 ± 1.0 mm ($m \pm SD$) compared to correct value of 10.3 mm, aberration ratio 7.5 ± 6.5 % (Table 1). To examine the in vivo accuracy of the system, the rubber disc with a diameter of 20 mm was placed in the human stomach and the size was measured. The diameter measured with front view was 20.1 ± 0.8 mm and with oblique view 19.4 ± 1.0 mm. The aberration ratio was 3.3 ± 2.1 %, 4.3 ± 3.4 % to each other (Table 2). The area of the disc was 342.0 ± 9.5 mm² compared to correct value of 314 mm², aberration ratio 8.9 ± 3.0 % (Table 3).

The healing process of acetic acid induced canine gastric ulcer was observed. The diameter of ulcer 3 days after local injection of acetate 20 %, 0.8 ml was 18 mm and reduced with linear curve to 6 mm at the day of 21st. Regenerative epithelium covered the ulcer floor to leave a depressed area of ulcer scar 5 mm in diameter at the day of 28th. Graphics of the cut surface of ulcer could be displayed on the CRT monitor of the computer. Calculation of the true depth of ulcer is thought possible when the larger computer acceptable of the program converging the axis of co-ordinate is used. The handling of the system was very easy.

It is thought that the system is useful to clinical evaluation of the healing process of gastric ulcer and quantitative pretreatment assesment of early gastric cancer in the case of non-surgical treatment.

Figure 1

Block Diagram for 3-Dimension

Measuring Endoscope

Table 1

Measurement of a Cubic Model

in Vitro - Height -

	VALUE MEASURED mm	ABERRATION RATIO %
1	9.8	- 4.9
2	10.4	+ 0.1
3	9.8	- 4.9
4	12.1	+17.0
5	11.4	+10.7
m ± SD 10.7 ± 1.0 mm		m ± SD 7.5 ± 6.5 %
CORRECT VALUE OF HEIGHT 10.3 mm		

Table 2

Measurement of a Standard Area

in the Stomach - Diameter -

WITH FRONT VIEW			WITH OBLIQUE VIEW		
	VALUE MEASURED mm	ABERRATION RATIO %		VALUE MEASURED mm	ABERRATION RATIO %
1	20.5	+ 2.5		18.1	- 9.5
2	19.4	- 3.0		19.4	- 3.0
3	19.5	- 2.5		19.9	- 0.5
4	21.4	+ 7.0		20.6	+ 3.0
5	19.7	- 1.5		18.9	5.5
m±SD 20.1 ± 0.8 mm 3.3 ± 2.1 %				19.4 ± 1.0 mm 4.3 ± 3.4 %	
CORRECT VALUE OF DIAMETER 20 mm					

Table 3

Measurement of a Standard Area

in the Stomach - Area -

	VALUE MEASURED mm ²	ABERRATION RATIO %
1	350	+11.5
2	334	+ 6.5
3	329	+ 4.8
4	344	+ 9.7
5	350	+11.5
m±SD 342.0 ± 9.5		8.9 ± 3.0
CORRECT VALUE OF THE AREA 314 mm ²		