Normal Histological Appearances of the Duodenum, Jejunum and Terminal Ileum in Indonesian People

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ABSTRACT

***Background**: There is no literature specifically on the normal appearance of small bowel mucosa amongst Indonesians. Diseases of the small bowel can cause chronic diarrhea. Chronic diarrhea is common in Indonesia.*

***Methods**: Thirty seven patients with normal stomach and small bowel on endoscopic and histopathologic examination were included in this study. Biopsies were taken from the duodenal bulb, descending part of duodenum, jejunum and terminal ileum. The scoring method for the inflammatory cells (lymphocytes, plasma cells and eosinophil cells) was carried out using the symbols 0 (negative), +, ++, and +++.*

***Results**: The mean height of the villi of the duodenal bulb was 265.00 ± 81.89 μm, the mean height of the crypts of the duodenal bulb was 196.67 ± 56.01 μm, the mean width of the villi were 59.14 ± 74.14 μm. The mean height of the villi of the duodenum pars descendens was 317.27 ± 99.66 μm and the mean height of the crypts was 218.79 ± 84.66 μm. The mean height of the villi of the jejunum was 341.76 ± 76.06 μm and the mean height of the crypts was 189.41 ± 58.15 μm. The mean height of the villi of the terminal ileum was 235.41 ± 73.32 μm, and the mean height of the crypts was 186.22 ± 64.09 μm.*

***Conclusion**: Histologically, the mean height of the villi of the normal small bowel was between 235.41 ± 73.32 to 341.76 ± 76.06 μm and the mean height of the crypts of the normal small bowel was between 186.22 ± 64.09 to 218.79 ± 84.66 μm.*

***Keywords**: normal, duodenum, jejunum, terminal ileum, histological appearances, villous height, villous width, crypt height*

INTRODUCTION

Small intestinal biopsy is now widely accepted as a useful and simple way to evaluate patients with primary intestinal malabsorption or other intestinal diseases.[1,2,3,4,5] The biopsy can be performed through enteroscopy (small bowel endoscopy) examination or Crosby capsule examination.[6,7,8] Normally, villi are not all perfectly tall, finger-like structures standing in a row perpendicular to the lumen.[2] Rather, many villi tend to bend in different directions and to vary in their structure from slender, index finger-like structures to plumper, thumblike structures with corrugated edges. Furthermore, not all villi are cylindrical with circular cross sections; many are normally leaf shaped, with elliptical cross sections.

The mucosa of the normal small intestine is designed so that a maximum absorptive surface is presented to

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the intraluminal intestinal contents. The submucosa of the elongated, hollow small bowel is thrown up into numerous spiral or circular folds, the plicae circulares, which increase the surface area by a factor of two to three. The mucosal surface itself is studied with numerous epithelial-lined villi which are approximately 0.5-1.0 μm in height and which have been estimated to increase the absorptive surface eightfold.[2] The villi are normally ridge or leaf shaped in the human proximal duodenum, leaf or finger shaped in the distal duodenum and proximal jejunum, and finger shaped in the distal jejunum and ileum. Three cell types, the absorptive, the mucous-secreting goblet, and the enterochromaffin cells form the single layer of columnar epithelium, which covers the villi.[9]

There is an assumption that Asian (including Indonesian) people have a shorter and smaller stature than Caucasian (American or European). We have normal data about the Caucasian small bowel's histologic appearance from the literature, but we have no data about the Indonesian small bowel's histologic appearances. The aim of this study is to examine the normal appearances of Indonesian small bowel. With this study, we can differentiate between pathologic abnormalities and normal appearances.

METHODS

A descriptive-analytic study was done on functional dyspeptic patients with no endoscopical abnormalities. The study was done at the Division of Gastroenterology, Department of Internal Medicine Cipto Mangunkusumo hospital Jakarta in 1998-1999. Upper and lower gastrointestinal endoscopy examinations were done in patients with functional dyspepsia. The patients were included in this study if the endoscopical and histological appearances of small bowel, stomach and colon were within normal limits. Upper GI endoscopy was done with Olympus PCF10 colonoscope, which can reach the proximal jejunum. The correct location of the tip of the endoscope (reaching the proximal jejunum) was confirmed with fluoroscopy. Gastro-duodeno-jejunum and terminal ileum were regarded as endoscopically normal if there was no hyperemia, no erosion, no ulcer, no tumor and no other abnormalities were observed. Biopsies were taken from the duodenal bulb (2 specimens), descending part of duodenum (2 specimens) and proximal jejunum near ligamentum of Treitz (2 specimens). A Olympus CF200 EVIS200 colonoscope was used for colonoscopy and ileoscopy. Biopsies were taken from the terminal ileum (2 specimens). Histopathological results of the biopsies specimens were read by an Indonesian pathologist and confirmed by a Dutch pathologist in AMC Amsterdam. If there was a disagreement between the two experts, we used the Dutch pathologist expertise. The height, width of the villous mucosa and intervillous space were measured with the measurement on the microscope (micrometer) objective 10 x 10, in magnifying 10 x: 1 U = 10 micron. The inflammatory cells were examined with objective 10 x 40 and 10 x 100. Haematoxyllin-Eosin was used for the staining. A scoring system for inflammatory cells (lymphocytes, plasma cells and eosinophils) was used as follows: 0 (negative), +, ++ +++. + if the histology showed that the distance between 2 cells was larger than the diameter of the cells. ++ if the histology showed that the distance between 2 inflammatory cells was smaller than the diameter of the cells. +++ if the inflammatory cells were touching each other. Goblet cell frequency in 100 μm was measured in all specimens.

Before the study, laboratory examinations were performed to exclude organic disease and infective disorder. The patients were excluded from the study if they were not cooperative or if there was organic abnormality of the stomach, duodenum, jejunum, ileum and colon. The data were analyzed with ANOVA or Kruskal-Wallis.

RESULTS

During the one year study (1998-1999), we found 38 functional dyspeptic patients from 101 dyspeptic patients, with endoscopically normal small bowel. The characteristics of the patients were as follows (table 1).

Table 1. Sex and age distribution of 38 patients with functional dyspepsia

Characteristics	Frequency	Percent (%)
Sex		
Male/female	17/21	44.7/55.3
Age group (years)		
20 - 29	10	26.3
30 - 39	9	23.7
40 - 49	9	23.7
50 - 59	8	21.1
60 - 69	2	5.3

From 38 cases with an endoscopically normal duodenal bulb (figure 2), there were 37 cases with a normal duodenal bulb histologically (figure 3). Histologic findings is shown in table 2.

Table 2. Histological appearances of normal duodenal bulb

Mucosal measurement		Mean ± SD
Height of villi		265.00 ± 81.89 μm
Height of crypt		196.67 ± 56.01 μm
Width of villi		96.00 ± 27.46 μm
Width of intervillous space		59.14 ± 74.14 μm
Crypt: villous ratio		0.80 ± 0.26
Goblet cells number per 100 μm villous height		2.95 ± 1.41
Inflammatory cells		**Frequency (%)**
Lymphocyte	+	8/37 (21.6)
	++	29/37 (78.4)
Intraepithelial lymphocyte	+	31/37 (83.8)
	++	6/37 (16.2)
Plasma cell	+	37/37 (100)
Eosinophil cell	+	9/37 (24.3)
	++	28/37 (75.7)
Brunner gland	+	34/37 (91.9)

From 38 cases with endoscopically normal duodenum pars descendens, one case was histologically found to have many lymphocytes in the epithelium and mucosa (abnormal). The patient with histologically abnormal duodenal bulb, was the same patient with histologically abnormal duodenum pars descendens, abnormal jejunum and abnormal terminal ileum. So, there were 37 cases with histologically normal pars descendens of duodenum. The size of the mucosa of the pars descendens of duodenum was larger than the duodenal bulb. Histological findings are presented as shown in table 3.

Table 3. Histological appearances of normal duodenum pars descendens

Mucosal measurement		Mean ± SD
Height of villi		317.27 ± 99.66 μm
Height of crypt		218.79 ± 84.66 μm
Width of villi		125.76 ± 35.88 μm
Width of intervillous space		30.91 ± 34.58 μm
Crypt: villous ratio		0.74 ± 0.34
Goblet cells number per 100 μm villous height		3.80 ± 2.01
Inflammatory cells		**Frequency (%)**
Lymphocyte	+	37/37 (100)
Intraepithelial lymphocyte	+	32/37 (86.5)
	++	5/37 (13.5)
Plasma cell	+	36/37 (97.3)
Eosinophil cell	+	17/37 (45.9)
Brunner gland	+	37/37 (100)

From 38 cases with endoscopically normal jejunum, histologically there was one same case seen with heavy intraepithelial infiltration of lymphocytes (not normal). This case with the histological abnormality was excluded from further analysis. The size of the jejunal mucosa was larger than the size of the duodenal bulb mucosa (table 4).

Table 4. Histological appearances of normal jejunum

Mucosal Measurement		Mean ± SD
Height of villi		341.76 ± 76.06 μm
Height of crypt		189.41 ± 58.15 μm
Width of villi		125.59 ± 40.76 μm
Width of intervillous space		24.12 ± 11.58 μm
Crypt: villous ratio		0.57 ± 0.23
Goblet cells number per 100 μm villous height		4.29 ± 1.53
Inflammatory Cells		**Frequency (%)**
Lymphocyte	+	37/37 (100)
Intraepithelial lymphocyte	+	36/37 (97.3)
	++	1/37 (2.7)
Plasma cell	+	36/37 (97.3)
Eosinophil cell	+	36/37 (97.3)
	++	1/37 (2.7)
Brunner gland	+	1/37 (2.7)

From 38 cases with endoscopically normal terminal ileum, histologically there was one same case with heavy lymphocyte infiltration in the epithelium and mucosa (not normal). This case was not included in this research. The height of the villi of the terminal ileum was 235.41 ± 73.32 μm, which was shorter than the height of the villi of the duodenal bulb (table 5).

Table 5. Histological appearances of normal terminal ileum

Mucosal Measurement		Mean ± SD
Height of villi		235.41 ± 73.32 μm
Height of crypt		235.41 ± 73.32 μm
Width of villi		114.59 ± 34.20 μm
Width of intervillous space		53.51 ± 25.19 μm
Crypt: villous ratio		0.88 ± 0.54
Goblet cells number per 100 μm villous height		14.99 ± 4.96
Inflammatory Cells		**Frequency (%)**
Lymphocyte	+	35/37 (94.6)
	++	2/37 (5.4)
Intraepithelial lymphocyte	+	35/37 (94.6)
	++	2/37 (5.4)
Plasma cell	0	1/37 (2.7)
	++	36/37 (97.3)
Eosinophil cell	0	2/37 (5.4)
	+	13/37 (35.1)
	++	21/37 (56.8)
	+++	1/37 (65.8)
Brunner gland	0	37/37 (100)

The sex and age did not affect the height of the villi, height of the crypts, villous width and width of intervillous space of the duodenal bulb ($p > 0.05$) (table 6).

Table 6. The characteristics of patients and the villi of small bowel mucosa

Characteristics	Height of villi	Height of crypt	Width of villi	Intervillous space
Duodenal bulb				
Sex				
Male	24.93 ± 5.97	18.00 ± 4.78	9.56 ± 2.87	8.06 ± 10.45
Female	27.75 ± 9.57	21.00 ± 5.95	9.63 ± 2.71	4.05 ± 2.27
	(ns)	(ns)	(ns)	(ns)
Age group (years)				
20 – 29	37.75 ± 6.02	26.25 ± 4.78	11.00 ± 4.00	4.00 ± 0.81
30 – 39	25.71 ± 10.78	18.57 ± 4.65	9.83 ± 2.56	3.50 ± 3.21
40 – 49	26.40 ± 5.32	21.00 ± 6.51	9.60 ± 1.34	3.60 ± 1.34
50 – 59	20.66 ± 10.69	20.00 ± 8.66	8.66 ± 3.21	4.33 ±1.52
60 – 69	30.00 ± 0.00	20.00 ± 0.01	6.00 ± 0.01	9.00 ± 0.06
	(ns)	(ns)	(ns)	(ns)
Duodenum pars descendens				
Sex				
Male	28.35 + 9.20	22.14 + 10.86	12.85 + 3.73	4.21 + 5.05
Female	33.61 + 9.82	21.28 + 6.32	12.52 + 3.43	2.57 + 1.59
	(ns)	(ns)	(ns)	(ns)
Age group (years)				
20 – 29	35.37 + 16.54	25.62 + 4.95	10.75 + 2.65	3.00 + 2.39
30 – 39	30.44 + 8.87	23.33 + 11.72	13.00 + 4.09	2.33 + 0.70
40 – 49	30.66 + 11.18	17.55 + 5.24	14.11 + 3.79	4.44 + 5.96
50 – 59	30.00 + 10.80	22.85 + 7.55	12.57 + 3.40	3.42 + 2.99
60 – 69	30.00 + 0.00	12.00 + 2.82	12.50 + 0.70	2.00 + 0.00
	(ns)	(ns)	(ns)	(ns)
Jejunum				
Sex				
Male	34.46 ± 33.94	19.80 ± 6.22	13.80 ± 4.66	2.53 ± 1.18
Female	33.94 ± 8.42	18.26 ± 5.54	11.57 ± 3.35	2.31 ± 1.18
	(ns)	(ns)	(ns)	(ns)
Age group (years)				
20 – 29	37.12 ± 6.28	20.25 ± 4.40	12.87 ± 3.72	2.00 ± 0.92
30 – 39	34.44 ± 10.44	19.66 ± 8.17	12.66 ± 3.74	2.22 ± 0.66
40 – 49	31.37 ± 4.59	16.87 ± 4.32	12.62 ± 4.17	2.37 ± 1.30
50 – 59	34.85 ± 8.57	18.85 ± 6.59	13.14 ± 5.30	3.00 ± 1.03
60 – 69	30.00 ± 0.00	19.00 ± 1.41	8.50 ± 3.53	3.00 ± 1.41
	(ns)	(ns)	(ns)	(ns)
Terminal ileum				
Sex				
Male	24.75 ± 7.87	20.93 ± 7.36	10.93 ± 1.73	5.06 ± 2.86
Female	22.61 ± 6.94	16.85 ± 5.07	11.85 ± 4.29	5.57 ± 2.27
	(ns)	(ns)	(ns)	(ns)
Age group (years)				
20 – 29	24.00 + 6.26	21.77 ± 7.34	10.66 ± 1.00	4.22 ± 1.85
30 – 39	24.44 ± 8.35	16.88 ± 6.00	12.88 ± 6.54	5.66 ± 2.39
40 – 49	23.88 ± 6.33	17.11 ± 5.13	11.88 ± 1.69	7.00 ± 2.50
50 – 59	20.62 ± 8.84	20.12 ± 6.66	10.62 ± 1.30	4.25 ± 2.65
60 – 69	27.50 ± 9.19	13.00 ± 4.24	10.00 ± 0.00	6.00 ± 2.82
	(ns)	(ns)	(ns)	(ns)

ns: Not significant

DISCUSSION

From this research we have found 38 cases with normal endoscopic features of the small bowel (duodenum, jejunum and terminal ileum). All patients had both endoscopically and histologically normal appearances except one patient, so we have 96.3% normal histological picture. The discrepancy between the endoscopic appearance and the histologic appearance in one patient in this study is in accordance with the literature hitch stated that only histologic examination of the biopsy specimen can determine the definite diagnosis. Although mucosal appearances of the small bowel looks normal with endoscopy, we could see some histologically pathologic changes.[6]

This study also showed that the majority of our patients were women (55.3%), age between 20-29 years (26.3%). These sex and age characteristics differed depending on different researchers or different places.

The height of the small bowel varied between 235.41 ± 73.32 to 341.76 ± 76.06 micron (μ) meter. The height of the small bowel villi of Indonesians was different compared with the literature where the data were derived from Caucasians (European/American) with a height of 500-1,000 micron (μ) m. This showed that the height of the small bowel villi in Indonesians was shorter than that found in Caucasians.[1,2,6,7] To my knowledge, there is still no data about the normal height of the small bowel villi in Asian population, so we cannot compare these results with the Asian data.

The height of the duodenal bulb villi and of the terminal ileum was shorter than in the descending part of duodenum and jejunum. This was in accordance with the literature where it was written that height of villi in the jejunum is the tallest for the digestion and absorption of food.[5,7]

The shape of the villi in the duodenum, jejunum and terminal ileum were like fingers/leaves in accordance with the literature. The height of the crypts varied between the duodenal bulb, jejunum and the terminal ileum depending on the place of the research, ethnic groups, etc.[1,2,6,7,10] The jejunum villous height in this study was shorter than the western study (313-512 μm, mean 413 ± 52 μm) but the same as the tropical study (155-431 μm, mean 311 ± 63 μm).[10] This finding is similar with the result of morphology study on the small bowel in British Indian and Afro-Caribbean subjects, which showed that both immigrant groups had decreased villous height ($p < 0.001$) and villous: crypt ratios ($p < 0.01$) compared with the white group.[11] The jejunum height of crypt in this study was the same as the Western study (114-231 μm, means 159 ± 29 μm) and the tropical study (89-195 μm, means 138 ± 34 μm).[10]

The width of the villi varied some what, in accordance with the literature on Africans, Europeans, etc.[1,2,6,7,10] The width of jejunal villi in this study was the same as the Western study (109-154 μm, mean 130 ± 34 μm) and the tropical study (111-219 μm, mean 153 ± 22 μm).

In the pars descendens of duodenum, Brunner's glands were found in 100% of the cases exactly the same as in the literature, where it was stated that the Brunner glands are positively present in the duodenum. In the jejunum there were only 2.7%. Brunner's glands, which differred from the literature, which stated that the Brunner glands cannot be found at this level. In the duodenal bulb and descending part of the duodenum, there were lymphocytes infiltration in 100% of the cases. In all small bowel biopsies, there was only mild or moderate intraepithelial lymphocyte infiltration.

CONCLUSION

Histologically, the mean height of the villi of the normal small bowel was between 235.41 ± 73.32 to 341.76 ± 76.06 μm and the mean height of the crypts of the normal small bowel was between 186.22 ± 64.09 to 218.79 ± 84.66 μm

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