
Histomorphometric Changes of The Parietal Cell of The Stomach with Age - A Postmortem Study

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Abstract

Background: The quantity of acid produced by the stomach correlates with the functional capability and number of parietal cell mass. Researchers have found that the number of parietal cells tends to increase with advancing age in different population-based studies. **Objective:** A cross-sectional descriptive type of study was designed to see the variation in the number and diameter of the parietal cells of the stomach with advancing age in Bangladeshi people. **Methods:** The present study was done in the Department of Anatomy, Dhaka Medical College, Dhaka, from July 2005 to June 2006, based on collection of 60 human stomachs from the unclaimed dead bodies that were under examination in the morgue of Dhaka Medical College, Dhaka. The samples were divided into three age-groups including group A (2-16 years), group B (17-22 years) and group C (23-65 years). A total of 8 relatively fresh samples from group A, 8 from group B and 14 from group C were selected for histological study. Then best prepared histological slides from each group were taken and examined under the light compound microscope to determine the number per sq. mm and average diameter of the parietal cells by using the ocular micrometer. **Results:** The number of parietal cells per square mm of microscopic fields were found 1197.88 ± 73.34 in group A, 1362.25 ± 55.67 in group B and 1615.57 ± 123.57 in group C. The difference between group A & B, B & C and A & C were statistically significant. The average diameter of the parietal cells were found $14.44 \pm 1.58 \mu\text{m}$, $16.87 \pm 0.48 \mu\text{m}$, $17.67 \pm 1.28 \mu\text{m}$ in group A, B and C respectively. The difference between group A & B and A & C were statistically significant. **Conclusion:** The number of the parietal cells increases with age, even in old age. However, the diameter of the parietal cell increases up to the 3rd decade of life and then remains static.

Key words: Stomach, histology, gastric gland, parietal cell.

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Introduction

The best known component of gastric juice is hydrochloric acid, which is the secretory product of the parietal cells.¹ The parietal cells are distributed along the length of the gastric glands, but tend to be numerous in the isthmus of the glands.²⁻⁴ These cells are recognized by their copious eosinophilic

cytoplasm and central nuclei.^{5,6} They are large, rounded and triangular cells.⁵⁻⁷ It is known that the capacity of the stomach to secrete hydrochloric acid is almost linearly related to parietal cell numbers.^{8,9} From the end of the first trimester, parietal cells are present in a mature, functional form in the gastric mucosa with the potential to secrete gastric acid.¹⁰ A normal human stomach contains approximately one

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billion parietal cells, which are capable of producing and concentrating hydrochloric acid⁸. The quantity of acid produced by the stomach correlates with the functional capability and number of parietal cell mass.^{10,11} It is also evident that the patients of chronic gastritis and peptic ulcer generally have a larger parietal cell mass than that of normal persons.¹⁰ Moreover, researchers have found that the number of parietal cells tends to increase with advancing age in different population-based studies.¹⁰⁻¹³ Analysis of the normal production and loss of parietal cells provides the basis for understanding the pathogenesis of several diseases that affect parietal cell mass (e.g. Zollinger-Ellison syndrome and chronic atrophic gastritis).¹⁴ Therefore, the aim of the present study was to find out the histomorphometric changes, i.e. number and size, of the parietal cells in a Bangladeshi population and compare with the previous studies. The results of the present study can be used as a standard reference for the morphometry of gastric glands and to correlate the abnormality in functional capacity in pathological cases.

Methods

Collection of Sample: A cross-sectional descriptive study was carried out in the Department of Anatomy, Dhaka Medical College, Dhaka, from July 2005 to June 2006, based on the postmortem collection of human stomach. The samples of human stomach were collected from the unclaimed dead bodies that were under examination in the morgue of Dhaka Medical College, Dhaka. The present study was approved by the Ethical Review Committee of Dhaka Medical College, Dhaka.

All the samples were collected within 24-36 hours of death without any sign of putrefaction and taken from medicolegal cases excluding poisoning, any cutting or crushing injury to stomach, and viscera having grossly abnormal size. During collection appropriate age, sex and cause of death were noted from morgue's record book. The samples were tagged immediately, which was bearing a code number for subsequent identification. Soon after collection, each sample was gently washed in tap water on a dissection tray. Blood and blood clots

were removed as far as possible. Omenta, fat and other unwanted tissues were removed. Then the samples were fixed in 10% formol saline solution. After isolation, the samples were divided into three age-groups i.e. group A (2-16 years), group B (17-22 years), and group C (23-65 years), according to Farinati et al.⁵

Preparation of histological slides: The stomach was fixed in 10% formol saline in a plastic container. A total of 8 relatively fresh samples from group A, 8 from group B and 14 from group C were selected for histological study. A sharp knife was placed on the stomach, and it was cut sharply to obtain a slice of tissue having 3 mm in thickness. Each of the samples was fixed with 10% formol saline for 24 hours. Then the tissues were washed in running tap water, dehydration was done with ascending grades of alcohol, cleared with xylene, infiltrated and embedded in paraffin. Paraffin blocks were cut at 5mm thickness and were stained with routine Harris' Haematoxylin and Eosin (H & E) stain. Only best prepared slides from each of the tissue blocks was chosen for the study.

Estimation of the number of the parietal cells per sq. mm area of the microscopic field: The light compound microscope which was used for the microscopic measurement was OLYMPUS CHB, made in Tokyo, Japan. According to Enayetullah¹², the stained tissue section on the slide (´ 40 objective, ´ 10 eyepiece) was divided into three equal parts by a computer generated, photographically produced equal sized room over a transparent plastic sheet by drawing three lines which radiated from the centre towards the periphery at 10 o'clock, 2 o'clock and 6 o'clock position. Then, this sheet was fixed on the top of the cover slip by adhesive tape. The centre of this sheet corresponded with the centre of the tissue section. From each triangular area, one microscopic field was selected near the centre for study. Thus from each slide, three different fields were chosen for counting the number parietal cells. Therefore, a total of 45 fields were taken for the study. A counting circle of 5 mm diameter was printed on a transparent plastic sheet, which was cut to fit into the eyepiece of the light microscope. Thus a black circular outline was

superimposed over the actual microscopic field. The parietal cells are large, rounded and triangular with eosinophilic cytoplasm and central nuclei (Figure 1). The circle encircled some total of the parietal cells, while some other parietal cells were partly included inside that circle. However, the rest of the parietal cells were also seen. Considering this circle as the field to be studied (rather than the whole microscopic field), the portions of the parietal cells inside this field were taken in consideration by an eye estimate e.g. 1, 0.75, 0.5, 0.25 etc. From the three counts of three different fields of each slide, an average count was calculated for each slide. Thus, the average counts of the slides for each species were available. The count was then converted into number per square mm by conversion measurement of an ocular micrometer and a stage micrometer.¹⁵

Measurement of the diameter of the parietal cells of the stomach: The parietal cells of the stomach were triangular rather than rounded (Figure 1), which was somewhat difficult in measuring the actual diameter. To overcome such type of drawback, the numbers of ocular micrometer divisions were read out from near to remote margins of the parietal cells and measurements were taken twice for parietal cell i.e. maximum transverse diameter and another perpendicular to it. Then the numbers of micrometer divisions were multiplied by the correlation factor derived earlier keeping the magnification constant ($\times 40$

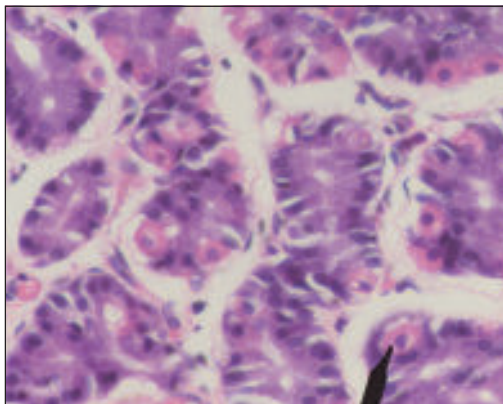


Figure 1. Photomicrograph of parietal cell of the stomach taken from group B (17-22 years) ($\times 40$ objectives, $\times 10$ eyepiece) (H & E stain).

objective, $\times 10$ eyepiece). Therefore, the diameter of parietal cell was calculated as follows:

Diameter of parietal cell = (Maximum transverse diameter + Maximum perpendicular diameter) \div 2

Then the average diameter was calculated in μm by conversion measurement of an ocular micrometer and a stage micrometer¹⁵.

The data collected from the histological studies were processed and statistical analyses were done by one-way ANOVA test, using the SPSS 11.0 version.

Results

The number of the parietal cells per square mm of microscopic field were 1197.88 ± 73.34 in group A, 1362.25 ± 55.67 in group B and 1615.57 ± 123.57 in group C. The difference between group A vs B, B vs C and A vs C were statistically significant (Table I). The average diameter of the parietal cells were found $14.44 \pm 1.58 \mu\text{m}$, $16.87 \pm 0.48 \mu\text{m}$, $17.67 \pm 1.28 \mu\text{m}$ in group A, B and C respectively. The difference between group A & B and A & C were statistically significant (Table I).

Table I: Number and diameter of parietal cells in different study groups

Group	Number / sq. mm	Diameter (in μm)
	Mean \pm SD	Mean \pm SD
A	1197.88 ± 73.34	14.44 ± 1.58
(n=8)	(1042-1293)	(11.34-16.26)
B	1362.25 ± 55.67	16.87 ± 0.48
(n=8)	(1300-1462)	(16.28-17.68)
C	1615.57 ± 123.57	17.67 ± 1.28
(n=14)	(1503-1865)	(15.98-19.58)
P value		
A vs B	<0.01**	<0.001***
A vs C	<0.001***	<0.001***
B vs C	<0.001***	>0.01 ^{ns}

Figures in parentheses indicate range. Statistical analyses were done by ANOVA (multiple comparison), ns = not significant, **/** = significant. Group A : 2-16 years; Group B : 17-22 years; Group C : 23-65 years

Discussion

Farinati et al.⁵ found that the number of the parietal cells tends to increase with age. Naik et al.¹⁰ found that the average parietal cell mass in human stomach 1005.12±445.34 million (with a range from 539.4 to 1981.9 million) in adult. Helander et al.¹⁶ estimated that in gastric mucosal tissue sections, the parietal cell number comprises of all epithelial cells 12% in humans. Mercer & Robinson¹⁷ reported that biopsy specimens taken from the stomach have demonstrated that parietal cells account for 13% of epithelial cells of its mucosa. Kelly et al.⁸ and Kumar et al.¹⁸ stated that the normal human stomach contains approximately 1 billion parietal cells. Kopic et al.¹⁹ stated that the parietal cells are found in high abundance in the gastric gland, with typically 70-90 parietal cells per gland. The findings of the present study are more or less similar to that of Farinati et al.⁵, Kopic et al.¹⁹. However, percentage volume of parietal cells in gastric glands was not determined in the present study.

Ito²⁰ stated that the most conspicuous cells of the gastric mucosa are the parietal cells and their average diameter is up to 25µm. Rohrer et al.²¹ found that human parietal cells are larger cells with an average diameter of 16-22µm. Gartner & Hiatt²² reported that they are about 20 to 25µm in diameter. The findings of the present study are similar to Rohrer et al.²¹, but lower than that of Ito²⁰ and Gartner & Hiatt.²² The difference may attribute to racial variation and measurement procedure. To the best of our knowledge, it was the first ever study on microscopic anatomy of parietal cell of the stomach in our country. Hence, no local data were found to compare with our study.

Conclusion

The number of the parietal cells increases with age, even in old age. However, the diameter of the parietal cell increases up to the 3rd decade of life and then remains static. Further studies are recommended to determine the percentage

volume of parietal cells in gastric glands and physiological changes with secretions of local hormones and other biochemical modulators.

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