



MORPHOGENESIS OF ENDOCRINE ISLETS OF PANCREAS OF GEESE

I. FESENKO, O. MIROSHNIK & Y. MASLAK

Kharkiv State Zooveterinary Academy

Summary

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The features of microscopic structure of endocrine islets of pancreas of geese of large grey breed from 1 day up to 5 years of age were investigated. Dark and light endocrine islets in geese were discovered. The former consist mostly of A- and D-cells, the latter are made of B- and D-cells. Dark endocrine islets take big area, have irregular rounded shape and are located between acini around excretory ducts of lobes. Light endocrine cells are much smaller, have regular rounded shape and are located evenly between acini in parenchyma. The number, average and relative area of islets of geese increased with age. The biggest number and relative area of dark and light islets were determined at the age of eight months and one year-old geese. The biggest average area of dark islets of geese was at the age of one, and of light islets was on the twenty first day.

Key words: age-related changes, endocrine islets, geese, morphogenesis, pancreas

INTRODUCTION

An important feature of geese is their ability to consume accessible and cheap forage. Besides, they have high rate of safety of goslings (Ibatulin *et al.*, 2007; Balish, 2009). On comparison to other kinds of poultry geese have the highest growth rate. For the first two months their weight increases in 40–50 times, while the weight of cattle – only 1.9, the weight of pigs – 10.8 times. The relative energy of growth during the first month of life is 200%, the second – 96%, the third – 17% (Gaduchko, 2006; Ibatulin *et al.*, 2007; Derevyanko, 2008).

In particular, the state of digestive apparatus determines productive features of organism. Only pancreas combines the structures with double secretion: as exo-

crine – it releases important digestive enzymes in the intestines, and as endocrine – it synthesises hormones, which regulate carbohydrate and lipidic metabolism and exocrine secretion of digestive apparatus (Balish, 2009).

We did not find information concerning microscopic structure of endocrine islets of pancreas of geese in age aspect, hence the task of this work.

The endocrine part of pancreas is made of Langerhans islets, the number of which in a person is about 1–3 million or 1–3 % of organ mass. Average diameter of endocrine islets is 200–300 μm (Ogneva, 1972; Laugier, 1985). Incretory part of pancreas of white rat is arranged in the form of pancreas islets, their square is

0.84 % of the general and equals 14 210 μm^2 (Zheleznov, 2002).

Endocrine islets of mammals are “blended”. According to morphofunctional classification there are five types of cells among endocrine cells islets: A-, B-, D-, D-1 and PP- types of cells. A-cells make up 24–27 %, B-cells – 60–75 %, D-cells – only 5–16 % (Detyuk, 1972; Jaglov, 1977; Porchesku, 2007). Phylogenetic “young” types of endocrine islets are typical for poultry: some of them are created with A- and D-cells, others – with B- and D-cells. The first ones are “dark”, and the second ones are “light” (Jeletskiy, 1974). Besides, “mixed” islets which consist of A-, B- and D-cells are defined (Makami, 1962; Girolamo, 1966). Endocrine part of gland of hens and geese is made with “dark”, “light” and “mixed” pancreatic islets. Dark islets of geese make up 0.67 % of the volume of parenchyma, light – 0.23 %, mixed – 0.2 % (Jeletskiy, 1974). There are not any mixed islets in geese (Beger, 1990).

The task of the research was to study the age changes of microscopic structure of endocrine islets of pancreas of geese of the Large grey breed.

MATERIAL AND METHODS

The material for the research was selected from clinically healthy domestic geese of the Large grey breed at the age of 1-, 3-, 7-, 14-, 21 days, 1-, 2-, 6-, 8 months and 1-, 2-, 3-, 5 years. Geese got balanced mixed fodder according to DSTU 4120-2002, had free access to water and went to the pasture.

The material for the research was selected from five geese of every age group. For histological research pieces of organ were taken from the middle part of the gland, which had dorsal and ventral lobes. The material was set in 10% solution of

neutral formalin; paraffin histocuts prepared by a common method were coloured with haematoxylin and eosin (Mallory), azure II-eosin. The experiments of the histological preparations were held with the help of light microscope JENAMED-2 and eyepiece graticule, photo camera Canon and computer program Adobe Photoshop CS5. The relative content of parenchyma and endocrine part of gland were defined on microphoto in the program Adobe Photoshop CS5 with the help of eyepiece graticule. Numerical indicators of the results of the research were worked over using variational and statistical methods (methods of variational statistics) and with the help of the program Microsoft Excel. The estimation of statistical probability of quantitative indicators was made according to Student's criteria.

RESULTS AND DISCUSSION

The pancreas of geese is located in the loop of the duodenum on the right side of phrenic cavity, ventrally belongs to air-bearing sack. It is white with cream hint. The gland consists of two large main lobes – dorsal and ventral. Approximately 30% of poultry have the third lobe – lienal. Every lobe includes one large excretory duct. The duct of 1–3 days goslings is located in dorsal and ventral lobe approximately in the middle. When poultry gets older, the duct in the dorsal lobe dislocates to its ventral part, and in ventral lobe stays in the middle.

Dark endocrine islets large in area are the most noticeable structures on the exocrine part of gland. They have irregular rounded shape and are made up mostly of A-cells. Most of the big islets of dorsal and ventral lobes are located between acini around excretory ducts of lobes.

Light islets are much smaller than dark ones. They have more regular shape and are made up mostly of B-cells. Light islets are located evenly between acini along the whole parenchyma.

Average number of dark and light islets of 1-day goslings was 3.6 ± 0.73 and 11.7 ± 0.94 on 1 mm^2 of the section respectively. with average area of one dark islet – 5485.8 ± 527.5 and one light islet – $2593.8 \pm 247.5 \text{ }\mu\text{m}^2$ respectively. At the same time relative area of dark and light islets made up 0.20 ± 0.09 and 0.16 ± 0.04 % respectively (Table 1 and 2).

Endocrine cells of islets have rounded and oval shape, mostly central-located rounded nucleus and there are small oxyphilic granules in the cytoplasm.

Endocrine cells in the structure of dark islets are located approximately evenly. They are divided by separate blood capillaries.

In the structure of small light islets endocrine cells make up of cells which are rounded or oval in shape and are divided by blood capillaries and broad layers of

amorphous substance of friable connective tissue.

On comparison to 1-day goslings the number of dark endocrine islets in parenchyma of pancreas of goslings fluctuated and gradually decreased: at the age of 3-days to 6.0 ± 0.55 , at the age of 7-days to 5.3 ± 0.23 , at the age of 14 days to 5.0 ± 0.55 and to the least indicator at the age of 21-days to 3.7 ± 0.47 on mm^2 of the section area.

The average area of dark islets increased from 5485.8 ± 527.5 to $11027.5 \pm 1208.8 \text{ }\mu\text{m}^2$ at the age of 3-days, to $30486.1 \pm 5727.0 \text{ }\mu\text{m}^2$ at the age of 7 days, then to $42729.2 \pm 15126.7 \text{ }\mu\text{m}^2$ at the age of 14-days, but changed at the age of 21-days to $34975.0 \pm 1972.2 \text{ }\mu\text{m}^2$.

Relative area of dark islets at the age of 21-days was the least – 0.19 ± 0.04 % (Table 1).

The number of endocrine islets in parenchyma of pancreas of goslings increased on comparison to 1-day goslings. It made up 13.8 ± 2.51 at the age of 3-days, 16.3 ± 2.3 at the age of 7-days, 17.7 ± 1.91

Table 1. Indicators of dark endocrine islets (EI) of pancreas of geese at the age of 1 day up to 5 years (mean \pm SEM, n=5)

Age of geese	Number of EI per 1 mm^2 of area	Average area of one EI, μm^2	Relative area of EI, %
1 day	$3.6 \pm 0.73^*$	$5485.8 \pm 527.5^*$	$0.20 \pm 0.09^*$
3 days	$6.0 \pm 0.55^*$	$11027.5 \pm 1208.8^{**}$	0.22 ± 0.05
7 days	5.3 ± 0.23	$30486.1 \pm 5727.0^{**}$	0.38 ± 0.18
14 days	5.0 ± 0.55	$42729.2 \pm 15126.7^*$	0.47 ± 0.12
21 days	3.7 ± 0.47	34975.0 ± 1972.2	0.19 ± 0.04
1 month	$6.3 \pm 0.87^*$	39701.3 ± 2486.2	0.28 ± 0.05
2 months	6.0 ± 0.55	45238.1 ± 4555.5	$0.44 \pm 0.06^*$
6 months	6.3 ± 0.82	51916.7 ± 3426.1	0.47 ± 0.02
8 months	$9.1 \pm 0.32^*$	45569.3 ± 3392.0	0.56 ± 0.07
1 year	8.6 ± 1.61	$59843.4 \pm 4254.2^*$	$0.82 \pm 0.08^*$
2 years	6.7 ± 1.44	55540.5 ± 9711.3	0.79 ± 0.03
3 years	4.1 ± 0.48	55902.7 ± 3569.8	0.66 ± 0.15
5 years	4.2 ± 0.38	60312.5 ± 48247.8	0.71 ± 0.19

*** $P \leq 0.001$; ** $P \leq 0.01$; * $P \leq 0.05$ compared to previous age.

Table 2. Indicators of light endocrine islets (EI) of pancreas of geese at the age of 1 day up to 5 years (mean±SEM, n=5)

Age of geese	Number of EI per 1 mm ² of area	Average area of one EI, μm ²	Relative area of EI, %
1 day	11.7±0.94	2593.8±247.5	0.16±0.04
3 days	13.8±2.51	2208.3±383.5	0.07±0.01
7 days	16.3±2.33	3545.5±357.3*	0.12±0.03
14 days	17.7±1.91	4135.6±369.3	0.18±0.05
21 days	12.7±0.93*	4734.1±259.0	0.06±0.01
1 month	27.3±2.63***	4196.6±295.4	0.14±0.01
2 months	32.3±5.70	3564.1±222.6	0.17±0.03
6 months	48.7±3.04*	3096.3±290.3	0.25±0.04
8 months	66.3±4.04**	2078.6±313.6*	0.33±0.06
1 year	61.3±8.21	2994.3±208.4*	0.38±0.07
2 years	56.7±5.08	2858.0±397.1	0.30±0.06
3 years	39.3±1.47*	2771.7±233.6	0.33±0.02
5 years	35.2±2.03	2785.15±446.8	0.20±0.02

*** P≤0.001; ** P≤0.01; * P≤0.05 compared to previous age.

unit on mm² at the age of 14-days goslings, but decreased to the indicator 12.7±0.93 unit on mm² of the section area of 21-days poultry.

The relative area of light islets at the age of 21-days was also the least – 0.06±0.01 %.

The average area of light endocrine islets in the parenchyma of pancreas fluctuated and increased to 2208.3±383.5 μm² at the age of 3-days, to 3545.5±357.3 at the age of 7 days, to 4135.6±369.3 μm² in 14-day-old goslings and in 21-day-old goslings reached its maximum 4734.1±259.0 μm² (Table 2).

Henceforth in parenchyma of pancreas of goslings the number of dark endocrine islets increased and reached its maximum at 8-month- and in 1-year-old goslings and made up 9.1±0.32 and 8.6±1.61 unit on mm² of section area respectively. In 2- and 5-year-old goslings the number of islets decreased and fluctuated between 4.1±0.48 – 6.7±1.44 per mm² of section area.

The average area of dark endocrine islets increased gradually. It made up 39701.3±2486.2 in 1-month-old goslings, 45238.1±4555.5 at 2 months of age, 51916.7±3426.1 at 6 months of age, 45569.3±3392.0 at 8 months of age and 59843.4±4254.2 μm² in 1-year-old goslings. At 2- and 5 years of age the average area of one dark islet fluctuated between 55540.5±9711.3 – 60312.5±48247.8 μm².

The relative area of dark islets in 1-year-old goslings was the largest and made up 0.82±0.08 % (Table 1).

After 21 days the number of light endocrine islets in parenchyma of pancreas of goslings began to increase swiftly and reached its maximum at 8 months and 1 year and made up 66.3±4.04 and 61.3±8.21 on mm² of section area respectively. At the age of 2 and 5 years. the number of islets decreased and fluctuated between 35.2±2.03 – 56.7±5.08 per mm² of section area.

The relative area of light islets in 1-year-old goslings was also the largest and made up 0.38±0.07%. However the ave-

rage area of light endocrine islets in parenchyma of pancreas after 21 days only decreased. At 6 months of age it made up 3096.3 ± 290.3 , at 1 year of age – 2994.3 ± 208.4 , at 3 years – $2771.7 \pm 233.6 \mu\text{m}^2$ (Table 2).

Endocrine cells are located approximately evenly in dark isles. They become orange after colouring (Mallori). Blood capillaries are located between cells. Insulocytes make up of cells in light islets which are separated by wide intercellular space with big number of capillaries. The cytoplasm of cells of light islets is garnet after coloring (Mallori).

CONCLUSIONS

The average number of dark and light islets from the age of one day increased from 3.6 ± 0.73 and 11.7 ± 0.94 unit on 1 mm^2 of the section. The biggest number of dark and light islets was defined between 8 months and 1 year of age. Their content per unit area of the organ was 9.1 ± 0.32 – 8.6 ± 1.61 and 66.3 ± 4.04 – 61.3 ± 8.21 respectively.

The average area of dark and light endocrine islets from 0.20 ± 0.09 and $0.16 \pm 0.04\%$ in one-day-old goslings increased gradually and reached its maximum at the age of one year – 0.82 ± 0.08 and $0.38 \pm 0.07\%$ respectively.

When goslings are 21-day-old, the average number of dark and light endocrine islets of pancreas was the least: 3.7 ± 0.47 and 12.7 ± 0.93 unit per mm^2 of section area respectively. The relative area of dark and light islets at this age was also the least (0.19 ± 0.04 and $0.06 \pm 0.01\%$, respectively).

The average area of dark islets increased with age gradually from $5485.8 \pm 527.5 \mu\text{m}^2$ in day-old to 55540.5 ± 9711.3 – $60312.5 \pm 48247.8 \mu\text{m}^2$ at 1–5 years of age, the average area of

light – from 1 day to 5 years of age fluctuated between 2593.8 ± 247.5 – $4734.1 \pm 259.0 \mu\text{m}^2$.

Prospects of further research are studies on lymphoid structures of pancreas, the system of excretory ducts depending on the age of poultry, their changes under the influence of biotic and abiotic factors.

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