ORIGINAL ARTICLE

COMPERATIVE STRUCTURE OF MUCOSA COAT OF THE PIG`S AND THE HUMAN`S RECTUM

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ABSTRACT

The aim: To determine whether the pig could be used as biomodel for study and reconstruction of rectal pathology for development the new approaches for prevention and treatment of rectal diseases.

Materials and methods: For the research the rectum of 8 vietnamese pot-bellied pigs were used. Via macro- and microscopy the structure of mucosa coat of the pig`s and human`s rectum was compared.

Results: Mucosa coat`s peculiarities of pig`s and human`s rectum in comparative aspect are described in this article. With the help of traditional methods, known as macroscopy the structure of the pig`s rectal mucosa was study and compared wih macrostructure of human`s rectum. The microstucture of pig`s rectal mucosa was study due to histological method too. The macro- and microscopy demonstrated that structure of pig`s and human`s rectal mucosa are similar and includes same structural components.

Conclusions: Thus, the research proved that pigs can be used as biomodels in biomedical research for creating various new methods and applications in approaching the prevention and treatment of rectal pathology in humans.

KEY WORDS: rectal mucosa, proctology, biological model

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INTRODUCTION

Number of non-cancer rectal pathology cases are still high in spite of achievement of biomedical researches and progress in modern technic of treatment. More over, surgical treatment is complicated with relapsing of the rectum are observed in 35 – 40,2% of patients, purulent-inflammatory complications 13 – 20% of patients [1 – 4]. It demands implementation of new biomodels representing human rectal diseases. Nowadays, a pig as biomodel is used increasingly for various biomedical fields: medical industry researches (medical technologies: instruments, apparatus etc.), for medical education (anatomy and physiology practical classes, surgery practical skills), for biomedical researches (creation the mechanism of human diseases at a molecular level, such as muscular dystrophy Duchenna, cystic fibrosis), endocrinology (disorder of metabolism, diabetes, etc.), in the field of xenotransplantation, creating methods to grow organs capable of human transplantation [5 – 8]. The swines as biomodel were used for pre-clinical experiment for occluder into heart [9].

These are justified by the anatomical and physiological similarity of cardiovascular system, the immune system, the respiratory system, skeletal muscles, metabolism, pig`s phonotype reflects the phenotype of a human, etc. Nowedays research of the scientists from China demonsrated ability to use the swine`s gut mictobiota for restoration the gut microbiota in humans [10].

THE AIM

To determine whether the pig could be used as biomodel for study and reconstruction of rectal pathology for development the new approaches of prevention and treatment of rectal deseases.

MATERIALS AND METHODS

For research the vietnamese pot-bellied pigs were used. The experiment used 8 castable males of 5 month age and an average weight of 11-11.3 kg. Conditions of maintenance of experimental animals conform to current norms of Ministries of agrarian policy of Ukraine. The feeding of animal was corresponded to needs in high-quality and biologically active substances. The eperiment was carried out in a specially equipped veterinary laboratory, provided by all necessary equaipment for interventions and individual observation of animals. The high-qualified employers of Scientific center "Vetmedservis" were involved in the work with animals.

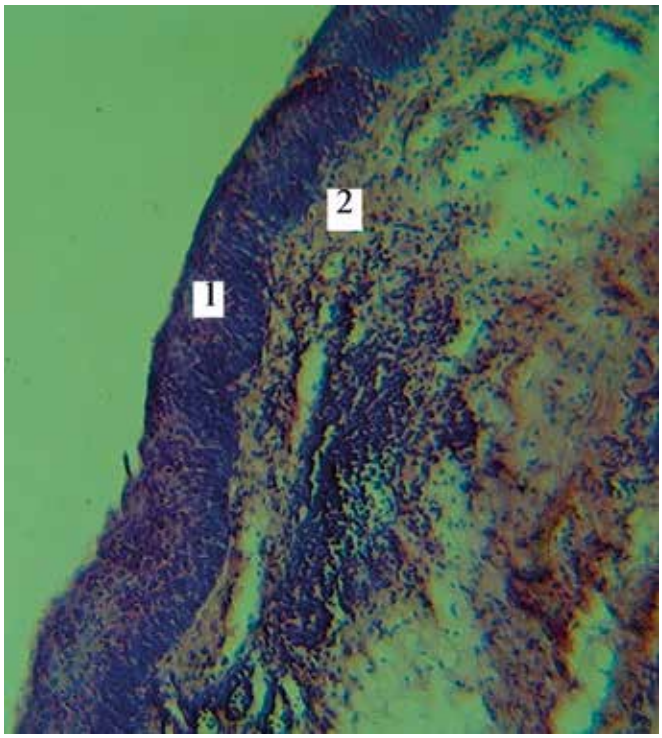

Fig.1. Microscopic structure of the anal canal`s wall. Stained with hematoxylin and eosin, X 60.
1- mucosa; 2 – submucosa.

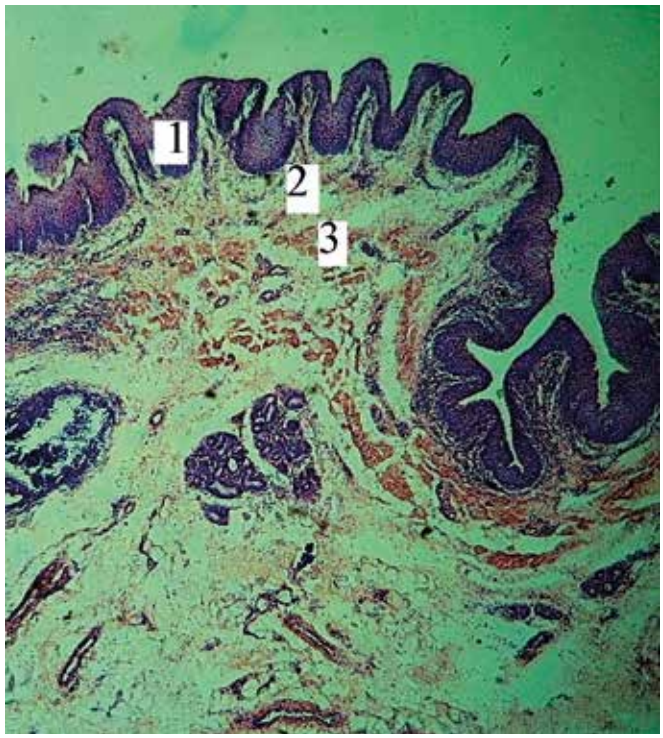

Fig.2. Microscopic sructure of anorectal area`s wall. Stained with hematoxylin and eosin, X 40.
1- mucosa; 2 – submucosa; 3- muscular layer.

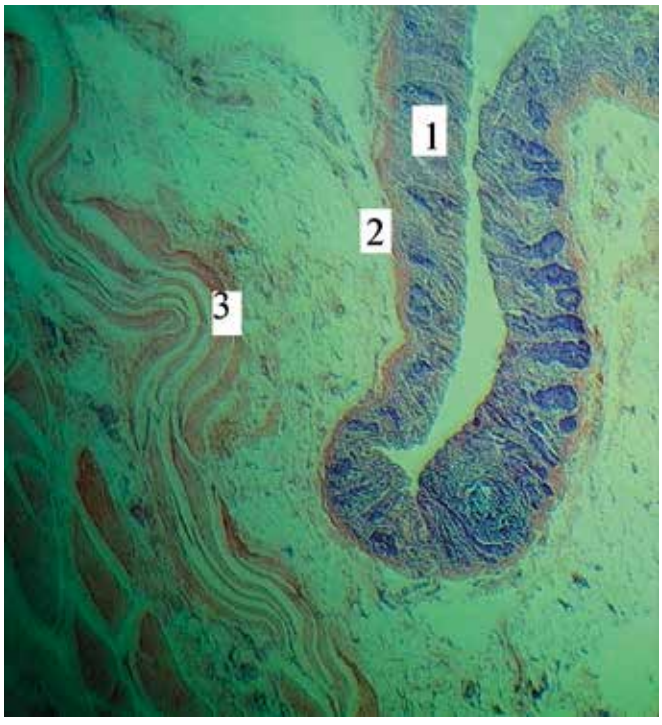

Fig.3. Microscopic structure of rectal apulla`s wall. Stained with hematoxylin and eosin, X 40.
1- mucosa; 2 – submucosa; 3- muscular layer.

For all animals after the confirmation of animal health by veterinarian the blood test and anoscopy were done. The study was conducted in compliance with the current legislation of Ukraine, the Council of Europe Convention on the Protection of vertebrate animals used in experiments and other scientific purposes (18.03.1986), the EU Directive №609 (24.11.1986).

For morphoscory the pig`s rectum was cut in horizontal section along the left side. It is important to note that horizontal plain applied onto animal`s body is corresponded to frontal plane applied onto human body. This is because of tetrapod position of animals. Due to macro- and microscopy the structure of mucosa coat of the pig`s rectum was compared with known data about human`s rectum. The morphoscopy and morphometry allowed to clearly present the relief of mucosa coat, shape and size of its structural elements, interlocation, relative dimensions, etc. In addition, this made it possible to accurately conduct morphometry – to determine the size and length of pig`s rectum.

RESULTS AND DISCUSSION

Due to morphoscopy the strucrure of pig`s rectum was examined. As known, wall of rectum is represent with three layers: internal layer (mucosa) and submucosa, middle layer (muscular) and external layer (adventitia or peritoneum) [11, 12]. The pig`s rectum consists of pelvic part and anal canal. There are 2-3 semicircular folds on mucosa coat of pelvic part. These folds absolutely correspond to Nelaton`s semicircular fold of human`s rectum. Mucosa coat in region of anal canal of pig`s rectum forms 7-9 longitudinal folds, the anal columns (columna anales; Morgagni) that anteriorly connected with semilunar folds known as anal valves (valvulae analis; Morgagni). These valves form ring known as pectineal line. The depressions, anal sinus-

es (sinuses anales; Morgagni) are located between anal columnes. The dot-like openings (8-9 in number) of anal glans are visible on the bottom of anal sinuses. Tranzitory zone (0.8-1cm) terminates with the anocutaneous line, that gradually continuous with perianal pigmented skin. This results demonstrate the similarity of the mucosa of pig`s and human`s rectum [13, 14].

It was determined that the distance between the anocutaneous line and pectineal line is about 2 cm. It means that length of the anatomical anal canal of pig`s and human`s rectum are almost identical. The distance between anocutaneous line and cranial border of anal columns (corresponds to the upper edge of the muscle ring formed by internal and external anal sphincters) is about 4 cm. It means that length of the surgical anal canal of pig`s and human`s rectum are almost identical too. The results coincide with the data of literature [15]. Thus, the length of the pigs`s rectum is 20-22 cm, it is about equal to human`s rectum length.

Histological method detected that microscopic structure of mucosa of pig`s rectum and human`s rectum are similar too. The rectal mucosa of both types is covered with the typical intestinal epithelium (simple columnar) which consists of columnar enterocytes and goblet cells (Fig.1). As known, this type of epithelium covers gastrointestinal tract and increase the absorbing surface. The single layer columnar cells lay on basal membrane, their oval-shaped nuclei are concentrated at the basal region of the cell.

Intestinal epithelium changes gradually, and at the anal transitional zone the columnar epithelium flattens more and more and eventually becomes stratified squamous non-keratinized epithelium, and anocutaneous line is covered with skin-type epithelium, stratified squamous keratinized epithelium (Fig.2, 3).

The epithelial layer is located on connective tissue (lamina propria) with blood and lymph vessels and a muscle layer (lamina muscularis mucosae). The submucosa contains blood vessels, lymph follicles and the rectal venous plexus, Meissner's plexus. The submucosa of columnal zone contains 6-8 branched tubular glands (gll. anales), that direct to circular layer of muscular coat, then perforate it and terminate in the intermuscular connective tissue. The muscular layer consists of internal circular smooth muscles and external longitudinal smooth muscles.

Structural differences of epithelial cover can be explained with difference of embryogenesis. It is known, that pelvic part of rectum up to upper third of anal canal placed valvulae anales develpoes from ectoderm of hindgut. But wall of lower part of canal is developed from ectodermal proctodeum and surrounding mesenchyme. Definitive border between two this parts is anorectal line, that located 2 cm above anus and corresponds to anorectal junction [16,17]. According to modern scientific researches the anal canal and proper rectum (ampula) are separated morphological parts of terminal portion of alimentary tract united with common function such as collection and excretion of feces mass. Based on the fact that ampula of rectum and anal canal are derivatives of different germ layers, the clinicists do use term "anorectum" and describe non-tumor diseases such as proctalgia, coccyalgy, anococcygeal pain syndrome characterized with pain (single symptom) in region of anus and coccyx without any organic changes [2-4].

CONCLUSIONS

Due to the morphoscopy and histological method of the pig`s and human`s rectum, the structural similarity is established. On the basis of this result we conclude that pigs can be used as biomodel for reconstruction the rectal pathology for biomedical researches and development of the new methodics of prevention diseases and treatment in proctology.

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Conflict of interest:
The Authors declare no conflict of interest.

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