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MORPHOFUNCTIONAL CHARACTERISTICS OF THE REPRODUCTIVE SYSTEM OF COWS WITH HEMORRHAGIC ENDOMETRITIS

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The article presents the results of studies of the morphofunctional characteristics of the reproductive system of cows with hemorrhagic endometritis. In the ovaries of cows, the number of primary follicles is reduced, but the number of atretic follicles is increased. The area of protoplasm and nuclei in the left ovary increases by 23.8% and 13.01% compared to the norm, in the right – by 63.4% and 41.4%, respectively. The functional activity of follicular epithelial cells in the left ovary decreases by 4.2%, in the right – by 14.6%. In case of hemorrhagic endometritis, the mass of the right ovary is 30.76% less, and the mass of the left ovary is within the normal range. The length of both oviducts is within the physiological norm. The width of the left and right oviducts is 39.93% and 13.89% less than normal. In general, the wall thickness of the left oviduct decreases by 13.3% compared to that in clinically healthy cows, while the right one, on the contrary, thickens by 33.6%. At the same time, there is a thickening of the mucous layer of the left oviduct by 37.6% compared to the norm.

The submucosal and muscular layers are thinner by 43.6% and 38.4%, respectively. In the right oviduct, a thickening of the submucosal layer by 55.5% was noted, and the thickness of the muscular layer was within the normal range. The area of protoplasm and nuclei of the surface epithelium in the left oviduct decreases compared to those in clinically healthy cows by 11.7% and 10.2%, in the right – by 31.3% and 45.2%, respectively. The functional activity of cells in the left oviduct increased by 7.7%, in the right – by 35.4%.

Key words: hemorrhagic endometritis, pathology, ovaries, oviducts, follicle.

ГЕМОМРАГИЯЛЫҚ ЭНДОМЕТРИТТЕРІ БАР СИЫРЛАРДЫҢ РЕПРОДУКТИВТІ ЖҮЙЕСІНІҢ МОРФОФУНКЦИОНАЛДЫ СИПАТТАМАСЫ

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Мақалада геморрагиялық эндометриттері бар сиырлардың репродуктивті жүйесінің морфофункционалды сипаттамасын зерттеу нәтижелері келтірілген. Сиырлардың аналық бездерінде бастапқы фолликулалардың саны азаяды, бірақ атретикалық фолликулалардың саны артады. Сол жақ аналық бездегі протоплазма мен ядролардың ауданы нормамен салыстырғанда 23,8% және 13,01%-ға, оң жақта тиісінше 63,4% және 41,4%-ға ұлғайды. Сол жақ аналық бездегі фолликулярлық эпителий жасушаларының функционалдық белсенділігі 4,2%-ға, оң жақта – 14,6%-ға төмендейді. Геморрагиялық эндометритте оң жақ аналық бездің массасы 30,76%-ға аз, ал сол жақ жұмыртқа өткізгіштің массасы қалыпты шектерде. Екі жұмыртқаның ұзындығы физиологиялық норма шегінде. Сол және оң жұмыртқа жолдарының ені қалыптыдан 39,93% және 13,89% аз. Жалпы, сол жақ жұмыртқа өткізгіштің қабырғасының қалыңдығы клиникалық сау сиырлардағы тиісті көрсеткішпен салыстырғанда 13,3%-ға, ал оң жақ, керісінше, 33,6%-ға қалыңдайды. Бұл жағдайда сол жақ жұмыртқа өткізгіштің шырышты қабатының қалыңдауы нормамен салыстырғанда 37,6%-ға байқалады. Шырышты және бұлшық ет қабаттары сәйкесінше 43,6% және 38,4% жұқа. Оң жақ жұмыртқада шырышты қабаттың қалыңдауы 55,5%, ал бұлшықет қалыңдығы қалыпты шектерде байқалады. Сол жақ жұмыртқа жолындағы протоплазма мен эпителий ядроларының ауданы клиникалық сау сиырлардағы көрсеткіштермен салыстырғанда сәйкесінше 11,7% және 10,2%, оң жақта 31,3% және 45,2% азайды. Сол жақ жұмыртқа жолындағы жасушалардың функционалдық белсенділігі 7,7%-ға, оң жақта – 35,4%-ға артты.

Түйінді сөздер: гемморрагиялық эндометрит, патология, аналық без, жұмыртқа, фолликул.

МОРФОФУНКЦИОНАЛЬНАЯ ХАРАКТЕРИСТИКА РЕПРОДУКТИВНОЙ СИСТЕМЫ КОРОВ ПРИ ГЕМОМРАГИЧЕСКОМ ЭНДОМЕТРИТЕ

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В статье приведены результаты исследований морфофункциональной характеристики репродуктивной системы коров при геморрагическом эндометрите. В яичниках у коров снижено количество первичных фолликулов, но увеличено количества атретических фолликул. Площадь протоплазмы и ядер в левом яичнике увеличено по сравнению с нормой на 23,8% и 13,01%, в правом – на 63,4% и 41,4%, соответственно. Функциональная активность клеток фолликулярного эпителия в левом яичнике снижается на 4,2%, в правом – на 14,6%. При геморрагическом эндометрите масса правого яичника меньше на 30,76%, а масса левого яйцепровода в пределах нормы. Длина обоих яйцепроводов находится в пределах физиологической нормы. Ширина левого и правого яйцепроводов меньше нормы на 39,93% и 13,89%. В целом, толщина стенки левого яйцепровода уменьшается, по сравнению с соответствующим показателем у клинически здоровых коров на 13,3%, а правого, наоборот, утолщается на 33,6%. При этом отмечается утолщение слизистого слоя левого яйцепровода по сравнению с нормой на 37,6%. Подслизистый и мышечный слои тоньше на 43,6% и 38,4%, соответственно. В правом яйцепроводе отмечено утолщение подслизистого слоя на 55,5%, а толщина мышечного в пределах нормы. Площадь протоплазмы и ядер покровного эпителия в левом яйцепроводе уменьшено по сравнению с таковыми показателями у клинически здоровых коров на 11,7% и 10,2%, в правом на 31,3% и 45,2%, соответственно. Функциональная активность клеток в левом яйцепроводе повышена на 7,7%, в правом – на 35,4%.

Ключевые слова: геморрагический эндометрит, патология, яичники, яйцепроводы, фолликул.

Introduction. The current level of development of cattle breeding in farms requires reliable prevention of violations of the reproductive function of cattle, the development of methods for diagnosing and predicting forms of infertility, treatment of cows with obstetric and gynecological diseases, stimulation of reproductive function, on the basis of which it will be possible to ensure an increase in the efficiency of the dairy cattle industry [1, c.116].

The intensification of cattle breeding is possible provided that the number of livestock increases further, its productivity increases and accelerated reproduction. However, the successful implementation of these factors is hampered by obstetric and gynecological diseases such as acute and chronic endometritis, cervicitis, salpingitis, oophoritis, various functional disorders of the uterus and ovaries, which cause infertility, decreased productivity and premature culling of animals [2, p.179].

Endometritis most often begins between about 20 and 60 days after childbirth. Clinical endometritis is more often observed in 20-30% of dairy cows. At the same time, subclinical endometritis occurs in cows from 25 to 33%. [3, c.1325]. The insemination rate in cows with endometritis is 20% lower than in clinically healthy cows. To do this, up to 10% of additional insemination procedures are performed for conception. Accordingly, this leads to an increase in the intervals between calving due to the greater number of open days. Thus, the culling process grows by 1.7 times [4, p.714]. According to research data by D.V. Volkova (2009), of the diseases of the genital organs of cows, the largest percentage (from 5.0-20.0%) falls on afterbirth retention, uterine subinvolution and acute postpartum endometritis, the extent of which ranges to 40.0-57.0% [5, p.1820].

The issues of congenital pathology of the reproductive system organs have not been sufficiently studied [6, p.15]. At the same time, there is information in the literature about the spread of anomalies and deformities regarding the reproductive organs of females. In this regard, the morphology and pathology of the ovaries and uterus of heifers and cows require further study using modern research methods [7, p.37].

Histostructural studies indicate profound changes in the endometrium during its inflammation. Meanwhile, to date, the morphofunctional characteristics of the endometrium have not been studied in detail enough in the normal and pathological course of involution processes in cows, as well as in evaluating the effectiveness of appropriate therapeutic measures for pathology of the genital organs in cows [8, p.90]. In this regard, issues related to the study of morphological changes in the normal and pathological course of involution processes and the development of methods for the diagnosis and therapy of the above processes are relevant, which allow us to uncover the causes of mass infertility in cows, as well as its prevention.

The purpose of the study – the study of the morphofunctional characteristics of the reproductive system of cows with hemorrhagic endometritis.

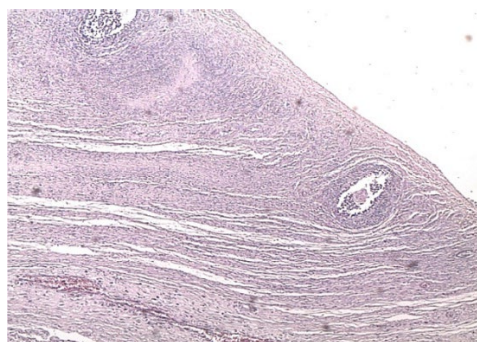
To achieve this goal, the following tasks were set:

-to study the histological parameters of the reproductive system of cows with hemorrhagic endometritis;

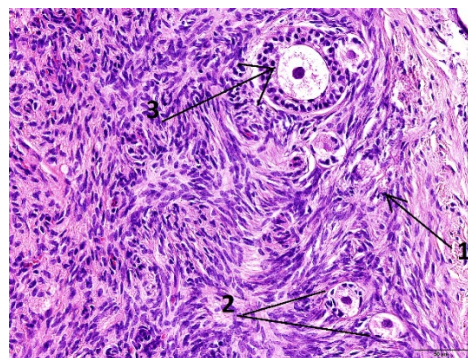
-to study cytometric parameters of the reproductive system of cows with hemorrhagic endometritis.

Materials and methods. The work was performed at the Department of Veterinary Medicine of the A.Baitursynuly Kostanay Regional University, the Laboratory of Histology of the Institute of Emergency Medicine in Chelyabinsk, Russia. The object of the study were Kazakh white-headed cows aged 4 to 9 years. To study the linear and weight parameters of the ovaries and uterus, animals were slaughtered and then dissected. The linear parameters of the ovaries (length, width) and oviducts were measured using a measuring thread, ruler and caliper, and the absolute mass was calculated. Fixation of the material for histological studies in 10% neutral formalin, pouring into paraffin. Histological preparations are made according to the generally accepted method. To identify the general histological characteristics of the organs, the preparations were stained with hematoxylin and eosin. In ovarian histopreparations, the number of follicles at different stages of development was calculated, the general histological structure was studied, as well as the structure of the tissues of the oviducts. Micrometry was performed in histological preparations of the reproductive system of cows. The thickness of the mucous membrane, muscle and serous membranes, the diameter of the terminal sections of the glands (external, internal) and the height of exocrinocytes were measured. To identify the functional activity of epithelial cells, the area of protoplasm and nuclei, nuclear-protoplasmic relations of the follicular epithelium of the ovaries were determined. A Leica DMRXA microscope (manufactured in Germany) was used, which is paired with a computer using a DFC 290 digital camera (manufactured in Germany). The Image Scope program (Russia, Moscow) was used to analyze the image. Then the TIFF graphic files were analyzed in the RGB color space.

Results. In the ovaries of cows with hemorrhagic endometritis, the number of primary follicles is reduced. Atretic follicles were found (Figure 1).



Restructuring of the ovarian cortex
Figure 1 – Left ovary of cows with hemorrhagic endometritis (hematoxylin-eosin, X50)



1 – primary follicle, 2 – maturing follicles, 3 – mature follicle
Figure 2 – Ovary of clinically healthy cows (hematoxylin-eosin, X20)

The protoplasm area of follicular cells of the left ovary is $71.73 \pm 21.60 \text{ mm}^2$ ($P \geq 0.001$), the right one is $70.43 \pm 19.94 \text{ mm}^2$ ($P \geq 0.001$). Linear analysis in the left and right ovaries demonstrates a single generation of cells with a left-sided modality shift. In this case, small-sized cells predominate (Figure 3,a).

The area of the epithelial cell nuclei of the left ovary of cows is $28.50 \pm 7.46 \text{ mm}^2$ ($P \geq 0.01$), the right one is $30.42 \pm 10.04 \text{ mm}^2$ ($P \geq 0.001$). A linear analysis of the area of the nuclei in both ovaries revealed the presence of cell generations with a left-sided modality shift, which indicates the presence of small nuclei. The nuclear-protoplasmic ratio (NPR) index of the left ovary is 0.406 ± 0.068 ($P \leq 0.05$). Linear analysis indicates that part of the follicular epithelium has low follicular activity, as evidenced by the left-sided location of the modality. The functional activity of the follicular epithelium of the right ovary is 0.428 ± 0.033 ($P \leq 0.05$). Linear analysis revealed that the cells have an average functional activity (Figure 3,b,c).

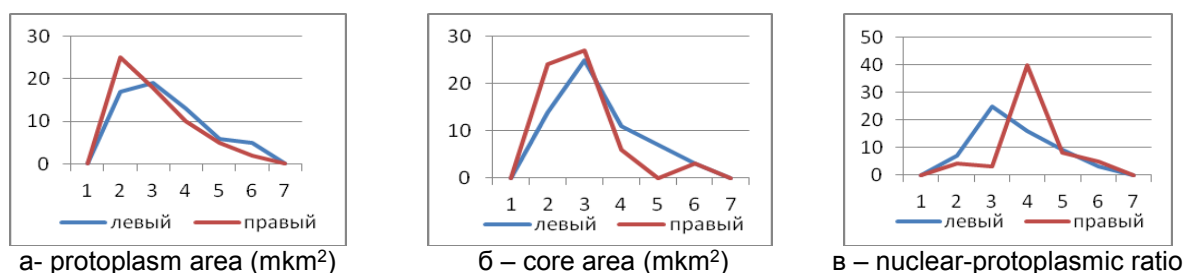


Figure 3 – Cytometric characteristics of the follicular epithelium of the ovaries of cows with hemorrhagic endometritis

The processes of follicular epithelium atrophy are more pronounced in the right ovary, which is confirmed by the results of cytometric studies. Despite this, the area of protoplasm and nuclei in both ovaries has no significant differences. At the same time, functional activity does not have any special differences. However, in the right ovary, the functional activity of the follicular epithelium is higher than in the left.

Morphofunctional characteristics of the oviducal ducts of the uterus of cows with hemorrhagic endometritis.

During morphometric studies of cow oviducts in hemorrhagic endometritis, it was found that the absolute mass of the left oviduct is $2.43 \pm 0.87 \text{ g}$, the right one is $1.81 \pm 0.75 \text{ g}$. The length of the left and right oviducts is $289.66 \pm 14.29 \text{ mm}$ and $260.07 \pm 39.71 \text{ mm}$, width is $2.2 \pm 0.98 \text{ mm}$ and $2.53 \pm 0.32 \text{ mm}$, respectively.

Two types of cells can be distinguished in the oviducts of cows: high prismatic ciliated and non-ciliated. The boundaries between the cells are poorly defined. Clearly defined cells filled with enlightened cytoplasm are visible near the basement membrane. The apical end of the epithelial cells is covered with protoplasmic outgrowths in the form of a uniform border.

As shown in Table 1, the thickness of the mucous layer in the left ovipositor is $266.80 \pm 233.10 \text{ mkm}$. ($P \geq 0.01$) (from 57.30 mkm to 696 mkm), in the right – $523.97 \pm 487.6 \text{ mkm}$. ($P \geq 0.001$) (from 165 to 1670 mkm). In linear analysis, the predominance of areas of thinning of the mucous layer was noted in the left and right ovipositor. The submucosal layer of the left ovipositor is $48.60 \pm 16.80 \text{ mkm}$ thick ($P \geq 0.001$) (from 22 microns to 77.50 mkm), the right one is $150.30 \pm 46.90 \text{ mkm}$ ($P \geq 0.001$) (from 89.20 mkm to 265 mkm). Linear analysis demonstrates two generations in the left ovipositor with an extreme left and extreme right modality shift, in the right – generation with a left-sided modality shift.

Table 1 – Morpho- and cytometric characteristics of cow oviducts in hemorrhagic endometritis

Cow oviducts		
Wall thickness and its components		
Indicators	Left	Right
The mucous membrane (mkm)	266,8±233,1**	523,97±487,6*
The submucosa (mkm)	48,6±16,8*	150,3±46,9*
The muscular membrane (mkm)	177,3±49,8*	387,9±167,5***
The integumentary epithelium		
Protoplasm area (mkm ²)	65,11±21,0***	61,15±16,32**
Core area (mkm ²)	23,98±8,19**	26,04±10,06*
Nuclear-protoplasmic ratio	0,374±0,08***	0,413±0,08***
P≥0,001*; P≥0,01**; P≤0,05***		

The thickness of the muscular layer of the left horn throughout the ovipositor is 177.3±49.8 mkm. (P≥0.001) (from 113 to 304 mkm). The graphic illustration shows the predominance of thinning areas. The thickness of the muscular layer of the right ovipositor of cows is 387.9±167.5 mkm. (P≤0.05) (from 121 to 682 mkm). Linear analysis revealed an equivalent amount of thinning and thickening of the muscular membrane of the right ovipositor.

Morphofunctional characteristics of the integumentary epithelium of the mucous membrane of the ovipositor in hemorrhagic endometritis. The protoplasm area of epithelial cells of the integumentary epithelium of the left ovipositor of cows with hemorrhagic endometritis is 57.9±23.3 mkm² (P≥0.01) (from 27.5 to 98.1 mkm²), the right one is 38.50±13.40 mkm² (P≥0.001) (from 21.80 mkm² to 78.80 mkm²) (Table 1). Linear analysis revealed two generations with a left-sided and right-sided modality in the left oviduct, and one large generation of cells with a left-sided modality in the right (Figure 4, a).

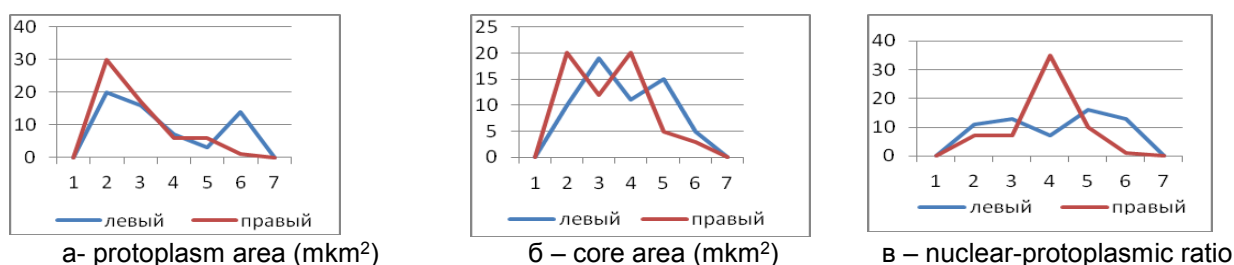


Figure 4 – Cytometric characteristics of the integumentary epithelium of the oviparous ducts in hemorrhagic endometritis

The area of the nucleus of epithelial cells of the left ovipositor is 23.9±5.8 mkm² (P≥0.01) (from 13.5 to 36.2 mkm²). Linear analysis has established two generations with left and right modality shifts. The index of the area of the nuclei of the epithelial cells of the right ovipositor is 17.41±4.66 mkm² (P≥0.001) (from 10.1 to 29.4 mkm²). Linear analysis revealed two generations of small and medium-sized nuclei (Figure 4, b).

In the integumentary epithelium of the mucous membrane of the left horn of the uterus of cows with hemorrhagic endometritis, the NPR index is 0.447 = 0.103 (P= 0.05) (from 0.261 to 0.608). At the same time, two generations of epithelial cells with different functional activity were identified. In the right oviduct, the functional activity of epithelial cells is 0.472=0.010 (P=0.05) (from 0.190 to 0.756). In the linear analysis, one pronounced cell generation was noted, which occupies a central location. Epithelial cells have an average functional activity (Figure 4,c).

Discussion. In scientific publications, we found a description of the macroscopic pattern in the uterine wall of cows with hemorrhagic endometritis [10]. However, scientists, describing changes in the uterine cavity, do not provide information at all about how changes in the uterus affect the structure of the ovary, and, moreover, on the functional activity of the follicular epithelium of the ovaries.

Conclusion. Our studies have shown that in case of hemorrhagic endometritis in cows, the number of primary follicles in the ovaries is reduced. At the same time, an increase in the number of atretic follicles was found.

The absolute weight of both ovaries in hemorrhagic endometritis is less than normal by 30.34% and 37.47%. The length of the left and right ovaries is within the physiological norm. The width of the left and right ovaries is 24.83% and 15.52% higher, respectively.

The area of protoplasm and nuclei in the left ovary increases by 23.8% and 13.01% compared to the norm, in the right – by 63.4% and 41.4%, respectively. The functional activity of follicular epithelial cells in the left ovary decreases by 4.2%, in the right – by 14.6%.

The following changes were found in the oviducts in hemorrhagic endometritis: the mass of the left oviduct is within the normal range, and the right one is 30.76% less. The length of both oviducts is within the physiological norm. The width of the left and right oviducts is 39.93% and 13.89% less than normal.

In general, the wall thickness of the left ovipositor decreases by 13.3% compared to the corresponding indicator in clinically healthy cows, while the right one, on the contrary, thickens by 33.6%. At the same time, there is a thickening of the mucous layer of the left ovipositor compared to the norm by 37.6%. And the submucosal and muscular layers are thinner by 43.6% and 38.4%, respectively. In the right ovipositor, a thickening of the submucosal layer by 55.5% was noted, and the thickness of the muscular layer was within the normal range.

The area of protoplasm and nuclei of the integumentary epithelium in the left ovipositor decreases compared to those in clinically healthy cows by 11.7% and 10.2%, in the right by 31.3% and 45.2%, respectively. The functional activity of cells in the left oviduct was increased by 7.7%, in the right – by 35.4%.

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