

Analysis of Pathomorphological and Morphometric Changes in Indices of Uterine Myoma

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Abstract With the help of a dotted grid G.G. Avtandilov made morphometry of various histological forms of uterine fibroids. At the same time, it was noted that the highest indicators of smooth muscle cells in cellular myoma, myofibrils in the epithelioid form, mitoses in the atypical form.

Keywords Cellular myoma, Proliferative myoma, Epithelioid cell myoma, Atypical myoma, Morphometry, Smooth muscle cells, Vessels, Mitoses

1. Relevance

Uterine fibroids are benign tumors of the uterus, consisting of muscle (phenotypically altered smooth muscle cells of the myometrium) and connective tissue, a hormone-dependent disease and a type of hyperplastic processes of the uterus. In recent years, there has been a trend of “rejuvenation” of uterine fibroids, so the number of young women with the disease at the age of 20–25 years is increasing [1,2,3,5].

Research goal: proliferation leiomyocytes based on morphometric studies of various histological forms of uterine fibroids, study the relationship between parenchyma and stroma.

2. Materials and Methods

In this study, 50 hysterectomies performed during 2019–2022 were analyzed by general morphological and morphometric analysis, and 5 uterine fibroids amputated for other reasons.

When conducting morphometric studies, we modified the point study method by transferring it to a computer screen, that is, we took 10 pictures of histological preparations prepared for each group of the material under study from different areas and applied a linear grid of 200 cells on a computer monitor corresponding to these pictures, and we the points of intersection of the lines were counted depending on what tissue structure they correspond to. The fact that the grid nodes G.G. Avtandilova are distributed

unevenly over all areas of the surface of the painting of the fabric, which corresponds to the law of relativity. The area of all existing structural units in the picture is taken as V_v , i.e. for 100%, the area of each calculated structural unit is specified by putting the name of this structure, for example: V_{mh} (muscle cell), V_{mf} (myofibrils), V_{qt} (blood vessels), V_{st} (stromal structures and V_{mi} (mitosis). In this regard, in As a result of counting the points, the relative area of the studied structural units in the tissue was calculated. The area occupied by all structural units in the studied tissue is equal to V_v , i.e. if it is equal to 100%, then the points evenly distributed in it are denoted by z , and if the ratio of each point to the structural unit is taken as R , then its formula is expressed as follows: $P = V_v / 100$.

Correspondence of points to other structural subdivisions is determined by the following formula: $Q = 100 - V_v / 100$.

If we take the points corresponding to the structural units under study as x , then its error coefficient is calculated by the formula: $x / z - P$, the percentage of absolute error is calculated by the following formula: $e = (x / z - R) \cdot 100 \approx 100 x / z - V_v$.

The calculation error according to the theory of relativity – $x / z - R$, is calculated using a different formula: $t = \sqrt{Rq/z}$.

In this formula: x is the number of points corresponding to the studied structural units; z is the total number of all points in the test system; R is the unit of relativity of the points falling on the structures under study; q is the unit of relativity of points that fall into other structural units; t is the normalized difference between the indicators.

Based on the foregoing, the absolute error of quantitative indicators is calculated by the following formula: $e = t \sqrt{V_v} (100 - V_v) / z$.

Using the morphometric method, G.G. Avtandilova "counting points – a test system" counted uterine leiomyoma in the following histogenetic forms by dividing the composition of cells and tissue structures into the following groups: 1) cellular leiomyoma; 2) proliferative leiomyoma; 3) epithelioid cell leiomyoma; 4) atypical leiomyoma (BSST, 2003) [4]. These histogenetic forms of uterine myometrial leiomyoma were isolated and isolated by microscopic examination of preparations stained with hematoxylin and eosin. There were an average of 10 points from each group.

The area occupied by the following tissue and cellular structures corresponding to all histogenetic forms of leiomyoma was calculated in %: smooth muscle cells – Rmh; myofibrils – Rmf; blood vessels – Rqt; stroma structures – Rst; mitosis – Rmi.

Each structural unit was added 10 points, numbered in the figure, the average value was calculated and the area occupied by the structural unit (V) was calculated using the following formula, for example: in cellular leiomyoma, the area occupied by the cell muscle was calculated using the following formula – $V_{mh} = R_{mh} / R \times$. In this regard 1) cellular leiomyoma; 2) proliferative leiomyoma; 3) epithelioid cell leiomyoma; 4) in histogenic forms of atypical leiomyoma, the area occupied by all cellular and tissue structures was calculated: V_{mh} , V_{mf} , V_{qt} , V_{st} , V_{mi} . The obtained digital data were subjected to statistical processing.

3. Results and Discussions

The most common histogenetic form of leiomyoma, the area occupied by smooth muscle cells in the tissue of simple fibroids, had the highest rate and averaged 64.3%. It was confirmed that it makes up 3/2 of the entire area of leiomyoma tissue, and it was found that the main place in the tissue of this histogenetic form of leiomyoma is occupied by smooth muscle cells (Table 1). It was determined that the area occupied by myofibrils of smooth muscle cells is 3.4 times less than the area of cells. So, with this leiomyoma, smooth muscle cells proliferated and the reproduction process was confirmed. It has been established that blood vessels supplying smooth muscle cells consist of small capillaries and their area is much smaller; equals 8.6%. In the

simple form of this leiomyoma, there were no structural changes indicative of mitosis, which are characteristic of the mitotic process of cells.

With proliferative leiomyoma, the area occupied by smooth muscle cells was somewhat less compared to the previous form, that is, it averaged 51.7%. This rate is also relatively high, which means that even in this form, smooth muscle cells occupy half the tissue area, indicating a high level of cell proliferation and reproduction. With this form of leiomyoma, the area occupied by myofibrils increases by 4% compared with cellular leiomyoma. Since the blood vessels in this leiomyoma tissue were relatively large and numerous, they also occupied a high area, which was observed to occupy an average of 15.9% of the area (Table 1). It has been established that stromal structures take up relatively little space, and mitoses (2.8%) are present among smooth muscle cells in this form of leiomyoma.

With epithelioid cell leiomyoma, a significant change in the quantitative indicators of tissue structures was noted in comparison with the previous forms. It was found that the area occupied by smooth muscle cells is less (41.3%) compared to the previous forms and the subsequent atypical form of leiomyoma. Despite this, the area occupied by myofibrils in this leiomyoma tissue was relatively high (Table 1). With this form of leiomyoma, it was noted that the areas occupied by vascular and stromal structures have almost the same indicators. Among the smooth muscle cells of this form, it was found that mitoses are higher than in other forms; equal to 3.85%.

When studying the quantitative indicators of tissue structures of atypical leiomyoma, it was found that the area occupied by smooth muscle cells in the tissue is significantly less than half of the total area, equal to 44.1%. The relatively rare location and small nuclei of smooth muscle cells were taken into account. It has been established that myofibrils occupy a relatively large area in the leiomyoma tissue and their area averages 27.7%. It was confirmed that the location of the vessels and structures of the stroma is close to those of previous forms of leiomyoma (Table 1). Only in this form, the number of mitoses among smooth muscle cells, equal to 4.2%, indicated a high level of proliferation of smooth muscle cells.

Table 1. Morphometric Parameters of Histogenetic Forms of Uterine Leiomyoma (%)

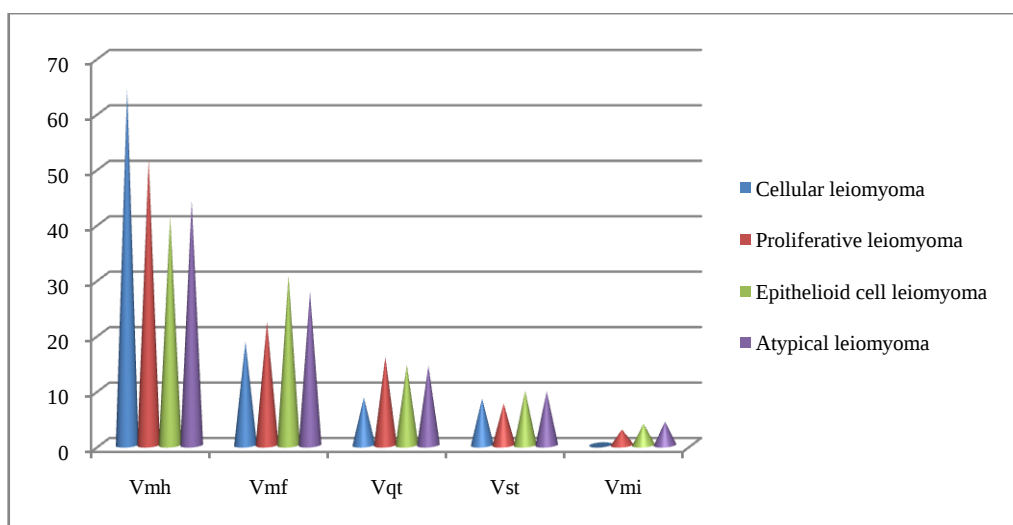
	Histogenetic forms of leiomyoma	V_{mh}	V_{mf}	V_{qt}	V_{st}	V_{mi}
1	Cellular leiomyoma	64.3 ± 2.1	18.7 ± 1.7	8.6 ± 1.3	8.4 ± 1.2	–
2	Proliferative leiomyoma	$51.7 \pm 2.2^*$	$22.3 \pm 1.9^*$	$15.9 \pm 1.6^*$	$7.5 \pm 1.1^*$	2.8 ± 0.7
3	Epithelioid cell leiomyoma	$41.3 \pm 2.2^{**}$	$30.7 \pm 2.1^{**}$	$14.5 \pm 1.6^{**}$	$9.8 \pm 1.3^{**}$	3.85 ± 0.9
4	Atypical leiomyoma	$44.1 \pm 2.2''$	$27.7 \pm 2.0''$	$14.3 \pm 1.6''$	$9.7 \pm 0.9''$	4.2 ± 0.6

Note: V_{mh} –muscle cell, V_{mf} –myofibril, V_{qt} –blood vessels, V_{st} –stromal structures, V_{mi} –mitosis.

* – $R \leq 0.05$ reliability of indicators of proliferative leiomyoma compared to cellular leiomyoma.

** – $R \leq 0.01$ reliability of epithelioid leiomyoma compared to cellular leiomyoma.

'' – $R \leq 0.01$ significance of atypical leiomyoma compared to cellular leiomyoma.



Note: Vmh–muscle cell, Vmf–myofibrils, Vqt–blood vessels, Vst–stromal structures, Vmi–mitosis.

Diagram 1. Morphometric Indicators of Histogenetic Forms of Uterine Leiomyoma (%)

The study of the histogenetic form of uterine leiomyoma by comparing the quantitative indicators of smooth muscle cells, myofibrils, vessels, stromal structures and mitotic figures in the tissue structures of each of the forms of leiomyoma on the basis of graphs helps to understand how large or small the area they occupy. First of all, when the comparative indices of smooth muscle cells, which are the main structural unit of leiomyoma tissue, were converted into a diagram (diagram–1), it became clear that the column of the diagram in the cellular form is much longer, while in the proliferative form it is relatively lower than the epithelioid cell leiomyoma and significantly lower in atypical leiomyoma.

The next structural unit studied was the myofibril index. Since leiomyoma is a benign tumor of muscle tissue, among its tissue structures, myofibrils are the second largest structure after smooth muscle cells. Information about its quantitative indicator complements the qualitative indicators and gives an idea of how much space the leiomyoma occupies in the tissue. This tissue structure occupies the smallest area in a normocellular leiomyoma, since its bar is low in the diagram. The fact that the epithelioid cell leiomyoma had the longest bar in the diagram suggested that the myofibrils occupied a wider area in this type of tumor. With an atypical form of leiomyoma, the bar on the graph is lower, and with proliferative leiomyoma it is even lower.

It was noted that the areas occupied by blood vessels in different histogenetic forms of leiomyomas differed from each other. Epithelioid cell leiomyoma has been found to be the type of leiomyoma with the largest blood vessels. In the cellular and proliferative forms, the columns were almost the same in length, as indicated by their close location to each other. However, the area occupied by blood vessels in atypical leiomyoma was relatively small, as evidenced by the shortening of the corresponding column in the graphic image.

In fact, it is known that the rate of cell mitosis is high if the tumor has a dangerous indicator. Since the tumors studied by us developed from intact and smooth muscle cells, it was found that the mitosis of parenchymal cells in the tumor tissue depends on their histogenetic origin.

No mitotic figures were found in the cell tissue of leiomyoma. In the proliferative tissue of leiomyoma, the mitosis rate was 2.8%, since the process of cell reproduction depends on mitosis. An increase in the frequency of mitosis up to 3.8% was observed in late forms of leiomyoma, i.e., epithelioid cell leiomyoma. In the atypical form of leiomyoma, a change in the histotopographic structure of smooth muscle cells due to nuclei was noted.

4. Conclusions

It has been observed that the area occupied by smooth muscle cells in leiomyoma tissue is highest in cellular form, followed by proliferative form, and relatively less in epithelioid cell form. It has been established that the area occupied by muscle tissue myofibrils is the smallest in cellular leiomyoma and relatively large in the epithelioid–cellular form. It has been confirmed that the vessels occupy a smaller area in cellular leiomyoma and the same extent in other forms. It was found that mitoses account for 2.8% in proliferative leiomyoma, 3.8% in epithelioid cell form and 4.2% in atypical form.

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