

ADRENAL GLAND MORPHOMETRY IN COVID-19

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Abstract

For morphometric analysis, less than 10 sections of each of the previously prepared microsamples were taken and processed on the NanoZoomer scanning device. These microsamples scanned on the NanoZoomer were subjected to multiplex confocal measurements using the QuPath-0.5.0+ ImageJ program. A total of 5 morphological and functional areas were calculated for the analysis of the adrenal gland tissue structures: 1) glomerular (GA), 2) fasciculata (FA), 3) reticularis areas (RA), 4) interstitial tissue (IT), and 5) areas occupied by pathological changes (PCh).

Keywords: COVID-19, adrenal gland, zona fasciculata, fibrinoid necrosis, thrombosis, infarction.

The average sizes obtained using this program were presented with statistical differences of sizes with a confidence level of $P \leq 0.01$ using special formulas.

In our study, the digital data obtained on the morphometric indicators of the adrenal gland in COVID-19 were used to obtain the sizes of the cellular composition of the adrenal gland, the area occupied by blood vessels, fibrous structures and the area occupied by inflammatory infiltrate. An average of 10 microimages was taken from each group, and the average sizes of the studied areas were presented. (See Table 1):

Table 1 Quantitative indicators of the morphofunctional areas of the adrenal glands and the areas occupied by pathological changes in patients who died from various diseases due to COVID-19, presented in μm

Groups	GA	FA	RA	IT	PCh	$P \leq$
Control group	15,4 \pm 0,81	64,6 \pm 1,1	7,8 \pm 0,60	12,2 \pm 0,73	0	0,01
Viral pneumonia	23,7 \pm 0,95	37,3 \pm 1,1	11,3 \pm 0,71	10,4 \pm 0,68	17,3 \pm 0,85	0,01
Cardiovascular diseases	21,4 \pm 0,92	43,5 \pm 1,1	10,6 \pm 0,69	11,7 \pm 0,72	12,8 \pm 0,75	0,01
Diabetes mellitus	17,3 \pm 0,85	39,1 \pm 1,1	9,4 \pm 0,65	14,6 \pm 0,79	19,6 \pm 0,89	0,01
Acute renal failure	24,8 \pm 0,97	30,1 \pm 1,0	14,2 \pm 0,78	9,4 \pm 0,65	21,5 \pm 0,92	0,01

In addition to assessing the pathomorphological signs of damage to the adrenal gland tissue structures in COVID-19 disease by qualitative criteria, the reliability of the criteria for assessing changes characteristic of pathology is higher if they are assessed by quantitative indicators. Those who died from various diseases as a result of the development of COVID-19 disease were divided into the following groups, and those who died from other diseases

unrelated to adrenal gland damage and COVID-19 disease were taken as a control group for comparison in the assessment of adrenal gland tissue structures by quantitative indicators. A total of 5 morphological and functional areas were calculated for the analysis of the adrenal gland tissue structures: 1) glomerular (GA), 2) fasciculata (FA), 3) reticularis areas (RA), 4) interstitial tissue (IT), and 5) areas occupied by pathological changes (PCh).

The following data were obtained when the area occupied by the adrenal gland tissue structures in the control group was calculated using the multiplex confocal morphometry method. It was found that the morphofunctional areas of the adrenal gland and the interstitial tissue were normally distributed into the following areas. The cortical layer, which occupied the largest area, turned out to be the fascicular area (64.6%). The glomerular area was located under the capsule and occupied an average of 15.4%. The remaining areas were found to be occupied by the reticularis area (7.8%) and interstitial tissue (12.2%) (Table 1).

The first group we studied, those who died of acute pneumonia due to the development of COVID-19, had pathological changes in the adrenal gland tissue structures and the area occupied by pathological changes in the gland tissue, such as hemorrhage, necrosis, and inflammation, under the influence of viral infection, and the following results were obtained. It was observed that the area of the glomerular layer of the gland was severely swollen with interstitial fluid and the area of the adrenocorticotocytes was also enlarged due to vacuolization, occupying 23.7% of the area, which was 8.3% larger than the control group. It was found that other areas of the gland were also enlarged due to edema in this group, and the area of the reticular area reached 11.3%. As a result, the area of the glomerular area, which occupied a large area in the control group, was reduced by 2 times. It was found that secondary changes developed in the adrenal gland tissue under the influence of viral pneumonia, including pathological changes such as hemorrhage and necrosis, and their area occupied 17.3%.

In the second group, i.e. those who died from cardiovascular complications due to the development of COVID-19, the following changes were detected when calculating the morphological and functional areas of the adrenal gland, interstitial tissue and areas occupied by pathological changes. It was found that the glomerular area was slightly reduced (21.4%), the total area was expanded (43.5%), the reticular area occupied 10.6% of the area, and the interstitial tissue was slightly expanded and amounted to 11.7%. In this group, the area occupied by secondary pathological processes in the gland tissue was slightly less than in the previous group and occupied 12.8%.

When calculating the areas of the adrenal gland morphofunctional areas, interstitial tissue and secondary changes in the group of patients who developed COVID-19 and died from complications of diabetes mellitus, the following results were obtained. In this group, a decrease in the area of all morphofunctional areas, glomerular, fasciculata and reticularis areas of the gland tissue was observed, and the area of interstitial tissue and pathological changes was increased. It is clear that due to the extensive development of pathological changes in the

gland tissue and the expansion of the area of interstitial tissue, all morphofunctional parenchymatous areas of the gland were reduced.

In the group of patients who died from acute renal failure, morphometric changes in the adrenal gland tissue were particularly striking. In this group, the area occupied by pathological changes (21.5%) was the highest. As a result, the interstitial tissue area was also sharply reduced (9.4%), the total area of the gland parenchyma was also very low (30.1%), and the area occupied by the spongy tissue was higher than in all groups (14.2%). Another noteworthy feature of this group was the sharp increase in the area of the glomerular area of the gland (24.8%) and was the highest among all groups.

Conclusion

In the absence of pathologies affecting the adrenal gland, it was found that the spongy area occupied the largest area of the gland's morphofunctional areas, the glomerular area occupied 15.4%, reticular area 7.8%, and the interstitial tissue 12.2%. In patients who died from COVID-19, the pathological changes areas in the adrenal gland tissue were enlarged, and 17.3% of the gland tissue was occupied by secondary pathological changes.

Literature

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