



MORPHOLOGICAL FEATURES OF THE SPLEEN IN RATS DURING EARLY POSTNATAL ONTOGENESIS UNDER MATERNAL EXPOSURE TO FIPRONIL

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ABSTRACT

The spleen is one of the key organs of the immune system, playing an important role in the formation of immune status in mammals [2–5]. A number of studies describe the morphological structure of the spleen in adult animals under normal conditions and under acute toxic exposure to pesticides. However, the morphological features of the spleen during postnatal development under chronic exposure to fipronil through the maternal organism remain insufficiently studied [1,6–10].

The purpose of the present study was to identify the morphological features of the development and formation of the spleen in rats during early postnatal ontogenesis under the influence of fipronil administered through the maternal organism.

Materials and methods.

Experiments were conducted on 60 adult, nonpregnant, nulliparous white female rats weighing 150–170 g and on their 200 offspring (control – 100, experimental – 100). After excluding somatic and infectious diseases, the females of the experimental group received fipronil orally via a probe at a dose of 0.97 mg/kg, corresponding to 1/100 LD₅₀ of the substance. On day 31 of treatment, the animals were mated. Fipronil administration continued throughout pregnancy (21–22 days) and lactation (22–24 days). On days 3, 7, 14, 21, and 30 after birth, morphological features of the spleen structure in the offspring were studied.

Light microscopy and statistical analysis methods were used.

For morphological examination, spleen tissue was fixed in 10 % neutral formalin or Bouin's solution, dehydrated in 60°, 70°, 80°, 96°, and 100° alcohols, and embedded in paraffin. Sections prepared using a microtome were deparaffinized in xylene and toluene solutions and stained with hematoxylin and eosin for morphological and morphometric analysis.

Results and discussion.

Our studies showed that chronic exposure of mother rats to low doses of fipronil during pregnancy and lactation leads to significant disturbances in postnatal spleen morphogenesis in their offspring.

In newborns from females exposed to fipronil, as well as in the control offspring, the spleen parenchyma was mainly represented by red pulp. The organ was externally surrounded by a thin connective tissue capsule from which trabeculae later developed. The

capsule appeared thickened, with unevenly distributed collagen and elastic fibers. Its cellular component included fibroblasts and a few elongated smooth muscle cells. The reticulostroma of the red pulp was poorly developed, its fibers were loose, and the structure, unlike that of controls, was more uniform; sinusoids were dilated and congested. The cellular component consisted of connective tissue and erythroid cells distributed unevenly. Single, usually small megakaryocytes were observed.

Erythroblastic islands composed of a centrally or peripherally located macrophage surrounded by erythropoietic cells at different stages of differentiation were found mainly in the central part of the organ; their number was lower than in the control. The white pulp was not yet formed. Among the cellular elements, lymphocytes and macrophages were present in smaller numbers than in controls, often showing dystrophic changes, along with occasional granular leukocytes sometimes exhibiting degeneration.

At early stages (days 3–7 of postnatal life), marked microcirculatory alterations were noted in the spleen—dilation and congestion of venous vessels. The white pulp was practically absent. Against the background of numerous foci of erythro- and granulocytopoiesis, isolated lymphocytopoietic islands appeared. Periarterial zones on days 14–21 still showed low density of lymphoid cells; the growth of periarteriolar lymphoid sheaths was delayed and their thickness reduced. On days 21–30, the formation of lymphoid follicles lagged behind the control, and follicular hypoplasia was evident. The number of lymphoid follicles was smaller than in the control group, with a reduced proportion of white pulp and relative predominance of red pulp.

By day 30 of postnatal ontogenesis, active development of the white pulp was observed, yet its formation still lagged behind that in the controls. The spleen retained signs of delayed differentiation of structural zones. The red pulp predominated; sinusoids were dilated and congested, and dystrophic changes in cellular elements were seen. There was a marked reduction in erythroblastic islands and megakaryocytes; erythropoietic and mature erythrocyte counts were lower, while the number of macrophages in the red pulp increased—apparently indicating the beginning of full spleen function as a blood-destruction organ.

The white pulp consisted of isolated lymphoid formations that were smaller than those of control animals of the same age. Its structure was loose, with few lymphocytes and some degenerating cells. The distinction between T- and B-dependent zones was poorly expressed. At this stage, unlike earlier periods, indistinct germinal centers began to form; the number of lymphoid follicles with germinal centers remained lower than in controls. Nonetheless, each follicle contained, along with periarterial and marginal zones, an intermediate zone located between them.

Conclusions.

1. Chronic exposure to the pesticide fipronil through the maternal organism leads to delayed postnatal development and differentiation of spleen lymphoid tissue as well as the formation of its morphofunctional zones.

Impaired postnatal spleen morphogenesis under toxic influence of fipronil through the maternal organism may be a primary cause of secondary immunodeficiency conditions in newborns and infants, highlighting the need for targeted pharmacological correction.

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