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MORPHOLOGICAL BLOOD PARAMETERS OF LAMBS AFTER CAUDOTOMY BY DIFFERENT METHODS

Abstract. The article provides a comparative assessment of certain hematological parameters of blood during caudotomy performed by different methods in Akzhaik meat-and-wool lambs. The experiment included 40 lambs divided into two groups: in the first group, caudotomy was performed surgically, while in the second group it was carried out by elastration using rubber rings. Hemoglobin, erythrocytes, platelets, and leukocytes in the blood were studied dynamically (before the operation, and on days 1, 2, 5, 7, and 10 after the procedure). The obtained data were processed using standard biometric methods. The study established that the surgical method of caudotomy was accompanied by a sharp increase in hemoglobin and erythrocytes during the first day after the operation, a significant rise in platelet count, and physiological leukocytosis. In animals of the second group (elastration), the changes were less pronounced and more stable. By day 10, the indicators in both groups tended toward normalization, although hematological shifts persisted longer in the first group. The results indicate that elastration is a less traumatic method compared to traditional surgical caudotomy. It reduces the intensity of stress responses, promotes faster stabilization of hematological parameters, and decreases the load on the hematopoietic and hemostatic systems. The obtained data can be used in veterinary surgery and sheep farming practice to select the optimal method of caudotomy, minimize postoperative complications, and improve animal productivity. The proposed elastration method ensures a lower level of hematological stress responses, making it more preferable under conditions of intensive livestock production.

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Keywords: caudotomy in lambs, blood morphology of lambs, hematopoiesis, hemostasis, meat-and-wool sheep farming, wool productivity.

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ӘРТҮРЛІ ӘДІСТЕРМЕН КАУДОТОМИЯДАН КЕЙІН ҚОЗЫ ҚАНЫНЫҢ МОРФОЛОГИЯЛЫҚ КӨРСЕТКІШТЕРІ

Аңдатпа. Мақалада ақжайық етті және жүнді қозыларға әртүрлі тәсілдермен жасалған каудотомия кезінде қанның кейбір гематологиялық көрсеткіштеріне салыстырмалы баға берілген. Экспериментке екі топқа бөлінген 40 қозы қолданылды: бірінші топта каудотомия хирургиялық жолмен, екіншісінде резеңке сақиналарды қолданып эластрация әдісімен жасалды. Қандағы гемоглобиннің, эритроциттердің, тромбоциттер мен лейкоциттердің құрамы динамикалық түрде зерттелді (операция алдында, 1, 2, 5, 7 және 10 күннен кейін). Алынған деректер стандартты биометриялық әдістермен өңделді. Зерттеуде каудотомия хирургиялық әдісі операциядан кейінгі бірінші тәулікте гемоглобин мен эритроциттердің күрт жоғарылауымен, тромбоциттер санының және физиологиялық лейкоцитоздың айтарлықтай өсуімен жүретіні анықталды. Екінші топтағы жануарларда (эластрация) өзгерістер азырақ айқын және тұрақты болды. 10-шы күні екі топта да индекстер қалыпқа келуге бейім болды, бірақ бірінші топта гематологиялық өзгерістер ұзағырақ сақталды. Алынған нәтижелер эластрация дәстүрлі хирургиялық каудотомиямен салыстырғанда аз жарақатты әдіс екенін көрсетеді. Ол дененің стресстік реакцияларының ауырлығын төмендетеді, гематологиялық параметрлердің тезірек тұрақтануына ықпал етеді және гемопоэз және гемостаз жүйелеріне жүктемені азайтады. Алынған мәліметтерді ветеринариялық хирургияда және қой шаруашылығы тәжірибесінде каудотомия оңтайлы әдісін таңдау,

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операциядан кейінгі асқынуларды азайту және мал өнімділігін арттыру үшін пайдалануға болады. Біз ұсынып отырған эластрациялық әдіс гематологиялық стресс реакцияларының төмен деңгейін қамтамасыз етеді, және оны интенсивті мал шаруашылығы жағдайында қолайлырақ етеді.

Кілт сөздер. қозы каудотомиясы, қозы қанының морфологиясы, гемопоэз, гемостаз, етті және жүнді қой шаруашылығы, жүн өнімділігі.

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МОРФОЛОГИЧЕСКИЕ ПОКАЗАТЕЛИ КРОВИ ЯГНЯТ ПОСЛЕ КАУДОТОМИИ РАЗНЫМИ СПОСОБАМИ

Аннотация. В статье дана сравнительная оценка некоторых гематологических показателей крови при проведении каудотомии разными способами у ягнят акжаикской мясошерстной породы. В эксперименте было включено 40 ягнят, разделённых на две группы: у первой группы каудотомию проводили хирургическим способом, у второй - методом эластрации с использованием резиновых колец. В динамике (до операции, через 1, 2, 5, 7 и 10 суток) исследовали содержание гемоглобина, эритроцитов, тромбоцитов и лейкоцитов в крови. Полученные данные обрабатывали с использованием стандартных биометрических методов. В исследовании установлено, что хирургический метод каудотомии сопровождался резким повышением гемоглобина и эритроцитов в первые сутки после операции, выраженным увеличением количества тромбоцитов и физиологическим лейкоцитозом. У животных второй группы (эластрация) изменения носили менее выраженный и более стабильный характер. К 10-м суткам показатели у обеих групп стремились к нормализации, но у первой группы гематологические сдвиги сохранялись дольше. Полученные результаты свидетельствуют о том, что эластрация

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является менее травматичным методом по сравнению с традиционной хирургической каудотомией. Она снижает выраженность стресс-реакций организма, способствует более быстрой стабилизации гематологических параметров и уменьшает нагрузку на системы гемопоэза и гемостаза. Полученные данные могут быть использованы в ветеринарной хирургии и практике овцеводства для выбора оптимального метода каудотомии, снижения послеоперационных осложнений и повышения продуктивности животных. Предложенный нами метод эластрации обеспечивает меньший уровень гематологических стресс-реакций, и делает его более предпочтительным в условиях интенсивного животноводства.

Ключевые слова: каудотомия ягнят, морфология крови ягнят, гемопоэз, гемостаз, мясо-шерстное овцеводство, шерстная продуктивность.

Introduction. In the current conditions of development of the agro-industrial complex of the Republic of Kazakhstan, one of the key tasks is to increase the efficiency of livestock production. Among these sectors, sheep breeding holds special importance, as it occupies a significant place in the country's economy due to natural and climatic features and long-standing traditions of the population. Under production intensification, the most promising direction of sheep breeding is recognized as the precocious meat-and-wool type, which makes it possible to obtain both high-quality wool and excellent indicators of meat productivity. The versatility of such animals makes them especially valuable in the new economic environment, where competition is increasing not only between different types of sheep breeding but also among various branches of animal husbandry [1, p.7].

The Food Program of the Republic of Kazakhstan provides for the sustainable development of livestock farming as the basis of food security. Throughout human history, food production has remained the most important task determining the standard of living of society under any forms of ownership and management. Therefore, the use of animals with combined productivity has acquired particular strategic importance under modern conditions. One of the most striking representatives of such animals in the West Kazakhstan region is the Akzhaik meat-and-wool breed of sheep, distinguished by high growth rates, well-developed meat productivity, and simultaneous production of high-quality wool [2, p.6; 3, p.574].

In recent years, increasing attention in sheep breeding has been paid to improving the quality of crossbred wool. Crossbred wool, characterized by unique technological properties, is in high demand in the global market, and its shortage makes this type of product especially valuable [4, p.262; 5, p.28]. In order to improve wool quality and reduce contamination, various preventive measures and surgical interventions on certain parts of the animals' bodies are widely used in practice, including castration and caudotomy.

It is well known that in fine-wool and semi-fine-wool sheep breeds, a long natural tail leads to significant product losses. The contaminated part of the fleece in the absence of caudotomy can amount to 30–40% of the total fleece weight, which significantly exceeds acceptable standards and negatively affects its commercial quality. To prevent wool contamination with feces and urine, caudotomy (tail amputation) is performed in lambs of such breeds. This measure is aimed at reducing economic losses and increasing the overall profitability of sheep farming [6, p.22].

In Akzhaik meat-and-wool breed farms, caudotomy has traditionally been performed surgically at the age of 7–12 days. For this, dry sunny weather is chosen, which reduces the risk of complications. The operation is carried out with a sharp sterile knife, with the incision made between the third and fourth coccygeal vertebrae. It is important that the remaining part of the

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tail covers the anus and the vulva in females. During the operation, the skin is pulled toward the tail base so that it later covers the wound surface; afterward, the wound is treated with a 5% iodine solution. Operated lambs are placed together with their mothers in separate pens with clean, dry bedding, which promotes rapid healing and reduces the risk of infection. Practice has shown the high effectiveness of this approach; however, it requires strict adherence to the rules of asepsis and antisepsis.

The economic benefits of caudotomy have been confirmed by calculations and the experience of many farms. At the same time, it should be noted that this operation has not yet been sufficiently widely introduced into everyday practice, despite the fact that recommendations for its performance are provided in almost all veterinary reference books and methodological guidelines. This is due both to insufficient awareness among farmers and to the lack of studies substantiating the advantages of different methods of performing the operation, taking into account the breed-specific characteristics of animals.

Of particular scientific value in studying the consequences of surgical interventions is blood, as a universal and sensitive tissue of the body. It supplies organs and systems with nutrients, ensures the transport of oxygen and metabolic products, and participates in maintaining homeostasis. Any changes in metabolism, as well as stress reactions of the body caused by surgical intervention, are reflected in the morphological composition of the blood. Changes in the ratio of cellular elements, hemoglobin levels, leukocyte formula, and other indicators make it possible to assess the organism's response to surgical trauma, the severity of the inflammatory process, and the ability of tissues to regenerate [7, p.10; 8, p.55].

A comparative analysis of the morphological blood parameters of lambs undergoing caudotomy by different methods represents an important research direction [9, p.69]. Such an analysis makes it possible to identify the physiological features of the body's response, determine the most sparing and scientifically justified methods of performing the operation, and minimize the risk of complications. Under conditions of intensive sheep farming, such data have not only theoretical but also practical significance, as they contribute to increasing animal productivity and the overall economic efficiency of the industry.

Thus, the relevance of this study is due to the need to improve the quality of meat-and-wool sheep farming products, the shortage of crossbred wool, the risk of fleece contamination, and the importance of preventive measures, including caudotomy. A comparison of the morphological blood parameters of lambs after caudotomy performed by different methods will make it possible to develop scientifically grounded recommendations for practice and ensure the introduction of the most effective technologies in the industry.

In connection with the above data on the necessity of this operation and the causes of postoperative complications following surgical caudotomy, we set the goal of studying the effect of different methods on certain morphological blood parameters.

Materials and Methods of Research. The experimental material consisted of clinically healthy Akzhaik meat-and-wool lambs, selected from the pedigree sheep farm LLP "Izdenis" in the West Kazakhstan region. The research was carried out at the clinic of the West Kazakhstan Innovative-Technological University and in the pedigree sheep farm LLP "Izdenis". A total of 40 lambs aged 7–12 days were included in the experiment and were conditionally divided into two groups of 20 animals each.

The animals were kept together with their mothers under conditions close to farm practice. During the first days after birth, the lambs were kept in a separate pen (sakman), then gradually transferred into small and medium groups, and by the 20th day of life were united into larger groups. This management system corresponds to the traditional practice of sheep

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farms in the region and allows for an objective assessment of the effects of the performed operations under production-like conditions.

Caudotomy was performed during the sakman period — the most favorable time for carrying out mass preventive measures. In the first group, lambs underwent tail amputation by the surgical or "bloody" method: with a sharp disinfected knife between the third and fourth caudal vertebrae, followed by treatment of the wound with a 5% alcoholic iodine solution. In the second group, the A-1 device was used for elastration: the base of the tail was ligated with an elastic ring, causing ischemia and subsequent necrotic amputation of the tail.

To obtain reliable results on blood morphological parameters, biological material was collected in the morning, on an empty stomach, from the jugular vein, which minimizes the influence of nutritional factors and stress responses on blood indicators.

The determination of blood morphological parameters was performed comprehensively using an automatic veterinary hematology analyzer Mindray BC-2800Vet / BC-5000Vet (China). This device is equipped with 3- and 5-differential analysis modules and ensures high-precision blood cell counts as well as automatic leukogram formation. The research methodology is based on a combination of the impedance method (counting cells by changes in electrical resistance when passing through an aperture) and flow cytometry with laser detection, which guarantees the objectivity and reproducibility of the obtained data.

The comprehensive study included determining the concentration of hemoglobin, the counts of erythrocytes, platelets, and leukocytes. The obtained results were subjected to statistical processing using standard biometric methods to determine the reliability of differences between the studied groups.

Results and Discussion. In the first group (surgical caudotomy), lambs showed clear signs of stress within the first 24 hours after the operation: they searched for their mothers, suckled poorly, and often stood apart from the flock. Some ewes also displayed reluctance to accept their lambs due to the smell of iodine and medical agents applied to the tail area. In contrast, lambs of the second group (elastration with rubber rings) stayed close to their mothers most of the time and suckled actively. This ensured better integration into the general flock structure during the sakman stage, and in the following days, they successfully joined groups of 5–8 lambs together with their mothers.

As shown in table 1, before caudotomy, hemoglobin levels in lambs were within the physiological norm for this species and age. In the first 24 hours after surgery, a significant increase in hemoglobin was observed in the first group, reaching 144.9±0.05 g/L (range: 141.5–147.6 g/L). This increase is regarded as a protective response of the body to stress caused by surgical intervention. In the second group, hemoglobin also rose, but less sharply - up to 121.8±0.01 g/L (range: 120.3–123.3 g/L), which was 25.5% lower compared to the surgical group.

Table 1 – Changes in Hemoglobin and Erythrocyte Levels in the Blood of Lambs After Caudotomy by Different Methods (n = 40)

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Time (days)	Hemoglobin, g/L				Erythrocytes, 10^{12}/L			
	Lim		$\bar{X} \pm S\bar{X}$		Lim		$\bar{X} \pm S\bar{X}$	
	1	2	1	2	1	2	1	2
Before surgery	111,8-115,2	112,5-115,7	113,7± 0,02	114,1± 0,05	8,0-11,6	8,2-12,0	9,5± 0,15	10,1± 0,11
After 1 day	141,5-147,6	120,3-123,3	144,9± 0,05	121,8± 0,01	16,0-19,6	10,8-13,6	18,3± 0,10	12,3± 0,14
After 2 days	134,2-139,5	121,9-124,1	137,5± 0,05	121,8± 0,01	14,0-17,5	10,2-11,9	16,1± 0,20	10,8± 0,12
After 5 days	131,1-138,0	119,2-122,8	134,2± 0,02	121,2± 0,05	10,7-14,8	9,9-11,8	11,4± 0,22	9,5± 0,15
After 7 days	126,6-134,5	117,2-121,1	129,5± 0,10	119,5± 0,12	10,4-12,5	8,0-9,5	10,8± 0,02	9,2± 0,05
After 10 days	116,2-120,5	112,8-119,8	118,5± 0,16	115,2± 0,04	8,7-11,8	8,2-8,9	9,5± 0,02	8,4± 0,10

After 48 hours, hemoglobin levels in the first group decreased slightly to 137.5±0.05 g/L (range: 134.2–139.5 g/L), while in the second group they remained at 121.8±0.01 g/L, which was 21.3% lower. By day 5, the average hemoglobin concentration in the first group was 134.2±0.02 g/L (range: 131.1–138.0 g/L), and in the second group it was lower by 9.5%. On day 7, the level decreased further to 129.5±0.10 g/L (range: 126.6–134.5 g/L), while in the second group it averaged 119.5±0.12 g/L, a difference of 7.4%. By day 10, hemoglobin concentrations in both groups approached physiological norms, with only a 2.4% difference remaining. Thus, the hemoglobin dynamics indicate a more pronounced stress response in lambs subjected to surgical caudotomy compared with elastration.

Alongside hemoglobin changes, there was also a notable rise in erythrocyte count in lambs of the surgical group. Within the first 24 hours, their average erythrocyte count reached 18.3±0.10 $\times 10^{12}$/L (range: 16.0–19.6 $\times 10^{12}$/L), which was 43.8% higher than in the second group (12.3±0.14 $\times 10^{12}$/L, range: 10.8–13.6 $\times 10^{12}$/L). In subsequent days, a gradual decline in erythrocyte levels was observed: on day 2 they dropped to 16.1±0.20 $\times 10^{12}$/L, which was still 32.1% higher than in the second group; on day 5 the difference narrowed to 21.4%, on day 7 to 17.0%, and by day 10 the erythrocyte count had decreased to 9.5±0.02 $\times 10^{12}$/L, only 8.7% higher than in the elastration group, and approaching baseline values.

The obtained results confirm that surgical caudotomy causes stronger and more prolonged deviations in hemoglobin and erythrocyte levels, reflecting a heightened stress reaction of the body. In contrast, elastration ensures a milder and more stable physiological response, which favors quicker recovery and better adaptation of the lambs.

In the experiment, the high levels of hemoglobin and erythrocytes observed in the first days after surgery in the animals of the first group were caused by a combination of stress factors: pain reaction to surgical intervention, activation of the sympathoadrenal system, increased cardiac activity, and a higher oxygen demand of the body. The gradual decline of these parameters indicates normalization of hematological values as the animals recovered after surgery.

Analysis of the data presented in table 2 showed that the dynamics of platelet changes in lambs differed significantly depending on the method of caudotomy. Before surgery, the

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average platelet count in the first group was 9.5±0.12 ×10⁹/L, which corresponded to the physiological norm. In the second group, this indicator was considerably higher-15.7±0.10 ×10⁹/L, indicating initial intergroup differences. Already one day after caudotomy, there was a pronounced increase in platelet count in the first group, reaching 17.8±0.24 ×10⁹/L, which reflects the activation of the platelet component of hemostasis as a response to surgical trauma. In the animals of the second group, this parameter also changed, but to a lesser extent-up to 12.7±0.20 ×10⁹/L, which was 28.6% lower than in the first group.

Table 2 – Changes in Platelets and Leukocytes in the Blood of Lambs After Caudotomy by Different Methods (n = 40)

Time (days)	Platelets, 10⁹/L				Leukocytes, 10⁹/L			
	Lim		$\bar{X} \pm S\bar{X}$		Lim		$\bar{X} \pm S\bar{X}$	
	1	2	1	2	1	2	1	2
Before surgery	8,0-11,6	8,2-12,0	9,5±0,12	15,7±0,10	14,5-17,0	14,9-16,8	15,1±0,12	15,5±0,02
After 1 day	15,5-19,1	10,5-13,1	17,8±0,24	12,7±0,20	32,2-36,6	20,2-23,5	34,8±0,12	21,8±0,10
After 2 days	13,-17,0	10,2-11,0	14,7±0,10	10,5±0,30	27,0-31,5	17,4-22,5	29,3±0,05	20,6±0,02
After 5 days	10,8-14,7	9,8-11,7	12,5±0,16	10,5±0,20	22,5-26,5	16,5-20,5	24,5±0,10	19,4±0,20
After 7 days	10,1-12,2	8,0-9,5	11,1±0,14	8,8±0,15	17,3-20,2	13,3-18,2	18,2±0,05	16,8±0,08
After 10 days	8,5-11,4	8,0-9,0	10,2±0,14	8,4±0,12	13,8-16,5	12,5-15,0	14,2±0,24	13,8±0,10

On the second day after surgery, the number of platelets in the first group decreased to 14.7±0.10·10⁹/L, but still remained above the values of the second group (10.5±0.30·10⁹/L). By the fifth day, differences persisted: 12.5±0.16·10⁹/L versus 10.5±0.20·10⁹/L, respectively. Such dynamics indicate a more pronounced stress and inflammatory response of the body with traditional surgical caudotomy.

By day 7, the platelet level in the first group reached 11.1±0.14·10⁹/L, while in the second it decreased to 8.8±0.15·10⁹/L. By day 10, the values returned to baseline levels: 10.2±0.14·10⁹/L in the first group and 8.4±0.12·10⁹/L in the second.

Thus, in the experiment, the traditional surgical method was accompanied by a more pronounced increase in platelet count, which is associated with tissue trauma, blood loss, and activation of the coagulation system. At the same time, the elastration method caused a less intensive platelet response, confirming its lower invasiveness and milder impact on the body. These findings allow us to conclude that elastration is advantageous in reducing postoperative stress and minimizing hemostatic activation, which is practically important for improving the survival and adaptive potential of lambs.

The study of leukocyte levels in the blood showed that the leukocyte system of lambs is highly responsive to surgical intervention, which is expressed by the development of physiological leukocytosis of varying intensity depending on the caudotomy method.

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In the first group, on the first day after surgical intervention, leukocyte levels sharply increased to an average of 34.8±0.12·10⁹/L (range 32.2–36.6·10⁹/L), while in the second group the average was 21.8±0.10·10⁹/L, which is 35.0% lower than in the first group (Table 2). This difference indicates a pronounced stress response to surgical trauma and activation of nonspecific defense mechanisms.

In the following days, a gradual decrease in values was recorded in both groups, indicating normalization of hematological parameters and postoperative recovery. Thus, on the second day, animals in the first group had 29.5±0.08·10⁹/L leukocytes, which was 30.5% higher than the second group. On day 5, the difference was 20.1%, on day 7 only 7.7%, and by day 10 the intergroup difference decreased to 2.8%, suggesting stabilization of the immune system.

Physiological leukocytosis observed in the early postoperative period is explained by the redistribution of leukocytes in the blood and activation of hematopoietic organs. Against the background of surgical trauma, corticosteroid hormones are released, exerting a suppressive effect on the thymic-lymphoid system, disrupting lymphocyte integration, and inhibiting interleukin synthesis. This leads to a reduction in lymphocytes in peripheral blood. At the same time, production of granulocytes and monocytes is activated, which compensates the immune response and strengthens anti-infective defense of the organism.

The study of hematological parameters in lambs after caudotomy by different methods showed that the physiological response of the animals varies significantly depending on the degree of invasiveness. The most pronounced changes were recorded in animals of the first group, which underwent surgical caudotomy, while the elastration method was accompanied by less intense shifts in the blood system, confirming its lower invasiveness and better physiological tolerance.

Analysis of hemoglobin levels showed that on the first day after surgical caudotomy in the first group, there was a sharp increase (up to 144.9±0.05 g/L), which should be considered a compensatory response to surgical trauma. Such an increase is associated with activation of the sympathoadrenal system, increased cardiac activity, and higher oxygen demand in tissues. In the second group, changes were also noted, but they were more moderate (121.8±0.01 g/L). In the following days, normalization occurred in both groups, but values in the first group remained above baseline longer. This indicates a stronger stress factor with surgical caudotomy compared to elastration.

Changes in erythrocyte count also confirmed differences in physiological response. In animals of the first group, one day after surgery, erythrocyte levels reached 18.3±0.10·10¹²/L, which was 43.8% higher than in the second group. This increase can be explained by enhanced release of erythrocytes from blood depots and activation of erythropoiesis in response to blood loss and stress. In the following days, values gradually decreased and by day 10 approached baseline levels. In the second group, the dynamics were less pronounced, confirming the milder nature of elastration.

The dynamics of platelet counts demonstrate activation of the blood coagulation system, which was especially pronounced in the first group. On the first day, their level reached 17.8±0.24·10⁹/L versus 12.7±0.20·10⁹/L in the second group. This increase was caused by activation of the platelet component of hemostasis as a protective mechanism to prevent blood loss. Later, platelet counts gradually decreased, but in the first group they remained above baseline longer. In the second group, the changes were smoother, indicating less intense inflammatory and coagulation responses with elastration.

The leukocyte system showed the clearest response to surgical stress. In the first group, a pronounced physiological leukocytosis (34.8±0.12·10⁹/L) was recorded on the first day after surgery, which was 35% higher than in the second group (21.8±0.10·10⁹/L). This increase was

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explained by corticosteroid hormone release, mobilization of granulocytes and monocytes, as well as redistribution of blood cells. In the following days, leukocyte levels gradually decreased, and by day 10 intergroup differences were minimal. The sharper fluctuations in the first group confirm that surgical caudotomy is accompanied by a stronger inflammatory response and greater stress for the body.

Conclusion. Thus, the comparative analysis of all four blood parameters demonstrates a consistent relationship between the degree of surgical trauma and the severity of hematological changes. The novelty of this study lies in proving the advantages of elastic banding (elastration) from the perspective of hematological responses, which has not been systematically highlighted in the scientific literature and holds significant importance for veterinary practice and the improvement of sheep farming technologies.

Surgical caudotomy induces a stronger stress response: a sharp increase in hemoglobin, pronounced erythrocytosis and thrombocytosis, as well as a marked physiological leukocytosis. In contrast, elastration leads to more moderate shifts that normalize more rapidly. This indicates that elastration is a less traumatic method, ensuring better adaptation of animals in the postoperative period.

The practical significance lies in the fact that the use of elastration helps reduce the risk of complications, maintain normal hematological status, and improve lamb survival rates.

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