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Immunohistochemical Characterization of Inflammatory and Regenerative Responses in the Epididymis After Local Anesthesia

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Relevance of the topic: Local anesthesia is widely used in urological and andrological practice for scrotal interventions; however, the method of anesthetic administration (intratesticular, conduction, or combined) affects not only analgesic efficacy but also the extent of local tissue damage, subsequent inflammation, and epididymal remodeling. Given the key role of the epididymis in sperm maturation and transport, even moderate inflammatory or degenerative changes may impair reproductive function and contribute to chronic post-traumatic alterations [1]. Evidence suggests that intratesticular injection of anesthetics, while common in clinical and experimental settings, may induce more pronounced tissue reactions due to direct exposure of parenchymal and microvascular structures [2], whereas conduction anesthesia is considered less traumatic and associated with reduced inflammatory response [3]. Therefore, comparative morphoimmunological assessment of different administration routes remains clinically important. Modern studies increasingly employ immunohistochemical markers to objectively evaluate tissue responses, with CD45 indicating inflammatory infiltration and immune activation, and CD56 (NCAM) reflecting regenerative and reparative processes [4]. The combined analysis of these markers enables assessment of the balance between inflammation and tissue recovery under different anesthesia techniques[5]. Accordingly, a comprehensive evaluation of CD45 and CD56 expression following various methods of lidocaine and novocaine administration represents a relevant scientific and practical objective, providing a morphological basis for selecting minimally damaging anesthesia strategies in urological and andrological practice [6].

Purpose of the study:To evaluate the inflammatory and regenerative tissue response of the epididymis under various methods of local anesthesia based on immunohistochemical analysis of the expression of CD45 and CD56 markers[7].

Materials and methods of research:

The study was performed as an experimental controlled randomized trial on 90 white mongrel male rats (weight 250-300 g). The animals were divided into 6 groups of 15 animals: control; intratesticular administration of 1% lidocaine (L-IT); conduction anesthesia with 1% lidocaine (L-CB); intratesticular administration of 1% novocaine (N-IT); conduction anesthesia with 1% novocaine (N-CB); combined technique (N-IT + L-CB)[8].

Epididymal tissue samples were collected 24 hours, 7 days, and 14 days after the procedure (five animals in each group per day). Morphological examination was performed on paraffin sections (4–5 μ m) stained with hematoxylin and eosin and van Gieson staining.

Immunohistochemical evaluation was performed using the markers CD45 (leukocyte infiltration) and CD56 (reparative/regenerative activity). Expression was determined as the percentage of CD-positive cells in the epithelium and interstitium (at least 5 fields of view \times 400 per animal)[9].

Statistical data processing was performed in Microsoft Excel 2021 and Statistica 12.0 using the Student's t-test, χ^2 , and Pearson correlation analysis; differences were considered significant at $p < 0.05$ [10].

CONCLUSIONS:

1. Intratesticular administration of lidocaine causes a pronounced inflammatory reaction in the tissue of the epididymis, which is confirmed by a sharp increase in CD45-positive cells to 19.34% compared to the control (1.84%).
2. Intratesticular administration of novocaine reduces the regenerative potential of tissue, which is manifested by a decrease in CD56 expression to 0.98% versus 2.1% in the control group.
3. Conduction anesthesia with lidocaine is the most gentle technique, as it is accompanied by an increase in CD56 expression to 7.39%, which indicates more favorable conditions for reparation compared to intratesticular methods.

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