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# Evaluation of Free-Radical Oxidation in Nephropexy Using Implants during Experimental Urological Studies

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## Abstract

The method of nephropexy, using different kinds of implants, is practiced in modern urology. It is established that the free-radical oxidation processes are activated when an organism is under stress, so the study purpose was experimental investigation of Lipid Peroxidation Antioxidant Protection (LPO-AOP) condition in the case of nephropexy in implantation zones in rats' tela, using implants of different kinds. Research results showed the influence of different kinds of implants on metabolic processes in rats' tela in zones of implants insertion; also while comparing experimental research results, faster regeneration of metabolic processes by the animals with implants made of decellularized xenoabdominal membrane is established.

## Keywords

Free-radical oxidation processes; Nephropexy; Implants; Modern urology; Xenoabdominal membrane; Lipid peroxidation antioxidant protection (LPO-AOP); Metabolic processes

## Introduction

Current trends in modern urology are the use of different types of implants made of synthetic materials of different chemical composition and the method of nephropexy using peritoneum [1-4].

It is established that an implant operation is accompanied by an appropriate and pronounced activation of lipid peroxidation (LPO). Therefore laboratory data on LPO and antioxidant protection (AOP) can also indicate the severity and extent of the pathological process [5].

In almost any disease and any adverse (stressful) exposure on organism-activated processes of free-radical oxidation leads to the accumulation of toxic substances, which are referred to as exotoxins. Increase in blood-serum content of the products of LPO and an increase in the activity of enzymes that detoxify reactive oxygen species (ROS) are nonspecific tests for endotoxemia. Oxygen radicals (superoxide, hydroxyl, peroxide) formed during inflammation, possessing high reactivity, speed up the process of peroxide oxidation of unsaturated fatty acids. The concentration of malonic dialdehyde (MDA) in the tissue reflects the activity of LPO in the body and can serve as a marker of the degree of endogenous intoxication [6-8].

At excessive formation of ROS and failure of systems, AOP develops the condition of oxidative stress, which is expressed in the enhancement of peroxidation processes, in violation of the structure and function of biological macromolecules of proteins, lipids, damage of biological membranes and membrane-bound enzyme systems, and the development of enzymes and cytotoxic effects [9].

It is now established that systemic disorganization of the membranes of cell organelles favor an early manifestation of the metabolic responses of the organism to the adverse effects of environmental factors and can be considered as a biochemical criterion of membrane damage [10,11].

In the studied literature, there are no data about the status of free-radical oxidation and AOP at nephropexy in the areas of implant meshes, which determine the aim of the present study.

## Materials and Methods

Researches were conducted in the laboratory on the base department of molecular biology and medical genetics. Molecular and biochemical methods studies were conducted in tissues of adult white rats that were divided into subgroups depending of the time of removal of animals from the experiment on the seventh and fourteenth days.

Allocation of the animals was performed depending on the kind of the implants and the duration of the postoperative period. All laboratory animals were divided into four groups: group 1, acellular xenogenous peritoneum (AXP); group 2, polyester mesh (PM); group 3, mesh "UltraPro" (UP); group 4, own peritoneum flap (OPF).

To assess the status of free-radical oxidation in the tissues of laboratory animals to carry out certain secondary products of LPO (MDA) and antioxidant enzymes (glutathione peroxidase [GPO]). Determination of MDA in the tissues of experimental animals was performed by the modified method [12].

The determination of middle molecules and peptides (MMP) in the tissue was done using a technique given by A.N. Kovalevsky and O.E. Nifanteva [13]. GPO activity was determined by the method of S.N. Vlasova involving reaction with reduced glutathione [14].

## Results and Discussion

A result of research were identified general patterns characterizing the direction the molecular changes in the cell depending on the time that has elapsed since the operation and use of mesh implants.

Implants, as foreign tissue, contribute to the development of mild local inflammation in the areas of implementation, but one of the

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Types of implants/ number of rats	Periods of the experiment (days)	MMP Conditional units/ml	GPO μmol/ml	MD μmol/ml
AXP, n = 8	7	0.22 ± 0.02	4.26 ± 0.54	8.65 ± 1.03
	14	0.25 ± 0.02	4.20 ± 0.53	10.99 ± 1.60
PM, n = 8	7	0.20 ± 0.01	7.64 ± 2.03	19.24 ± 3.40**
	14	0.14 ± 0.01*	4.60 ± 0.09	15.77 ± 2.41
UP, n = 8	7	0.19 ± 0.03	4.17 ± 0.05	11.26 ± 2.23
	14	0.16 ± 0.01**	18.33 ± 2.88*	6.71 ± 0.80***
OPF, n = 8	7	0.53 ± 0.02*	5.82 ± 0.11***	31.76 ± 1.57*
	14	0.16 ± 0.04**	4.31 ± 0.12	8.84 ± 1.35

\*The accuracy in comparison with the first group, \* $p < 0.001$ ; \*\* $p < 0.01$ ;  
\*\*\* $p < 0.05$ .

**Table 1:** Indicators of oxidative stress in tissues of rats with various types of implants, M ± m.

leading pathogenic mechanisms that lead to inflammation, regardless of etiology, is oxidative stress. In order to justify the presence of endogenous intoxication, we investigated the quantitative content of the marker of oxidative stress—MDA in the tissues of animals in the areas of implant meshes at nephropexy (Table 1).

It should be noted that in the tissues of the second and third groups of animals at the seventh day of the experiment, in zones of nephropexy, MMP level hardly differs from the first group with the implant AXP, but in the group with the implant of OPF, performance-level middle molecules were reliably higher 2.4 times relative to the indicator of the first group.

On the fourteenth day of the postoperative period, there was a significant reduction of SMP in all treatment groups compared to the group with the implant AXP.

The study results showed that the mean tissue (MD) in the second group on the seventh day was significantly higher than the 1.8 times of the first group; the third group with the implant UP was 1.3 times; in the fourth group of the implant of BF3, sixfold, respectively, indicating the activation of LPO and MD accumulation in tissues. Comparative evaluation indicators showed that MD content in blood on seventh day did not reveal any significant differences between the groups.

Analysis of the level of MDA in the tissue in areas of nephropexy, on the fourteenth day of the experiment showed a tendency for a significant reduction of catabolites in the third and fourth groups, as well as a slight increase in the second group, but these figures were not reliable. The predominance of highly reactive accumulation of secondary products indicates expressed growing nature of free-radical processes in animals exposed to implants PM, UP, and OPF.

Increased concentration of MD reflects the activity of LPO and serves as a marker of the degree of oxidative stress and endogenous intoxication in the origin and development of inflammatory processes. In this regard, it is believed that excessive induction of free-radical oxidation can be considered as one of the biochemical mechanisms of formation of endogenous intoxication in nephropexy polypropylene mesh.

Violations of oxidative metabolism are compensated by the antioxidant system, which normally restricts the free-radical oxidation of lipids in the body. Data obtained as a result of postoperative studies

of enzymes AOP-GPO on the seventh day in tissues suggest reliable activation of this indicator in the fourth group, indicators of GPO in the second and third groups are invalid character. On day fourteen of the experiment, the most reliable level of GPO activity was recorded in the third group with the UP implant.

Thus, the obtained results allow us to make a reasoned conclusion that the use of polyester mesh, UP mesh and peritoneum-fascial flap for implants entails activation of LPO processes in animals.

## Conclusion

Investigation of free-radical oxidation of endogenous intoxication and AOP in nephropexy showed that implants of various types have an influence on metabolic processes in the tissues of rats in the areas of introduction of implants.

When comparing the results of an experimental study of different types of implants at the nephropexy, it was revealed that the use of implants of AXP already on the seventh and fourteenth postoperative days caused in laboratory animals a reduction in the level of middle molecules, MD, and increased the activity of GPO, indicating a rapid recovery of metabolic processes in areas of the graft and the evidence that they are less aggressive in respect of cells and tissues in nephropexy.

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