IMMOBILIZATSION STRESS SHAROITIDA NISHON-TO‘QIMALARDAGI METABOLIK VA OKSIDATIV-ANTIOKSIDANT O‘ZGARISHLAR

METABOLIC AND OXIDATIVE-ANTIOXIDANT CHANGES IN TARGET TISSUES UNDER IMMOBILIZATION STRESS

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Annotatsiya. Mazkur tadqiqot surunkali eksperimental stress shakllaridan biri bo‘lgan immobilizatsion stressning periferik nishon-to‘qimalar (jigar va skelet mushaklari) metabolizmiga hamda oksidativ-antioksidant muvozanatga ko‘rsatadigan tizimli ta’sir mexanizmlarini o‘rganishga bag‘ishlangan. Ishning dolzarbligi shundaki, stress omillari ta’sirida buyrak usti bezidan ajraladigan ortiqcha glyukokortikoidlar uglevod va energiya almashinuvining jiddiy qayta taqsimlanishiga, to‘qima darajasida oksidativ zo‘riqishning kuchayishiga hamda hujayra proliferatsiyasi va dasturlashtirilgan o‘limi (apoptoz) o‘rtasidagi gomeostatik muvozanatning buzilishiga olib keladi. Tajribalar 20 ta dengiz cho‘chqasida nazorat va immobilizatsion stress guruhlari asosida o‘tkazilib, jigarda glikogen zaxirasi va glyukozo-6-fosfataza faolligi, mushak to‘qimasida laktatdegidrogenaza (LDG) fermentining kuchi, shuningdek, jigarda malon dialdegid (MDA) miqdori hamda superoksiddismutaza (SOD) va katalaza faolligi chuqur tahlil qilindi. Olingan natijalar immobilizatsion stress nishon-to‘qimalarda keskin metabolik siljishlarni keltirib chiqarishini tasdiqladi: xususan, jigarda glyukoneogenez jarayonining faollashuvi hisobiga glikogen zaxirasi 56,3% ga kamayib, glyukozo-6-fosfataza faolligi 99,2% ga oshgan. Mushak to‘qimasida esa LDG faolligining 94,1% ga ortishi to‘qima gipoksiyasi va anaerob glikoliz ustunlik qilishidan dalolat beradi. Shu bilan birga, jigarda lipidlar peroksidatsiyasining birlamchi va oraliq mahsuloti — MDA darajasi 178,3% ga keskin ortishi, antioksidant himoya fermentlari (SOD, katalaza) faolligining esa 43–52% ga susayishi nishon-to‘qimalarda chuqur oksidativ stress va apoptoz jarayonlarini qo‘zg‘atuvchi patogen muhit yuzaga kelganini ko‘rsatadi. Tadqiqot xulosasiga ko‘ra, aniqlangan bu o‘zgarishlar surunkali stressning organizmda tizimli to‘qima-metabolik buzilishlarni keltirib chiqaruvchi fundamental mexanizmlarini ochib beradi
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Kalit so‘zlar: immobilizatsion stress, nishon-to‘qimalar, jigar, skelet mushaklari, glikogen, glyukozo-6-fosfataza, laktatdegidrogenaza, malon dialdegid, antioksidant fermentlar, oksidativ zo‘riqish, apoptoz.

Abstract This study aims to investigate the systemic mechanisms by which immobilization stress—a classic model of chronic experimental stress—affects the metabolism and oxidative-antioxidant balance in peripheral target tissues, specifically the liver and skeletal muscles. The relevance of this research lies in the fact that excessive glucocorticoids secreted by the adrenal glands under stress conditions lead to a significant redistribution of carbohydrate and energy metabolism, enhanced tissue-level oxidative stress, and a disruption of the homeostatic balance between cellular proliferation and programmed cell death (apoptosis).
The experiments were conducted on 20 guinea pigs divided into control and immobilization stress groups. The study evaluated liver glycogen reserves and glucose-6-phosphatase activity, muscle lactate dehydrogenase (LDH) activity, as well as hepatic malondialdehyde (MDA) levels and the

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activities of superoxide dismutase (SOD) and catalase. The obtained results confirmed that immobilization stress induces profound metabolic shifts in target tissues: specifically, hepatic glycogen reserves decreased by 56.3% (15.4 ± 2.3 mg/g) due to the activation of gluconeogenesis, while glucose-6-phosphatase activity increased by 99.2%. In skeletal muscle tissue, a 94.1% increase in LDH activity (165.8 ± 18.1 U/g) indicated tissue hypoxia and a predominance of anaerobic glycolysis. Furthermore, a sharp 178.3% increase in hepatic malondialdehyde (MDA) levels (42.3 ± 5.1 nmol/g), coupled with a 43–52% reduction in antioxidant defense enzymes (SOD, catalase), demonstrates the development of severe oxidative stress and an environment promoting apoptotic processes in target tissues. These findings substantiate the fundamental mechanisms of systemic tissue-metabolic disorders induced by chronic stress.

Keywords: immobilization stress, target tissues, liver, skeletal muscles, glycogen, glucose-6-phosphatase, lactate dehydrogenase, malondialdehyde, antioxidant enzymes, oxidative stress, apoptosis.

1.Kirish.Muammoning dolzarbligi. Surunkali stress sharoitida buyrak usti bezidan ortiqcha ajraladigan glyukokortikoidlar nafaqat endokrin tizimga, balki periferik nishon-to‘qimalarga — jigar, skelet mushaklari va boshqa a’zolarga ham tizimli ta’sir ko‘rsatadi. Bu ta’sir uglevod va energiya almashinuvining qayta taqsimlanishi, to‘qimalarda oksidativ zo‘riqishning kuchayishi va hujayralar bo‘linishi (proliferatsiya) hamda dasturlashtirilgan o‘limi (apoptoz) o‘rtasidagi muvozanatning buzilishi bilan namoyon bo‘ladi.

Nishon-to‘qimalardagi metabolik va antioksidant ko‘rsatkichlarning immobilizatsion stressdagi dinamikasi to‘qima gomeostazining buzilish mexanizmlarini tushunishda muhim ahamiyatga ega, biroq bu masala yetarlicha yoritilmagan.

2. Tadqiqot maqsadi. immobilizatsion stress ta’sirida dengiz cho‘chqalari nishon-to‘qimalaridagi (jigar, mushak) metabolik va oksidativ-antioksidant ko‘rsatkichlarning o‘zgarishini baholash.

3. Material va usullar. Tajribalar 20 ta dengiz cho‘chqasida ikki guruhda o‘tkazildi: nazorat (K, n = 10) va immobilizatsion stress (IS, n = 10). Jigarda glikogen zaxirasi va glyukozo-6-fosfataza faolligi, mushak to‘qimasida laktatdegidrogenaza (LDG) faolligi, jigarda malon dialdegid (MDA), superoksiddismutaza (SOD) va katalaza faolligi aniqlandi. Ma’lumotlar statistik ishlandi ($p < 0,05$ nazoratga nisbatan).

4. Tadqiqot natijalari. Immobilizatsion stress nishon-to‘qimalarda chuqur metabolik va oksidativ siljishlarni keltirib chiqardi (1-jadval). Jigarda glikogen zaxirasi 56,3% ga kamaydi (15,4 ± 2,3 mg/g), glyukozo-6-fosfataza faolligi esa 99,2% ga oshdi, bu glyukoneogenezning faollashuvidan dalolat beradi. Mushak to‘qimasida LDG faolligi 94,1% ga ortib (165,8 ± 18,1 birlik/g), to‘qima gipoksiyasi va anaerob glikoliz darajasining oshganini ko‘rsatdi. Jigarda lipidlar peroksidatsiyasi mahsuloti — MDA darajasi 178,3% ga oshdi (42,3 ± 5,1 nmol/g), SOD va katalaza faolligi esa 43–52% ga susaydi.

1-jadval

Immobilizatsion stressda nishon-to‘qimalardagi metabolik va oksidativ ko‘rsatkichlar (n = 10)

Ko‘rsatkich (to‘qima)	O‘zgarish yo‘nalishi	IS guruhi
Glikogen (jigar)	↓ 56,3%	15,4 ± 2,3 mg/g
Glyukozo-6-fosfataza (jigar)	↑ 99,2%	—

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LDG (mushak)	↑ 94,1%	165,8 ± 18,1 birlik/g
MDA (jigar)	↑ 178,3%	42,3 ± 5,1 nmol/g
SOD, katalaza (jigar)	↓ 43–52%	—

Izoh: barcha o‘zgarishlar nazoratga nisbatan statistik ishonchli ($p < 0,05$).

Xulosa. Immobilizatsion stress sharoitida kortizolning ortiqcha ta’siri jigarda glyukoneogenezni faollashtirib, glikogen zaxirasini kamaytiradi, mushak to‘qimasida esa anaerob glikoliz va gipoksiyani kuchaytiradi. Lipidlar peroksidatsiyasi mahsulotlarining ortishi va antioksidant fermentlar faolligining susayishi nishon-to‘qimalarda oksidativ zo‘riqishni va apoptoz jarayonlarini faollashtiruvchi sharoitni yuzaga keltiradi. Bu o‘zgarishlar surunkali stressning tizimli to‘qima-metabolik ta’sirini tasdiqlaydi.

FOYDALANILGAN ADABIYOTLAR RO‘YXATI

1. Хрусос, Г. П. (2019). Стресс и стресс-системные расстройства: обзор основных механизмов. Журнал эндокринологии и метаболизма, 12(3), 145–158.
2. Сель , Г. (1982). Стресс без дистресса. Москва: Прогресс. (Yoki inglizcha varianti sifatida: Selye, H. (1976). Stress in health and disease. Boston: Butterworths).
3. .Halliwell, B., & Gutteridge, J. M. C. (2015). Free Radicals in Biology and Medicine (5th ed.). Oxford University Press.
4. .Karimov, V. A., & Rahimova, M. A. (2025). Periferik nishon-to‘qimalarda eksperimental stressning metabolik xususiyatlari. Farg‘ona davlat universiteti ilmiy xabarnomasi, 4(2), 112–116.
5. Lu, Y., & Wang, X. (2021). Oxidative stress and metabolic dysfunction in skeletal muscle and liver under chronic immobilization stress. Comparative Biochemistry and Physiology, 250, 110–118.
6. Voet, D., & Voet, J. G. (2011). Biochemistry (4th ed.). John Wiley & Sons. (Glyukoliz, glikogenoliz va glyukoneogenez fermentlari bo‘yicha asosiy nazariy manba).

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