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ORIGINAL ARTICLE

The Oxidative Stress Level in Children with Inguinal Hernia

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Abstract

Introduction: Inguinal hernias (IH) are among the problems frequently encountered by surgeons, and they have the risk of developing significant complications. This study determines the levels of oxidative stress in pediatric patients with IH as a case–control study.

Methods: Inguinal hernia patients who applied to the Bezmialem Vakif University and Health Sciences University Umraniye Health Application and Research Center Pediatric Surgery Outpatient Clinic and healthy control group were studied with the inert blood. Oxidative stress biomarkers total oxidant status (TOS), total antioxidant status (TAS), total thiol (TT), native thiol (NT), and myeloperoxidase (MPO) levels measured by photometric methods. Oxidative stress index (OSI) and disulfide (DIS) were calculated.

Results: Oxidative damage biomarker levels increased statistically in the IH group, TOS, OSI, DIS, and MPO levels (p<0.001). TAS, TT, and NT levels were statistically significantly decreased in the IH group (p <0.001).

Discussion and Conclusion: As a result of our study, while oxidative stress is induced in an IH, antioxidant defense is decreased. Our results can guide the determination of the factors that cause IH and the development of current treatment.

Keywords: Inguinal hernia; oxidative stress; pediatric; thiol-disulfide homeostasis.

Inguinal hernia (IH) is a prevalent childhood disease with 0.8–4.4% incidence and requires surgical repair at diagnosis[1,2]. IH is caused by a weakness or tears in the posterior wall of the inguinal canal[3].

Oxidative stress results from imbalances in the oxidant and antioxidant systems and these imbalances can occur in many pathological disorders. In case of tissue damage, free radicals in the tissue cause imbalances in the oxidant-antioxidant system[4]. Reactive oxygen species play a role in the pathology of many diseases[5]. IH creates direct mechanical pressure on the hernial sac and may reduce blood flow in this area. Herniated tissue damage in IH may increase oxidative stress markers,[6] which increases oxidative damage.

This study determines the levels of oxidative stress in pediatric patients with IH.

Materials and Methods

IH patients who applied to the Bezmialem Vakif University and Health Sciences University Umraniye Health Application and Research Center Pediatric Surgery Outpatient

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Clinic and healthy control group were studied with the inert blood remaining after the blood samples were routinely requested. Thirty male children under 18 diagnosed with IH were included in the study as the case group, and 30 healthy children were included as the control group. The ethics committee of this study was approved by Health Sciences University Hamidiye Scientific Research Ethics Committee with the decision numbered 21/646, and an informed consent form was signed by all the volunteers involved in the study.

Sample Preparation

After the routinely requested blood was studied, the remaining inert blood was studied. The remaining EDTA blood was centrifuged at 3000×g for 10 min, and then their plasma was separated and stored at –80°C until analysis.

Oxidant and Antioxidant Biomarkers

Serum samples taken from the patients were measured commercially obtained human thiol-disulfide homeostasis, total antioxidant status (TAS),[4] total oxidant status (TOS),[5] oxidative stress index (OSI),[7] myeloperoxidase (MPO), total thiol (TT), native thiol (NT), and disulfide (DIS) [8] were measured by photometric methods.

Statistical Analysis

Parametric data were expressed as mean±standard deviation (SD) and non-parametric data as the interquartile range. The difference between the two parameters in the groups was calculated with the Mann–Whitney *U* test. And in addition, the correlation between the two variables was evaluated with the Spearman rank correlation coefficient. The significant difference between the results was expressed as $p<0.05$ SPSS version 25.0 program was used for all statistical analysis.

Results

Oxidative stress biomarkers such as antioxidants and oxidants in blood samples taken from patients diagnosed with IH Pediatric Surgery Outpatient Clinic and healthy control group, who have any additional disease and had not undergone previous surgery, are given in Table 1. Among the oxidative stress biomarkers, TOS, MPO OSI, and DIS, which indicate oxidative damage, in the IH group increased statistically significantly compared to the healthy control group. TAS, TT, and NT activity levels showing antioxidant capacity in the IH group statistically significant decreased ($p<0.001$).

Discussion

IHs are among the problems frequently encountered by surgeons, and they have the risk of developing significant complications[9]. This study determines the levels of oxidative stress in pediatric patients with IH.

The oxidant capacity can be defined as the total charge resulting from many reactions at the molecular level and having an adverse effect. On the other hand, the antioxidant state is the protective response that develops in response to oxidant molecules[10]. And the shift in the balance between oxidants and antioxidants in favor of oxidants is called oxidative stress[11]. A study showed that increased oxidative stress was associated with collagen tissue damage in tissue samples taken from children with joint hyper-

Table 1. Oxidative stress biomarkers in inguinal hernia patients and healthy controls

Oxidative stress biomarkers	Healthy controls Mean±SD	Inguinal Hernia Mean±SD	*p*
Total oxidant status *μmol H_2O_2 Eq./L*	10.61±0.93	12.91±1.22	<0.001
Total antioxidant status *mmol Ascorbate Eq./L*	1.18±0.14	0.70±0.08	<0.001
Oxidative stress index *AU*	9.16±1.63	18.64±2.41	<0.001
Myeloperoxidase *ng/mL*	10.49±3.92	85.57±10.49	<0.001
Total thiol *μmol/L*	563.24±49.51	482.13±51.19	<0.001
Native thiol *μmol/L*	424.19±49.49	252.80±29.04	<0.001
Disulfide *μmol/L*	69.52±8.10	114.67±27.34	<0.001

mobility syndrome and IH[6]. In our study, the IH group significantly increased the OSI level.

Studies investigating the importance of thiol/DIS homeostasis in many diseases have recently been reported. In a review investigating the role of this balance in clinical practice, 35 studies were evaluated. It was stated that the thiol/DIS balance has a protective effect in the body and in many diseases can be used as a diagnostic marker[12]. Thiols have multiple functions in biological systems, including a central role in coordinating the antioxidant defense network[13]. Thiol groups of amino acids such as sulfur-containing cysteine and methionine in proteins are the primary target point of oxygen radicals. Oxygen radicals and thiol groups are oxidized to form reversible DIS bonds[14]. This transformation is the earliest manifestation of radical-mediated protein oxidation. Oxidative stress causes DIS formation, and these DIS bonds are reduced back to thiol groups. Maintain this dynamic thiol-DIS homeostasis[8]. Dynamic thiol-DIS homeostasis is involved in many mechanisms such as antioxidant protection, apoptosis, regulation of enzyme activity and detoxification. TT and NT values were statistically significantly lower in this study in IH patients, while DIS values were significantly higher.

MPO is a hemoprotein associated with many inflammatory events and is produced in large quantities by leukocytes[15]. In addition to the decrease in antioxidant capacity, it is a marker showing oxidative stress. The MPO levels in our study were significantly higher in the IH patient group than in the healthy control group. We showed that MPO levels increased more In IH patients than in the normal control group. These results showed that oxygen-derived free radicals play an important role in patients.

Conclusion

This study proved, while oxidative stress is induced in an IH, antioxidant defense decreases. Our results can guide the determination of the factors that cause IH and the development of current treatment.

Ethics Committee Approval: Health Sciences University Hamidiye Scientific Research Ethics Committee with the decision numbered 21/646 on 22.10.2021.

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References

1. Raveenthiran V, Agarwal P. Choice of repairing ınguinal hernia in children: Open versus laparoscopy. Indian J Pediatr 2017;84:555–63. [CrossRef]
2. Pan ML, Chang WP, Lee HC, Tsai HL, Liu CS, Liou DM, et al. A longitudinal cohort study of incidence rates of inguinal hernia repair in 0- to 6-year-old children. J Pediatr Surg 2013;48:2327–31. [CrossRef]
3. Seidenberg P, Beutler A. The sports medicine resource manual. 1st ed. Amsterdam: Elsevier; 2008.
4. Erel O. A novel automated direct measurement method for total antioxidant capacity using a new generation, more stable ABTS radical cation. Clin Biochem 2004;37:277–85. [CrossRef]
5. Erel O. A new automated colorimetric method for measuring total oxidant status. Clin Biochem 2005;38:1103–11. [CrossRef]
6. Cevik M, Yazgan P, Aksoy N. Evaluation of antioxidative/oxidative status and prolidase parameters in cases of inguinal hernia with joint hypermobility syndrome. Hernia 2014;18:849–53. [CrossRef]
7. Erel O. A novel automated method to measure total antioxidant response against potent free radical reactions. Clin Biochem 2004;37:112–9. [CrossRef]
8. Erel O, Neselioglu S. A novel and automated assay for thiol/disulphide homeostasis. Clin Biochem 2014;47:326–32. [CrossRef]
9. Smietański M, Lukasiewicz J, Bigda J, Lukianski M, Witkowski P, Sledzinski Z. Factors influencing surgeons' choice of method for hernia repair technique. Hernia 2005;9:42–5. [CrossRef]
10. Güney T, Alişik M, Akinci S, Neşelioğlu S, Dilek I, Erel O. Evaluation of oxidant and antioxidant status in patients with vitamin B12 deficiency. Turk J Med Sci 2015;45:1280–4. [CrossRef]
11. Birben E, Sahiner UM, Sackesen C, Erzurum S, Kalayci O. Oxidative stress and antioxidant defense. World Allergy Organ J 2012;5:9–19. [CrossRef]
12. Erenler AK, Yardan T. Clinical Utility of Thiol/Disulfide Homeostasis. Clin Lab 2017;63:867–70. [CrossRef]
13. Sen CK, Packer L. Thiol homeostasis and supplements in physical exercise. Am J Clin Nutr 2000;72(Suppl 2):653S–69S. [CrossRef]
14. Köseoğlu H, Alışık M, Başaran M, Tayfur Yürekli Ö, Solakoğlu T, Tahtacı M, et al. Dynamic thiol/disulphide homeostasis in acute pancreatitis. Turk J Gastroenterol 2018;29:348–53. [CrossRef]
15. Pálinkás Z, Furtmüller PG, Nagy A, Jakopitsch C, Pirker KF, Magierowski M, et al. Interactions of hydrogen sulfide with myeloperoxidase. Br J Pharmacol 2015;172:1516–32. [CrossRef]