International Journal of Scientific Engineering and Research (IJSER)
www.ijser.in
ISSN (Online): 2347-3878
Volume 2 Issue 9, September 2014

Status of Lipid - Peroxidation, Superoxide Dismutase, Ascorbic Acid and Vitamin E in Osteoarthritis Patients

Shweta Dwivedi[1], Dr. Shreesh Singh[2], Dr. Geeta Jaiswal[3]

Department of gastroenterology, Department of pharmacology, Department of Biochemistry

Corresponding Author: Dr. Shweta Dwivedi, Clinical Biochemist (Lecturer), Department of Gastroentrology & Hepatology, Moti Lal Nehru Medical College, Allahabad, India

Abstract: ***Objective: Oxidative stresses are believed to function as primary degenerative mechanism in the development and progression of osteoarthritis. The exact oxidant and antioxidant status in osteoarthritis is not clear. The objectives of our study to evaluate the changes in oxidative stress marker (lipid-peroxidation), antioxidant enzyme (superoxide-dismutase) and non-enzymatic antioxidants in osteoarthritis patients. These patients are also suffering from anemia. Method:-This study was carried out in 100 osteoarthritis and 100 normal individuals are studied. Levels of Lipid-peroxidation were measured by Utley's method, Superoxide dismutase measured by Marklund's & Marklund's method, Ascorbic acid by Carl A Burtis method and vitamin E by Emer Engle method& Blood Hemoglobin by Cyanide method. Result:- Increased blood hemolysate MDA & Superoxide dismutase levels are found in OA as compared to control. Significantly decreased Hb%, Vitamin E & Vitamin C levels found in OA as compared to control. Conclusion: -The result shows increased oxidative stress and decreased non-enzymatic antioxidant in osteoarthritis patients.***

Keywords: osteoarthritis, oxidative stress, lipid-peroxidation (MDA), superoxide-dismutase, non-enzymatic antioxidant

1. Introduction

Osteoarthritis (OA) is the most common arthritic & the leading cause of chronic disability in the elderly. OA typically affects the knee, hip, cervical & lumber spine, distal interphalangeal, proximal interphalangeal, carpometacarpel and metatarsophangeal joints[(1)]. The etiology of Knee OA is multifactorial. Excessive musculo skeletal loading, high body index, previous Knee injury, female gender & muscle weakness are well-known risk factors [(2)].

Osteoarthritis (OA) is one of the most common chronic diseases that cause pain and physical disability in patients. Although OA is considered as a global disease affecting all joint tissues, cartilage degradation is the end point. The degradation of cartilage results from the combination of mechanical stress and biochemical factors, mainly metalloproteinases and ROS. The activity of ROS is balanced by enzymatic and non-enzymatic antioxidants, that act by inhibiting oxidative enzymes, scavenging free radicals or chelating ion metals[(3)].

Overproduction of ROS results in oxidative stress, a deleterious process that can be an important mediator of damage to cell structures, including lipids and membranes, proteins, and DNA [(4)]. Prime targets of ROS attack are the polyunsaturated fatty acids in the membrane lipids causing LPO which may lead to disorganization of cell structure and function. Further decomposition of peroxidized lipids yields a wide variety of end-products, including malondialdehyde (MDA) [(5)]. Measurement of MDA is widely used as an indicator of LPO [(6)].

Inflammation and oxidative stress are believed to function as primary degenerative mechanism in the development and progression of osteoarthritis [(7)].The term oxidative stress refers to the situation of a serious imbalance between production of reactive oxygen species and antioxidant defense [(8-9)]. [Chen & his colleges] [(10)] Discovered a high predisposition to free radical release and tissue damage in osteoarthritis. Other researchers have called attention to the role of the free radicals in actual destruction of joint tissue in osteoarthritis and emphasized the importance in utilizing antioxidant and free radical scavengers in treating the disease [(11)].

We hypothesized that oxidative stress would increase, whereas antioxidant status would decrease in osteoarthritis. Therefore, the purpose of this study was to evaluate the oxidative stress and antioxidant status in serum of osteoarthritis patients with anemia.

2. Patients and Methods

This study included 100 osteoarthritis patients diagnosed according to the ACR criteria for classification of OA [(12)] and 100 normal individuals with a median age of 50 years (range 30-60years). The results were compared with those of normal healthy controls of same age group. None of these subjects were chronic smokers or alcoholics and did not suffer from any diabetic complication. Venous blood was withdrawn without stasis before commencement of any treatment. Heparinised blood sample was used for the determination extent of lipid-peroxidation & superoxide-dismutase by Utley's method [(13)] & Marklund& Marklund's method [(14)], hemoglobin by Cynide method [(15)], ascorbic acid by Carl A Burtis method [(16)] & vitamin E by Emer- Engles method [(17)].

3. Statistical Method

All data were expressed as mean ± SD. The statistical significant was evaluated by the student t test. P< 0.001 was considered significant.

4. Result

The mean ± SD of blood Hb, MDA, SOD, Ascorbic acid and Vitamin E are reported in (Table-1) there was a statistically significant increase in (MDA) Lipid-peroxidation & Superoxide-dismutase levels in patients with osteoarthritis compared to control.

5. Discussion

The result of present study indicates higher oxidative stress in osteoarthritis patients, either due to increased extent of lipid-per oxidation. Excessive oxidative stress is thought to have an important role in the pathogenesis of autoimmune diseases by enhancing the inflammation, inducing apoptotic cell death, and breaking down the immunological tolerance [18]. The increased MDA level in our OA patients coincides with the results of Maneesh et al. [19] and Rubyk et al [20] who reported significantly increased serum MDA levels in OA patients compared to controls. Thus, these findings are in keeping with possible evidence of free radical production and damage in OA.

We observed a significant decrease in the levels of Hb%, ascorbic acid & vitamin E in patients with osteoarthritis when compared to controls. The decrease in Hb% similar results is found in other researches. The decrease in the levels of these non-enzymatic antioxidant parameters may be due to the increased turn over for preventing oxidative damage in osteoarthritis. [21, 22]

Vitamin E is one of the non-enzymatic antioxidant systems. Alpha-tocopherol is a major component of vitamin E that exhibits an antioxidant activity and which also plays a role in the prevention of cartilage degeneration [23]. In the current study, it appeared that vitamin E concentrations in serum of OA patients were significantly lower than those in healthy controls. Vitamin E may enhance chondrocyte growth, provide protection against ROS and RNS and exhibit an anti-inflammatory activity [24-26]. Moreover, several clinical studies which were done on vitamin E supplementation have shown the beneficial effect of vitamin E in OA patients [27-29].

Elevated SOD activity found in OA patients as compared to control. Similar results of SOD activity have been reported in patients with rheumatic diseases [30-32]. SOD is an important antioxidant enzyme having an antitoxic effect against superoxide anion. The over expression of SOD might be an adaptive response, and it results in increased dismutation of superoxide to hydrogen peroxide. Ostalowsk et al. [33] have reported increased activities of SOD in synovial fluid of patients with primary and secondary knee OA.

The result of present study indicate higher oxidative stress in osteoarthritis patients, either due to increased extent of lipid-peroxidation or due to decreased level of non-enzymatic antioxidants.

6. Conclusion

In conclusion, oxidative stress may be involved in osteoarthritis. The results of over study suggest higher oxygen free-radical production and decreased non-enzymatic antioxidant levels. An oxidant-antioxidant imbalance leads to pathophysiological effects which are associated with OA, such as joint inflammation, cartilage damage, and synovitis. The development of preventive and therapeutic approaches should be considered for OA, for decreasing oxidative stress and for increasing antioxidants in blood circulation and local tissues of OA patients. The result suggests that treatment with antioxidants at the initial stages of disease may prevent further oxidative injury in osteoarthritis.

7. Observation Table

Table 1: Levels of oxidative stress marker, hemoglobin and non-enzymatic antioxidant status in osteoarthritis and control groups

S.N.	*Particulars*	*Control (n=100)*	*Osteoarthritis patients (n=100)*
1	Lipid-peroxidation (µmol/MDA)	1.678±0.994	2.19±1.21
2	Superoxide dismutase (µg/Hb %)	2166±145	2377±38.5
3	Ascorbic acid (mg/dl)	0.87±0.25	0.53±0.07
4	Vitamin E (mg/dl)	o.907±0.25	0.45±0.03
5	Hemoglobin % (gm/dl)	12.29±0.79	10.69±2.01

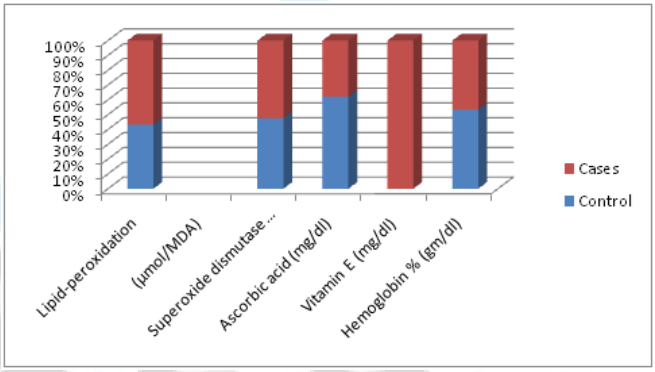

Figure 1: Levels of oxidative stress marker, hemoglobin and non-enzymatic antioxidant status in osteoarthritis and control groups

Reference

[1] Anandacoomarasamy A., March L. (2010).Current evidence for osteoarthritis treatments. Ther Adv Musculoskel Dis 2: 17-8. [PMC free article] [Pub Med]

[2] Takada H., Nakagawaten Engebresten L. (2011). Prevention and management of knee osteoarthritis and knee cartilage injury in sports. Br J Sports Med 45: 304-309. [Pub Med]

[3] Henrotin Y, Kurz B. Antioxidant to treat osteoarthritis: dream or reality? Curr Drug Targets 2007; 8(2):347–57.
[4] Valko M, Leibfritz D, Moncol J, Cronin MTD, Mazur M, Telser J. Free radicals and antioxidants in normal physiological functions and human disease. Int J Biochem Cell Biol 2007; 39:44–84.
[5] Gambhir JK, Lali P, Jain AK. Correlation between blood antioxidant levels and lipid peroxidation in rheumatoid arthritis. Clin Biochem 1997; 30:351–5.
[6] Romero FJ, Bosch-Morell F, Romero MJ, Jarenˇ o EJ, Romero B, Marı´n N, et al. Lipid peroxidation products and antioxidants in human disease. Environ Health Perspect 1998; 106:1229–34.
[7] G. M. Rao, Sreelaxmi, A. Naser, Vandana. "Reduced blood glutathione and erythrocyte stability in osteoarthritis". Biomedical Research; 2005:16 (3):201-203.
[8] Dalle- Donne, I., Rossi, R., Giustarini, D., Milzani, A. & Colombo, R. "Protein carbonyl groups as biomarkers of oxidative stress". Clin. Chim. Acta, 2003: 329, 23-38.
[9] Renke, J., Popadiuk, S., Korzon, M., Bugajckyk, B & Wozniak, M. "Protein carbonyl groups' content as a useful clinical marker of antioxidant barrier impairment in plasma of children with juvenile chronic arthritis". Free. Radic. Biol. Med. 2000, 29, 101-104.
[10] Chen BX, Francis MG, Duthie RB, Bromey L, Osman O. "Oxygen free radical in human Osteoarthritis". Chin Med J, 1989; 102: 931-933.
[11] Henrotien Y, Deby DG, Deby C, Franchimont P, Emerit I. (1992). Active oxygen species, articulr inflammation and cartilage damage. Exs ; 62: 308-322.
[12] American College of Rheumatology and HDC Committee on Clinical Guidelines. Guidelines for the management of rheumatoid arthritis. Arthritis Rheum, 1996: 39:713-22.
[13] Utley, H.G. Bernhein, F,& Hochstein, P. (1967) Arch. Biochem, Biophys, 118-28.
[14] Stefen Marklund & Gudrun Marklund. Involvement of the superoxide Anion Radical in the Autooxidation of Pyrogallol ana a convenient Assay for superoxide dismutase, Eur. J. Biochem. 47: 469-474.
[15] Beutler, E. (1984) Red Cell Metabolism: A manual of Biochemical methods, 3rd ed. (Graune & Stratton Inc. New York) 68-71.
[16] Burtis, C. A. (1994) Tiez Text book of Clinical Chemistry. 2 WEI.
[17] Hashim, S.A. & Schuttranger, G. (1996) Am. J. Clin. Nutrl August 19: 137-141.
[18] Kumagai S, Jikimoto T, Saegusa J. Pathological roles of oxidative stress in autoimmune diseases. Rinsho Byori 2003; 51(2):126–32.
[19] Maneesh M, Jayalekshmi H, Suma T, Chatterjee S, Chakrabarti A, Singh TA. Evidence for oxidative stress in osteoarthritis. Indian J Clin Biochem 2005; 20(1):129–30.
[20] Rubyk BI, Fil'chagin NM, Sabadyshin RA. Change in lipid peroxidation in patients with primary osteoarthrosis deformans. Ter Arkh 1988;60(9):110–3.21-22 missing
[21] Cimen MY, Cimen OB, Kacmaz M, Ozturk HS, Yorgancioglu R, Durak I. "Oxidant/antioxidant status of the erythrocytes from patients with rheumatoid arthritis". Clin Rheumatol ,2000: 19(4): 275-7
[22] Scherak O, Kolarz G, Scholdl C, Blankenhorn G. High dosage vitamin E therapy in patients with activated arthrosis. J Rheumatol1990; 49:369-73.
[23] Blankenhorn G. Clinical effectiveness of Spondyvit (vitamin E) in activated arthroses. A multicenter placebo-controlled double-blind study. Z Orthop Ihre Grenzgeb. 1986; 124:340–43. [PubMed]
[24] Machtey I, Ouaknine L. Tocopherol in Osterarthritis: a controlled pilot study. J Am Geriatr Soc. 1978; 26:328–30. [PubMed]
[25] Wang Y, Prentice LF, Vitetta L, et al. The effect of nutritional supplements on osteoarthritis. Altern Med Rev. 2004; 9:275–96. [PubMed]
[26] Stuyvesant VW, Jolley WB. Anti-inflammatory activity of d-alpha-tocopherol (vitamin E) and linoleic acid. Nature. 1967; 216:585–86. [PubMed]
[27] Canter PH, Wider B, Ernst E. The antioxidant vitamins A, C, E and selenium in the treatment of arthritis: a systematic review of randomised clinical trials. Rheumatology (Oxford) 2007; 46:1223–33. [PubMed]
[28] Blankenhorn G. Clinical effectiveness of Spondyvit (vitamin E) in activated arthroses. A multicenter placebo-controlled double-blind study. Z Orthop Ihre Grenzgeb. 1986; 124:340–43. [PubMed]
[29] Machtey I, Ouaknine L. Tocopherol in Osterarthritis: a controlled pilot study. J Am Geriatr Soc. 1978; 26:328–30. [PubMed]
[30] Sato M, Miyazaki T. "Antioxidants inhibit tumor necrosis factor-alpha meadiated stimulation of interleukin-8, monocyte chemo attaracted protein-1 and collagenase expression in cultured human synovial cells". J Rheumatol1996; 23(3):432-8.
[31] Cimen MY, Cimen OB, Kacmaz M, Ozturk HS, Yorgancioglu R, Durak I. "Oxidant/antioxidant status of the erythrocytes from patients with rheumatoid arthritis". Clin Rheumatol ,2000: 19(4): 275-7
[32] Scherak O, Kolarz G, Scholdl C, Blankenhorn G. High dosage vitamin E therapy in patients with activated arthrosis. J Rheumatol 1990; 49:369-73.
[33] Ostrakhovitch, E.A. and Afanas'ev, I.B. Oxidative stress in rheumatoid arthritis leukocyte: suppression by rutin and other antioxidants and chelators. Biochem.Pharmacol. 2001;62:743-746