Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/11421
DOI URL: http://dx.doi.org/10.21474/IJAR01/11421

RESEARCH ARTICLE

EFFECTIVENESS OF HYPERBARIC OXYGEN THERAPY FOR TREATMENT OF POSTMENOPAUSAL OSTEOPOROSIS -A CASE REPORT

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Manuscript Info

Manuscript History
Received: 28 May 2020
Final Accepted: 30 June 2020
Published: July 2020

Key words:-
Hyperbaric Oxygenation, Osteoporosis, Hyperbaric Oxygen Therapy, Postmenopausal Osteoporosis, Osteogenesis

Abstract

Postmenopausal osteoporosis is a common degenerative bone disease that can be challenging to manage when a patient does not respond to or tolerate conventional treatment plans like estrogen replacement therapy, bisphosphonates, and vitamin supplementation. This case represents a 63-year-old woman with refractory postmenopausal osteoporosis, who demonstrated measurable improvement in her bone density and bone turnover marker serum C-terminal telopeptide after completing hyperbaric oxygen therapy treatment. Hyperbaric oxygen therapy's effect on bone regeneration and remodeling warrants further studies on its effectiveness on improving bone health and as an adjunctive therapy option in osteoporosis patients.

Introduction:-

Postmenopausal osteoporosis is a common degenerative bone disease that can be challenging to manage when a patient does not respond to or tolerate conventional treatment plans.[1,2] Hyperbaric oxygenation's effects on osteoporosis has not been extensively studied but has shown other beneficial effects, including improved angiogenesis, decreased inflammation, reduced marrow edema, and an increase in circulating stem cells.[9] When a patient is not responding to conventional treatment, hyperbaric oxygen may be considered as a future adjunctive therapy, and the effect on bone regeneration and remodeling warrants further studies. We present a case of investigational outpatient hyperbaric oxygenation therapy in a postmenopausal female with advancing osteoporosis.

Case Presentation:-

A 63-year-old Caucasian postmenopausal female presented to an outpatient hyperbaric oxygen therapy facility for consultation regarding her advancing osteoporosis. The patient had been initially diagnosed with age-related osteoporosis at the age of 55 by her family medicine physician. Since diagnosis, the patient was unsuccessful with standard therapy and supplemental vitamins due to intolerance of the medication side effects; bisphosphonates (alendronate, risedronate) led to the development of muscle cramps and esophagitis. The patient was offered targeted therapy with the monoclonal antibody, denosumab, but refused to start therapy due to the fear of developing additional side effects. The patient attempted estrogen replacement therapy in addition to supplementation with calcium, vitamin K2, and vitamin D3, boron, and riboflavins yielding no improvement in bone mineral density. Over a four-year period, the patient lost 14% of her hip density and but did not experience any fractures. The patient's osteoporosis Fracture Risk Assessment Tool results indicated a 10-year probability of major osteoporotic fracture of 13%. Past medical history consisted of hypothyroidism and panic disorder, and she utilized levothyroxine

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for thyroid supplementation for the past 15 years. She does not smoke and nor does she drink alcohol or caffeine excessively. She considers herself physically active since she hikes, walks, and dances regularly during the week. The only family history of osteoporosis was identified in her cousin and aunt.

Hyperbaric oxygen therapy (HBOT) was initiated. The patient received 20 daily sessions over four weeks of hyperbaric treatment in a monoplace chamber. The patient understood the investigational nature of hyperbarics role in the treatment of osteoporosis prior to starting therapy. Each session consisted of hyperbaric therapy for 90-minutes at 2.0 ATA. Air breaks were provided during treatment to reduce the risk of oxygen toxicity, and the patient did not report any adverse reactions while receiving hyperbaric therapy. Baseline laboratory tests were performed and revealed thyroid function, phosphorus, 25-OH Vitamin D, calcium, and bone alkaline phosphatase levels all within normal ranges. Dual X-ray absorptiometry (DXA) scans and laboratory assays of serum bone alkaline phosphatase (bone ALP), and serum C-terminal telopeptide of cross-links of type I collagen (CTx) were obtained prior to and after hyperbaric therapy (Table 1). At the conclusion of therapy, the patient's serum CTx levels had decreased by 33%, indicating a general decrease in bone resorption. This is further supported by a decrease in serum bone ALP levels and slight improvement in bone mineral density based on lumbar DXA scans.

Discussion:-

Osteoporosis is the most common degenerative bone disease affecting 200 million women worldwide that is characterized by reduced bone density; osteoporosis leads to more than 8.9 million fractures a year.[1,2] Osteoporosis associated with a decrease in estrogen production in women aged 51 to 64 has been shown to increase the incidence of vertebral, radial, and ulnar fractures in its early stages, eventually progressing to more complex fractures involving the femoral neck in the absence of adequate treatment.[2] Clinicians identify long term osteoporotic changes by obtaining measurements of bone mineral density obtained via dual X-ray absorptiometry. Additionally, serum C-terminal telopeptide of type I collagen has been utilized as a bone turnover marker and can provide prognostic information on fracture risk.[3] As type I collagen is degraded during bone resorption, the c-terminal telopeptide is released, and this marker can also be used in the evaluation of the potential efficacy of osteoporosis treatment therapies.[4,5]

Key recommendations for the treatment of postmenopausal osteoporosis include calcium-vitamin D supplementation, bisphosphonates, and estrogen replacement therapy.[4,6,7] Some postmenopausal women do not respond to conventional therapy. The role of hyperbaric oxygen therapy in improving bone turnover and density has yet to be studied in women who do not adequately respond to conventional treatment. The beneficial effects of hyperbaric oxygen therapy include improved angiogenesis, decreased inflammation, reduced marrow edema, and an increase in circulating stem cells.[9] By elevating the plasma and tissue concentrations of oxygen, HBOT has been shown to increase the rate of osteoblast differentiation and osteoclast suppression, leading to a general shift towards bone regeneration. A study on femoral head necrosis patients revealed a reduction in bone lesion size and an increase in serum osteoprotegerin (OPG) in response to HBOT. The association of OPG and receptor activator of nuclear factor-kappa B ligand (RANKL), prevents RANKL from binding to its transmembrane protein in osteoclasts, receptor activator of nuclear factor-kappa B (RANK). Increased OPG will reduce RANKL/RANK binding, and osteoclastogenesis and bone resorption is inhibited.[8,9] According to Yano et al., postmenopausal osteoporotic women had higher levels of OPG than age-matched controls and higher OPG concentrations in osteoporotic patients with lower bone mass. It is theorized that the increased OPG level in osteoporotic women is a compensatory feedback response to increased osteoclast activity.[8,9]

This case represents a 63-year-old woman with refractory postmenopausal osteoporosis, who demonstrated measurable improvement in her bone density and bone turnover markers after completing hyperbaric oxygen therapy treatment. Hyperbaric oxygen therapy's effect on bone regeneration and remodeling warrants further studies on its effectiveness on improving bone health and as an adjunctive therapy option in osteoporosis patients.

Table 1:- Lumbar dual X-ray absorptiometry T-Score and serum C-terminal telopeptide of cross-links of type I collagen before and after initiating hyperbaric oxygen treatment.

Date	Lumbar DXA T-Score		Date	CTx Value (pg/mL)
2005	-1.5		2/2017	574
2008	-1.8		12/2017	598
2011	-2.7		5/2018	596

1/2019	**-3.8***		**11/2018**	**552***
2/2019	**-3.6****		**2/2019**	**377****
*Value at initiation of HBOT series **At conclusion of HBOT series				

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