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Case Report

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Will Long-Time Diving Lead to Chronic Kidney Disease?

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ABSTRACT

In recent years, the medical problems of divers, whose number has been increasing for scientific, recreational, industrial, and commercial purposes, are also increasing in parallel with the number of divers. Because of fewer studies on long-term medical problems of diving, healthcare professionals find it difficult to identify the underlying etiology. We aimed to present the etiologically suspicious conditions of 2 young male patients diagnosed with end-stage renal disease. The two young male patients shared a similar medical history, both of whom have had a kidney transplant and have dived in 10-15 m of seawater almost every day for over 10 years. Our aim is to study with this case report whether continuous, repetitive, and prolonged diving activities may be one of the risk factors of chronic kidney disease of unknown etiology.

Keywords: Chronic kidney disease, diving, kidney transplantation

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INTRODUCTION

There are more than 9 million recreational SCUBA (self-contained underwater breathing apparatus) divers in the United States alone, and another several hundred thousand new divers are trained annually.[1] The incidence of diving-related disorders has increased in accordance with this increasing population at risk.[2] Hypothermia, trauma, and submersion-related injuries are potential complications of diving. In addition, a variety of emergencies specific to diving may occur such as barotrauma, arterial air embolism, decompression sickness, nitrogen narcosis.[1,3] Barotrauma is the most common form of diving-related injury and develops when an air-filled body space fails to equilibrate its pressure with the environment following changes in ambient pressure. Its specific symptoms and signs are dependent upon the final location of gas emboli; the most serious clinical consequences occur with embolization to the cerebral and coronary arteries. Although it is a rare condition, embolization to the kidney can produce hematuria, proteinuria, and renal failure.[4] In the light of this information, we will present 2 young male patients diagnosed with end-stage chronic renal failure who have been diving for commercial purposes for about 10 years. They appeared to be chronic kidney disease (CKD) patients with an unknown cause at the first medical examination, but common features of these patients are long-term diving. We will discuss that in the light of the literature.

CASE PRESENTATION 1

Our 33-year-old male patient used to dive to collect fish feed (worms) in the Aegean Sea at a depth of 7-10 m almost every day between 2007 and 2019. In 2016, he was admitted to a hospital with complaints of weakness, fatigue and drowsiness, and burning in the feet. Renal failure was detected in the patient with no previous history of kidney disease. Also, there was no history of kidney diseases in the first-degree relatives of the patient. The patient with CKD on follow-up for 3 years in another center was admitted to our hospital in October 2019. At that time in laboratory tests, his fasting blood glucose

was 73 mg/dL, blood urea nitrogen (BUN) was 55 mg/dL, creatinine (Cr) was 5.28 mg/dL, sodium (Na+) was 137 mEq/L, potassium (K+) was 3.9 mEq/L, calcium (Ca++) was 9.2 mg/dL, phosphorus was 3.3 mg/dL, albumin was 3.9 g/dL, uric acid was 2.9 mg/dL, glomerular filtration rate (GFR) was 13 mL/dk/1.73 m^2.Complete blood counts (CBC) showed that white blood cell count was 4480/µL, hemoglobin (Hb) was 8.6 g/dL, and platelet count was 188/µL. Urinalysis showed urine density as 1010, and protein and erythrocyte were not detected. The amount of protein in 24-h urine was 219 mg/day. The urinary ultrasonography (USG) showed right kidney dimensions as 96 × 32 mm, left kidney dimensions as 85 × 33 mm, and parenchymal echoes had a grade 2 increase.

The patient has undergone a successful pre-emptive living kidney transplant operation, has good graft functions, and still has been followed up regularly in our center. There was no history of alcohol, narcotics, and drug use other than smoking in the medical history of the patient. The diseases such as diabetes mellitus (DM) and hypertension (HT), urological diseases, autoimmune diseases, and Fabry disease were not detected in the medical examination of the patient.

CASE PRESENTATION 2

Our 28-year-old male patient used to dive almost every day in the Aegean Sea to collect mussels at a depth of 5-15 m between 2008 and 2019 (except 2012-2013). He was admitted to the hospital with complaints of weakness, fatigue, nausea, vomiting, and high blood pressure in February 2019. After medical examination, the patient with no previous history of kidney disease was diagnosed with stage 5 CKD in March 2019.

In laboratory tests, his fasting blood glucose was 100 mg/dL, BUN was 107 mg/dL, Cr was 9.86 mg/dL, Na+ was 137 mEq/L, K+ was 4.44 mEq/L, Ca++ was 9.4 mg/dL, phosphorus was 3.7mg/dL, albumin was 4.5 g/dL, uric acid was 4.3 mg/dL, GFR was 6 mL/dk/1.73 m^2. White blood cell count was 11 140/µL, Hb was 12.4 g/dL, and platelet count 239 000/µL in CBC. Urine analysis showed urine density as 1012, and protein trace and erythrocyte was not detected. The amount of protein in 24-h urine was 220 mg/day. In blood gas, pH was 7.22, HCO_3 was 18.6 when detected. Kidney sizes were normal on urinary USG, but renal parenchyma echo was observed as grade 3. Upon the development of uremic complaints, hemodialysis treatment was started by inserting a jugular catheter. There were not any illness, drug, and narcotic use in the medical history of the patient. There were no clinical findings implicating systemic vasculitis and collagen tissue diseases, and acute phase reactants and autoantibody tests were normal. There was no history of kidney diseases in the patient. There was no history of genetic or renal disease in 10 siblings of the patient and he had no history of chronic disease. His 26-year-old brother was a compatible donor candidate for kidney transplantation and all of his examinations (in terms of autoimmune diseases, Fabry disease, Alport syndrome, urological anomalies, etc.) were found to be normal. At the same time, there was no obstacle for kidney transplantation in all examinations including genetic tests of the recipient candidate. Due to the COVID-19 pandemic that started in March 2020, the kidney transplantation operation was first postponed to a later date. The kidney transplant of the patient was performed in September 2020, his brother being the kidney donor. Now the patient is in a good clinical condition and has good graft functions.

DISCUSSION

Medical conditions related to diving are one of the unfamiliar subjects among healthcare providers. In both patients with the history of continuous and repetitive diving for 10 years, it raised doubts whether kidney failure may have been developed as a result of the adverse effects of barotrauma and the consequence of adverse effects of air embolism. Arterial air embolisms have direct or indirect effects on the kidney.[5-9] In direct effect, air in the arterial circulation can occlude the microcirculation and cause ischemic end-organ damage. In indirect effect, secondary effects of an air embolism can also result in end-organ damage. Possible underlying pathophysiological mechanisms and air bubbles in the pulmonary microcirculation are associated with local endothelial damage and the accumulation of neutrophils, platelets, fibrin, and lipid droplets at the gas-fluid interface. Although it is a very rare condition, acute kidney injury has also been reported in divers. The underlying pathophysiological mechanism might be the release of inflammatory cytokines as the reason for gas embolism and endothelial dysfunction in response to gas embolism.[10-11] Research on the kidney diseases caused by repetitive, long-term diving are extremely rare. According to a study on women from South Korea, who traditionally dive for commercial purposes (Haenyeo), CKD can be seen twice as common compared to non-divers women. Although the exact mechanism for the negative effect of long-term diving on kidney function is not yet known, it has been suggested that prolonged underwater apnea episodes may lead to kidney ischemia.[12] Experimental studies have shown that long-term intermittent hypoxia caused kidney damage in laboratory rats (13). Apart from this, it has been suggested that hematuria and proteinuria may be seen in the kidney as a consequence of long-term and continuous diving.[4]

As a result, the patients with the history of repetitive and long-term diving should be regularly followed up for kidney function. Given the lack of data on the negative effects of continuous diving on kidney functions, future studies might shed light on diving-related medical conditions.

Informed Consent: Written informed consent was obtained from all participants who participated in this study.

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