

Pulmonary Overinflation Syndrome in an Underwater Logger

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Summary

Pulmonary overinflation syndrome (POIS) is a group of barotrauma-related diseases caused by the expansion of gas trapped in the lung, or over-pressurization of the lung with subsequent over-expansion and rupture of the alveolar air sacs. This group of disorders includes arterial gas embolism, tension pneumothorax, mediastinal emphysema, subcutaneous emphysema and rarely pneumopericardium. In the case of diving activities, POIS is rarely reported and is frequently related to unsafe diving techniques. We report a classical case of POIS in an underwater logger while cutting trees for logs in Tasik Kenyir, Terengganu. The patient, a 24-year-old worker, made a rapid free ascent to the surface after his breathing equipment malfunctioned while he was working underwater. He suffered from bilateral tension pneumothoraces, arterial gas embolism giving rise to multiple cerebral and cerebellar infarcts, mediastinal and subcutaneous emphysema as well as pneumopericardium. He was treated in a recompression chamber with hyperbaric oxygen therapy and discharged with residual weakness in his right leg.

Key Words: Pulmonary overinflation syndromes, Underwater logger, Underwater logging, Recompression chamber, Hyperbaric oxygen therapy

Introduction

Pulmonary overinflation syndrome (POIS) is a group of barotrauma-related diseases caused by the expansion of gas trapped in the lung, or overpressurization of the lung with subsequent overexpansion and rupture of the alveolar air sacs. This group of disorders includes arterial gas embolism, tension pneumothorax, mediastinal emphysema, subcutaneous emphysema and rarely pneumopericardium¹. This classical syndrome is rarely reported and is related to mechanical underwater pressure in unsafe diving activities when a diver makes a rapid ascent to the surface.

Statistics of diving accidents from the Institute of Underwater and Hyperbaric Medicine (IUHM) showed that about 75 underwater loggers out of 182 divers (41.2%) received treatment at the Armed Forces Hospital Lumut from 1996 to 2004. They were all from Thailand, working in Tasik Kenyir, Terengganu and Tasik Temenggor, Perak. The majority of cases were decompression illness (DCI) (97.3%) followed by a case of POIS and a case of sinus barotrauma².

We report a classical case of POIS in an underwater logger engaged in underwater logging activities in Tasik Kenyir, Terengganu. This report is based on the medical admission record of the patient at the Armed Forces Hospital Lumut in 2003.

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A Case Report

The patient, a 24-year-old Thai citizen, worked at a timber concession in Tasik Kenyir, Terengganu. His routine task was to dive and cut the logs underwater at depths that varied between 15 and 50 meters. He performed repetitive dives in a single working day in order to harvest the logs. He had air supplied from the surface through a makeshift breathing apparatus.

On the day of the incident, while he was cutting timber underwater at the depth of 25 meters, his breathing apparatus suddenly malfunctioned and he ran out of breathing air. He made a rapid free ascent to the surface without following proper diving procedures. After reaching the surface, he became drowsy. He also complained of chest pain and difficulty in breathing. His fellow workers brought him to a government hospital in Terengganu. He was then referred to the Armed Forces Hospital Lumut for recompression treatment.

On admission, he was drowsy but able to follow command. Vitals signs were stable. There was a diffuse swelling over his face and neck region where palpable crepitations were felt over the chest, neck and face. Chest examination findings showed hyper-resonance and increased air entry over the right and left lungs. The power of his right upper limb was 4/5 and there was complete paralysis of his right lower limb.



Fig 1 : MRI showing extensive infarcts with cerebral oedema at the left parietal region due to arterial gas embolism

His chest radiograph showed bilateral pneumothoraces, mediastinal emphysema, a small pneumopericardium and subcutaneous emphysema over the neck region. Magnetic resonance imaging (MRI) of the brain showed multiple areas of cerebral and cerebellar infarction (Figure 1).

Chest drains were inserted. He was recompressed and given hyperbaric oxygen therapy (HBOT) in a recompression chamber. HBOT was based on the treatment format of the British Royal Navy using Tables RN 62 and RN 61 at the depth of 18 meters and 14 meters, respectively. He stayed in the ward for three weeks and HBOT was repeated 16 times followed by lower limb muscle exercises. He was discharged with mild residual weakness of his right lower limb.

Discussion

This patient is a classical case of POIS. He suffered bilateral tension pneumothoraces, arterial gas embolism giving rise to multiple cerebral and cerebellar infarcts, mediastinum and subcutaneous emphysema as well as pneumopericardium.

Underwater logging is a dangerous activity which may result in barotrauma. Barotrauma refers to trauma or damage caused to body tissues by the mechanical effects of a pressure differential (between a body cavity and the hydrostatic pressure surrounding the body). Pulmonary barotrauma of ascent is more frequent and serious because of the inverse relationship between pressure and volume of gas (according to equation of the Boyle's Law)¹.

In this case, due to the malfunctioning breathing equipment, the worker had to make a quick ascent to the surface without allowing the gas or air to escape. According to Godden et al, the most common situations in which barotrauma of ascent (with risk of arterial gas embolism, pneumothorax and mediastinal or subcutaneous emphysema) occur is when compressed gas or air runs out at depth or during loss of buoyancy control during a rapid uncontrolled ascent³. This may result in overpressurization and overexpansion of the gas in the alveolar sacs, which can cause rupture of the alveolar wall. This then leads to escape of the gas into the hilum and mediastinum (mediastinal emphysema), the pericardium (pneumopericardium) or the pleural space (tension pneumothorax). Gas may also enter the pulmonary venous system leading to arterial gas embolism and into systemic circulation¹.

CASE REPORT

The definitive treatment of POIS is to recompress the injured divers in recompression chambers as soon as possible. Recompression with HBOT must be started immediately to force obstructing air or gas bubbles into solution and restore blood flow. Before starting the recompression treatment, a chest radiograph should be taken to rule out pneumothorax which if present necessitates chest tube insertion. Other treatment modalities of POIS include immediate basic life support (cardiopulmonary resuscitation) when the patient surfaces as well as adequate hydration. Early referral to a recompression chamber facility is vital in order to save lives. Delay in recompression treatment may lead to death or permanent residual morbidity.

In Malaysia, most diving activities are not well supervised. Abd Halim Mohamed reported that underwater loggers generally have no prior diving

training, perform incorrect diving techniques and use faulty breathing equipments⁴. As a step to prevent any occurrence of diving accidents among underwater loggers, the Department of Occupational Safety and Health has published a protocol for underwater logging activities in 2004⁵. It contains procedures and checklists for the enforcement of OSHA 1994 for underwater logging activities. It also discusses pre-employment medical examinations and medical surveillance.

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