FIRST REPORT OF DECOMPRESSION SICKNESS (DCS) IN A SEI WHALE (*Balaenoptera borealis*) STRANDED IN SOUTHERN PENINSULAR MALAYSIA

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ABSTRACT. Decompression sickness, a condition in whales caused by bubble formation in certain body tissues from dissolved inert gases. It occurs during transition from a high pressure environment to one of lower pressure, resulting in a range of conditions from itching to joint pain, convulsions, and death. A carcass of a stranded Sei Whale, *Balaenoptera borealis*, found on the shores of southern coast of Peninsular Malaysia was presented for postmortem. Investigation results showed that the male Sei Whale, named *Si Corner* showed pathologic lesions as seen from histology with the formation of fibrosis, emphysema and edema in the lungs and hepatic atrophy which indicated chronic starvation. It believed that he also suffering from "Barotrauma or decompression sickness" which affected the ear or lungs which lead to unbalanced movement due to changes in air pressure. This may have caused the whale to beach and consequent mortality. The pathologic lesions found give an insight into possible causes of death of beached whales in Malaysia.

Keywords: sei whale; *Balaenoptera borealis*; barotrauma; decompression sickness*;* Peninsular Malaysia.

INTRODUCTION

The sei whale *Balaenoptera borealis* is the third largest member of the Balaenopteridae family, after the blue whale *B. musculus* and the fin whale *B. physalus*, and is one of the least known mysticete whales. The species is cosmopolitan, inhabiting the world's temperate to subpolar oceans, with

generally antitropical distribution centred in temperate zones. Sei whales are thought to undertake seasonal migrations from low-latitude wintering areas to high-latitude summer feeding grounds. The locations of winter calving grounds are unknown (Perry *et al*., 1999), and summer distribution on the feeding grounds exhibits great year-to-year variability (Jonsgård and Darling 1977). Throughout their range, sei whales occur predominately in deep waters. Sei whales feed primarily on calanoid copepods and euphausiids, although small schooling fishes and squid form an important part of their diet in some areas (Horwood J, 1987).

Decompression sickness (DCS) is the syndrome associated with the liberation of gas originally held in solution into a free gas phase within the tissues of the body consequent to a reduction in barometric pressure. This gas phase can most easily be detected in the form of venous bubbles. They are called venous gas emboli (VGE) (Nishi RY., 1993). Arterial gas embolism (AGE) occurs secondary to pulmonary barotrauma when gas is forced into the pulmonary vasculature. There are a few earliest, syndrome of DCS such as Bends, Chokes and Skinny bends.

Bends is characterized by deep, boring pain in a large joint. The hips, elbows, and knees are most commonly affected. Symptoms generally occur within 6 h of exposure but on occasion will first develop as long as 12 to 24 h after exposure. The term, bends is most often used to describe the syndrome of musculoskeletal pain (i.e., spinal cord bends, skin bends, etc.). Surprisingly little is known about its pathophysiology.

Chokes. When symptoms of cough, substernal chest pain (usually described as burning), and shortness of breath with or without hemodynamic collapse occur. This form of (cardiopulmonary) DCS is thought to be due to an extremely high load of VGE in the pulmonary artery. Increased pulmonary artery and right ventricular pressures, possibly associated with the generation of increased interstitial fluid, play a major role in the development of this form of DCS. It is most commonly seen in the period immediately following decompression.

Skin (or skinny) bends. There are a variety of cutaneous signs and symptoms associated with decompression, and not all are specifically classified as DCS. When one is decompressed in a chamber, after a relatively deep and brief exposure in a dry environment, diffuse cutaneous itching is a frequent if not uniform experience. This symptom is thought to be due to transcutaneous passage of gas and therefore is almost never seen in a wet environment. It is generally considered to be a benign consequence of exposure and not usually treated with recompression.

This paper reported the decompression sickness (DCS) in a sei whale (*Balaenoptera Borealis)* stranded in southern Peninsular Malaysia.

MATERIALS AND METHOD

On February 2016, a sei whale (*Balaenoptera borealis*) named 'Si Corner' by villagers was found stranded 50 meters from Rambah Beach, Pontian, Johore, and was subsequently found dead after being stuck in the mud. The *Balaenoptera borealis* weighing 9 tons and measuring 11.9 m in length, male whale, was declared as an endangered species by the International Union for Conservation of Nature (IUCN). These mammals are reported to swim as far as 90 nautical miles from Pontian before being stranded in the estuary of Sungai Sarang Buaya, Semerah, Batu Pahat. Necropsy was done *in-situ*. Samples of fresh lung, liver, spleen, kidney and lymph nodes were sent for virus confirmation named poxvirus, herpesvirus and mobilivirus by PCR; bacteriology and fungus isolation; liver, spleen and lung were fixed in 10% buffered formalin. Samples were processed according to routine procedures and stained with hematoxylin and eosin (H&E) for histopathology. The worms were preserved uncompressed in 70% GL ethanol and were sent for helminth identification while liver, kidney, and stomach content were sent for toxicology test.

RESULTS AND DISCUSSION

Details of results from the investigation are shown as in figures below

a) Necropsy finding

On physical observation, it was found that the skin on his entire body was sloughing off. Teeth that act as a filter was covered with mud. The skin around the blowhole was also filled with mud. The left lateral side of the abdomen appeared swollen with bulbous raised swellings approximately 2-5 cm in diameter. When tapped, the surface of the dermis was frothing and bruised. There is a scratch in the tail between the flukes and caudal pendacles. Necropsy revealed esophagus and trachea filled with dense mud, diaphragm was collapsed and filled with mud. Lung was dark grey in color and when incised the mud and blood oozed out with a large amount of bubbles from the cut surface, haemopericardium, greyish liver filled with mud and oozed a large amount of bubbles from the cut surface, and so was the spleen and stomach was fill with mud. Duodenum was hyperaemic and there were approximately 200 worms; orange in colour, 2 cm in length attached to the mucosa. See Figures 1 to 4.

b) Laboratory Finding

The PCR test revealed negative result for poxvirus, herpesvirusand

Figure 1. Teeth filled with mud.

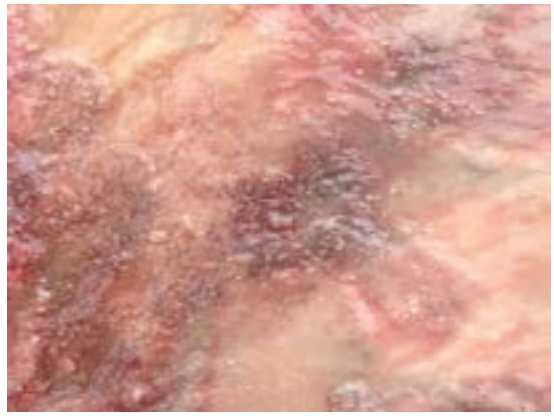

Figure 2. Epidermis become bruises and present of large amount of bubbles.

Figure 3. Liver was dark grey and filled with mud. Bubbles oozed out from the cut surface.

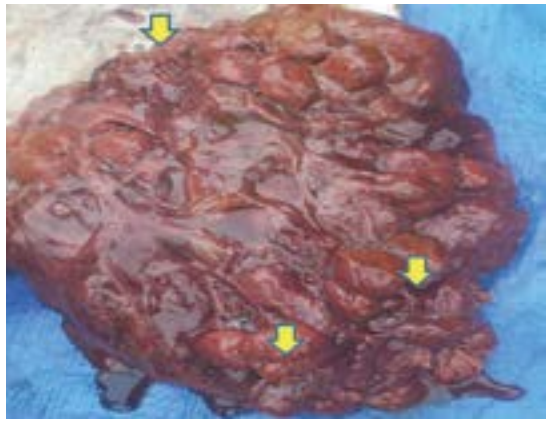

Figure 4. Congested and globulated kidney with bubbles oozing out from the surface.

Figure 5. Adult *Balbosome sp,* orange in colour

Figure 6. Mouth part with hooks [Light microscope x 40]

mobilivirus. While *V. parahemolyticus* and *Edwardsiella tarda* was isolated from organs. Duodenal parasite was confirmed as Acanthocephalan under Nematode group, and identified as *Balbosome* sp. which is also commonly known as "thorny-headed" worms. The worm *Balbosome* sp. was measured as 30 mm long and 1mm in width. The body is cylindrical and is covered with a thick cuticle (Figures 5, 6,

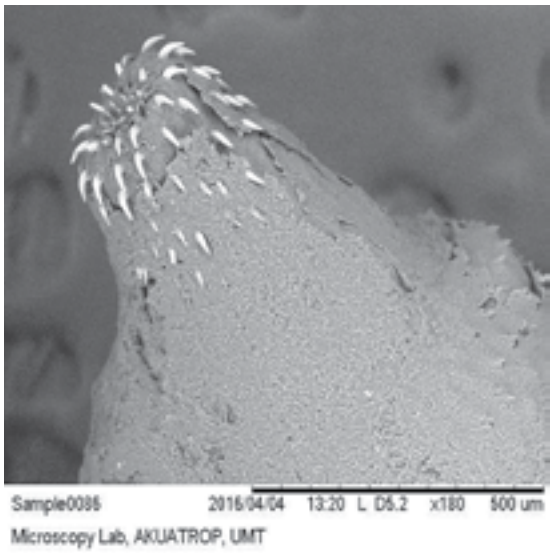

Figure 7. *Bolbosoma* sp. (a) adult body is cylindrical and is covered with a thick cuticle [Table-top electron microscope, 500 mm].

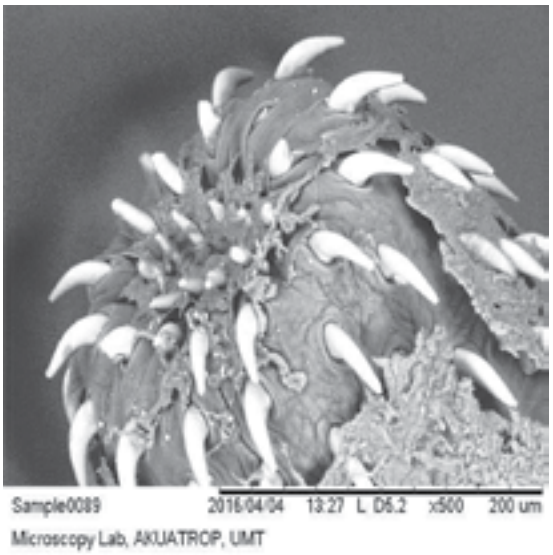

Figure 8. The anterior part of the proboscis had slender apical hooks, robust median hooks and reduced basal hooks [Table-top electron microscope, 500 mm].

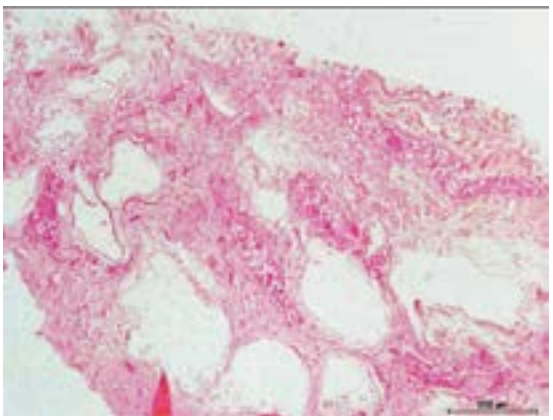

Figure 9. Lung – emphysema and congestion had lead to poor gas exchange [×40, HE]

Figure 10. Alveolar – presented with hyaline membrane lining the alveolar wall [×400, HE]

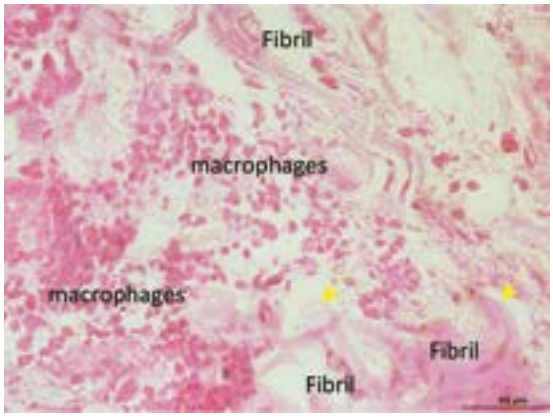

Figure 11. Lung – presented with string of fibril, fibrocytes and macrophages which indicate a chronic stage [×400 HE].

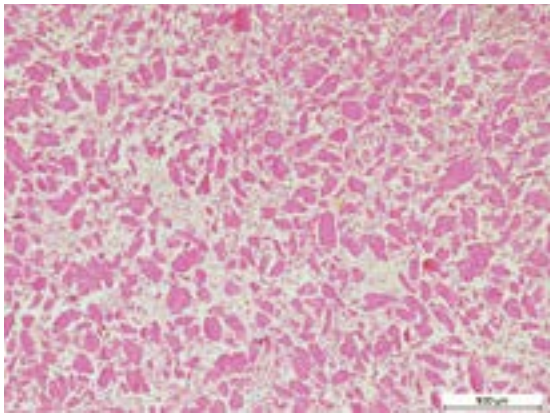

Figure 12. Liver – Disarranged hepatocytes cells and hepatic atrophy indicating chronic starvation [×200 HE]

7 and 8). The anterior part of the proboscis had slender apical hooks, robust median hooks and reduced basal hooks.

The histological examination revealed no infection and no toxicity in all vital organs. The lung revealed emphysema and congestion which lead to poor gas exchange (Figure 9). Alveolar structure revealed the hyaline membrane lining the alveolar wall with severe pulmonary congestion and emphysema which lead to formation of macrophages and hyaline membrane (Figure 10). There was also the presence of strings of fibril, fibrocytes and macrophages which indicated chronic stage of pathologic changes (Figure 11). The liver revealed chronic starvation with disarranged of hepatocytes cells and hepatic atrophy (Figure 12).

DISCUSSION AND CONCLUSION

Cetacean stranding is a phenomenon in which cetaceans strand themselves on land, usually on a beach. Beached whales often die due to dehydration, collapsing under their own weight, or drowning when high tide covers the blowhole (Blood and Matt, 2012). Every year, up to 2,000 animals beach themselves (*Martin and Anthony, 1991).* Although the majority of stranding result in death, they pose no threat to any species as a whole. Only about 10 cetacean species frequently display mass beaching, with 10 more rarely doing so. Stranding can be grouped into several types. The most obvious distinctions are between single and multiple stranding. The carcasses of deceased cetaceans are likely to float to the surface at some point; during this time, currents or winds may carry them to a coastline. Since thousands of cetaceans die every year, many become

stranded posthumously. Most carcasses never reach the coast and are scavenged or decomposed enough to sink to the ocean bottom, where the carcass forms the basis of a unique local ecosystem called whale fall. Single live stranding are often the result of illness or injury, which almost inevitably end in death in the absence of human intervention. Multiple stranding in one place are rare and often attract media coverage as well as rescue efforts. Even multiple offshore deaths are unlikely to lead to multiple stranding due to variable winds and currents.

Whale stranding occur in many parts of the world, and we don't know why. Scientists are still searching for the answers that will unlock this mystery. There are many theories about why whales sometimes swim into shallow water and end up stranding themselves on beaches in various parts of the world. Some scientists have theorized that a single whale or dolphin may strand itself due to illness or injury, swimming in close to shore to take refuge in shallow water and getting trapped by the changing tide. Because whales are highly social creatures that travel in communities called pods, some mass stranding may occur when healthy whales refuse to abandon a sick or injured pod member and follow them into shallow water. Many beached whales in stranding associated with sonar also show evidence of physical injuries, including bleeding in their brains, ears and internal tissues. In addition, many whales stranded in areas where sonar is being used have symptoms that in humans would be considered a severe case of decompression sickness, or "the bends," a condition that afflicts SCUBA divers who resurface too quickly after a deep dive. The implication is that sonar may be affecting the whales' dive patterns. Other possible causes put forth for the disruption of whale navigation system, causing them to lose their bearings, stray into shallow water, and end up on the beach. These include weather conditions, diseases (such as viruses, brain lesions, parasites in the ears or sinuses), underwater seismic activity (sometimes called seaquakes), magnetic field anomalies; and unfamiliar underwater topography.

Si Corner could have had respiratory problems earlier that made him being left behind by his group and get stuck in the muddy coastal areas. This can be seen in histology with the formation of fibrosis, emphysema and edema in the lung and hepatic atrophy which indicate chronic starvation. It is believed that he also was suffering from "barotrauma" or "decompression sickness (DCS)" whereby causing ear or lung problems which lead to unbalanced movement due to different changes in air pressure. Decompression sickness starts with the formation and increase in size of extravascular and intravascular bubbles when the sum of the dissolved gas tensions (oxygen, carbon dioxide, nitrogen, helium) and water vapor exceeds the local absolute pressure. Barotrauma or decompression sickness (DCS) can be defined as a severe pain in muscles and joints, cramp, and difficulty

in breathing, caused by a sudden and sustained decrease in air pressure, resulting in the deposition of nitrogen bubbles in the tissues due to a sudden drop in external pressure, as during a too rapid ascent from diving, and resulting in pain in the lungs and joints and faintness. A syndrome, including bends, chokes, neurological disturbances, and collapse. However, no evidence of infection or toxicity was identified in these case.

In conclusion, the sei whale may have had some pathological condition related to the respiratory tract allowing it to have barotrauma which led to its subsequent inability to eat, swim and keep up with the rest of the herd, and finally beached and death. The presence of heavy worm burden may have contributed to its poor body condition too. This information is vital to understand the logistics in dealing with beached whales in future and knowledge on current conditions in whales.

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