Disorientation Stress with Jet-Splashing into the Sea: The Survival of INS Admiral Peter Debrass

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In 1912 one of the first seaplanes developed was the Short S-27 and its derivative, the Short-Sommer biplane. These were a series of early British aircraft that were used by the Naval Wing of the Royal Flying Corps for training the Royal Navy's first pilots. In the beginning these Short aircraft were towed to early aircraft carriers by camel, launched onboard by catapult, and then recovered back onboard with trolley-trap arrester-wires. There were many accidents resulting in ditching at sea. After World War II, with the first use of jet aircraft flying off of more advanced aircraft carriers, accidents occurred more frequently, often with fatal ditching at sea. To align the ship, the aircraft, the sea, the wind, and atmospheric forces, each with differing vectors and mechanical forces, was always a challenging proposition.

Escaping from a naval aircraft that has splashed down at sea with a locked canopy is similar to escaping from a London bus that is being dropped into the sea from a height of 50 ft. During the 1950s and early 1960s, 30% of the aircrews failed to escape from these ditching incidents. Even more challenging and tragic were escapes from aircraft that after ditching rapidly became submerged. A long series of tragic ditching accidents occurred that was marked by many heroic deaths and resulted in many posthumous awards. Efforts were made to improve the system by developing new escape equipment and providing more intensive training for the men who flew them. Underwater escape procedures were tested using canopy seats with ejection guywires.[6]

The Indian Navy selected a light naval fighter bomber from the types available from the British. The Sea Hawk jet aircraft was deployed by the Indian Navy with the first successful landing at sea on the Indian carrier INS *Vikrant* in 1961. The officers of the Royal Navy were entrusted with training the Indo-British crew. Many experienced British and Indian pilots lost their lives during ditching at sea before the Hawker-Harriers replaced the Sea Hawks in 1979. In the case of ditching accidents, the reliability and safety of these newly developed escape systems, such as the Martin-Baker ejection seat, also depended greatly on individual judgment and human physiological factors. Indian Navy pilot Commander Peter Debrass was the pioneering survivor who lived to recount his experience after a faulty catapult launch (**Fig. 1**). Debrass was the squadron commander onboard the INS *Vikrant* when he was launched off in his Sea Hawk fighter 100 nmi west of Goa on March 4, 1976. A briefing on aircraft emergencies, including the underwater ejection procedures, had been performed just before his takeoff, as was mandatory on all flights. Despite losing control of his aircraft followed by a steep turn into the water, he was able to complete a successful ejection from underwater at a greater depth than ever experienced by a pilot before. His survival is an example of human performance under extreme stress in highly turbulent and disorienting conditions underwater.

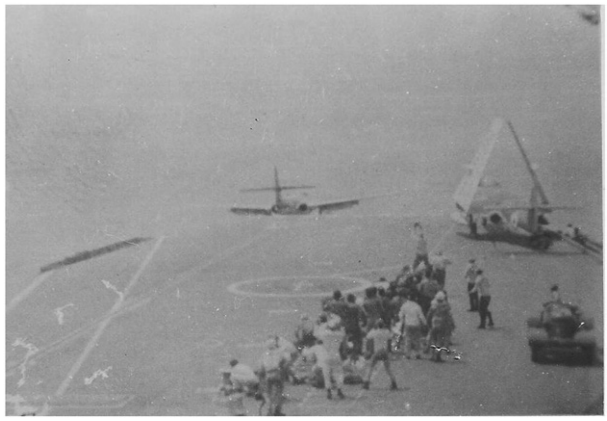

Fig. 1. The faulty catapult launch of Cmd. Debrass in his Sea Hawk fighter onboard the INS *Vikrant* in 1976.

Physiological responses such as autonomic conflict, bradycardia, arrhythmias, an increased heart rate by 20%, and breath holding leading to a 200% increase in pulmonary volume are known to be pilot adaptations to underwater escape. The large expiratory volumes would have reflected the need to wash out carbon dioxide.[1,2,7] Debrass's cardiorespiratory responses were undoubtedly enhanced by the training he had received in respiratory control. The initial cardiac arrhythmias he experienced on submersion were mainly asymptomatic and managed well by this individual because of his young age and extreme physical fitness. Responses such as this still need to be measured more precisely, to better understand the changes in cardiac output as can be evaluated by noninvasive rebreathing. Certainly, these changes could not be monitored in Peter Debrass at the time of his ejection. More recently, Actiwatch and Actiheart monitors in water immersion studies and in parabolic flights show that reclining or squatting positions minimize the effects of changes in gravitational force on heart rate.[10]

Postural changes such as trunk-motion counts drop by 50% in hypergravity conditions. Hypogravity also leads to differences in the kinematics of the ankle, knee, and hip movements as well as to an approximate 30% decline in isokinetic strength. Underwater

From New Delhi, India.

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postural disorientation is also associated with a reduction in trunk motion. Movements of the ankle, knee, hip, and lumbar regions shift the center of mass horizontally and backward,[4,5] exacerbating postural disorientation.

In Debrass's own words; "*I nose-dived into the water at an angle of around 60 degrees ahead of the ship… in pitch black conditions, with the cockpit completely full of sea water, I braced myself, took a deep breath, I activated the ejection mechanism and ejected 50 to 60 feet below water with … tremendous pressures and turbulence on my body. ... I immediately began pushing myself away from the ship's side with my hands. I tried to kick away with my feet but could not feel the ship's side with my feet. I felt the water very turbulent and though I fought it, the suction effect was keeping me against the side. I then bodily pushed away from the ship's side by the water pressure … which means I most probably crossed under the ship from left to the right side*" (Debrass PA. A date with Lord Varuna. Personal communication; July 1993).

He had waited the stipulated 9–10 s that he was trained to do in pitch black conditions with the cockpit becoming completely full of sea water. He then used his hands to prevent being pushed into the side of the ship. He tried also to use his legs but was unable to reach the hull with his feet. He recalled that the water was very turbulent, and a suction effect pressed him against the side of the ship. Later he was luckily pushed away from the ship by the water currents. He believed that he had been pushed away and crossed under the ship from left to right. With arms moving deliberately to keep from flailing out of control, he was able to reorient himself and float toward the surface.

Following his recovery, the only major clinical sign noted in Peter Debrass were bruised arms, indicating a whole-body adaptation to this extreme disorientation stress. The deeper understanding of the physiological basis for the postural reflexes exhibited during near-fatal underwater escapes, based on the primordial fright-flight response, makes this historical survival by Peter Debrass worth noting. Studies of such events enable improvements to be made in the escape equipment and the ability of crews to deal with future emergencies. Air Force pilots have also described the initial symptoms of forced ejections in air such as blacking out, being dazed yet still conscious, or as a shock that is gradually decreased[8] by physiological adaptations. These pilot experiences in turbulent energy fields are similar to what happens during spaceflight to an astronaut following roll rotation when his perception of the vertical is reestablished and self-righting is again possible.[3,9]

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