Case Report

Hypoxia : the silent operator in helicopter flying Wg Cdr P

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ABSTRACT

Somewhere in the Eastern Sector an unpressurised helicopter took off from a fighter base for a hill training sortie. The pilot was tasked to undertake helipad-training sortie at an altitude of around 18,900 ft. The helicopter carried our three circuit approaches of a helipad at an altitude of around 16,000 ft and then proceeded to the second helipad located at 18,900 ft. Two uneventful approaches terminating in a hover were carried out successfully. During the third approach, at short finals, the ground speed and / or ROD was suddenly perceived to be high for which the pilot took brisk corrective actions resulting in an over pitching with sudden increase in ROD. Further corrective actions on the part of the pilot led to a port side drift of the helicopter. The helicopter impacted the ground on the right skid and toppled to the left. The crew and passenger came out safely. Strip examination of the aero engine and main gearbox did not reveal any malfunction. The accident was labeled as a human error accident. The possible underlying role of hypoxia is discussed in the article.

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Key Words : Helicopter crash, hypoxia, human error accidents

Hypoxia is an aviation stressor, which needs no introduction. It is well known that hypoxia sets in silently and insidiously without giving any kind of forewarning to the individual. Cheetah helicopters have been flying in the IAF and the Indian Army for more than two decades and more so on hilly and mountainous terrain. They have been flying at altitudes, which can cause an appreciable degree of hypoxia. It is well known that acclimatization improves one's tolerance to hypoxia, therefore, the aircrew who are routinely positioned at altitudes greater than 10,000 ft are better tuned to withstand the early stages of hypoxia. This is not the case with the aircrew who take off from near sea altitudes. If a perfect oxygen system was available for these pilots, as in fighter aircraft, there would be no problem, but as is well known that a perfect oxygen mask - helmet system for

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unpressurised helicopter pilots has been eluding us for the last two decades [1] and that the unpressurised helicopter pilots are still resorting to the antiquated pipestem system of breathing oxygen. The issue, thus, invites solemn scrutiny.

A case of an unpressurised helicopter crash at an altitude of 18.900 ft is presented in which the accident was finally labeled as a human error accident. The underlying possibility of hypoxia having played a significant role in contributing to the accident is discussed. It also brings forth the urgent need to address the long overdue requirement of acquiring a perfect integrated oxygen mask - helmet for the helicopter pilots.

Case Report

A 28 year old unpressurised helicopter pilot, fully Ops, instrument rated Green, medically 'Fit' with a total of 1501 hrs of service flying and 780 hrs of flying on type, was detailed to undertake a hill training sortie. He was accompanied by another 35 year old, senior pilot who was detailed to fly as a copilot for hill Ops training sortie. This was latter's first area / helipad familiarization sortie. The first pilot was area cleared. As per the briefings of the Fit Cdr, after following the valley upstream, the pilots were to first carry out three circuit approaches / landings on a helipad located at around 16,000 ft and then proceed to a helipad located at 18,900 ft for another three circuit approaches / landings. Out of the three circuits the co-pilot was briefed to carry out one circuit at each of the helipads after familiarizing himself with the circuit.

The helicopter proceeded as per briefing and carried out three approaches at 16,000 ft and then proceeded to the higher helipad for continuing with the approaches. The pilot first carried out a low level recce followed by an approach, ending in a hover over the helipad. The second approach was carried out by the co-pilot and was correctly executed till hover. The first pilot then attempted the third approach but while at short finals the pilots reported hearing an abnormal noise followed by a sudden increase in the ROD. The first pilot rapidly came up on the collective to arrest the sink. The helicopter drifted to the left of the helipad and impacted on the ground. The right skid was the first to hit the ground 5.1m to the left of the helipad, and then due to a slope just outside the edge of the helipad, the helicopter rolled over on its left side in an uncontrolled manner. Both the pilots came out of the toppled helicopter safely and the helicopter sustained Cat 'B' damages.

Pilot Factors

First pilot was 28 years of age with more than five years of service. He had a total of 1500 hrs of flying to his credit with 780 hrs on type. He was rated above average and had extensive experience of more than four years in hill flying. He had a good record of flying discipline and his documents did not reveal any adverse remarks whatsoever. However, this was his first independent sortie as captain over the specified terrain. Second pilot was also very experienced with more than 13 years of service behind him. He had a total of 3419 flying hours with 2042 hours on type. He had extensive maritime experience and has also served in Somalia with the UN peace keeping forces. He had flown extensively in the Siachen region and had more than 750 hours of hill flying experience. On the eventful day it was his first area familiarization sortie. It is important to bring out

these pilot related factors because they only go to demonstrate that both the aircrew were competent to accomplish the assigned mission and not given to making silly mistakes. A helicopter pilot from day one learns to approach and hover over a helipad, therefore, it becomes very difficult to explain how two experienced pilots could make a mistake in performing as simple a procedure as approaching and hovering over a helipad.

Apart from their flying experience both pilots were medically fit in full flying category and had been declared fit to undertake the sortie during the pre-flight medical. The medical documents of the pilots did not reveal any contributory information. The crew had had a restful sleep the night before and had taken the perfunctory pre-flight meal before the sortie.

Both the pilots were briefed at length about the sortie by the Flight Commander. The route and number of approaches to be made were properly explained. There is no evidence that the crew violated any of the laid down SOPs for heptroperations in the hills.

Weather

On the day of the accident the weather over the helipad was clear and there were no clouds over the sky. Similarly the weather over the take - off base was fine and clear. The pilots did not experience any turbulence enroute or any downdrafts / windshear over the helipads. Weather, therefore, did not contribute towards the accident.

Technical Aspects

Perusal of the technical documents did not reveal any major snags in the past. On the day of the sortie the aircraft had been declared fit for the sortie. The aero - engine of the helicopter was examined and repeated tests of the engine without / with full load did not reveal any malfunction. The main gearbox was also examined and found to be fault free. The abnormal noise heard by the pilots was probably due to over pitching / over torqueing of the engine and the main gearbox. The investigating agency ruled out technical malfunction as the cause of accident.

Human Error

The accident was attributed due to human error because of poor approach with high ground speed / high rate of descent. Once the error was appreciated the deceleration was commenced late and rather rapidly. The collective was then required to be raised rapidly at the final stages of approach. The helicopter over pitched as the engine could not cater for the sudden power requirement. The increased torque reaction lead to a drift of the helicopter to the left. All this was aggravated due to the rarefied atmosphere at the high altitude. The helicopter sunk rapidly and impacted the ground on the left side of the helipad.

Hypoxia: the silent operator

It is a well known fact that hypoxia acts silently. It sets in insidiously without giving any forewarning and by the time its manifestations become obvious the subject is far beyond redemption. The symptoms of hypoxia start manifesting from 10,000 ft and above. A person at rest hardly manifests any signs or symptoms but there is a definite diminution in performance of skilled tasks [2, 3,4]. But from 15,000 ft onwards,

if the individual is not on oxygen, there are definite symptoms, which are likely to set in which gradually lead to performance deterioration. This will be more so if the individual is physically active.

Loss of critical judgement, impairment of self criticism and weakened will power are the higher mental functions to be affected first and along with this comes a deterioration in the neuromuscular control. The pilot does not become aware of these subtle changes and if at all he makes diminutive mistakes he does not appreciate them due to impaired self-criticism .Another hazardous effect is the slowing of mental calculations, which results in delayed initiation of corrective actions. The unfortunate part is that the subject is not aware of this slowing of actions too. The situation is akin to slowing down of time. First the facts are appreciated slowly, next the brain delays the decision to respond and ultimately the final response is slowed down too. Over and above the brain does not appreciate this sequence of slowing down. These responses have been more than often observed on subjects sitting in a high altitude simulation chamber. Along with this other associated features of hyperventilation may also manifest but since they are not relevant to the discussion in hand they will not be dwelled upon.

Oxygen Breathing Norms in Unpressurised Helicopter

The unpressurised helicopter is cleared to fly up to 20,000 ft and breathing of supplementary oxygen is mandatory for altitudes 10,000 ft and above. For want of a perfect integrated mask - helmet system the present day norm is to use periodic intermittent oxygen (pipe - stem breathing) during the sortie. Although the pilots who carry out repeated sorties in hilly terrain swear to its efficacy if not convenience, from the medical point of view the system is fraught with hazards.

Pilots stationed at altitudes above 10,000 ft are acclimatized to high altitudes, but when it comes to pilots who take off from near ground level and then fly up to 16,000 to 20,000 ft in a short span of time the story is slightly different. In case of latter the pilots are exposed to what is called an acute hypoxii and in such cases if the supplementary oxygen is not taken properly there are going to be definite manifestations of hypoxia.

The helipads in the-hilly terrain are very small in size and the word "postage - stamp size" has been aptly coined for them [1]. Approach and hover / landing over them requires rapt attention, unmitigated concentration and perfect precision. While all the effort and energy is being focused on the approach / landing the pilot is required to keep breathing intermittently from the mouth piece of the mask to prevent hypoxia. The latter task is no less important for the success of the mission at hand. The face mask is \either kept on the lap of the pilot or held in the left hand and used as and when required. There is no fixed schedule or SOP, which is followed, it is by experience each pilot follows his own laid down drill.

Due to preoccupation with some stressful situation the pilot may overlook to breathe oxygen at regular intervals or due to a very demanding maneuver the pilot may not get enough time to pick up and breath oxygen. In either case at high altitudes of 16,000 to 20,000 ft an inordinate delay in breathing oxygen can be disastrous. Hypoxia is likely to set in silently and quietly and the finely

honed concentration, and the precise neuromuscular activities at work, may get adversely affected thereby jeopardizing the mission safety. As such multiple landings and take-off are carried out in short periods of time making the situation all the more intense and stressful [5, 6].

Discussion

The accident was rightly labeled as a human error accident But can the aircrew be held blameworthy for negligent flying? Retrospective, in - depth analysis of the accident does not rule out the latent complicity of hypoxia.

The first pilot, although well versed with hill flying was going for the first time as "independent first pilot" to an altitude of 18,900 ft. This was also his first independent approach and landing over a small helipad and that too when his co-pilot was going there for the first time on an area familiarization sortie. An iota of anxiety or apprehension in him cannot be ruled out categorically. His intense preoccupation with the flying controls for precision approach and hover cannot rule out the possibility of his ignoring to breath oxygen at regular intervals. At 16,000 ft when he made the first three approaches and hovers he remained asymptomatic and carried out his tasks correctly. At 18,900 ft he carried out his first hover correctly. The second approach / hover was carried out correctly by the co-pilot while the first pilot was guiding him. In the third approach the pilot made some errors and then there has been a delay in appreciating them too. The corrective actions were also kneejerk type, which made the helicopter to react violently ending in its crash.

The co-pilot was a well experienced pilot with more than 750 hrs of hill flying to his credit, but all his experience was in the Siachen region wherein he was based at altitudes above 10,000 ft. This sortie of his was first of its type in which after taking off from almost 3000 ft he had climbed to 18,900 ft in a short span of time. Inadvertent delay in breathing oxygen at such altitudes cannot rule out the remote likelihood of hypoxia. During the first approach, as copilot, he was rightly involved in reading and calling out the instruments and paid scant attention to the outside. The second approach and hover was carried out by him and during the third approach he was again concentrating on the instruments inside the cockpit when he heard a loud noise from the engine followed by a rapid ROD. By the time he could contribute to any of the corrective actions initiated by the first pilot, the helicopter crashed on the ground.

Step by step analysis of the events preceding the crash reveal that the first two approaches and hover were in proper order. The pilot commenced the third approach with the co-pilot calling out the approach parameters At about 10 ft distance and 8 ft height from the helipad the pilots heard a sudden engine noise with a sudden increase in ROD. The pilot pulled on the collective but the helicopter crashed by then. In this short span of time the helicopter had drifted 66 ft to the left of the helipad. Other than an error in judgement about the alignment, height and distance from the helipad, it is physically impossible to explain how in a couple of seconds a helicopter at a height of 8 ft and just 10 ft distance from the helipad could drift 66 ft to the left and crash.

Subsequently, during the course of investigations, the pilots had conceded that an error of judgement could have had been made regarding the height and distance.

When the pilots heard the sudden engine noise the co - pilot had noticed a sudden fall in RPM with rise in JPT. Post crash strip examination of the engine and main gearbox revealed no abnormality. The only alternative to the sudden noise was momentary engine surge. Sudden engine surge could have been due to either interruption of air and or fuel flow or a sudden additional demand imposed by the pilot. In case of a fuel or airflow interruption there would have been an engine surge but the JPT would not rise whereas in the case in hand the co-pilot had reported a rise in JPT with fall in rpm. The only feasible alternative is a sudden demand for power by coming up harshly on the collective.

In case of a fall in rpm due to engine failure or a sudden loss of power the helicopter would have yawed to the right and also drifted to the right. On the contrary in a powered low speed flight, a sudden harsh demand on the collective would cause the helicopter to drift to the left. This is exactly what happened in this flight too.

Complicity of Hypoxia

It is probable that due to the high demand imposed on the pilot, who was on his first independent sortie at 18,900 ft the pilot was, too keenly, absorbed in the task at hand that he might have delayed in using his oxygen mask. There is no way to prove or corroborate this statement but it is strongly plausible. If mild hypoxia had set in, it too, would not leave any tell tale sign other than its transient effects on the higher brain functions. Transient impairment of judgment, clouding of senses and slackened neuromuscular controls are all the ingredients that are required to go into shaping this accident, Firstly the pilot made an error of judgment about visible distance and height of the helipad, the appreciation of this error did come, but a bit too late and then the pilot acted hastily by harshly pulling on the collective. All this while the co-pilot's attention was riveted on the instrument and was not directly following the pilot on controls. With a total flying experience of more than 3400 hrs behind him and having himself cleared pilots for hill flying in his previous unit, the co - pilot would have instinctively appreciated when the first pilot pulled the collective harshly but he failed to do so, probably because of impaired critical judgement due to mild hypoxia. He was pulled out of his fixation on the instruments only when he heard a sudden loud noise from the engine. By the time he could take stock of the situation and wrest controls from the first pilot the helicopter crashed.

At no time during the investigation the pilots admitted to having been disoriented. They asserted that they used oxygen regularly but there is no way to corroborate this statement. They also indirectly mentioned that in the absence of an integrated mask-helmet, the procedure of intermittent breathing is cumbersome. The weather was fine, there were no strong winds, they were in good physical health and the engine was also behaving normally. With everything fine why then two experienced pilots suddenly made silly errors of judgement followed by harsh actions on the part of one pilot and delayed reaction on the other leading to an accident. The complicity of mild

hypoxia as being the latent operator cannot, therefore, be explicitly ruled out.

Conclusion

There is a very thin line between a normal error of judgement by an experienced pilot or a mild impairment of judgement due to hypoxia. The latter will never come to light because hypoxia at no time leaves any telltale signs other than its end results. It is for the investigative agencies to ascertain its complicity in accidents where exposure to hypoxia is a strong probability.

The accident also, over and again, brings to focus the long drawn need of a universal integrated helmet - mask for unpressurised helicopter pilots. These helicopters are there to serve IAF for many years to come and it would be prudent to find an early solution to this festering problem.

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