

Human Performance & Limitations · Module C — The Thin Air

Hypoxia

Chapter 6 — The single most-tested block in the paper, and a killer that gives no warning: the four types of hypoxia, its insidious stages, and the altitude thresholds every pilot must know.

BOOK

Human Performance & Limitations

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EXAM

DGCA CPL / ATPL — HPL

CHAPTER

6 of 26 · Module C

GHOST AVIATOR

In this chapter

1. [Hypoxia — definition, stages, the four types, thresholds](#)



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1 / 7

§ 10

HYPOXIA

TECHNICAL DEFINITION — "CEREBRAL HYPOXIA"

The term **cerebral hypoxia** technically refers to **lack of oxygen supply to the cerebral hemispheres** (the outer portion of the brain). However, it is more typically used to refer to a **lack of oxygen supply to the entire brain**.

10.1 Why Hypoxia Matters to a Pilot

TWO WAYS THE BODY CAN BE STARVED OF OXYGEN

1. The body's organs and tissues may be **deprived of the oxygen they need because of illness or disease**.
2. **But the pilot must know that oxygen deprivation or hypoxia can be caused by breathing air at low pressures at high altitude.**

This second category — **altitude-induced hypoxia** — is the aviator's main concern, and the form most commonly tested in DGCA exams.

EFFECT ON THE PILOT — DIRECT QUOTE, MEMORISE

Hypoxia will cause a pilot's intellectual and sensory judgment to become impaired. In **mild cases**, hypoxia causes only:

- **Inattentiveness,**
- **Poor judgment,** and
- **Uncoordinated movement.**

10.2 Stages & Clinical Course — from "tipsy" to lethal

SEVERE CASES — THE CASCADE TO DEATH

Severe cases result in a state of complete unawareness and unresponsiveness (coma) — brain-stem reflexes, including response to light and the breathing reflex, stop. Only blood pressure and heart function are maintained. If this persists, **brain death is inevitable.**

If the lack of oxygen to the brain is limited to a **very brief period of time**, coma **may be reversible** with varying levels of return to function, depending on the extent of injury. Sometimes **seizures** may occur, which may be **continuous with no stop between them** — a condition called **STATUS EPILEPTICUS**.

Serious oxygen deprivation can kill a pilot within minutes.

THE STAGES OF HYPOXIA

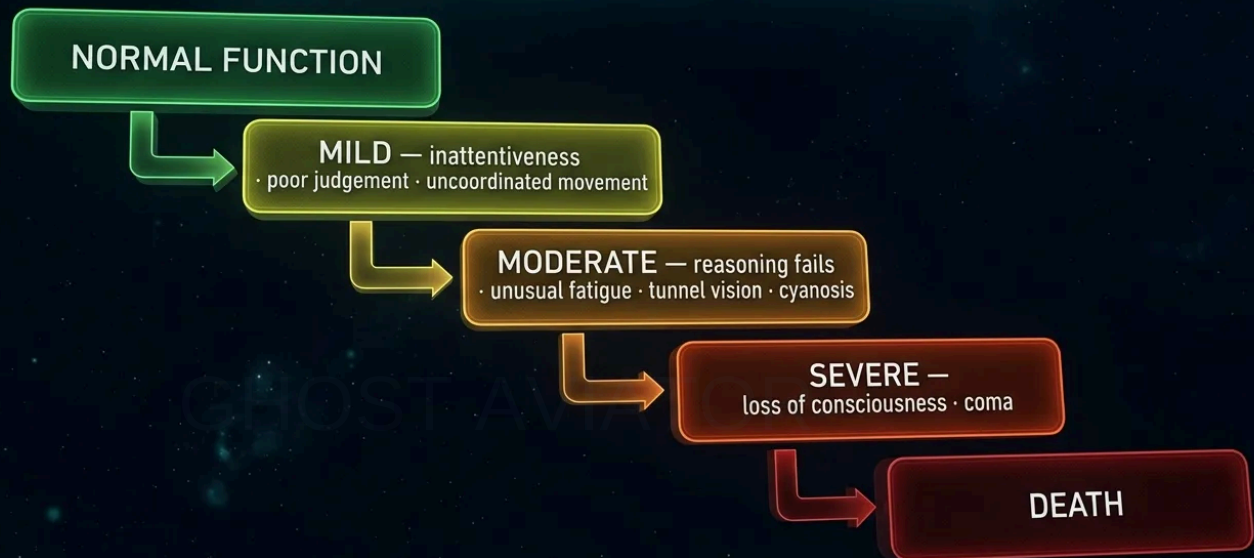


Figure 6.2 — The clinical course of hypoxia, from normal function through mild and moderate to coma and death.

ONSET CHARACTERISTIC — NOTE THE WORD "INSIDIOUS"

The symptoms are **slow but progressive, insidious in onset**, and are most marked at altitudes **starting above 10,000 ft (3,500 m)**. Night vision, however, can be impaired starting at altitudes **5,000 ft**.

"Insidious" means it *sneaks up on you*. You will not realise you are hypoxic — that is the entire problem. Your buddy in the right seat may notice it before you do.

WHY "EUPHORIA" IS THE MOST DANGEROUS EARLY SYMPTOM

The onset of hypoxia **may be accompanied by a feeling of well-being, known as EUPHORIA**. The pilot feels good — even *great* — and is therefore the **last person in the cockpit** who will suspect anything is wrong. This is why CRM and crew cross-checks are critical above 10,000 ft.

10.3 The FOUR Types of Hypoxia

CLASSIFICATION — OPENING LINE OF EVERY DGCA HYPOXIA QUESTION

HYPOXIA IS CLASSIFIED INTO FOUR DIFFERENT TYPES:

TYPE (a)

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Hypoxic Hypoxia

Cause: low oxygen *levels* in the bloodstream.

The pilot's type: in pilots, this most often occurs with **exposure to altitude** — **hypobaric hypoxia**. At low altitudes the partial pressure of oxygen is adequate to maintain brain function at peak efficiency. **Atmospheric pressure and the partial pressure of oxygen both decline at higher altitudes.**

TYPE (b)

Anemic Hypoxia

Cause: blood cannot carry enough oxygen even though atmospheric oxygen may be plentiful. Oxygen in blood is carried by **haemoglobin**, which is found in red blood cells. When the **RBC count decreases**, or the **haemoglobin does not function properly**, less oxygen can be carried by the blood.

Occurs in: heavy bleeding · some cancers · sickle-cell anemia · **carbon monoxide poisoning**, to name a few.

Symptoms: **breathlessness, fatigue, chest pain** — and they **worsen at higher altitudes**, as the effects of hypoxia and anemia are **additive**.

TYPE (c)

Ischemic / Stagnant Hypoxia

"Ischemia" = inadequate supply of blood. **Ischemic hypoxia** occurs when there is **inadequate blood flow to body tissues**.

Occurs in:

- **Constriction of blood vessels** (e.g. fingers and toes exposed to cold).
- **Low blood pressure / low cardiac output** such as fainting.
- **Exposure to high sustained accelerations** like excessive G-forces (stagnant hypoxia).

Oxygen therapy is not very helpful in this form. The **best remedy is to correct the underlying cause**.

TYPE (d)

Histotoxic Hypoxia

Cause: the **inability of the cells of the body to use the oxygen available**. The oxygen is there in the blood, in the tissues — but the cells can't metabolise it.

Rare in pilots, but can occur with:

- **Cyanide poisoning,**
- **Chemical poisoning,**
- **Intoxication with certain drugs.**

Can also be caused by HIGH BLOOD ALCOHOL LEVELS. (Direct link to §14 in Part 4.)

THE FOUR TYPES OF HYPOXIA

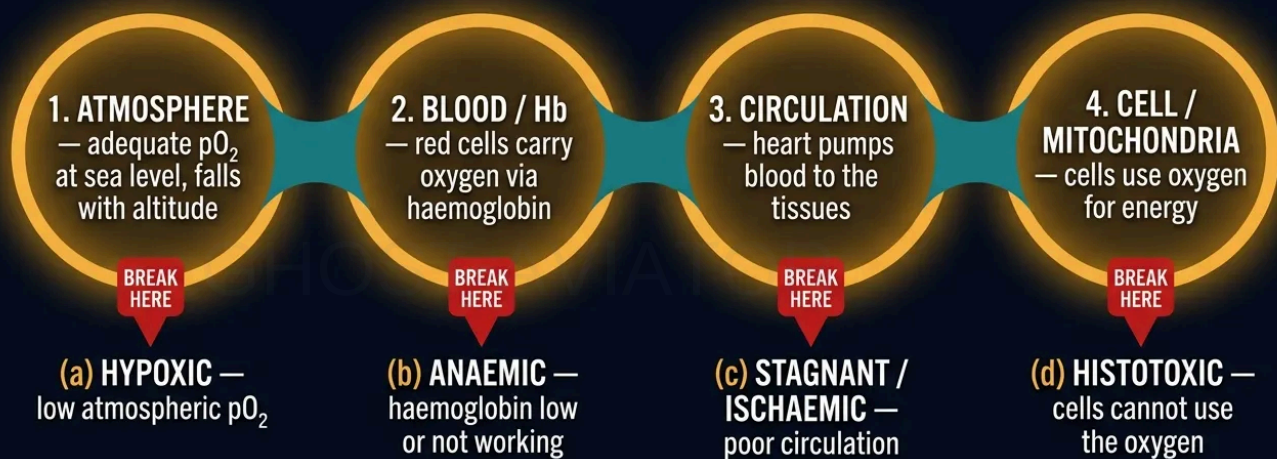


Figure 6.1 — The four types of hypoxia, each breaking the oxygen-delivery chain at a different point.

10.4 Causes · Symptoms · Immediate Actions — Master Table

The DGCA syllabus consolidates Hypoxia management into **one master tabulation** of all causes, all symptoms, and the immediate actions if hypoxia is suspected. This is reproduced verbatim below.

GHOST AVIATOR

Hypoxia Causes	Symptoms	Immediate Actions if Hypoxia is suspected
• Drug overdose / alcohol • Asphyxiation caused by smoke inhalation • Very low blood pressure • Strangulation • Cardiac arrest (when the heart stops pumping) • Carbon monoxide poisoning • High altitudes • Choking • Compression of the trachea • Diseases that paralyze the respiratory muscles • A tobacco smoker is likely to experience the effects of hypoxia at a lower altitude than a non-smoker	• The symptoms are slow but progressive, insidious in onset, and are most marked at altitudes starting above 10,000 ft (3,500 m). Night vision can be impaired starting at altitudes 5,000 ft. • Its onset may be accompanied by a feeling of well-being, known as EUPHORIA. • Even minor hypoxia impairs night vision and slows reaction time. • More serious hypoxia interferes with reasoning, gives rise to unusual fatigue and, finally, results in loss of consciousness / death. • Impaired Judgment • Headache • Tingling in hands & feet • Hyperventilation (yes, hypoxia can <i>trigger</i> hyperventilation) • Muscular Impairment • Memory Impairment • Sensory Loss • Tunnel Vision • Cyanosis (a bluing of the body extremities) • Formication (a feeling of ants under the skin)	• Provide Oxygen. • Descend below 10,000 feet or Minimum Safe Altitude if it is higher than 10,000 ft.

MEMORISE — THE IMMEDIATE-ACTION DRILL (A 2-STEP REFLEX)

1. **PROVIDE OXYGEN** — don the mask, 100 % flow, regulator to "EMERGENCY" if available.
2. **DESCEND BELOW 10,000 ft** (or below MSA — Minimum Safe Altitude — if MSA is higher than 10,000 ft).

This is the standard DGCA-examined answer. Do not over-elaborate in the exam — write these two steps in this order.

10.5 Altitude Thresholds & Night Vision

NIGHT VISION IMPAIRMENT FROM
5,000 ft

DAY SYMPTOMS MARKED FROM
10,000 ft (3,500 m)

ACTION THRESHOLD — DESCEND
BELOW
10,000 ft

SMOKER EFFECTIVE ALTITUDE
(RECAP)
≈ 7,000 ft

DGCA REASONING THE EXAMINER IS TESTING

The reason the action threshold is **10,000 ft** and not, say, 14,000 ft is because **symptoms are most marked at altitudes starting above 10,000 ft (3,500 m)**. The reason supplemental O₂ is required **at night above 5,000 ft** in many jurisdictions is because **night vision is impaired starting at 5,000 ft** — the rod cells in the retina are extraordinarily sensitive to even mild hypoxia. (*Vision pathophysiology is dealt with in a later part of this chapter.*)



Figure 6.3 — Altitude thresholds: night vision impaired from 5,000 ft, marked day symptoms by 10,000 ft.

◆ END OF CHAPTER 6 ◆