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CASE REPORT

ALPHA THALASSEMIA IN A PILOT FLYING HELICOPTERS: A CASE REPORT

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Introduction: The disease/disability Alpha-Thalassemia is a rare genetic disorder wherein there is reduced production of haemoglobin. An individual suffering from this may sugffer from easy fatiguability, fluctuating anemias, leg ulcers, all depending upon the severity of the condition. It is an aerospace safety concern in case an aircrew member is diagnosed with Alpha Thalassemia. The pilot being discussed in this case study presented with complaints of easy fatigability and anemia. The paper discusses the aeromedical disposal dilemma in the first and only case of Alpha Thalassemia documented in military aviation across the globe.

Case report: This is a case of an Indian Air Force pilot who has been flying helicopters in the forces and was diagnosed as a case of α-thalassemia. The pilot was extensively evaluated, including aeromedical stresses, and was declared fit for flying under waiver after due consideration.

Discussion: A literature review of a case report on disposal of cases of α-thalassemia in military flying did not reveal any results. However, based on the observation on the ground, simulated aviation stressors, haemoglobin and haematocrit values and international best practices, the pilot was awarded a flying category under waiver. The pilot has been asymptomatic and is currently flying without compromising aerospace safety.

Keywords: alpha-thalassemia, helicopter, consciousness, safety, aeromedical decision making

Figures: 2 • **Tables:** 2 • **References:** 9 • **Full-text PDF:** http://www.pjambp.com • **Copyright** © 2023 Polish Aviation Medicine Society, ul. Krasińskiego 54/56, 01-755 Warsaw, license WIML • **Indexation:** Index Copernicus, Polish Ministry of Science and Higher Education

INTRODUCTION

The disease/disability Alpha-thalassemia (α-thalassemia), is a rare genetic disorder wherein there is reduced production of haemoglobin. An individual suffering from such a condition has anemia which may manifest itself through weakness, pale skin and fatigue. Broadly two types of α thalassemia are of concern. The more severe type known as Hb Bart syndrome and the other one which is a milder form known as HbH disease. Hb Bart syndrome cases are characterised by hydrops fetalis, hepatosplenomegaly, severe anemia, heart defects and genito-urinary abnormalities. Most of the babies are either still born or die soon after birth. Cases with HbH disease may cause mild to moderate anemia, jaundice, hepatosplenomegaly.

α thalassemia results from deletion involving HBA1 and HBA2 genes. These genes instruct the formulation of alpha protein. The two alpha protein genes are located close together in the region of chromosome 16 which is known as alpha globin locus. This is a component of haemoglobin which in turn carries oxygen in the red blood cells.

Haemoglobin is made of four subunits, two of which are the alpha globin and two are another type of globin [1]. There is no effective treatment for Hb Bart Syndrome, however occasional red blood cell transfusions may be required for HbH disease [8].

The genetic inheritance in cases of α thalassemia is because of the two copies of the HBA1 gene and two copies of the HBA2 gene in each cell. Each copy is called an allele. Thus, 4 alleles produce alpha-globin, the protein that results from these genes. For each of the 2 genes, one allele is inherited from each parent.

α thalassemia is inherited in an autosomal recessive manner. Defects in one or more of the 4 α-globin genes (αα/αα) lead to reduced or absent production of the alpha-globin polypeptide chains. These gene mutations are of different types. These could be partial (α+) deletions or total (α0) deletions), or non-deletional types. 3.7 single-gene deletions are the most common alpha-thalassemia mutations. Single gene deletion cause α+-thalassemia. Double gene deletions cause α0-thalassemia. HbH disease is caused by three-gene deletions (α+ with α0-thalassemia) or a combination of two-gene deletions with a non-deletion mutation. A case presents itself as Hb Bart's hydrops fetalis if there are deletion mutations on 4 α-genes [5].

α thalassemia manifests itself with different genetic combinations as follows:

a. Individual with one mutated allele is a 'carrier' and has no signs or symptoms.
b. Individual with two mutated alleles may have mild signs or symptoms of alpha-thalassemia (called alpha-thalassemia minor, or alpha-thalassemia trait).
c. Individual with three mutated alleles has moderate to severe symptoms (called HbH disease).
d. Individual with four mutated alleles, suffers from alpha-thalassemia major or hydrops fetalis [4].

In this paper, a case is presented where an Indian Air Force (IAF) rotary wing pilot was diagnosed with a case of α thalassemia. The primary concern in re-flighting such an aircrew member was effects of hypoxia with his inherent low Hb values. Indian Air Force as a policy permits a Hb value of 13 gm/dl in males and 11.5 gm/dl in females as fit and cases with values below these are termed as anemia and are to be evaluated completely, treated, and awarded a non-flying category [6]. The pilot underwent a detailed evaluation, and was exposed to aeromedical stressors. Upon clearing all, he was declared fit for flying duties under a waiver. The paper discusses the aeromedical dilemma and aeromedical disposal awarded in the first and the only case of α thalassemia documented in the military flying.

CASE REPORT

A 26-year old IAF rotary wing male pilot, current on Chetak aircraft with a total of 740 flying hours, reported complaints of easy fatigability. The pilot was diagnosed with anemia with hemoglobin at 11.3 gm/dl. Personal history revealed the aircrew member to be a non-vegetarian, non-smoker, non-drinker. The results of baseline investigations and follow up hemogram is shown in Table 1. The aircrew member was managed with Capsule Autrin (Salt: Ferrous Fumarate), Tablet Folic Acid (Salt: Folic Acid) and Injection Neurobion (Salt: Cyanocobalamin) initially.

During the initial medical examination of the aircrew member at the time of entry, he did not have any symptoms and the investigations carried out did not reveal any features of anemia.

In Dec 2011, the aircrew member was diagnosed with anemia and was managed conservatively. In May 2012 the aircrew member was evaluated in detail and Hb Electrophoresis revealed a normal result. High Performance Liquid Chromatography (HPLC) showed low HbA2 with thalassemic indices on hemogram. There was no evidence of the Beta

Thalassemia Trait, features were suggestive of Alpha thalassemia.

Tab. 1. Results of basic tests.

Investigation	Baseline results	May 2012	Jun 2012
Hb	11.3 gm/dl	10.7 gm/dl	10.7 gm/dl
MCV	58.6fl	58.1 fl	58.9 fl
MCH	18.7pg	18.4 pg	17.6 pg
MCHC	31.92g/dl	31.69/dl	29.8/dl
PCV	35.4%		
TLC	7300		
DLC	Polymorphs 67, Lymphocytes 28, Eosinophil 2, Monocytes 3	PBS	Moderate hypochromia Anisopoikilocytosis present
Platelet	2,14,000	Serum Ferritin	184.20ng/ml
CXR PA View	Nothing Abnormal Detected	ECG	Within Normal Limits

(Abbreviations: Hb-Haemoglobin, Hct-Hematocrit, PCV-Packed Cell Volume, MCV-Mean corpuscular volume, MCH-Mean corpuscular hemoglobin, MCHC-Mean corpuscular hemoglobin concentration, TLC-Total Leucocyte Count, DLC- Differential Leucocyte Count, PBS-Peripheral Blood Smear, ECG- Electrocardiogram, CXR-Chest X Ray posteroanterior view).

α thalassemic study confirmed that the aircrew member is a case homozygous for α3.7 deletion and negative for the rest. Mutation analysis confirmed thalassemia (-α/α) (Homozygous for α3.7 deletion).

The aircrew was extensively evaluated with measurement of Time of Useful Consciousness and the TUC was comparable to that of a normal individual. The Hb Charting from the available medical documents is as shown in Figure 1.

From 2011 onwards the Hb has never been above 11.5 gm/dl and the aircrew member was observed in a non-flying category for a period of 87 weeks. In addition to the Hb values, the Hct values were also compared. Hb and Hct Recordings as per medical documents are shown in Figure 2.

The aircrew had microcytosis with MCV as 58.9 fl. The Flight Surgeon (Aerospace Medicine Specialist) opined that the aircrew member should be observed on the ground and the threshold for performance decrement due to hypoxia may be assessed in a Decompression Chamber before reconsidering flying. Subsequently, the aircrew member underwent a decompression chamber run. The pilot tolerated the Ear Clearance Run well. At 25000 feet, Time of Useful Consciousness

Graph 1: Hb charting from the medical documents

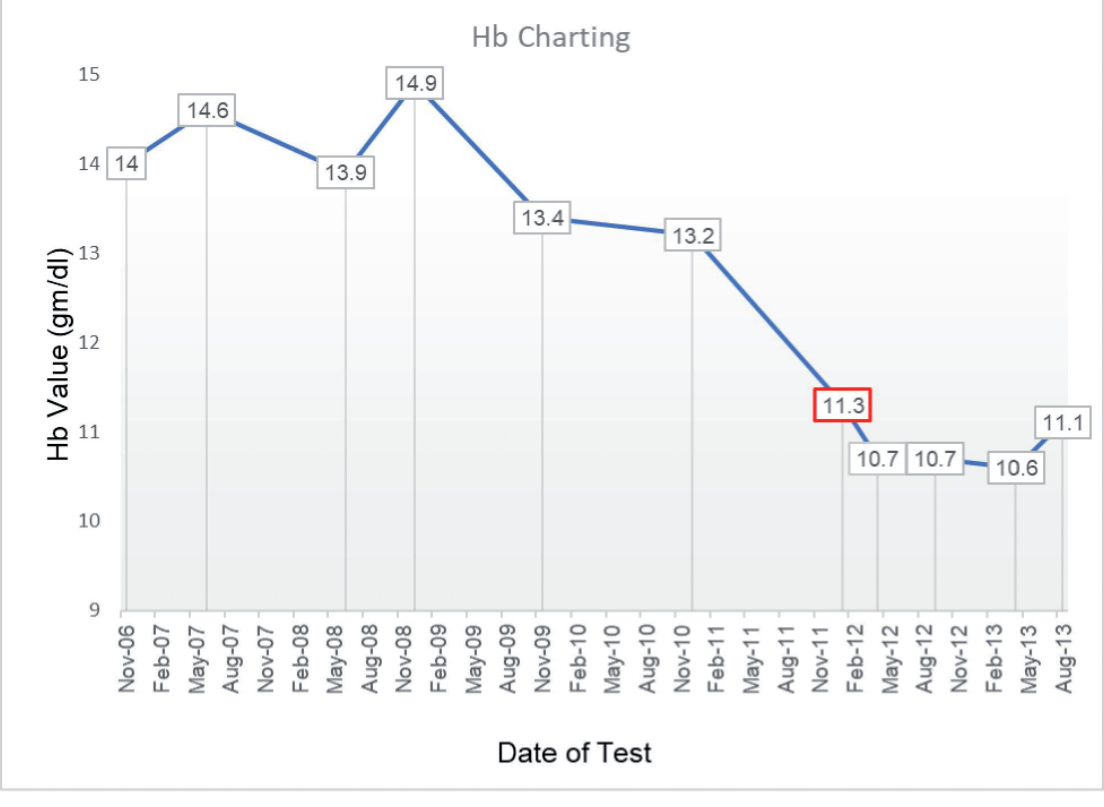

Fig. 1. Hb charting from the medical documents.

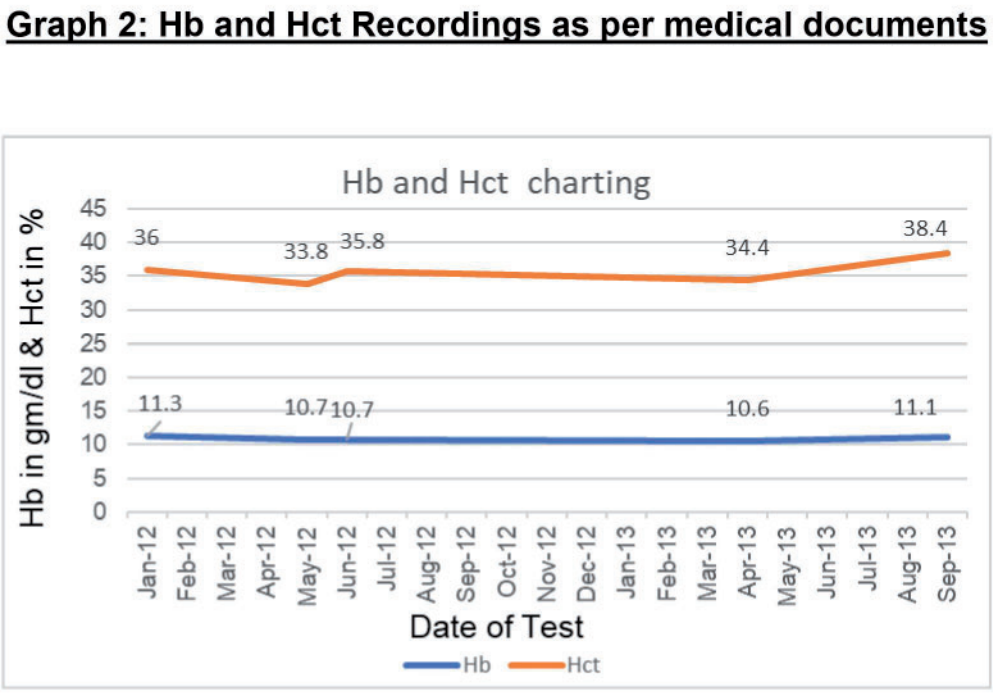

Fig. 2. Hb and Hct Recordings as per medical documents.

(TUC) was 320 seconds, which was comparable to that of a normal individual. During the decompression run, the aircrew member was made to breathe 100% oxygen initially followed by Ear Clearance run, taken up to 10000 feet @ 3000ft/min and brought back @ 3000ft/min. For calculation of TUC, the individual was taken to an altitude of 25000ft and the oxygen mask was removed. During that period at 25000ft simple mathematical calculations were given. TUC was found to be 320 seconds and SpO2 was 75 after 4 minutes. Average time for TUC at 25000 feet is 270±96 seconds as per Ernsting's Textbook of Aviation Medicine [3]. However, during the review in Sep 12 the aircrew member had a Hb of 10.7 gm/dl and did not satisfy the requirement for being fit for flying as per the disposal criteria (Hb >11.5 gm/dl) in the Indian Air Force. The pilot was placed in a non-flying category for a period of 24 weeks.

During the next review in March '13, the hemogram profile was Hb 10.6 gm/dl, Hct 34.4%, MCV 58.4 fl, MCH 18.1 pg, MCHC 30.9 pg. The pilot was again awarded a non-flying category with advice to get an opinion of a Specialist from High Altitude Physiology Department or a Physiologist on acceptability of low Hb or Hct as a parameter for assessing anemia along with opinion of a Senior Flight Surgeon (Senior Advisor in Aerospace Medicine).

This aircrew member was a case of homozygous two gene deletion (α [2, 5] gene). Cases with Thalassemia trait exhibit mild hypochromia with microcytosis with or without mild chronic anemia. These individuals generally remain asymptomatic and do not require any medication except folic acid supplements [2].

The aircrew member was initially awarded restricted flying and then full flying duties. He was reviewed annually thereafter and Hb and Hct values are as shown in Table 2.

Tab. 2. Hb and Hct values post-upgrade to flying category.

	Hb (gm/dl)	Hct (%)
Jan 14	10.8	35.9
Sep 14	11.3	39.2
Aug 15	10.7	39.2
Sep 16	10.5	34.9
Mar 17	10.8	35.3
May 18	10.7	35.6

DISCUSSION

The discussed case is a case of α thalassemia in a pilot flying helicopters, the first reported and documented case in the aviation field.

The primary concern in re-flighting such an aircrew was effects of hypoxia with his inherent

low Hb values. As mentioned earlier, the Indian Air Force policy permits a Hb value of 13 gm/dl in males and 11.5 gm/dl in females as fit and cases with values below these are termed as anemia and are to be evaluated, treated and awarded non flying category [6]. Only cases of Beta Thalassemia with Hb >11.5 gm/dl in males and 10.5 gm/dl in females are considered fit for flying duties under a waiver.

A literature review of case report on disposal of cases of α thalassemia in military aviation did not reveal any results.

The Hgb provides a direct measure of the oxygen carrying capacity of the blood, whereas the Hct provides an indirect one. Besides, their calculation depends on the method used for their determination. Both parameters can be assessed either with an automated blood-counter or by manual methods such as microhematocrit readings for Hct, or colorimetric methods. The Hgb estimates the erythrocytic function and is more stable against plasma volume changes such as dehydration, which makes it somewhat more reliable for the assessment of anemia. Unfortunately, in many settings automated methods for Hgb determinations are not available and rough values are estimated using observed Hct levels, which is a simpler and cheaper approach (specially in studies carried out away from western hospitals/ centres, where it is often difficult to have complete hemograms).

Relationship between Hemoglobin (Hb) and Hematocrit (Hct) was also analyzed. Hb estimation provides a direct measure of the oxygen carrying capacity of the blood. Hct provides an indirect measure of oxygen carrying capacity. Calculation of these values depends on the method used for their determination. Automated and manual methods can be used for estimation of Hb and Hct [7].

Based on the above reports and United States Air Force (USAF) waiver guidelines, the aeromedical disposal in this aircrew member was deliberated. The aircrew member had remained asymptomatic with mild anemia and had failed to reach the pre-requisite of 11.5 gm/dl despite being observed in the ground medical category for 87 weeks. Thus, it was construed that it is unlikely that in the instant case the Hb level is further going to improve to the level required by the present regulations in the Indian Air Force. His hematocrit levels were 34.4% in April '13 and 38.4% in September '13 which have remained more than 32% as required by USAF for a waiver.

The α thalassemia trait rarely produces more than a mild anemia and as per the USAF waiver guide [9], is not disqualifying for flying duties provided all other aeromedical standards are met [9]. In view of the above, the aircrew member was awarded a restricted flying category and was to be closely monitored in a dynamic condition of flying as an aircrew member. In addition, with the Chetak aircraft being a multi-crew aircraft, there is an added advantage of monitoring any subtle manifestations, if any at all, leading to in-flight incapacitation without compromising flight safety and individual safety.

CONCLUSION

To conclude, we have presented the only documented case of α thalassemia in IAF and in military aviation the world over. The case was duly deliberated and aeromedical concerns were addressed before re-flighting the aircrew member with α thalassemia in IAF. No laid down disposal or waiver policy exists of such a case in IAF and an extensive web search did not provide any such case report in other military flying personnell across the globe. After proper evaluation of the aircrew member on the ground, fitness to fly was declared, and thus, for a disability for which no disposal or policy existed, a waiver was declared and the aircrew member was pronounced fit to fly, since there was objective evidence of tolerating hypoxia like a 'normal' individual.

AUTHORS' DECLARATION:

Study Design: Piush Renjhen, Deepak Gaur. **Data Collection:** Piush Renjhen, Deepak Gaur. **Manuscript Preparation:** Piush Renjhen, Deepak Gaur. The Authors declare that there is no conflict of interest.

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