Biochemical Abnormalities in Indian Aircrew

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ABSTRACT

Introduction: Medical fitness of aircrew is of utmost importance to flight safety. Periodic medical examinations and biochemical investigations help in maintaining a high standard of physical fitness of all aircrew so as to ensure maximum operational efficiency of the human element. During these medicals, the aircrew should not only be physically or mentally fit but at the same time, should be fit biochemically. This study aimed to determine the prevalence of biochemical abnormalities amongst Indian aircrew in order to know the magnitude of the problem.

Material and Methods: This is a retrospective cross sectional descriptive study of freshly detected biochemical abnormalities amongst Indian aircrew reporting for evaluation at an evaluation centre over a period of five years (01 Jan 2011 to 31 Dec 2015).

Results: A total of 14,431 Indian aircrew were included in the study. Dyslipidemia was the commonest biochemical derangement encountered with a prevalence of 3.7%. Pre-diabetes was found in 1.85%, asymptomatic transaminitis in 0.59% and hyperbilirubinemia in 0.59% of the study population.

Conclusions: Biochemical investigations play a major role in periodic medical examination. Interpretation of biochemical results must always be exercised at the discretion of the medical examiner, taking into consideration not only medical but also operational and environmental factors of relevance for the overall medical fitness. This study gives an insight into the magnitude of the problem and the need for evidence based polices on evaluation and disposal of such biochemical abnormalities in Indian aircrew.

Key words: Medical Fitness, Biochemical Abnormality, Dyslipidemia, Pre-diabetes, Asymptomatic Transaminitis, Hyperbilirubinemia

INTRODUCTION

Medical fitness for flying is of utmost importance. The aircrew should not only be physically and mentally fit but at the same time should be fit biochemically. Indians due to peculiarities of lifestyle and also genetically are prone to the components of the metabolic syndrome[1-3]. Periodic medical examinations and biochemical investigations help in maintaining a high standard of physical fitness of all aircrew personnel so as to ensure maximum operational efficiency of the human element[4]. They have a two-fold aim. First, they help in primary prevention of disease so that early diagnosis and treatment can be provided. Secondly, they determine an individual's capacity to carry out the flying tasks assigned. Whether to downgrade an asymptomatic aircrew due to a biochemical abnormality remains a dilemma that is frequently faced by the aero-medical fraternity. This also adds to the economic burden of the state. This study aimed to determine the prevalence of biochemical abnormalities amongst Indian aircrew in order to know the magnitude of problem.

MATERIAL AND METHODS

This is a retrospective cross sectional descriptive study of freshly detected biochemical abnormalities amongst Indian aircrew reporting for evaluation at this evaluation centre over a period of five years (01 Jan 2011 to 31 Dec 2015). Only healthy aircrew were included in the study. The aircrew with pre-existing systemic diseases and metabolic disabilities such as diabetes mellitus, dyslipidemia and hyperuricemia were excluded from the study. Aircrew on medications likely to affect metabolic profile were also excluded. Demographic, anthropometric and clinical data were recorded from the medical files held with this centre. All the reports were retrieved from the archives held with the Department of Biochemistry at this evaluation centre. The biochemical analysis for all the aircrew was carried out in-house. Blood samples were collected by venipuncture after fasting for 8-12 hours. Blood was collected in plain vaccutainers for measurement of Lipid profile, Liver function Test (LFT) and Renal function test (RFT) and in sodium fluoride vaccutainers for Plasma glucose estimation**.** Morning urine samples were collected for estimation of protein creatinine ratio. The analysis was carried out on a fully automated biochemistry analyzer. Plasma glucose was measured by glucose oxidase-peroxidase method. Total cholesterol (TC), Low Density Lipoprotein Cholesterol (LDL-C), High Density Lipoprotein Cholesterol (HDL-C) and Triglyceride (TG) concentrations were measured by International Federation of Clinical Chemistry (IFCC) approved enzymatic methods. ERBA reagents and calibrators were used for the analysis.

Certain definitions and cutoff values which were taken as the standard for comparing the results are as below:-

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	Normal glucose tolerance	IFG or IGT (Prediabetes)	Diabetes Mellitus
Fasting Plasma Glucose	< 100 mg/dL	100-125 mg/dL	≥126 mg/dL
2 h Plasma Glucose	<140 mg/dL	140-199 mg/dL	≥200 mg/dL
HbA1C	<5.6%	5.7-6.4%	≥ 6.5%
Random Plasma glucose			≥200 mg/dL with polyuria, polydipsia, weight loss

Table-1: Classification of Diabetes as per American Diabetes Association Criteria

S No	Parameter	Mean (SD)
1	Height (cm)	172.7 (4.79)
2	Weight (kg)	74.5 (7.61)
3	BMI (kg/m2)	24.5 (2.44)

Table-2: Anthropomorphic parameters of aircrew

S No	Parameter	Mean (SD)
1	SBP (mmHg)	125.8 (6.12)
2	DBP (mmHg)	82.6 (4.23)

Table-3: Systolic and Diastolic blood pressure of aircrew

Metabolic Abnormality	Prevalence (%)
Dyslipidemia	536 (3.7%)
Hypercholestolemia	341
Hypertriglyceridemia	267
High LDL	153
Low HDL	294
Pre-diabetes	268 (1.85%)
Asymptomatic Transaminitis	85 (0.59%)
Hyper bilirubinaemia	71 (0.5%)
Hyper uricemia	28 (0.2%)
Proteinuria	19 (0.13%)
Total	1007

Table-4: Prevalence of Biochemical abnormalities

Common Causes	Uncommon Causes
NAFLD	Wilson's disease
Alcoholic liver disease	Hemochromatosis
Chronic viral hepatitis	Alpha-1 - AT deficiency
Medication	
Autoimmune hepatitis	
Celiac disease	

Table-5: Causes of Asymptomatic Elevation of Transaminases

Obesity: Generalized obesity was defined as Body Mass Index (BMI) ≥25 kg/m^{2}; overweight as BMI from 23–25 kg/m^{2} as per Asia-Pacific guidelines[5].

Hypertension: Hypertension was diagnosed as those with systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg as per Joint National Committee 7 (JNC7) Criteria[6].

Coronary Artery Disease (CAD): The diagnosis of CAD was established by a positive medical history of angina pectoris and/or ischemic changes on a conventional 12-lead ECG which included ST-segment depression (Minnesota codes 1-1-1 to 1-1-7) or Q-wave changes (Minnesota codes 4–1 to 4–2)[7].

Pre-diabetes: The American Diabetes Association definition

as shown in Table 1 was used for the purpose of diagnosing diabetes and pre- diabetes. HbA1c was not used for the diagnosis as the method used at our centre for estimation of HbA1c was not as per National Glycohemoglobin Standardization Program (NGSP)[8].

Asymptomatic Transaminitis: The normal range of aspartate transaminase (AST) and alanine transaminase (ALT) is <40U/L. An elevation beyond the normal range for more than 4 weeks was considered as persistent elevation. The following working definition was used:-
Mild elevation < 3 times Upper limit of normal (ULN)
Moderate elevation 3 - 20 times ULN
Marked elevation > 20 times ULN
Aircrew with mild elevations were advised repeat blood test after 2 weeks. The patients with moderate and severe elevation were further evaluated with ultrasonography abdomen and serological investigations for viral hepatitis.

Dyslipidemia: For serum lipids the National Cholesterol Education Programme Adult Treatment Pannel (NCEP - ATP III) Guidelines were followed. According to these guidelines, dyslipidemia was defined as presence of one or more abnormal serum lipid concentration[9].
Hypercholesterolemia – Serum cholesterol ≥240 mg/dl
Hypertriglyceridemia – Serum triglyceride ≥150 mg/dl
Low HDL cholesterol – HDL cholesterol <40 mg/dl
High LDL cholesterol – LDL cholesterol ≥130 mg/dl

Hyperuricemia:- Hyperuricemia was defined as serum uric acid levels greater than 8 mg/dl[10].

Hyperbiliruinemia:- Hyperbilirubinemia was defined as total bilirubin of more than 1.3mg/dl. Unconjugated hyperbilirubinemia was defined as unconjugated bilirubin more than 1.1 mg/dl[11].

STATISTICAL ANALYSIS

The information received from the evaluation centre was recorded on day to day basis in Microsoft excel spread sheet windows 7 and evaluated using software package used for statistical analysis (SPSS) version 21. The results were interpreted as percentages, mean and Standard deviation.

RESULTS

During the study period 01 Jan 2011 to 31 Dec 15 a total of 14,431 Indian aircrew underwent Periodic medical examination and biochemical investigations at this evaluation centre.The mean age of the study group was 42.6 yrs (24-63). The anthropometric parameters of the study population have been presented in Table 2. The systolic and diastolic blood pressure have been presented in Table 3.
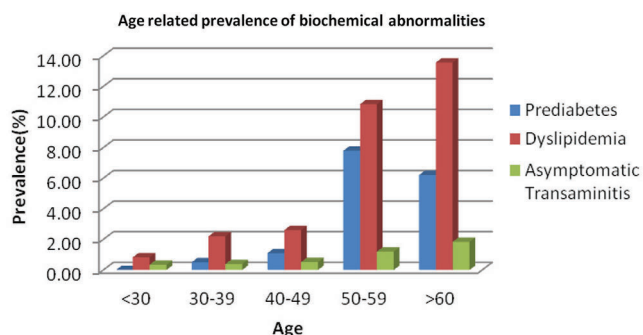
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Figure-1: Age related prevalence of biochemical abnormalities

Seven hundred and forty three aircrew (5.14%) were detected with 1007 abnormalities with a mean of 1.35 (1-3) abnormalities per aircrew. The list of biochemical abnormalities detected and their prevalence in the study group is shown in Table 4. Dyslipidemia was the commonest metabolic abnormality with a prevalence of 3.7%. The age wise prevalence of Dyslipidemia, Transaminitis and Pre-diabetes has been shown in Fig 1.

Prevalence of Dyslipidemia: Dyslipidemia was the commonest biochemical derangement encountered with a prevalence of 3.7%. 88% aircrew with dyslipidemia were obese (BMI > 25). 26.7% of these aircrew also had impaired glucose tolerance (IGT).

Prevalence of Pre-diabetes: The prevalence of pre-diabetes was found to be 1.85% in the study population. 22% aircrew with pre-diabetes were obese (BMI > 25). 56% also had deranged lipid profile and 8% were found to have concomitant hyper-uricemia. Eight aircrew were found to have one or more evidence of Coronary artery disease (CAD). Pre-diabetes without any evidence of Coronary Artery Disease/ Obesity does not invite any restriction on flying.

Prevalence of asymptomatic transaminits: The prevalence of asymptomatic transaminitis was found to be 0.59% in the study population. 45% aircrew found to have asymptomatic transaminitis (moderate to marked elevation) were teetotalers. 14.4% of these aircrew were found to have Fatty Liver (Grade I- II). A final etiology was found in only 17% of cases with a majority being Hepatitis B, C and alcoholic hepatitis.

DISCUSSION

There is limited literature available about the prevalence of glycemic abnormalities, dyslipidemia, asymptomatic transaminitis amongst aircrew. The prevalence of pre-diabetes amongst Indian aircrew was found to be 1.85%. This is much lower than the prevalence of pre-diabetes amongst general population in India which was 10.3% as per Indian Council of Medical Research-India Diabetes (ICMR-INDIAB) population-based cross-sectional study[12]. In a similar study by Mason et al in the U.S. Army aviator the incidence of diabetes mellitus was reported as 0.47 cases per 1000 aviator-years per year. They also found that the aviators over 35 yr old were at the greatest risk of developing pre diabetes[13-14]. The age related prevalence of pre-diabetes has

shown an increasing trend. The fall in the prevalence in the > 60 years category could be because of ruling out of the aircrew who progressed to diabetes mellitus. Eight of the aircrew in our study was found to have one or more evidence of CAD. In our study pre-diabetics without any evidence of Coronary Artery Disease/ Obesity does not invite any restriction on flying; however these patients were advised 6 monthly follow up and lifestyle modification for control of blood sugar. In our study 26.7% of these aircrew also had impaired glucose tolerance (IGT).

Dyslipidemia is an important risk factor for coronary artery disease. It is the leading cause of morbidity and mortality amongst Indians. Dyslipidemia was the commonest biochemical derangement encountered with a prevalence of 3.7%. Of these 76% had elevated total cholesterol and 88% were obese. Abnormal lipid profile without any evidence of Coronary Artery Disease/ Obesity does not entail lowering of medical category. Subjects with any lipid abnormality, had significantly higher BMI (p<0.001) as compared to those with no lipid abnormality. As compared to our study; the study conducted by ICMR-INDIAB the prevalence of hypercholesterolemia in Indians >20 years of age was 13.9%, hypertriglyceridemia was 29.5%, low HDL-C was found in 72.3% and 11.8% were found to have high LDL-C levels[15,16]. In another study by Chamley et al examined cardiovascular risk factors amongst military pilots in Royal air force, reported hypercholesterolaemia of 23% and abnormal exercise ECG findings in 21.8% subjects[17]. In our study 12.4% aircrew were started on Statins and downgraded to non-flying medical category.

Mildly elevated liver enzymes in an asymptomatic aircrew is a commonly encountered problem. The prevalence of asymptomatic transaminitis was found to be 0.59% in this study. This is in contrast to the findings of a study by Kundrotas et al in which 0.5% of 19,877 healthy air force trainees had elevated ALT levels. A cause for elevation was found in less than 12% of these individuals of which two thirds were due to hepatitis B and C[18]. The difference in prevalence between the two studies could be attributed to difference in the cohorts. Transaminase levels are sensitive indicators of hepatocellular injury and are helpful in diagnosing hepatocellular diseases e.g. hepatitis. The causes of elevation of transaminases are shown in Table 5[19]. If no underlying etiology is determined, the aircrew should be considered for award of restricted flying medical category with regular 3 monthly reviews locally and annually at central evaluation centre.

71 (0.5%) patients were found to have hyperbilirubinemia. 78.8% of these patients had unconjugated hyperbilirubinemia. All these aircrew were further evaluated with LFT and Peripheral Blood Smear (PBS) examination. 51 pilots were finally diagnosed with Gilbert's syndrome. The prevalence of Gilbert's syndrome amongst Indians has been reported to be 2-7% by different studies[20]. The difference in prevalence in our study could be explained by the screening effect of induction medical examination and the periodic medical examinations.

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CONCLUSION

Medical fitness for the aircrew is the foremost priority. The predictive power of even a comprehensive medical examination is limited. Aircrew with initial evidence of a pathological condition should be thoroughly investigated. Biochemical investigations plays a major role in periodic medical examination. Metabolic derangements may represent a serious disease process or a transient physiological variation. Disposal of an asymptomatic aircrew with biochemical derangement presents a dilemma for the aero medical fraternity. The interpretation of biochemical results must always be made in the light of medical but also operational and environmental factors of relevance for the overall medical fitness. This study gives an insight into the magnitude of the problem and the need for evidence based polices on evaluation and disposal of such biochemical abnormalities in Indian aircrew.

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