

## **Diagnosis and clinical implications of white coat hypertension in aircrew**

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### **ABSTRACT**

White coat hypertension (WCH), a high blood pressure recorded in the clinic with normal ambulatory blood pressure monitoring (ABPM) using automated devices, is a relatively common observation in hypertensive subjects and the general population at large. The phenomenon of WCH is probably consequent to an abnormal and heightened sympathetic response to the environment in which the recording is made. In the present study 55 asymptomatic aircrew, not on any medication (37 professional civil pilots & 18 military aviators) were detected to have elevated blood pressure recordings suggestive of hypertension (clinic recording of systolic / diastolic BP  $>$  or  $=$  140/90 mm Hg), at the time of periodic medical evaluation for fitness for flying. They were subjected to 24 hour ABPM with a view to differentiate the truly hypertensive from those with WCH. The evaluation also included a thorough clinical examination with fundoscopy, biochemical analysis, ultrasonography of the abdomen and a detailed cardiac evaluation, to exclude secondary causes of hypertension and to assess for evidence of target organ involvement. WCH was observed in 35 (63.6%) of the aircrew evaluated. None of them had any evidence of target organ involvement in the form of hypertensive retinopathy, renal involvement, concentric left ventricular hypertrophy or left ventricular dysfunction on echocardiography. In conclusion WCH is definitely more common among professional aviators when compared to the population at large. In evaluating centres where periodic evaluation is being carried out to assess fitness of aircrew, target organ involvement may not be evident as the cases of WCH are picked up at a very early stage. Prospective follow up studies, however, need to be done to assess whether these subjects of WCH are at a higher future risk for cardiovascular dysfunction or target organ involvement, thereby necessitating periodic follow up and early therapeutic intervention.

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**KEY WORDS:** WCH, ABMP

**T**he term “white coat syndrome” first appeared in 1983, when Manacia et al [1] reported on the basis of continuous intra-arterial blood pressure recordings, that the heart rate and both the systolic as well as diastolic blood pressure rose significantly, when a doctor entered the patient’s

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room in a hospital. White coat effect (WCE) or white coat phenomenon, is the transient rise in BP from before to during the visit to the doctors clinic, which settles down after a period of rest on the couch. WCH on other hand is a high blood pressure recorded in a medical setting with normal ambulatory blood pressure response. ABPM provides multiple blood pressure recordings throughout the day and night, in contrast to the conventional methods which rely on isolated measurements made under circumstances which may influence the blood pressure. In the past decade, with the advent of ABPM, an established tool for research and clinical purposes, the term WCH has now become an established entity. The present study was thus undertaken to observe the incidence of WCH in aircrew undergoing periodic evaluation, to assess for any target organ involvement in these subjects and to discuss the clinical significance of WCH and its implications with respect to the aviators.

#### **Material and Methods**

The study included the aircrew who reported for periodical medical evaluation (once in six months for professional civil aircrew and annually for military aviators) to the Air Force Central Medical Establishment, (AFCME), New Delhi, which certifies them fit for flying duties. The inclusion and exclusion criteria for the study are enumerated below.

#### **Inclusion criteria :**

1. Asymptomatic aircrew.
2. Evidence of elevated blood pressure recordings (office recording of systolic/diastolic BP more than or equal to 140/90 mm Hg) as per the Indian guidelines for management of hypertension 2001, WHO and the Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC-VI). [2, 3 & 4]
3. No prior or present history of intake of any antihypertensive medication or steroids.

#### **Exclusion criteria :**

1. Associated disease like diabetes or ischaemic heart disease.
2. Evidence of secondary hypertension.

The protocol included a comprehensive history including family history, a detailed and thorough clinical evaluation to exclude any secondary causes of hypertension and to assess for target organ involvement or other associated diseases. All cases were then subjected to a battery of investigations which included routine blood (haemoglobin, blood counts), urinalysis (albuminuria, glucose, microscopic examination for RBCs, other sediments) and biochemistry (blood sugar, cholesterol, creatinine, serum electrolytes, blood urea and uric acid). They underwent lipid profile studies only when indicated (in cases of obesity, family history or clinical evidence of dyslipidaemia). All the aircrew were subjected to ultrasonography of the abdomen to include the kidneys and adrenals, electrocardiogram (both resting and post exercise), chest X-ray (PA view) and 2D echocardiography.

All aircrew who formed the part of the study were then connected between 8.30 AM and 12 noon to a "Circadian BP Mate" blood pressure monitoring system, which is a small, compact and lightweight automated ambulatory blood pressure monitor. The blood pressure cuff was attached to the patients non dominant arm, while the other end of the tubing was connected to the 'BP Mate control module and monitor', which was carried in a pouch and strapped to and/or belted at the patients side. The control module was programmed to record the blood pressure every 30 minutes during the day time and every 60 minutes during the night time. The aircrew were instructed to keep their arm steady during measurements and to engage in normal activities between blood pressure recordings. They were all given a patient diary card to record the activity at the time of blood pressure recordings as well as the time of going to bed and time of rising. The ambulatory blood pressure monitor was then

disconnected after 24 hours on the next day. The blood pressure recordings during the 24 hour period, stored in the control module cum monitor, were then subsequently analysed by connecting it to a personal computer and obtaining a final print out. For analysis more than 14 systolic and diastolic blood recordings during the day time and at least 07 records during the night were mandatory. The ambulatory blood pressure monitoring data was analysed for the percentage systolic recordings greater than 140 mm Hg and diastolic recordings greater than 90 mm Hg, for the mean 24 hour systolic and diastolic blood pressure and also for the mean day time and night time blood pressure records.

**Criteria for labeling as White Coat Hypertension :**

1. Aircrew with a 24 hour average blood pressure, on ambulatory blood pressure monitoring, less than or equal to 135/85 mm Hg **and / or**
2. Day time average blood pressure less than or equal to 140/90 mm Hg were diagnosed as having white coat hypertension.
3. All recordings above these values were classified as primary hypertension.

**Results**

During the period Jan 2000 to Jan 2002, 55 asymptomatic aircrew (37 professional civil pilots & 18 military aviators) who were symptom free and not on any medication, were detected to be hypertensive on clinical evaluation, as per the inclusion criteria of the study.

However following analysis of the ABPM records of the 55 aircrew evaluated, 35 (63.6%) were detected to have evidence of WCH, while the remaining 20 (33.4%) were finally diagnosed as primary hypertension. Interestingly a higher percentage of WCH was observed in the younger age groups, 81% (9/11) in those below 35 years and 77% (14/18) in those aircrew between the ages 35 and 45 years. In the older age groups the incidence of WCH was less, while primary hypertension was more. For those between 46 and 55 years, 52% (11/21) and in the case of aircrew above the age of 55 years, 20% (01/05) had evidence of WCH. (Table 1).

All the cases of WCH were observed in patients diagnosed with stage I to II hypertension on clinical evaluation (diastolic BP in the range 90 - 105 mm Hg). 49 of the 55 aircrew (89%) had evidence of stage I hypertension on clinical evaluation of which 34 (69.4%) were diagnosed to have WCH while 15 (30.6%) had primary hypertension. The remaining 06 (11%) aircrew had stage II hypertension on clinical evaluation, of which only 01 (16.7%) had WCH while 05 (83.3%) had primary hypertension. (Table 2).

None of the 35 cases of WCH had any evidence of target organ involvement. There was no evidence to suggest hypertensive retinopathy in the form of generalised or focal narrowing of retinal arteries, haemorrhages / exudates on fundoscopic evaluation. Also no evidence of renal involvement in the form proteinuria and / or elevation of serum creatinine was observed and the ultrasonography

**Table 1 : Age distribution of 55 aircrew evaluated with those detected to have white coat hypertension and primary hypertension**

Age group (years)	All subjects	WCH	Primary hypertension
< 35	11	09	02
35-45	18	14	04
46-55	21	11	10
> 55	05	01	04
	<b>55</b>	<b>35 (63.6%)</b>	<b>20 (36.4%)</b>

**Table 2 : Aircrew with clinical evidence of elevated blood pressure (stage wise) compared with the subjects finally diagnosed as WCH and primary hypertension on ABPM**

<b>Blood pressure (mm Hg)</b>	<b>Total number of cases</b>	<b>WCH</b>	<b>Primary</b>
<b>Clinic recordings hypertension</b>			
<b>Stage 1 hypertension</b>	<b>49</b>	<b>34</b>	<b>15</b>
SBP/DBP* 140 - 150 / 90 - 94	33	28	05
SBP/DBP 151 - 159 / 95 - 99	16	06	10
<b>Stage 2 hypertension</b>	<b>06</b>	<b>01</b>	<b>05</b>
SBP/DBP 160 - 170 / 100 - 105	05	01	04
SBP/DBP 171 - 179 / 106 - 109	01	–	01
<b>Stage 3 Hypertension</b>	<b>00</b>	<b>00</b>	<b>00</b>
SBP > or = 180 or DBP > or = 110	–	–	–
<b>Number of aircrew evaluated</b>	<b>55</b>	<b>35</b>	<b>20</b>

\* SBP/DBP Systolic blood pressure / diastolic blood pressure.

**Table 3 : Target organ involvement observed in the 55 aircrew with hypertension evaluated**

<b>Target organ involvement</b>	<b>WCH (n = 35)</b>	<b>Primary hypertension (n = 20)</b>
Hypertensive Retinopathy	Nil	01 (05 %)
Renal involvement	Nil	Nil
LVH* (voltage criteria on ECG)	Nil	Nil
Concentric LVH	Nil	04 (20%)

\* LVH = left ventricular hypertrophy

revealed normal size and echotexture of both kidneys. Further left ventricular hypertrophy (by voltage criteria) was not evident on 12 lead resting electrocardiography nor was there any evidence of concentric left ventricular hypertrophy on 2D echocardiography. The left ventricular ejection fractions were also well within the normal in all cases of WCH. On the other hand of the 20 cases detected to have primary hypertension early hypertensive retinal changes was observed in 1 case, none of the cases had evidence of renal involvement However

evidence of early concentric left ventricular hypertrophy was observed in 4 cases. (Table - 3)

All the 55 aircrew evaluated by ABPM (35 with WCH & 20 with primary hypertension) were observed to have a normal nocturnal dip of systolic / diastolic blood pressure ranging between 10 / 05 mm Hg during the night / sleep time recordings. None of the cases had evidence of nocturnal hypertension. Further the analysis of data revealed that the average blood pressure recordings did not vary significantly

whether day and night were labeled as per sleeping pattern or by fixed time intervals (wide fixed interval - 6 AM to 10 PM as day and 10 PM to 6 AM as night or narrow fixed interval - 10 AM to 8 PM for day and 12 PM to 6 AM as night).

## **Discussion**

Hypertension is often called “the silent killer” as in most cases it presents with no symptoms at all, hence the need to diagnose the condition early and institute appropriate therapy in time. Until quite recently physicians have relied almost exclusively on blood pressure recordings taken in the clinic wherein hypertension is defined as per the standards laid down by the WHO / ISH and the JNC-VI [3, 4]. With the advent of self monitoring at home and 24 hour ambulatory monitoring, by a properly validated device, the chances of being misdiagnosed as hypertension have reduced. ABPM gives a more realistic picture of the blood pressure and has brought to the fore front the diagnosis of WCH. Ambulatory blood pressure monitoring is however not recommended to be used for the routine diagnosis or management of cases, the guidelines for the use of ABPM have been clearly outlined by a number of studies [5, 6, 7].

WCH also referred to as “office” hypertension or “isolated clinic hypertension” [3], is therefore a persistently elevated office blood pressure in the presence of a normal BP outside the office [8]. The importance of WCH lies in the relatively benign cardiovascular risk with which it is associated when compared to primary hypertension. The dilemma however lies in the fact that although the definition of elevated office BP is not debatable, controversy still exists about the definition of normal BP, WCH and hypertension, based on ABPM. In fact a variety of normal values have been used in various studies for ABPM [4, 7, 9, 10, 11, 12, 13], resulting in a wide variation in the reported incidence varying from 15 - 30 % in the general population [7, 8] and upto 50% in studies conducted on hypertensive subjects [12, 13, 14]. In the present study involving a selected population, namely professional aircrew, a much

higher incidence of 63.6% is observed. This could be attributed to the fact that these subjects are more apprehensive as their career, flying prospects and finances are at stake, probably making them more vulnerable to WCH than the general population.

Interestingly ABPM is also not entirely free from white coat effect and first few readings as well as last few readings, after connecting and before removing the device are also observed to be high. This has led to a new term of “ambulatory white coat hypertension” and this sub group has been considered to be at a slightly higher risk than the classical WCH and therefore advised more intensive follow up [6]. In our study also this phenomenon has been observed in some cases.

Review of the literature on whether WCH carries an increased risk is variable and inconclusive. Studies both favouring [6, 13, 15, 16] as well as against [17, 18] an increased risk of target organ involvement have been reported. In the present study, none of the cases of WCH had any evidence of target organ involvement. This is probably because the aircrew were detected to have WCH at an early stage of evolution, since these subjects undergo regular periodic follow, with normal BP recordings observed at least six months to a year prior to entering the study. However in the case of the 20 aircrew finally diagnosed as primary hypertension early retinal changes were observed in one case (5%), while early evidence of concentric left ventricular hypertrophy was observed in 04 cases (20%). Interestingly these aircrew with primary hypertension were all cases with clinical evidence of stage II hypertension at the time of diagnosis. Studies by other workers have, however, shown that, even in cases of WCH retinal changes and echocardiographic changes in the form of higher left ventricular mass index, posterior as well as ventricular wall thickening are observed [13, 15, 16].

## **Conclusion**

WCH is a relatively common occurrence in aircrew who undergo periodic medical examination as

part of their evaluation for flying fitness. This underlines the importance of the need for regular follow up of all cases of WCH, more closely than the normotensive subjects. The aim being to detect early target organ involvement in the form of microalbuminuria, retinopathy or cardiovascular involvement on echocardiography, so that appropriate therapeutic intervention can be initiated as and when required. This calls for prospective follow up studies in all cases diagnosed as WCH.

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