Ambulatory blood pressure monitoring in civil aircrew

Wg Cdr J K Shrivastava*

ABSTRACT

Hypertension is of the foremost ground for loss of flying category among the civil aircrew. The detection and treatment of hypertension is important to prevent long-term cerebrovascular and cardiovascular complications. Aggressive attempts to identify and treat hypertension must be balanced carefully with the presence of white coat hypertension (WCH) in these patients. Ambulatory blood pressure monitoring (ABPM) has become a widely used method for evaluation and diagnosis of white coat hypertension. In the present study carried out on commercial aircrew with elevated blood pressure readings, 17 aircrews (13 pilots and 4 flight engineers) were evaluated. Apart from ABPM, Stress ECG, 2-D Echocardiograms and standard biochemical profile were done to detect target organ involvement or presence of co-existing disorders. Only one pilot had an abnormal ABPM record, due to abnormal blood pressure load and elevated blood pressure recording. Five aircrew had abnormal biochemical tests (elevated serum triglyceride levels). All the participants had a normal stress ECG record; only one participant demonstrated a concentric left ventricular hypertrophy during 2-D echocardiography. Two subjects were made temporarily unfit for flying duties, pending adequate blood pressure control while 15 subjects were cleared for full flying duties. White coat hypertension may represent an early stage in the evolution of structural cardiovascular abnormalities; it is therefore not an innocent phenomenon and needs long term follow up, as seen by higher rates of cardiovascular and functional abnormalities. They even risk being misclassified as normotensive, since transition to the persistent hypertensive state may be overlooked as white coat hypertension. Thus, these cases of WCH need to have a long term follow up for early detection of persistent hypertension and target organ damage.

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KEY WORDS: WCH, ABPM, Aircrew

Even in the 18th century the presence of the doctor was known to affect the pulse of the patient, attributed to ‘the excitement and tension associated with the visit to the clinic or doctor's office’. For whatever reason, some people become inordinately anxious and tense in the setting of a doctor's office [1] and their body's reaction may include a temporary elevation in blood pressure. Interestingly, in people with white-coat hypertension, the problem seems to be related mainly to medical settings and not to other situations that cause tension [2]. ‘White-coat hypertension’ is recognized as a common cause of an elevated blood pressure in the absence of sustained high blood pressure.

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Hypertension is one the foremost grounds for loss of flying category among the civil aircrew. A wrong diagnosis of primary hypertension can cut short a flying career while classifying primary hypertension as white coat hypertension may lead to compromised flight safety. Ambulatory blood pressure monitoring has become a widely used method of blood pressure and heart rate evaluation for diagnosis of white coat hypertension. White coat hypertension occurs in about 20 percent of hypertensive patients and it is more common in women than in men [2]. Although the technique provides only intermittent readings throughout the 24-hour period, average blood pressures obtained in this way correlate well with a variety of hypertensive disease processes and are also better prognostic markers for future cardiovascular events than office blood pressure [3].

A study was conducted on the Ambulatory Blood Pressure Monitoring (ABPM) among civil aircrew detected to have elevated blood pressure and to evaluate the relevance of white coat hypertension in medical categorization of aircrew.

Materials and Methods

Commercial aircrew undergo periodic medical examination for renewal of license at designated aeromedical centers. Prior to their presentation for license medical examination at the aero-medical center the airline medical officers, to ensure their fitness for the said medical examination, evaluated the aircrews. Aircrew detected to have elevated blood pressure (>140/90mm Hg) on three different occasions, were taken taken up for further evaluation and ABPM. None of the aircrew were known hypertensive and all of them had valid current flying licenses. The selected aircrew underwent a 24-hour ambulatory blood pressure monitoring, followed by stress ECG, 2-D Echocardiograms and standard Biochemical profile, which included complete blood counts, urine examination, blood sugar, blood urea, serum creatinine, lipid profil and liver function tests.

Device Description

The ABPM device (SCALENE ABPM manufactured by Scalene Engineers Private Limited, Bangalore) used for the study is an oscillometric device, powered by dry cells. Patients wear the ABPM device for a single 24-hour period. During this time, the device is programmed to inflate and record blood pressure every 15 min during daytime hours and every 30 min during night time hours (2200 to 0600 h). Patients are asked to keep an activity log throughout the 24-hour period so that activities can be mapped onto the blood pressure recordings. The device has a patient-initiated event button whereby they can begin additional readings for unusual physical or mental activity. The ABPM device display usually is inactivated so that viewing each blood pressure reading does not distract partients [4]. The subjects were explained in detail the working of the ABPM machine and the precautions to be taken while the machine is in operation, to ensure accurate readings.

Reports are downloaded to a PC (Intel pentium III 733 MHz) from a session of ABPM containing each individual blood pressure recording for the entire 24 hours, heart rate, mean arterial pressure, blood pressure load and summary statistics for the overall 24-hour, daytime and night time periods. To be considered a valid recording, the number of satisfactory readings should exceed at least 80% of total readings programmed for the testing period. The criteria for normal and abnormal ABPM record are listed below [3].

<table>
<thead>
<tr>
<th>Blood Pressure Measure</th>
<th>Normal</th>
<th>Abnormal</th>
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</thead>
<tbody>
<tr>
<td>Systolic average (mm Hg)</td>
<td>24-hour</td>
<td>&lt; 130</td>
</tr>
<tr>
<td>Diastolic average (mm Hg)</td>
<td>24-hours</td>
<td>&lt; 80</td>
</tr>
<tr>
<td>Systolic load (%)</td>
<td>Day</td>
<td>&lt; 15</td>
</tr>
<tr>
<td>Night</td>
<td>&lt; 15</td>
<td>&gt; 30</td>
</tr>
<tr>
<td>Diastolic load (%)</td>
<td>Day</td>
<td>&lt; 15</td>
</tr>
<tr>
<td>Night</td>
<td>&lt; 15</td>
<td>&gt; 30</td>
</tr>
</tbody>
</table>

Day is the awake period and night is the sleep period. Since day time and night time pressures are estimated on a fixed time basis (night time record 2200 to
0600 hours) they do not necessarily correspond to awake and sleep. Threshold levels for estimate of load are 140/90 mm Hg during waking hours and 120/80 mm Hg during sleep.

Results

A total of 17 aircrew participated in the study, with a mean age of 45.8 ± 9.7 years; the youngest at 26 years and the oldest at 52 years. There were 13 pilots and 4 flight engineers who were evaluated during the study. Apart from ABPM, Stress ECG, 2-D Echocardiograms and Standard Biochemical Profile were done to detect target organ involvement or presence of co-existing disorders. Only one pilot had an abnormal ABPM record due to abnormal blood pressure load and elevated BP recording (more than 42% blood pressure load for night time records and a 24 hour average blood pressure record of 140/88 mm Hg). Five aircrews had abnormal biochemical tests, i.e. abnormal lipid profile (elevated serum triglyceride levels), as shown in Table I. All the participants had a normal stress ECG record; only one participant demonstrated a concentric left ventricular hypertrophy during 2-D echocardiography, without evidence of abnormal ambulatory blood pressure record. Two subjects were made temporarily unfit for flying duties, pending adequate blood pressure control while 15 subjects were cleared for full flying duties.

Discussion

The most publicised indication for ABPM is the suspicion of white-coat hypertension, a phenomenon whereby some patients who apparently have raised blood pressure actually have normal blood pressure when measurement is repeated away from the medical environment. Since decisions regarding antihypertensive therapy are made based on isolated clinic blood pressure readings, patients with white coat hypertension may receive an incorrect diagnosis of sustained hypertension [5,6].

The incorporation of ABPM into routine clinical practice requires that criteria be adopted for defining normal and abnormal ambulatory blood pressure. In all cases, ambulatory blood pressures were generally lower than clinic blood pressures both for patients with normal blood pressure and for those with hypertension. This is presumable because ABPM includes night time readings, which are generally lower. A growing body of evidence suggests that more advanced target-organ damage and worsened prognosis occurs in patients with blunted nocturnal reduction in blood pressure [3]. The accepted thresholds for diagnosis of hypertension on ABPM are >135 and >85 mm Hg 24 hour average systolic and diastolic blood pressure; >30% systolic or diastolic load over 24 hours [5,6]. Blood Pressure Load is an integrated measure of the 24-hour blood pressure and is defined as the proportion of 24-hour blood pressures that are

<table>
<thead>
<tr>
<th>ABPM</th>
<th>Biochemical Tests</th>
<th>Stress ECG</th>
<th>2-D Echocardiogram</th>
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</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Abnormal</td>
<td>Normal</td>
<td>Abnormal</td>
</tr>
<tr>
<td>16</td>
<td>1*</td>
<td>12</td>
<td>5#</td>
</tr>
</tbody>
</table>

*Elevated ABPM record (Blood Pressure Load and Elevated Blood pressure Readings)

# Abnormal Lipid profile / Elevated Triglyceride levels

** Concentric Hypertrophic Left Ventricular Myocardium
increased relative to the thresholds for waking and sleep blood pressures (> 140/90 mm Hg during the awake period and >120/80 mm Hg during the sleep hours). Blood pressure load has demonstrated usefulness in diagnosing and has been suggested as a better determinant of cardiac function since it closely correlates with left ventricular hypertrophy [5-7].

In a study conducted by Ganjoo et al for aircrew evaluated for white coat hypertension by ABPM, 5% had hypertensive retinopathy and 20% had concentric left ventricular hypertrophy. In the present study only 1 out of 17 (5.9%) subjects was detected to have sustained hypertension with a similar percentage for concentric left ventricular hypertrophy. The difference in the incidence may be due to the small sample of study. However, a significant percentage of aircrew (89%) could be put back to flying duties after being diagnosed as WCH, which would not have been possible without ABPM. Commercial pilots report a higher incidence of white coat hypertension for a variety of personal and professional reasons [8].

**Need for Long Term Follow-up**

There is lot of controversy over the status of white coat hypertension, its status as a marker for disease or merely a physiological variant? From being labeled as a figment of imagination to being a serious precursor of cardiovascular disorder, White Coat Hypertension has been much maligned. Changing parameters for definition to absence of controls have been implicated in the varied results of different studies [9-12].

Results from the Harvest study [11] demonstrated that White coat hypertension led to a concentric remodeling of the left ventricle - a factor associated with worsening progress of the disease. This may be explained by the fact that patients with high reactivity to physician’s blood pressure measurement may also have increased blood pressure responsiveness to daily stressors in life. In comparison to normotensive subjects, white coat hypertensives seem to be at a higher risk. Bidlingmeyer and colleagues [12] reported that persistent hypertension developed over a 6-year period in 60/81 patients (75%) with white-coat hypertension. In the study by Glen et al [13], indices of cardiac structure and function and carotid arterial compliance were compared among groups of normotensive, white-coat hypertensive and persistent-hypertensive patients of similar age, weight and sex distribution. Mean indices for arterial elasticity were reduced to similar extents in the white-coat and persistent-hypertensive groups. These two groups also had similar echocardiograms, indicative of diastolic dysfunction. However, only the persistent-hypertensive group showed an increase in left ventricular mass. Similar abnormalities of diastolic left ventricular function were identified in the patients with persistent hypertension and those with white-coat hypertension; both groups differed in these indices from the normotensive group. In addition, the white-coat and persistently hypertensive groups, when compared with the normotensive groups, showed similar abnormalities of elasticity, compliance and stiffness of the large arteries. White coat hypertension has also been linked to increased left ventricular mass and hypertrophy, as compared to normal subjects [14].

It has been postulated that white-coat hypertension may represent an early stage of evolution of structural cardiovascular abnormalities, not unlike Impaired Glucose Tolerance in the clinical history of Diabetes Mellitus. White coat hypertension is, therefore, not an innocent phenomenon and needs long term follow up, as seen by higher rates of cardiovascular and functional abnormalities.

**Implications for Civil Aircrew**

Despite differences of observation with regard to long-term implications of the disorder, white coat hypertensives in the aviation environment may present as a safety hazard. There is no follow-up of such cases once diagnosed as WCH and early hypertension may be misdiagnosed; such subjects even risk being misclassified as normotensive, since transition to the persistent hypertensive state may be overlooked or classified as white coat hypertension.

Patients with white-coat hypertension therefore, need close follow-up and should not be considered as having no added cardiovascular risk. Patients with white-coat hyperension must be kept under observation for a longer duration to prevent transition to persistent hypertension or at least, an early diagnosis of the disease.
Currently, the regulations for licensing for civil pilots make ABPM mandatory for suspected cases of elevated blood pressure. A normal ABPM record permits them to return to full flying category. It may be necessary to amend the policy for licensing for civil aircrew, to ensure that such aircrew after being returned to flying duties must undergo ABPM monitoring and relevant investigations at least once a year, to diagnose complications or development of hypertension early.

## Conclusion

The detection and treatment of hypertension is important to prevent long-term cerebrovascular and cardiovascular complications. Aggressive attempts to identify and treat hypertension must be balanced carefully with the risks of over-diagnosis and over treatment in these patients. ABPM has emerged from an investigative research tool to a valuable mechanism for assisting the clinician in balancing these risks when making treatment and disposal for civil aircrew. Of the 17 aircrews that participated in the study, only two were finally diagnosed as hypertensives or its sequelae (elevated blood pressure and LV hypertrophy), permitting the rest to carry out their duties. It not only prevents aircrew from being medically downgraded for diagnostic reasons, but also helps the airline maintain its pool of specialist pilots. However, there is a need for follow-up of these cases on a long-term basis, detect transition to persistent hypertensive status.

## References