

*Review article*

## HIV and Aviation Safety

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By the year 2000, about 38-110 million adults would be infected by the Human Immuno Deficiency Virus (HIV-1) and India would account for at least 5-10 million of cases of AIDS. World over, aviators who are HIV +ve are disqualified from flying duties. Is such a policy fair and reasonable, considering that approximately 5% of HIV +ve individuals remain clinically healthy and stable despite 12-15 years of HIV infection? This review therefore looks at the problems of screening asymptomatic HIV and neuropsychological abnormalities and disposal of aircrew.

**Key Words :** Asymptomatic HIV, Neuropsychological abnormalities, Aeromedical evaluation

One and half decades ago, we had almost believed that infectious diseases no longer posed any threat to the developed world. This confidence was shattered in the early 1980's by the advent of Acquired Immune Deficiency Syndrome (AIDS). With the discovery of the Human Immuno deficiency Virus - 1 (HDLV III [1], LAV [2] ) - a retrovirus, the tip of the iceberg was unveiled. To date there is no cure, the search for a vaccine continues and so does the pandemic.

By the year 2000, we will have 38-110 million adults and 10 million children infected by HIV. Of these, 24 million adults and children would have developed AIDS. The largest portion of these cases (42%) will come from Asia and 75% of these cases will be accounted for by heterosexual transmission [3]. The potential for acquiring HIV is enormous when we realize that between 250 and 500 million people currently engage in behavior patterns that

put them at risk for HIV infection [4] and the spread in a heterosexual population is increased by the presence of genital ulcers.

The range of AIDS cases in India is 5-10/1000 population and therefore we could expect at least 5-10 million cases by the year 2000, i.e., 5 years hence. In the Armed Forces, the AIDS control organisation periodically issues directives towards implementation of control. It was expected that by August 1994, 90% of all ranks and 50% of all families would have been educated on AIDS. This target was not achieved. It is also evident that notification procedures are not being adhered to.

From 1985, the US Department of Defense realised that the Armed Forces population was at increased risk and a memorandum of 25 Oct 1985 recommended official testing for HIV in all military personnel [5]. In 1986, the USAF started its screening program of all active duty personnel. Up to February 1991, 700,000

personnel were screened of whom 942, including 29 females, were found to be HIV positive [6]. Of these personnel, 37.3% were returned to active duty, 31.7% put on temporary disability list, 20.5% retired/left service and 10.7% died [6]. Till 1987, waivers were being granted by both the USAF and US Navy [7] but soon ceased as it was observed that 60% of individuals with AIDS had neurological dysfunction, and that acute infection of the central nervous system occurs with seroconversion to the HIV [8]. The process was further complicated by appearance of reports that neuropsychological changes are evident before outright AIDS was present [9-12].

In May 1992, a special committee of the Aerospace Medical Association (AsMA) studied the various aspects of HIV and aviation safety and concluded that: "The AsMA believes that the HIV-infected pilot places the flying public at increased and unnecessary risk, and therefore supports testing of pilots for infection by the Human Immuno deficiency Virus. Individuals confirmed to be so infected should be found medically disqualified for flying duties" [13]. The inability to predict when and in whom neuropsychiatric factors will be present was realised as a major problem since neuropsychological testing was restricted in its validity. The committee had also taken into account the proceedings of AGARD-ASMP Conference held in France 1992 [14].

Having advanced three years from that statement, our duty towards the public and the aviation community forces us to examine the issue in its current Indian context. The problem needs to be approached keeping three aspects in mind: *Screening, asymptomatic HIV positive*

*individuals, neuro psychological effects and disposal of HIV positive aircrew.*

### Screening

The Center for Diseases Control (CDC) in Atlanta, USA reports that 30% of people with HIV were not tested until two months before the diagnosis of AIDS and 50% were not tested until 1 year before the diagnosis of AIDS [15]. Perry [16] has reported six cases of civil aircrew who had manifested acute loss of consciousness/ TIA/sleepy periods/seizures and were found to be HIV +ve on investigation. He ponders as to what would the world's press say if just one aircraft was to crash and one of its pilots found to be HIV +ve.

With large populations at risk, such as in our country, routine screening could present a problem and therefore one has to decide whom to screen. Only those at risk or more? The Armed Forces has already made screening of blood and blood products compulsory. Since September 1994, all STD cases are being screened for HIV 1 and 2. Should we not screen all Armed Forces personnel, as well as candidates who apply to join the Armed Forces?

What is the method to use? Currently, the Armed Forces uses the ELISA as screening test and the Western Blot (WB) as confirmatory. Recently, as an alternate to the Western Blot, three ELISA tests on different biological systems are being used [17].

The ELISA is cheaper, easy to perform and as sensitive as the Western Blot [17]. However CDC still approves the Western Blot as the confirmatory test. The specificity reached is 97.8% when FDA

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approved kits and criteria are used [18]. There are other kits available in the market which are not FDA approved but are highly sensitive and specific when compared with the Western Blot [19]. On 23 December 1994, FDA approved the Ora Sure HIV test, the first saliva-based collection kit for HIV antibody screening for use by physicians [20].

The cost of screening also presents a problem. Recently the cost of HIV testing in the US Army was shown to be less than \$ 2.50 (Rs. 80.00) per serum specimen compared to commercial charges which are \$ 15.00 (Rs. 495.00) for screening and \$ 50.00 (Rs. 1650.00) for confirmatory testing [21]. The percentage of samples requiring the more costly WB assay was 0.2% in 1993 [21]. The experience of the US Army, therefore, demonstrates that large scale HIV testing can be performed at a low cost per specimen.

### Neuropsychological abnormalities in the HIV positive individual.

We are now becoming increasingly aware that the natural history and the pathogenic process of the human immunodeficiency virus (HIV-1) infection are complex and variable and a small number, approximately 5%, remain clinically healthy and immunologically stable despite 12-15 years of HIV infection [22]. This has two implications for us. The first is that a HIV positive individual (with non-progression) can carry on with his or her normal work with periodic monitoring for disease progression [23-27]. The second and more pertinent factor is whether such individuals manifest subclinical abnormalities which would affect their cognitive and motor performance in the cockpit.

The central neurological complications of HIV-1 infection as a function of

Table 1- Central Neurological Complications of HIV-1 Infection [28]

Complication	Systemic Disease State			
	Early	Clinically latent	Early-Late	Late
Acute encephalitis	_____			
Subacute syndromes		_____		
Aseptic meningitis	_____			
HIV-1 headache		_____		
AIDS dementia complex			_____	
Asymptomatic infection	_____			
Opportunistic infection			_____	
Primary CNS lymphoma			_____	
Metastatic systemic lymphoma			_____	
Seizures		_____		
Transient neurological disorders		_____		

advancement of the infection are shown in Table I [28].

Neurological problems can occur even in the absence of opportunistic infection or secondary cancer [29]. Important clinical manifestations include impaired mental concentration, slowness of hand movements and difficulty in walking. This was termed as the AIDS Dementia Complex (ADC) by Price et al [29] or more recently as the HIV-1 associated cognitive/motor complex [30]. The progression of the clinical signs of ADC occur without direct infection of neurons by HIV-1 but by the production of cytokines and other potentially injurious molecules - the final common pathology being the voltage dependent calcium channel and the NMDA receptor channel [31]. Neuronal loss may herald the onset of cognitive and motor deficit [32] though Sielhean et al report otherwise [33].

Perhaps the most important controversial finding at the asymptomatic stage of HIV-1 infection is that of neuropsychological dysfunction. In 1987, Grant et al [40] reported that 7 out of 16 asymptomatic HIV positive subjects had neuropsychological abnormalities compared with 1 out of 11 seronegatives. Numerous other studies soon thereafter indicated the same [45] ringing alarm bells for the aeromedical specialists and other investigators who also started such studies on larger numbers. Janssen et al [36] tested 100 HIV positive individuals vs 157 HIV negative individuals and found that 31% of AIDS Related Complex (ARC) cases had abnormal reactions compared to 12% of HIV positive subjects who were HIV positive but without ARC and were different from the

HIV negative group. However, their sample was not representative of all HIV infected individuals and therefore the findings could not be extrapolated. Other larger studies like the Multicentric AIDS Cohort Study (MACS) [37,38] which enrolled 4,954 homosexual and bisexual men and examined them semiannually did not find any difference between the HIV negative and asymptomatic HIV positive individuals in the prevalence of neuropsychiatric symptoms or in their neuropsychological performance. In this study 230 seropositive were tested against 193 seronegative using two series of tests. They also evaluated MRI abnormalities which were described by Grant et al [10] and noted that similar white matter hyper intensities were seen with frequency in HIV-1 infected individual and controls and that there were no associated neuro/psychological abnormalities.

In another study, Connolly et al [39] examined the relationship of long latency event related potentials (ERP) in asymptomatic HIV-1 infection. The long latency ERPs in response to certain stimuli are thought to be neurophysiological correlates of cognitive processes. No change was noted between the HIV positive asymptomatic group and the matched seronegatives. It had already been shown that there are no EEG abnormalities in men with asymptomatic HIV infection [40].

Mc Allister et al [41] did a prospective study on 95 seropositive asymptomatic and 32 seronegative homosexuals. They did not find any evidence of subclinical cognitive impairment, implying that despite early invasion of the CNS by HIV, major disturbances of function

manifest themselves only when the individual becomes sufficiently immuno-suppressed.

The evidence is therefore sufficient for us to say that asymptomatic HIV positive individuals do not suffer from subclinical neuropsychological abnormalities and should be treated like any others with respect to fitness for flying duties. Miller et al [38] have opined that "a fair and reasonable policy" is one that would protect not only the lives of the passenger but also one that would protect the human rights of aviation personnel who are infected with the HIV.

#### Disposal of HIV positive aircrew

The average time from HIV infection to death is 10 years [42] but clinical and immunological decline is generally evident much earlier. People with progressive disease are evident because of declining CD-4+ count lymphocyte counts. The other side is a group of infected persons whose HIV disease does not progress over an extended time. Though viral replication persists, plasma viremia is significantly lower [43,44]. This CD 4+ count decline has been used as an early marker of HIV infection and subclinical disease progression. Dolan et al [45] showed that when CD-4+ counts were greater than 400/mm<sup>3</sup>, the rate of initial occurrence of opportunistic infection was 1% and 4% at the end of the 1st and the 2nd year, and when less than 400/mm<sup>3</sup>, the rates were 21% and 31% (Table 2). Bornstein et al [46] showed that a faster rate of decline of CD 4- lymphocytes is associated with worse performance on memory and reaction time measures. However, their sample size was too small to offer definite conclusions.

**Table II - CD 4+ counts and rate of opportunistic infection**

CD 4+ mm <sup>3</sup>	Initial rate of opportunistic infection	
	1 Year	2 years
> 400	1%	4%
< 400	21%	31%

The need for a rational test battery for cases of mild AIDS dementia was developed by Maruff et al [47] who emphasized the subcortical nature of many of the deficits. The study was to determine which tests provide the earliest indicators of the onset of ADC. They concluded that if time constraints limit neuropsychometric testing, examination to detect mild ADC should be directed to the areas of executive function, memory and complex attention. Using a criterion of abnormal performance in at least two of the cognitive areas of executive function, memory and complex attention, all patients with mild ADC could be differentiated from HIV negative control with 100% sensitivity and specificity and from neurologically intact AIDS subjects matched for disease severity by CD 4+ lymphocyte count with 100% sensitivity and 94% specificity, which increased to 100% with the requirement of impairment in all three cognitive areas.

Thus there are two methods available by which HIV positive cases can be evaluated regularly to determine their neurological and immunological status.

#### Recommendations

What should be our policy on the detection and disposal of HIV positive personnel? Screening with ELISA is recommended for

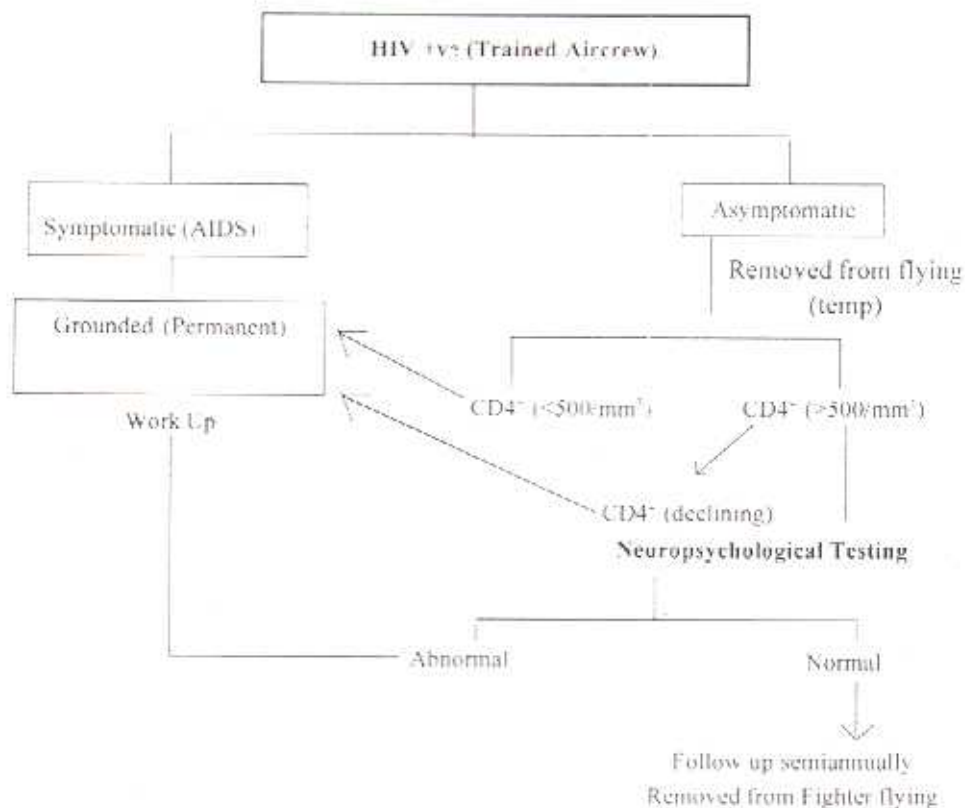
all personnel on initial entry and at least semiannually for all those engaged in increased risk / high risk professions. The latter include medical personnel involved in surgery, anesthesia, dental practice and haematology; and personnel presenting with any sexually transmitted disease. There is no policy at the moment to introduce routine screening for aircrew and other personnel in the Armed Forces or in Civil Aviation.

The disposal of HIV positive cases could be on the following lines:

On recruitment, they are to be rejected

and during the training period invalidated out. As far as trained personnel with AIDS - CDC Class or WR (Walter Reed) Class, they are to be worked up including immunological status. They should be considered permanently unfit for flying duties. Ground category will be based on the stage of the disease. Trained personnel who are symptomatic are to be subjected to CD4+ status (acceptable level  $> 500/mm^3$ ) and neuropsychological testing. If normal, they can be returned to duties with semiannual check up (Fig 1)

Fig. 1. Flow chart showing disposal of trained aircrew with HIV positivity



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