

Original Article

DESENSITISATION OF AIRSICKNESS IN TRAINEE PILOTS BY PHYSICAL EXERCISE THERAPY

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Airsickness management in IAF has so far been on conventional lines using reassurance, motivation and anti-motion sickness drugs. With the introduction of jet trainers at basic stage, the incidence of persistent airsickness among trainee pilots is higher (12.5%). Conventional management is not helpful except in mild cases. Therefore, airsickness desensitisation on ground by specially designed physical exercises, was tried out over a three year period. Of 69 trainee pilots who completed the therapy, 50.7% successfully completed jet training and 2.9% were sent for helicopter flying. The results are comparable with desensitisation programmes elsewhere, which utilise sophisticated rotation devices, linear and angular oscillation devices, biofeedback devices and special relaxation techniques followed by gradual reinduction to flying. The results confirm usefulness of airsickness desensitisation on ground, even with simple measures, and substantiate the need for desensitisation in air for optimum results.

Keywords: Motion sickness, pilot training, jet training.

Airsickness is a common malady affecting those who attempt to fly, whether as aircrew or as passengers. A variant of motion sickness, it is provoked in those who are susceptible, by the peculiar and unfamiliar

motion environment in flight. Fortunately, on repeated exposure there is a natural adaptation in most of the affected individuals. Among trainee pilots, 30-40% become airsick in their first air experience but many of them adapt adequately by the third or fourth sorties. A certain number, however, fails to adapt quickly and has persistent airsickness. Unlike the passengers who can tide over the problem by using anti-motion sickness drugs to suppress the unpleasant symptoms, aircrew in general and pilots in particular, cannot afford to depend on such remedies. It is established that nearly all known anti-motion sickness drugs have side effects which render them unacceptable for use by pilots and other aircrew while flying. Hence, desensitisation or suppressing the hypersensitivity to motion sickness by repeated and graded exposure to the provocative stimuli to encourage adaptation, is the most suitable measure available for long term management of persistent airsickness (6).

Pilot trainees in military aviation are particularly affected by airsickness because of the more demanding nature of flying. Airsickness interferes with the progress of flying training and contributes to higher wastage rates. Formerly, the management of such cases was limited to reassurance and psychotherapy coupled with a trial of three to four sorties flown with the instructor after the trainee was given an anti-motion sickness drug. A certain number improved and the remaining were suspended for failure to learn flying. In recent years the cost of flying training has increased enormously and therefore, the cost of flying effort wasted on airsick trainees as well. Besides, there is tremendous disappointment caused to many aspiring pilots. Many Air Forces and Naval Aviation Wings have, therefore, started airsickness desensitisation programmes which essentially involve the following two steps :-

a. Ground-based desensitisation: The affected trainee pilot is exposed to gradually increasing levels of provocative motion on rotation chairs or platforms so that his sensitivity to such motion is progressively reduced.

b. Airborne desensitisation: The trainee pilot is initially allowed to gain confidence in straight and level flying and then the different aerobatic manoeuvres are gradually introduced after sufficient repetitions at every stage to help adaptation.

The practice of desensitisation for chronic airsickness was first evolved by Dobie (3) in the RAF in 1966. He subjected the airsick aircrew to twice daily sessions of crosscoupled stimulation on a rotatory table for about two weeks. This was followed by gradual reinduction to flying by a doctor pilot, over 5 to 15 h of flying. This programme continued till 1980 during which 68% of subjects could successfully complete the training. Bagshaw and Staff (1) have reported modification of this programme from 1981 onwards. The affected trainees were moved from the flying training centre and given an improved ground based desensitisation by addition of 0.3 Hz \pm 0.25 G linear Oz oscillation and 0.02 Hz (\pm 150 deg/s) angular oscillation accompanied by visual search task. This was followed by an airborne phase of desensitisation for 10-15 h in a Hunter T-7 trainer with a doctor flying instructor. With this programme the number of trainees completing flying enhanced to 72%.

In 1970, a similar programme was started in the USAF and later, in 1979, biofeedback training was also added (5). Biofeedback training involves voluntary control by the subject of his autonomic responses to provocative motion and simultaneous induction of relaxation response which reduces anxiety. During rotation, the subject is instrumented for a continuous feedback of his surface skin temperature, skin conductivity level and EMG. By repeated sessions the subject is trained to use the feedback and keep the parameters within limits so that motion sickness symptoms are checked. This procedure was followed by reorientation flights for airborne desensitisation. They have reported 76% success in student pilots.

Another interesting work reported by Giles and Lochridge (4) is named 'Behavioural

Airsickness Management'. Their subjects, student pilots of USAF flying jet trainers, were trained in voluntary muscle relaxation technique and diaphragmatic breathing. Later they learnt to use these techniques to overcome motion sickness produced by disorientating exercises on Barany Chair. Using this technique, out of their 37 subjects 35 improved, but 20 could complete flying training (4).

In the IAF, airsickness was being managed on conventional lines with reassurance and anti-motion sickness drugs. We introduced desensitisation programme for the first time in 1981 at IAM, Bangalore (2). The subjects were all student pilots who had gone through ab initio training on piston engine trainer but had persistent airsickness on jet trainer. Six subjects were given desensitisation training by voluntary head movements during rotation on a motorised Barany Chair. However, on completion of desensitisation gradual reinduction to flying training could not be provided. Therefore, only one subject could cope with jet flying and complete his training. Two important observations from this programme were:

a. Trainees with low motivation for flying could not be helped. Four out of the six subjects had already lost their confidence and interest in flying.

b. By moving the trainee away from the flying training centre for desensitisation, there was discontinuity of flying as well as of other flying related training, and on return they found it difficult to complete the course in the remaining time.

In mid 1983, the basic (Stage I) training of IAF pilots was changed over from the slow HT-2 piston engine trainer to Kiran Mk-I jet trainer. This change exposed the trainees to higher speeds, accelerations and more demanding flying. A large number of trainees developed airsickness initially and many had persistent airsickness in spite of reassurance, psychotherapy and anti-motion sickness drugs. Under the circumstances, desensitisation therapy was needed but a rotational platform

was not readily available. Hence it was decided to try out voluntary rotation exercises designed to produce coriolis stimulation. The early results were encouraging and therefore it was decided to give the programme a full trial so that definite conclusions could be reached. This paper describes the methodology adopted and results obtained, with a discussion of the findings. Over the past few years, all cases of persistent airsickness have been given the desensitisation therapy by voluntary exercises. However, gradual reinduction to flying training which is an important component of desensitisation programme has not been possible.

Materials and Method

A majority of the trainees who feel airsick initially get adapted naturally and overcome the sickness by about the third air experience. This natural adaptation is encouraged and helped by reassurance and advice from instructors and doctors. In the present study, the flying instructors were requested to refer for desensitisation, trainees who came under any of the following categories :

- a. Those who vomited in all the three initial sorties and showed no evidence of adaptation.
- b. Airsickness which persisted or reappeared any time after the initial three sorties, with vomiting in at least two sorties.
- c. Persistent airsickness symptoms after the initial three sorties, interfering with the progress of flying training.

A total of 70 trainees from six Pilot Courses, undergoing ab initio flying in Kiran MK-1 aircraft, were referred for desensitisation therapy over the three year period of this study. They were interviewed in detail to assess their background, past motion sickness history, air experience, attitude and motivation for flying, details of present airsickness episodes and any other associated problems or sickness. A clinical

examination followed, to exclude any overt vestibular or other ailment. Detailed vestibular investigation was done initially but was not found very helpful and hence discontinued.

The subjects were then explained the nature of their problems as well as the procedure and implications of desensitisation therapy. The exercises were then explained and demonstrated. The subjects were made to practise the exercises repeatedly till they were able to perform correctly. The training involved four exercises which are as described below :

Exercise I: While standing upright, the subject holds his one arm vertically above his head and the head is extended fully backwards so that the face is looking up and nearly horizontal. From this standing position he starts turning his body in the vertical axis to right and completes five rotations at a near uniform rate. At the end of five rotations he lowers the arm and returns the head to the normal face forward position.

He is trained to maintain a nearly constant rate of rotation and to time his rotation so that he completes five rotations in 30 sec (10 rpm). At the end of five rotations, when he moves the head forward he experiences marked vertigo for 15-25 sec. The subject performs three such exercises with clockwise rotation (CW) and three with counterclockwise rotation (CCW) at intervals of 30 sec. The duration of vertigo reduces with repetitions but does not disappear altogether. With practice, the subjects could easily increase the speed to five rotations in 20 sec (15 rpm). The direction of post-rotatory vertigo is as follows : CW rotation produces CW rotatory vertigo, and CCW rotation produces CCW rotatory vertigo.

Exercise II : The subject stands erect with the hands close to the sides and locked at the back. He then bends forward at the waist level so that the upper trunk and head are in line and facing the ground. In this position he starts rotation through vertical axis at a uniform rate as in Exercise I. On completion of five rotations, he stops and

returns his upper body to vertical position when he experiences well marked vertigo for 15-25 sec. The direction of the post-rotatory vertigo is opposite to that in Exercise I, CW rotation producing CCW vertigo and CCW rotation, CW vertigo. The exercise is repeated thrice each in CW and in CCW directions at intervals of 30 sec.

Exercise III : Standing erect, the subject carries out rotation of the head over the shoulders so that in a CCW rotation, the head is fully flexed forward at first, then on the right shoulder, then fully extended backwards, then on to the left shoulder and again fully forward. The rotations of the head are carried out smoothly and at uniform rate. Thereafter, with the head rotating, the subject starts walking forward at a moderate pace to complete 20 steps. He then stops, turns around and returns to the starting position in the same manner, while the head is turning, and repeats the procedure with CW rotation of the head. During the exercise there may be a tendency to lose balance and fall. He is, therefore, advised to reduce the head rotation gradually till balance is regained.

Exercise IV : The subject is required to lie down on a flat couch, bed or on a carpet. He then raises both his legs together to assume a near vertical, head down position, with the body resting only on the shoulders and the head. The waist is supported by the hands. He holds himself in this position for a minute and then slowly lowers the legs to assume the horizontal position again. The slow lowering is important and any tendency of the head getting lifted in the process is to be curbed by lowering the buttocks gradually. The breathing is regulated so that inspiration is maintained during the raising phase and expiration during the lowering phase. After a pause of one or two minutes the exercise is repeated twice. This exercise is identical with the yogic posture of 'Sarvangasana' and is expected to familiarise the subject with the sensation of shifting of abdominal viscera upwards and rise of blood pressure in head and neck as experienced with negative G.

The complete workout of the four exercises

needs 20 min and was required to be carried out at least thrice daily. The subjects were advised to do the exercises, preferably on empty stomach or at least 2-3 h after food. They did the exercise under supervision once every day and were required to repeat them twice at their own convenience. It was made clear that the success of the therapy and in turn their success in flying training, depended fully on their sincere repetitions of the exercises. All efforts were made to motivate the subjects to carry out the exercises regularly. Each subject was kept off from flying for the initial 4 to 5 days of starting the exercises. Flying was resumed thereafter with the exercises continuing. Those subjects who could not do the exercises properly were given exercises for extended period up to 7-10 days, before resuming flying. It was also emphasised that the trainee should not as far as possible miss any flying related activity or ground training while undergoing the therapy. Besides, they were advised to carryout very thorough preparation for their subsequent sorties. A periodic follow up was maintained. The exercise schedules, durations, repetitions and resumption of flying were modified where necessary to suit the need of individual cases. Most subjects resumed flying training at the stage where they had left. Thereafter they practised exercises on an average twice daily according to their convenience. Once they flew a few sorties without any sickness they gained confidence following which most of them gradually discontinued the exercises as confirmed during follow up. Four subjects who discontinued exercises prematurely and suffered airsickness again, were given another spell of exercise therapy. Whenever there was break in flying, the trainees were advised to practise the exercises for a few days prior to resumption.

Results

During the three year period of the present study, it was observed that 12.5% of the trainees who underwent ab initio or Stage I flying training on Kiran MK I jet trainer, suffered persistent airsickness and required desensitisation. Airsickness persisting beyond

the initial three sorties, which was provoked by descent, turns and descending turns, was noted in 50 subjects. Another nine cases suffered marked airsickness when spin was introduced. Thereafter airsickness manifested in nine others during exposure to aerobatics. Those trainees had experienced nil or only mild symptoms during the initial three sorties.

Past history of motion sickness is often regarded as indicative of airsickness susceptibility. Of the total 70 subjects, 15 had mild or occasional motion sickness in childhood mostly during road journey. Another 10 cases admitted moderate to severe motion sickness in recent past. The remaining subjects denied any past motion sickness experience.

Previous air experience is expected to be very helpful in natural adaptation to motion and sensory environment in flying with reduction of airsickness incidence. 33% of our subjects had no previous air experience. The other 67% comprised of 43 trainees who had an average of 30 launches in gliders and four who had powered flying experience of around 60 h in piston engine trainer. Only two of them had suffered mild airsickness, one in gliding and one in flying.

A total of 69 subjects completed the desensitisation with physical exercise therapy of 4-7 days period following which they all resumed normal flying training. The results of this therapy are presented in Table I. About 80% subjects clearly improved with the physical exercise therapy and 10% were not benefited. In all 50.7% subjects successfully completed all stages of flying training and were distributed evenly in the fighter, transport and helicopter streams. Their follow up for one year confirmed that they were free from airsickness. At least eight were chosen to go directly for flying high performance fighters.

Discussion

The past experience of airsickness during ab initio flying training on the slower piston

Table-I
Results of Airsickness Desensitisation
by Physical Exercise Therapy

Classification of Results of Desensitisation	Trainees	
	No	%
1. Successful Completed flying training	35	50.7
2. Successful Failed to complete flying training for reasons other than airsickness.	25	36.2
3. Inadequate Airsickness reappears in aerobatics only. Accepted for helicopter flying (A recent provision)	2	2.9
4. Unsuccessful Failed to learn flying due to persistent airsickness	7	10.2
Total	69	100

engine basic trainer like HT-2 and even in the newer Deepak aircraft, indicates that 4 to 5% trainees are affected by persistent airsickness requiring medical attention. Many of these cases improved with simple measures. In some, airsickness reappeared during higher stages of flying and a number of them could not complete flying training due to airsickness. However, the practice of including such cases under the general category of 'Failure to Learn Flying' leaves us no way of knowing the contribution of airsickness to the wastage rates in flying training. Only in a few cases has the cause of suspension been recorded as 'Airsickness'. The 12.5% incidence of persistent airsickness noted during the present study is obviously higher and implies higher wastage rates. Suspending a trainee after about 20 h of flying results in a loss of about Rs. 3 lakhs, besides the loss of a potential pilot.

Desensitisation programmes can greatly help to reduce such wastage. Physical exercise therapy might appear too simple to be useful, particularly when compared with the elaborate desensitisation techniques involving rotation and tilt chair or platform, linear and angular oscillation devices, biofeedback devices and various relaxation techniques, being used elsewhere. The desensitisation techniques essentially require a means of provoking motion sickness so that with repeated experience, the subject learns to deal with the disturbing sensory input and is conditioned to evoke less and less response. Motion sickness can be most readily induced by crosscoupled or coriolis effect when head movements are done during rotation, whatever be the means of rotation.

With some practice it was easily possible for the subjects to rotate at nearly uniform rate up to speeds of 10 rpm initially and 15-18 rpm with further practice. These rotation rates are well comparable to those used for desensitisation with rotation devices. The Exercises I, II and III resulted in fairly strong sensations of vertigo which reduced as desensitisation progressed but did not disappear completely. Many subjects felt nausea during the exercise which they learnt to control.

Airsickness during descent from altitude is possibly due to the small element of negative G, with elevation of the Diaphragm and abdominal viscera. With a view to condition against such sensations, Exercise IV was introduced. While subjective improvement of descent tolerance was reported by many, this has not made any significant difference to the results. For the success of physical exercise therapy, it is essential that the subjects are keen, co-operative and well motivated to learn flying. Eight of our subjects were assessed as having inadequate motivation at the start of therapy and expectedly, most them were not helped by desensitisation.

A comparison of our results of exercise therapy and the reported results of other forms of therapy shows that where desensitisation is done by ground phase alone, over 50% success is possible. When it is

extended to an airborne phase of gradual induction to flying, over 70% success is possible. The optimum success rate for desensitisation programme is around 75%, since about 25% trainees are likely to fail as per the normal wastage rate. The proportion of trainees who did not improve with desensitisation, is around 10% in all the programmes and it is unlikely that this number can be reduced significantly. Among the 36% who appeared to have been successfully desensitised but ultimately failed in flying training, about half were assessed below average in flying skills. The other half had average flying skills and could have been possibly helped by further desensitisation. A small number of trainees failed, primarily because of loss of interest in flying.

An important feature of the physical exercise therapy is that, whenever the subject has a break in flying, he does exercises on his own before resuming flying. Practice can be continued in his future career as well. The knowledge that his embarrassing symptoms can be prevented by simple exercises does a great deal to boost his confidence and removes the fear of being sick or being an inferior. Besides, some of our subjects have been passing on the techniques of physical exercise therapy to their colleagues. In every batch, a few trainees have benefited from exercise therapy without having to report to us.

Conclusions

The present study confirms a higher incidence of airsickness among trainee pilots doing ab initio flying training on the faster jet trainer aircraft. Physical exercise therapy, if performed correctly and regularly, is capable of effectively reducing sensitivity to airsickness and can serve as a simpler alternative to rotation and oscillation devices for desensitisation. It requires no investment, can easily be blended with the flying training programme and causes minimum interference or break in flying. There is no need to shift the affected trainees to any specialised centre for desensitisation.

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