

## USE OF TOLERANCE TESTS IN ASSESSMENT OF FITNESS AFTER CRANIO-CEREBRAL INCIDENTS

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### Abstract

Apart from a thorough neurological and general examination, tests like E.E.G., E.E.G. under provocative technique, G.T.T., Thermal Stress and 'G' Stress appear to be helpful in assessment of fitness of asymptomatic aircrew (after cranio-cerebral incidents) and to provide a rational basis for periods of observation and non-effectiveness. An analysis of forty-eight cases is given.

### Introduction

Air Force medical boards are frequently faced with the question as to what criteria are to be used in assessing fitness for flying duties in cases of symptomless aircrew who had cerebral injuries or inflammatory processes.

Most of these cases do not show abnormalities even after careful general examination of the central nervous system. These aircrew are subjected to long periods of observation in all but very minor cases of cranio-cerebral incident. Since the aircrew feels absolutely fit, he is liable to think that he is being unnecessarily kept on the ground. Long period of observations is restored in order to avoid incipient cases of post traumatic epilepsy and other sequelae being returned to flying duties. This policy is in keeping with the practice in other important Air Forces of the World. The severity of the head injury is assessed not only by the

nature, and neuronal deficits present, but also by the period of unconsciousness and amnesia.

It is no doubt necessary that the period of non-effectiveness of aircrew is kept to the minimum possible extent, but this should be compatible with safe and efficient flying. Clinical recovery does not necessarily mean neurological and psychological fitness for present day flying. The latter fitness not only involves proper intellectual functions and emotional stability but also psychomotor abilities concerned with the skill of flying, as well as tolerance to stresses and discomfort, normally encountered in flying modern aircraft, *viz.*, 'G' effects, temperature, noise, glare, vibration, disorientation, etc. It is known that after cerebral incidents, tolerance thresholds to stresses are lowered. Early fatigability a symptom of post traumatic neurosis may be a manifestation of low tolerance to physical and psychological stresses. Existing knowledge does not clarify as to whether these lowered tolerances are to be considered as indicators of imperfect healing after cerebral catastrophies.

It is necessary that aircrew patients are to be subjected not only to E.E.G. (normal and under provocative techniques) but also to some practical tolerance tests to find out if they have normal threshold tolerances, for such stresses as they would encounter in flights, before they are considered fit for full flying duties.

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These tests could form a basis for assessment of fitness in such cases and may also possibly give a rational basis in determining the period of non-effectiveness.

#### Method

Special tests given to such cases at Institute of Aviation Medicine showed that some of them could be used as Indicators of fitness. The tests given were as follows:

- (a) E.E.G.—Normal and under provocative techniques of hyperventilation and photic stimulation.
- (b) E.E.G.—Under hypoxia—Same as above, but under hypoxia conditions, *i.e.*, at 15,000' for 3 minutes and 20,000' for 3 minutes.
- (c) Glucose tolerance test.

(d) Thermal stress—Subjecting the aircrew to temperature of 55°C with 50% humidity for thirty minutes.

(e) 'G' tolerance—Subjecting the aircrew to stress of 3 to 4 'G' in human centrifuge.

Types of cases studied included 47 head injury cases and one case of encephalitis.

Controls were readily available in cases of E.E.G., G.T.T. and Thermal stresses from amongst the pilots who came for assessment of fitness to fly high performance aircraft. Control group was not available for 'G' thresholds.

#### Results and Discussion

Results of tests on the case studied are given in Table I.

TABLE I

#### Results of Tests on 48 cases of Cerebral Incidents

0=Normal reaction

+ = Abnormal reaction (all degrees taken together)

Case No.	E.E.G.	E.E.G. under Hypoxia	G.T.T.	Thermal Stress	'G'	Remarks
1	..	0	0	+	0	0
2	..	+	+	0	+	0
3	..	0	0	0	+	0
4	..	+	+	+	0	0
5	..	0	0	+	0	0
6	..	0	0	+	0	0
7	..	+	+	0	0	0
8	..	0	0	0	+	0
9	..	0	0	0	0	0
10	..	0	0	+	0	0
11	..	+	+	0	+	0
12	..	0	0	+	0	0

Viral Enceph.

TABLE 1—Continued

<i>Case No.</i>	<i>E.E.G.</i>	<i>E.E.G. under Hypoxia</i>	<i>G.T.T.</i>	<i>Thermal Stress</i>	<i>'G'</i>	<i>Remarks</i>
13.	0	0	0	+	0	
14.	0	0	0	0	0	
15.	0	0	0	0	0	
16.	0	0	+	0	0	
17.	+	+	0	0	0	
18.	+	+	0	0	0	
19.	+	+	0	0	0	
20.	0	0	0	0	0	
21.	0	0	+	0	0	
22.	0	0	+	0	0	
23.	0	0	0	+	0	
24.	+	+	0	0	0	
25.	0	0	+	0	0	
26.	..	0	0	0	0	
27.	+	+	0	0	0	
28.	0	0	+	0	0	
29.	+	0	0	0	0	
30.	+	0	0	0	0	
31.	0	0	+	0	0	
32.	+	+	+	0	0	
33.	+	+	0	0	0	
34.	+	+	0	0	0	
35.	+	+	0	0	0	
36.	+	+	+	0	0	
37.	0	0	0	0	0	
38.	0	0	0	+	0	
39.	+	+	0	0	0	
40.	+	+	+	+	0	
41.	0	0	0	0	0	G.T.T. due to lowered kidney threshold.
42.	+	+	0	0	0	
43.	0	0	0	0	0	
44.	+	+	0	0	0	
45.	0	0	+	0	0	
46.	+	+	0	0	0	
47.	0	0	0	0	0	
48.	0	0	0	0	0	

Abnormalities were noticed as follows:

E.E.G. abnormal reaction ..	19	Thermal stress ..	9
E.E.G. under hypoxia ..	10	'G' stress ..	1
G.T.T. ..	16		

E.E.G. and E.E.G. under hypoxia showed abnormalities in the largest number of cases. Abnormalities were of a general nature and not localised or lateralised. In nineteen cases abnormal E.E.Gs. were noticed and the same cases showed abnormalities in E.E.G. under hypoxia also. It is possible that the degree and duration of hypoxia simulated in these studies were such as not to affect the normal E.E.G. pattern of the individual.

G.T.T. revealed abnormal type of curves in 16 cases. Abnormalities ranged from marginal lowering of threshold to definite lowered tolerance, and even 'diabetic' type of curves. In nine cases after a period of observation for 3 to 6 months the G.T.T. became normal. A few cases are still under observation. In one case, G.T.T. done previous to the head injury showed a normal curve. After the head injury abnormality was noticed which subsequently became normal, thus indicating that the abnormality was most probably a result of head injury.

Nine cases showed low heat tolerance compared to the control group.

The case which showed low 'G' tolerance also showed abnormalities in thermal stress. Tests done after six months on him showed normal thresholds in both.

It may be seen that a person showing abnormality in one test need not show abnormalities in others. In many cases where other tests were found to be normal, E.E.G. records showed abnormalities while in some cases the person showed abnormalities in more than one test.

#### References :

1. *Lakshminarayan, H.* : Evaluation of Cases of Head Injury in Aircrew. *J. Aero Med. Soc. Ind.*, 11 : 22, Oct. 1968.
2. *Sinha, K. C. and Lakshminarayan, H.* : Disorders of Carbohydrate Metabolism in Cases of Head Injury. *J. Aero Med. Soc. Ind.*, 12 : 31, Oct. 1969.

It is seen that the tolerance tests are helpful in giving indications of fitness in other cerebral conditions also. In one case of recovered Viral encephalitis (Case No. 11) though the patient was asymptomatic and did not show any neuronal deficit, the tolerances showed abnormalities both in E.E.G. and Thermal stress. Subsequent tests during review showed improvement.

It is seen that in 16 cases, the E.E.Gs. are normal but some of the other tests show abnormalities. It is known that lesions in deeply seated areas of the brain may not be recorded in normal methods of E.E.G. With special techniques the E.E.G. records could have possibly shown abnormalities.

It is not clear at this stage as to whether lowered tolerance indicates delayed healing process, faulty functioning, or areas of permanent damage. However these tests suggest that they can form reliable yardstick for assessment of fitness, and could help to rationalise and decrease the period of observation and non-effectiveness. The present study indicates that there are many areas of physiological and psychological functioning and their tolerance to various stresses which need further research before drawing decisive conclusions.

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