

Cold Air Caloric Test

—Its Results of Long-Term Trained Pilots—

Shoichi HONJO and Toru SEKITANI

*From the Dept. of Otolaryngology
(Director : Shoichi Honjo)
Yamaguchi University Medical School,
Ube City, Japan.*

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Caloric test is the most commonly used and indispensable method among many various effective vestibular function tests. However, caloric test using with water, neither hot nor cold, is contraindication for the patients with troublesome ear conditions such as; 1) perforated eardrum, 2) postoperative state, and 3) posttraumatic state of the head, especially ear and temporal bone.

Meanwhile, cold air caloric test is able to perform even those troublesome-dangerous case, without any contraindication, simply and safely.

According to McNally¹⁾, Sir James Dundas Grant used a coiled tube for cold air stimulation of the ear (Dundas Grant coiled tube (Fig. 1)) first.

Honjo²⁾ reported a modified, almost newly devised, cold air caloric test tube (Fig. 2) which is better device to avoid any stick pain or injury at the external auditory meatal wall and/or ear drum, and which made more favorable fitness to the canal for air douching. Furthermore, Honjo and his associates^{2,4)} investigated experimentally and clinically on many factors such as; the temperature of cold air, the cooling effect, effective duration, and douching air pressure, and obtained favorable and dependable results from normal adults and clinical cases. The advantages of this method are simplicity, safety and relatively accuracy, and can be done at any place.



Fig. 1. Dundas Grant coiled tube (McNally; cit. in Honjo³ (Tokyo), 1960).



Fig. 2. Honjo's cold air caloric test tube in profile.

In this present paper, the results of cold air caloric test of well trained aviation personnel (instructor pilots) are reported.

Materials and Methods:

Twelve instructor pilots in a primary training school (recipro-engined aircraft) of the Japanese Self Defence Air Force, those who aged from 33 years old to 44, average 38, and their total flight time ranged approximately 1,000 hours to 4,000 hours, average 2,475 hours. Their general condition were all excellent without any notable history of an otological disease, head injury or cardiovascular disorder.

Examinees were lying down on the examining table and their head position were 30° forward (upward) in order to stimulate the horizontal semicircular canal.

Cold air caloric stimulations were given with Honjo's cold air caloric test tube connected with double bellows.

Ethyl chloride solution was sprayed over the cloth mesh covering the coiled tube until the beautiful frost appears on the cloth (at this time, the thermometer attached to the tube points usually 10°C to 5°C, sometimes 0°C).

This frosted test tube was inserted into the external auditory canal, and its direction of the tube to the drum was ascertained by direct vision.

Cold air which passes through the frosted tube was douched into each side alternately for 15 seconds first, and then 30 seconds, respectively.

Each tests were done with an interval of several minutes rest.

Latent period and duration of the nystagmus were recorded, and its character and any accompanying symptoms (side effect) were observed.

Results :

Twelve examinees were satisfactorily examined.

Results of the test in case of 15 seconds stimulation and 30 seconds stimulation were shown in Table I and II.

When 15 seconds stimulation were given, as shown in Table I, latent period on the left ear ranges from 12 sec to 25; its of the right from 13 to 25. And duration of nystagmus of the left ear ranges from 75 sec to 100; its of the right from 64 to 120.

When 30 seconds stimulation were given, as shown in Table II, latent period of the left ear ranges from 12 sec to 30; its of the right from 12 to 25. And duration of nystagmus ranges from 90 sec to 140; its of the right from 85 to 165 sec.

Speaking of the mean values only, on 15 seconds stimulation, mean value of the left side and right are 17.6 ± 1.8 and 17.8 ± 1.9 , respectively; mean value of the duration of nystagmus of the left and right are 88.3 ± 3.3 and 85.8 ± 6.2 , respectively. Otherwise, on 30 seconds stimulation, mean values of latent period of the left and right are 17.8 ± 1.7 and 17.4 ± 1.9 ; mean value of the duration of nys-

Table I
Results of Cold Air Caloric Test for Pilots (15 seconds douching)

No.	Age	Total Fly Time	LEFT EAR		RIGHT EAR	
			latent	duration	latent	duration
1	33	1000	25 ^{sec}	70 ^{sec}	25 ^{sec}	65 ^{sec}
2	34	1500	14	100	13	115
3	38	1700	22	93	16	66
4	33	1900	20	100	20	115
5	37	2000	18	98	16	90
6	38	2000	20	75	20	96
7	36	2500	12	80	14	64
8	41	3000	18	99	14	90
9	44	3300	16	90	13	120
10	40	3300	22	80	20	65
11	39	3500	12	84	14	95
12	43	4000	12	90	22	94
M±m			17.6±1.8	88.3±3.3	17.8±1.9	85.8±6.2

Table II
Results of Cold Air Caloric Test for Pilots (30 seconds douching)

No.	Age	Total Fly Time	LEFT EAR		RIGHT EAR	
			latent	duration	latent	duration
1	33	1000	30 ^{sec}	90 ^{sec}	25 ^{sec}	85 ^{sec}
2	34	1500	15	118	13	108
3	38	1700	23	105	16	98
4	33	1900	18	122	20	127
5	37	2000	16	112	12	113
6	38	2000	23	108	21	112
7	36	2500	12	128	12	106
8	41	3000	13	137	13	124
9	44	3300	16	130	14	165
10	40	3300	20	140	22	117
11	39	3500	13	104	16	120
12	43	4000	14	111	24	121
M±m			17.8±1.8	117.1±4.1	17.4±1.9	116.3±5.3

latent : latent period

duration : duration of nystagmus

tagmus are 117.1 ± 4.1 and 116.3 ± 5.3 , respectively.

They did not pronounced any notable side reaction or intolerable discomfort during the examination.

Comparison and Comment

Comparison of the mean values of the latent period and duration of nystagmus on each side will be done between the results of pilots and that of normal subjects (as control) which were investigated by Inoue (1960),⁴⁾ our associate (Table III and VI).

As well known from the data on Table III and VI, there is no significant difference in the values left side to right side.

Table III

Comparison of Mean Values of Cold Air Test (15 sec) between Pilots (12) and Controls (171)

	PILOTS (M±m)	CONTROLS (M±m)	$\frac{M_1 - M_2}{\sqrt{m_1^2 + m_2^2}}$
LEET EAR			
latent	17.6±1.8 ^{sec}	19.4±0.3 ^{sec}	1.81*
duration	88.3±3.3	106.1±1.4	3.34**
RIGHT EAR			
latent	17.8±1.9	19.6±0.3	0.97*
duration	85.8±6.2	107.1±1.6	3.32**

Table VI

Comparison of Mean Values of Cold Air Test (30 sec) between Pilots (12) and Controls (171)

	PILOTS (M±m)	CONTROLS (M±m)	$\frac{M_1 - M_2}{\sqrt{m_1^2 + m_2^2}}$
LEFT EAR			
latent	17.8±1.8 ^{sec}	19.6±1.0 ^{sec}	0.88*
duration	117.1±4.1	133.8±2.0	3.65**
RIGHT EAR			
latent	17.3±1.8	19.3±0.2	1.07*
duration	116.3±5.3	131.0±2.0	2.59***

* statistically not significant

** statistically significant

*** not clearly significant

The average of latent period on both sides of pilots and normal subjects are 17.7±1.9 and 19.5±0.3, on 15 seconds stimulation, respectively; and 17.6±1.9 and 19.5±0.6 as 30 seconds stimulation, respectively, and the difference between them is not statistically significant.

Meanwhile, the average of duration of nystagmus on both sides of pilots and normal subjects on 15 seconds stimulation are 87.1±4.7 and 106.6±1.5, and the

difference is statistically significant.

On 30 seconds stimulation, average of duration of nystagmus on both sides of pilots and normal subjects are 116.7 ± 4.7 and 132.4 ± 2.0 , and the difference is almost significant.

These evidence apparently suggested that these well trained, highly qualified instructor pilots have relatively “short duration of nystagmus” than normal subjects.

This fact, i. e. “short duration of nystagmus” or “reduced vestibular excitability”, will be in accord with invaluable observations by Narita (printed in 1954) and later by Caporale R. and Camarda V. (1958); and recently by Fukuda, T. et al (1963).

Narita reported that duration of postrotatory nystagmus in long-experienced and skillful instructor pilots are, in general, remarkably shorter than that of normal adults. And he, furthermore, explained that fighter pilots have relatively short duration rather than bomber pilots, and concluded that these reduction of the vestibular excitability means an adaptation to flight activity. Caporale R. and Camarda V. studied the vestibular function of 4 pilots of acrobatic crews and explained “the existence of hypoexcitability in those pilots”. Fukuda T. et al (1963) described precisely that the “response decline” of the vestibular function develops after daily repetition of rotatory, centrifugal, see-saw and pendulum-like movements in the experimental animal, the domestic fowls; and further in men explained the “response decline” in the duration of the postrotatory nystagmus of skilled, specially trained, people such as dancers and athletes, showing “hyponystagmus”.

SUMMARY

Cold air caloric test on highly qualified instructor pilots, 12 persons, are done using with Honjo's test tube.

Mean values of latent period and duration of nystagmus on both sides induced by 15 seconds stimulation are 17.7 ± 1.9 and 87.1 ± 4.7 , respectively.

Mean values of those on 30 seconds stimulation are 17.6 ± 1.9 and 116.7 ± 4.7 , respectively.

Comparison of the mean values of pilots with the mean values of normal subjects revealed that duration of nystagmus of these pilots are significantly shorter than that of normal subjects.

REFERENCES

1. McNally, W. J. and Stuart, E. A.: *Examination of the Labyrinth in Relation to its Physiology and nonsuppurative diseases*, Douglas Printing Comp. (Omaha, Neb., USA) 1953.
2. Honjo, S.: The Use of Cold Air in Caloric Test (in Japanese), *Otolaryngology* (Tokyo), **35** : 5-7, 1963.

3. Honjo, S.: "*MEMAI*" (*Vertigo—Examinations and Treatments*) (in Japanese), Kanehara Print. Co., (Tokyo), 1960.
4. Inoue, H.: Clinical Study on Cold Air Test (in Japanese), *Zibi Rinsho* (Kyoto), **53** : 1557-1561, 1960.
5. Caporale, R. and Camarda, V.: The vestibular Function of some Pilots of Acrobatic Crews, (in Italian) *Rib. Med. Aero.*, **21** : 12-36, 1958 (cit. in *Excerpta Medica XI*, Vol. 12, No. 1. Abst No. 243, 1959)
6. Narita, H.: *Zibi Rinsho* (Kyoto) (in Japanese), **47** : 851-881, 1954.
7. Fukuda, T. et al : The Physiology of Training : The Functional Development of the Labyrinthine Function through daily Repetition of Rotatory, centrifugal, see-saw and pendulum-like Movements, *Acta Oto-laryngologica* (Stockh), **56** : Fasc 2-3, 239-250, 1963.

This Cold Air Caloric Test Tube (Honjo) was manufactured by Nagashima Medical Instrument Ltd. Co., (Bunkyo-ku, Tokyo, Japan).