Clinical application of Intermittent Hypoxic Training (IHT)

For information only

CONTENTS

1. INTERMITTENT HYPOXIC THERAPY

(The method of improving of body's non-specific resistance to illness by means of Intermittent Hypoxic Stimulation)

Approved by the Public Health Ministry of the USSR [Edited by *Strelkov*, 1988 and the following editions].

Methodical recommendations

I. Indications for the usage of Normobaric Hypoxic Therapy

1.1. Normobaric hypoxic therapy is indicated in:

- chronic non-specific lung diseases, including bronchial asthma,
- chronic diseases of the cardiovascular system, including ischaemic heart disease, post-infarction cardio-sclerosis, hypertension of stage I and II-a,
- neuro-circulatory dystonia,
- chronic inflammatory activities of the genitourinary system,
- hypoplastic and iron deficiency anaemia,
- post-radiation disorders of haematocrit,
- primary thyrotoxicosis, disorders of metabolism, neurosis and insomnia.

1.2. The treatment objective is an improvement in the working capacity of the body and resistance to emotional overtaxing.

1.3. Hypoxic normobaric stimulation improves an organism's resistance to side effects of pharmacological treatment, including toxic effects of certain chemotherapeutic treatments in oncology.

1.4. Normobaric hypoxic therapy may aid in improving non-specific immunity, and thus be advantageous in the in treatment of malignancy.

1.5. Short-term hypoxic hypoxia has protective properties against ionising radiation. Breathing with a Hypoxic Gas mixture during radiotherapy sessions protects patients from side effects of ionising radiation, thus improving the efficiency of radiotherapy.

1.6. The protocol of application of Intermittent Normobaric Hypoxic Therapy includes respiration with a hypoxic gas mixture consisting of 10,0 ? 1,0 % oxygen with nitrogen in balance (HGM-10) through the breathing mask. Total time of HGM respiration is 20-40 min daily. The course of treatment comprises 10-20 sessions, 5 days a week.

II. Contra-Indications for Usage of Normobaric Hypoxic Therapy

2.1. Absolute contra- indications toward the use of the method are acute somatic diseases or infections, and individual intolerance of oxygen insufficiency.

2.2. The method is contra-indicated in any chronic disease with symptoms of decompensation or during an acute exacerbation of the chronic illness.

III. Protocol for Normobaric Hypoxytherapy

3.1. **Patient Examination**. The patient undergoes a complete physical examination with a physician to determine any indications for IHT. If the patient does not have any general contraindications, the doctor then completes a test of individual tolerance to breathing with a hypoxic gas mixture. This test simultaneously may be used as an indicator of latent coronary deficiency.

3.2. **Hypoxic Test**. Prior to the hypoxic test, the patient should be fully informed that he/she will breathe with oxygen-reduced air as if he/she was at a high altitude. The patient should be aware that in case he/she experiences any unpleasant sensations, he/she may remove the breathing mask and breathe with ambient air.
Throughout the hypoxic test, a doctor or nurse monitors the patient's condition, homodynamic parameters and breathing frequency.

The symptoms of acute sensitivity to oxygen deficiency in the inspired gas mixture (apart from negative subjective feels) are:

- Marked sweating;
- Significant increase in heart rate (of up to 30-40 bpm);
- Development of bradycardia;
- Increase in arterial blood pressure of up to 20-30 mm Hg;
- Breathlessness.

The IHT cabinet it is required to keep an emergency kit.

It is good practise in patients with cardiovascular pathologies to perform an ECG during the hypoxic test, which will be an objective index for the evaluation of the efficacy of the IHT course. This ECG may later be compared with an ECG taken after the completion of the IHT course.

3.3. **IHT session completion.**

3.3.1. Respiration with lowered oxygen concentration gas mixtures is completed in a cyclical-fractionated mode: a cycle consists of respiration first with a hypoxic gas mixture for 2-5 min followed by atmospheric respiration for 2-5 min. The number of cycles in a single session may vary depending upon the medical indication and individual particulars of the patient, from 1-2 up to 5-6. Usually, the total time of hypoxic gas mixture respiration during one session is 20-30 min (4-6

of 5-min cycles). The total duration of the session, including breaks on atmospheric respiration is not more than 35-55 min. The duration of the IHT course is 2-3 weeks.

The usual schedule of the IHT course comprises daily sessions. It is possible to arrange an every second day schedule with a correspondingly lengthened course duration.

When using hypoxic gas mixture generators with constant O_2 concentration (*AN*-8, "*Narkon*-P", "*Elbrus*", MWA-0,014 with GS-20, "*Everest*", "*Bio-Nova*-204", "*Hypoxicator MM*", "*Gnom*" and etc.) it is reliant upon the doctor's discretion to increase the time of uninterrupted respiration to 10 and more minutes, provided that the total session duration is unchanged.

3.3.2. The initial session of IHT is to be completed under the supervision of a doctor. The following sessions are supervised by a nurse, provided the source of the hypoxic gas mixture is an apparatus with fixed O_2 content.

3.3.3. The result of a breath holding performance test (*Schtange Test*) may be used for the selection of an optimal breathing regimen in each particular case.

The *Schtange Test* (breath holding performance test) - breath holding time at the point of tidal inhalation - is a simple and informative parameter of a patient's condition. Please use Table 1 to determine the length of time for continuous hypoxic gas mixture breathing based on the breath holding time.

Table 1. Determination of the length of time of continuous hypoxic breathing depending upon breath holding performance

Breath holding time (sec)	Time of continuous breathing with the hypoxic gas mixture in one cycle (min)
< 10	2 or less
10 -20	3 or less
20-30	4 or less
> 30	5

The breath holding performance test is to be performed before and after the course of IHT treatment. An increase in breath holding time is an indication of the achievement of a positive result.

2. Clinical Protocol: IHT in Obstetrics and Gynaecology

Interval Hypoxic Training in Obstetrics and Gynaecology Practice
Methodical Recommendations

Ministry of Public Health of Russia

Moscow, 1993

Preface

Gynaecological and obstetric morbidity and mortality are areas of great concern.

A serious complication of pregnancy is gestosis, which is often accompanied by extragenital pathology and presumably results from a reduction in a woman's defence mechanisms.

Drug therapy of gestosis and other illnesses which complicate pregnancy is restricted by the requirement of complete drug safety for mother and foetus. Therefore, activation of natural self-defence mechanisms by treatment with non-drug methods (especially in patients of high risk) has very good prospects.

Pelvic inflammatory disease is one of the most common gynaecological diseases. Most often seen amongst women of reproductive age is chronic salpingo-oophoritis (82-89% of all diseases of the female reproductive system). As a rule, relapses of chronic salpingo-oophoritis are observed when there is a decrease in the body's resistance and depletion of compensatory reserves.

The traditional drugs for treatment of salpingo-oophoritis are often unsuccessful, and the duration of treatment is prolonged and has frequent relapses. Therefore, non-drug methods of treatment appear to be favourable.

From 1970 onwards, a method of acclimatisation to breathing with oxygen reduced air - Interval Hypoxic Training (IHT) has been used in clinical practise.

The basis for IHT is intermittent short-term breathing with a hypoxic gas mixture (HGM) followed by atmospheric respiration at normal barometric pressure.

As a result of hypoxic training, there is an increase in lung and alveolar ventilation, an increase in lung perfusion, a release of deposited erythrocytes and a stimulation of erythropoiesis, and an increase in the ability of cells to utilise oxygen due to facilitated activation of respiratory enzymes and the antioxidant system.

IHT is used for prophylaxis, treatment and rehabilitation in patients with cardiovascular pathology (ischaemic heart disease, hypertension I-IIA stage, neurocirculatory dystonia), haemopathology (hypoplastic and iron deficiency anaemia), chronic non-specific lung diseases (pneumonia, bronchitis, asthma), gastrointestinal system pathology, dermatitis, and other diseases.

The high efficacy of IHT in the treatment and rehabilitation of patients with chronic non-specific salpingo-oophoritis has been demonstrated [*Shutova*, 1989]. IHT treatment in these patients has led to remission for 1-2 years, improvement in overall well-being, and even cure of this disease.

At the moment, the following responses in human organisms are established as a result of IHT treatment:

- stimulation of all links of the oxygen transport chain to the tissues;
- increase in blood oxygen capacity;
- capillary dilation and neo-vascularisation;
- activation of tissue respiration due to an increase of the affinity of cytochrome-oxidase to oxygen;
- Increase in mitochondria number.

A large number of experimental and clinical data show absence of IHT side effects on maternal, foetal and newborn organisms. Such data were obtained from clinical observation, delivery outcome, and due to results of functional tests, foetal monitoring, ultrasound tests, and evaluation of kinetics of oxygen metabolism [*Karash* et al, 1980-1990 s].

IHT application in the prophylaxis and treatment of high risk women during preparation for pregnancy and during pregnancy (especially in patients with pre-eclampsia and first stage of gestosis (oedema of pregnancy)) was found to decrease the frequency and severity of gestosis, reduce the incidence of intra-uterine growth retardation (IUGR) three-fold, and reduce symptoms of concurrent illnesses (neurocirculatory dystonia, hypertension I-II stage) [*Egorova*, 1987;], [*Evgenieva*, 1989], [*Tsiganova*, 1992].

IHT stimulates the placenta's compensatory and adaptive mechanisms, and in turn, improves the metabolism between mother and foetus, promoting normal progression of pregnancy and delivery of a live and healthy neonate [*Tsiganova*, 1992].

Inspection of children delivered by mothers who received a course of IHT during pregnancy demonstrated normal physical development during the first year of life. Among these children, a significant reduction was evidenced in the number of cases of perinatal hypoxia, breach in brain blood circulation, and post-hypoxic encephalopathy [*Vernobol*, 1989].

IHT prophylactic application provides an opportunity to progressively decrease the frequency and dosage of hypotensive drugs in patients with hypertension stage I, and neurocirculatory dystonia of hypertensive type. There may even be a possibility for complete drug cessation.

The method of IHT is affordable and suitable for any health or prophylaxis clinic.

Indications

1. Chronic non-specific inflammatory diseases of the genital system (salpingo-oophoritis, endometritis)
2. Pregnancy with accompanying extragenital pathology (hypertension I-IIA stage, neurocirculatory dystonia of hyper- and hypotonic type)
3. Pre-eclampsia of pregnancy
4. Anaemia of pregnancy

IHT is indicated in preparation for pregnancy in patients with a poor obstetric history (nephropathy, eclampsia, IUGR, or foetal death in utero in previous pregnancies), coronary pathology (hypertension I-IIA stage, neurocirculatory dystonia of hyper- and hypotonic type). IHT is to be completed 1 month before conception.

With prophylactic intent, IHT may also be used during pregnancy in patients with poor obstetric histories and coronary pathology at 20-24, 30-32, and 38-40 weeks of gestation.

In preparation for delivery, IHT is used in pregnant patients at 37-38 weeks of gestation.

The course of IHT has anti-anaemic actions, normalises arterial pressure, improves the patient's sleep and mood, decreases irritation, enhances work capacity, has anti-allergic actions, and decreases general illnesses.

IHT may be performed in both inpatient and outpatient settings.

Contra-Indications

1. Acute somatic and viral diseases.
2. Chronic diseases with symptoms of decompensation.
3. Psychiatric illnesses, epilepsy.
4. Individual intolerance of oxygen insufficiency.

Clinical Protocol

Prior to the course of IHT, the patient must be inspected by a physician and gynaecologist. Pregnant patients undergo an ultrasound examination, and in third trimester, they also undergo cardio-tocography.

At the initial IHT session, a *hypoxic test* must be completed: 10 min of a hypoxic gas mixture respiration whose O_2 concentration is determined by the patient's history. Usually, the O_2 concentration in the hypoxic gas mixture for the hypoxic test is 11%.

A test is required to determine the sensitivity and tolerance of the patient to breathing with a hypoxic gas mixture.

During the test, the following parameters are registered: Heart Rate, Arterial Pressure, blood O_2 saturation, respiratory and gas exchange parameters, haemoglobin and erythrocyte counts.

The hypoxic test must be ceased in cases of subjective sensations of breathlessness, dizziness, headache, decrease in heart rate by more than 10% or increase by more than 50%; decrease in SaO_2 below 68%, increase in breathing frequency more than 40 breathes per min, or excessive foetal activity.

Based on the results received from the hypoxic test, the doctor then selects an appropriate regimen for the initial sessions and the duration of hypoxic breathing in each session. The initial session, as a rule, begins with 3-5 min of HGM-11 respiration, intermittently interrupted with atmospheric respiration for a sufficient time required to allow recovery of SaO2 to the initial value (3-5 min).

The number of hypoxic-atmospheric breathing cycles in the first 2 days is 4, and the following sessions - 5-6. After 6 sessions of IHT, the O_2 concentration in the hypoxic gas mixture is lowered to 10%.

Total hypoxic breathing time during 1 session is 20-40 min.

A course of treatment comprises 15-30 daily sessions. Daily sessions may be substituted with every second day sessions.

At the final session, a hypoxic test is taken to evaluate the efficacy of the treatment.

Prophylactic IHT courses in pregnant patients are commenced at 20-24, 30-32, 38-40 weeks of gestation with ultrasound and cardio-tocography. For treatment purposes, the IHT course is given starting at 20 weeks of gestation.

3. IHT in rehabilitation and prevention of diseases

In children with allergic asthma who were sent to an alpine resort (*Davos*, 1560 m), a reduction in airways inflammation was observed, and an assumption was formulated that this was due to the avoidance of an allergen (house dust mite) [*van Velzen et al*, 1996]. However, a placebo controlled trial of cleaning air filtration [*Bowler* et al, 1985] raised the question whether the major reason for this reduction in airways inflammation was lowered oxygen partial pressure, rather than lowered concentration of house dust mite.

Data on physiological alterations was received as a result of treatment of employees of a large textile manufacturing plant in a prophylaxic clinic. [*Strelkov* et al., 1988]. The results are put into Table 3.1, 3.2, 3.3.

Table 3.1. Data on Arterial pressure alteration as a result of a course of IHT treatment [*Strelkov* et al., 1988]

Arterial pressure (mm Hg)	**Before IHT course**	**After IHT course**
Normotension (n=70)		
Systolic	121.3? 0.6	112.0? 1.2
Diastolic	74.2? 0.9	71.1? 0.8
Hypertension (n=44)		
Systolic	154.5? 2.0	117.7? 1.4
Diastolic	90.3? 1.0	78.3? 1.0
Hypotension (n=18)		
Systolic	98.3? 0.7	103.9? 1.7
Diastolic	60.6? 1.3	62.2? 1.0

Table 3.2. Data on functional parameter alteration as a result of a course of IHT treatment [*Strelkov* et al, 1988].

Functional Parameters	**Before IHT course**	**After IHT course**	**p**
HR, bpm (n=132)	71.0? 1.1	68.0? 0.6	<0.05
Breath-holding performance (s) (n=132)	36.7? 2.0	64.9? 2.9	<0.001
VO_2max, (ml/kg? min) (n=35) (under load)	33.7? 1.1	40.4? 1.9	<0.01
PWC test, kgm/min (n=35)	632.9? 29.2	904.7? 51.0	<0.001

Table 3.3. Data on hemodynamics parameters in patients who have undertaken a course of IHT treatment [*Strelkov* et al., 1988].

Parameters	Before IHT	After IHT	p
SV, ml	65.3? 2.9	71.5? 3.6	>0.05
Minute Blood Circulation Q? $_{h,}$ ml	4108? 197	4626? 386	>0.05
Total Peripheral Resistance, dyn/cm^{-5}/s	2071? 73	1765? 113	<0.05
Blood Circulation Index, ml/kg/min	58.6? 1.7	64.1? 3.6	<0.001

The results shown in Tables 5.1, 5.2, and 5.3 confirm general physiological responses of the cardiovascular system to intermittent hypoxia [*Strelkov* et al., 1988], as described in Chapter 2. The strong IHT influence on the cardiovascular system resulted in decreased heart rate and peripheral resistance and possibly, decreased arterial pressure (both systolic and diastolic). The course of IHT produced an increase in PWC, breath holding performance, and elevated VO_2max (at load), implying increased functional capacity of the body.

The results of clinical experience in IHT application are shown in graphical form on FIG.5.1., FIG.5.2., and in Table 5.5. Statistically significant data indicates that after a course of IHT treatment, the following effects become apparent:

- Decrease in fatigue
- Decrease in head, joint, and heart aches,
- Increase in working capacity

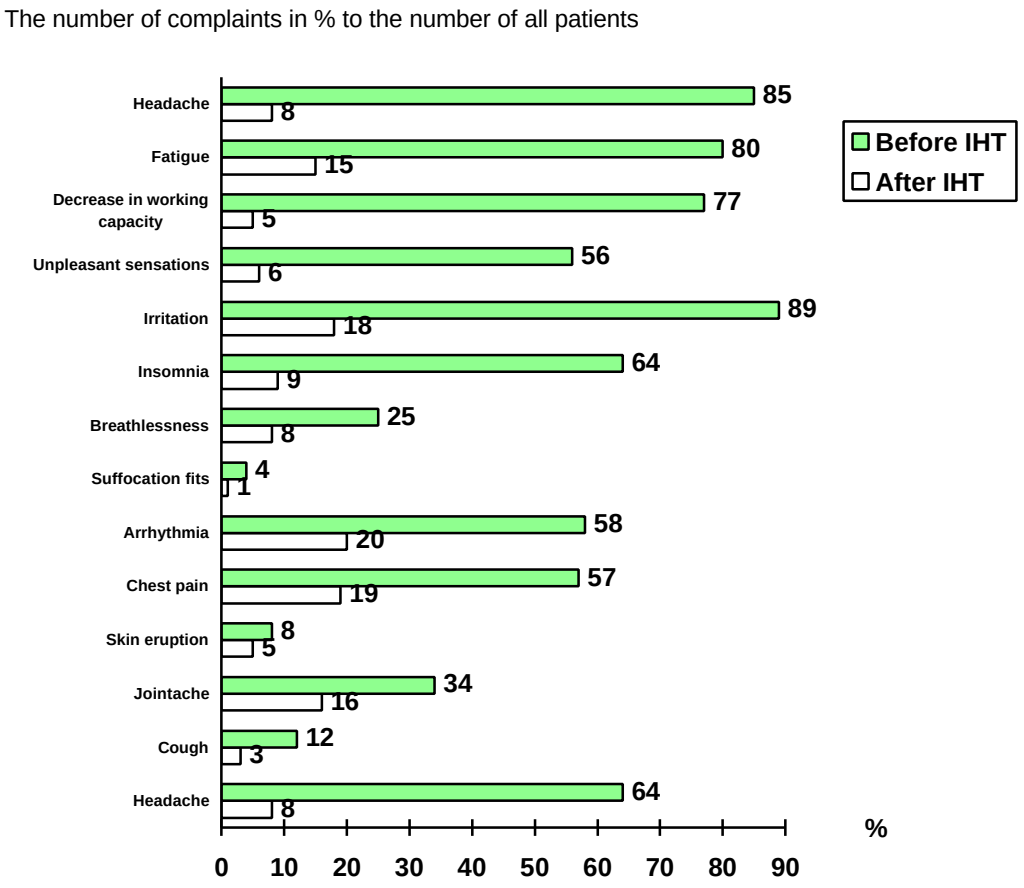

Fig.3.1. The results of IHT treatment in the prophylaxic clinic "Orbita", *Kursk nuclear power station* (4180 cases) [*Agadzhanian* et al, 1997].

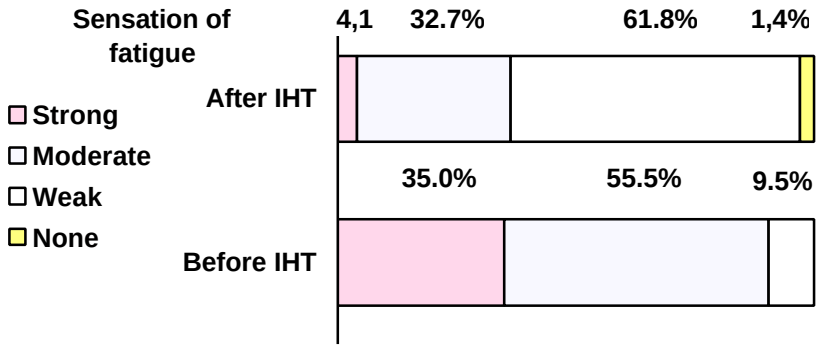

Fig.3.2. The results of the change in individual sensation of fatigue. Employees of *Kursk* nuclear power station before and after the course of IHT ("Mointain Air" method) (% cases). [*Agadzhanian* et al, 1997].

Table 3.4. demonstrates clinical results of treatment of various diseases by means of IHT. Significant improvements are apparent in the following illnesses:

- Ischaemic heart disease
- Hypertension

- Neurocirculatory asthenia
- Chronic bronchitis
- Ulcerative disease of stomach and duodenum
- Liver and Pancreas diseases
- Diseases of locomotion

Table 3.4. Efficacy of Hypoxytherapy in the treatment of different diseases in patients in the prophylaxic clinic "*Tamara*", Murmansk, Russia. [*Kononenko* et al, 1997]

N	Pathology	All cases	From 10 to 15 IHT sessions			From 16 to 25 IHT sessions		
			In all	Improve-ments	Without changes	In all	Improve-ments	Without changes
1	Ischaemic Heart Disease (IHD)	88	55	52	3	33	32	1
2	IHD + Hypertension	6	4	3	1	2	2	-
3	Hypertension	116	77	72	5	39	31	2
4	Neurocirculatory asthenia	46	37	35	2	9	9	-
5	Bronchial asthma	10	4	4	-	6	6	-
6	Chronic bronchitis	59	43	41	2	16	16	-
7	Ulcerative disease of stomach, duodenum	42	28	27	1	14	14	-
8	Liver and Pancreatic diseases	31	25	23	2	6	6	-
9	Diabetes mellitus	3	3	3	-	-	-	-
10	Toxaemia of pregnancy	2	-	-	-	2	2	-
11	Anaemia	1	1	1	-	-	-	-
12	Diseases of locomotion	217	161	150	11	56	55	1
13	Diseases of urinary tract	20	13	13	-	7	7	-
14	Others	46	34	32	2	12	11	1
	In all	687	485	456	29	202	197	5
	%		100	94	6	100	97.5	2.5

Table 3.5. The results of IHT treatment (‘Mountain Air’ method) in the prophylaxic clinic “*Tamara*”, Murmansk, Russia. [*Kononenko* et al, 1997] (the number of complaints in % to overall number of patients)

?	Complaints	Before IHT treatment	After IHT treatment	?
1	Headache	39.2? 1.5	7.1? 0.8	< 0.001
2	Heart aches	36.3? 1.5	4.4? 0.6	<0.001
3	Breathlessness	24.7? 1.3	13.7? 1.0	<0.001
4	Suffocation fits	4.1? 0.6	0.7? 0.3	<0.001
5	Cough	20.1? 1.2	4.6? 0.6	<0.001
6	Insomnia	33.3? 1.4	3.3? 0.5	<0.001
7	Irritation	37.5? 1.5	6.6? 0.8	<0.001
8	Fatigue	72.7? 1.4	17.2? 1.1	<0.001
9	Impaired work capacity	58.0? 1.5	5.7? 0.7	<0.001
10	Unpleasant sensations	70.8? 1.4	7.8? 0.8	<0.001
11	Joint aches	37.0? 1.5	15.4? 1.1	<0.001
12	Depressed mood	37.6? 1.5	9.3? 0.9	<0.001

Normobaric hypoxic training was shown to normalise arterial pressure, improve cardiac arrhythmias, improve sensory coordination, and improve mental performance in patients with neurocirculatory dystonia [*Novikov* et al, 1998].

The results of clinical applications of IHT indicate that this therapy increases the non-specific living capacity of the body and is beneficial in the treatment of various diseases. Assuming that IHT improves the capacity of the antioxidant system, this explains the mechanism of clinical benefits of IHT treatment in degenerative diseases, as this treatment corrects the imbalance between pro- and ani-oxidants in the body.

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