

EFFECTS OF YOGA PRACTICES FOR RESPIRATORY DISORDERS RELATED TO THE UNION CARBIDE GAS DISASTER IN 1984

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ABSTRACT

In 1984, 500,000 people were exposed to methyl isocyanate and other toxic gases from a major gas leak at Union Carbide's plant in Bhopal, India. The most predominant symptoms among the survivors are respiratory disorders. There are no studies showing efficiency of allopathic (modern) medicines.

Sambhavna Trust offers Yoga education, in combination with allopathic and ayurvedic treatment. The objective of this study is to document objective changes in specific lung function parameters among survivors with chronic respiratory disorder.

A specific yoga programme was developed for each one of the 26 participants who were trained during a 15 day period. During the training period and the following 5,5 months, parameters were registered: Pulse and respiratory rate before and after standard exercise, peak flow meter, and spirometry.

The results show highly significant reduction of pulse and respiratory rate differences before and after exercise. The lung function parameters show significantly increased lung function. The use of medicines was decreased with two thirds.

Yoga seems to be an effective means to provide sustained relief to persons suffering from chronic breathlessness as a consequence of toxic gas exposure.

INTRODUCTION

On the midnight of 2-3 December 1984, 43 tonnes of methyl isocyanate (MIC) and other gases leaked from a pesticide factory owned by Union Carbide Corporation, USA. Over half of a million people of Bhopal were exposed the lethal chemicals. Over 16,000 persons have died as a result of the exposure and hundreds of thousands still carry multisystemic injuries. The respiratory system was one of the most affected, and chronic respiratory disorders are common among the survivors.

Till today, little is known about the medical treatment of exposure induced injuries and medical care of the survivors continues to be based upon symptomatic drugs that provide temporary relief, if at all. Dependence on drugs over a long period of time has also given rise to a host of iatrogenic problems. Yoga therapy is offered at the Sambhavna Clinic, a free clinic for survivors run by the

Sambhavna Trust, as a means to provide sustained relief from breathlessness without the use of drugs. The present study was undertaken to make an objective analysis of the efficacy of yoga therapy in the treatment of exposure induced chronic respiratory problems.

SURVEY OF LITERATURE

Isocyanate asthma is the dominating professional asthma, and 5-10 percent of those who are exposed to low to moderate doses are supposed to develop asthma (1). Among the highly exposed as many as 15-30 percent might develop asthma. The asthma can be chronic and exaggerated, even if the exposure is ceased.

Inhalation of nitrous or chloride gases can give bronchiolitis obliterans, with thickening of membranous bronchioli including collagenous storage and fibrosis (2). If lumina are constricted, the patient will be seriously and irreversibly obstructive. The symptoms are cough and increasing dyspnoea and obstructivity. Spirometry shows strongly reduced FEV₁ (forced expiratory volume per second) with normal or even increased diffusion capacity. There is no cure for bronchiolitis obliterans. Broncho-dilators seldom have good effect on the obstructivity. The long-term prognosis is bad.

Several studies (3, 4, 5) and reviews (6, 7, 8, 9) on survivors from the Bhopal gas leak indicate a heavy load of morbidity due to respiratory problems throughout the post disaster period. It continues to be a major cause of death among the exposed population.

Findings on gas victims concerning the respiratory tract include abnormal lung function with obstructive and/or restrictive disease, aggravation of old diseases like tuberculosis and chronic bronchitis, and pulmonary fibrosis (3).

A follow up study of a random sample of 288 cases showed that a large number of cases still were symptomatic at the end of five years (3). There was an emergence of hyper reactive airway injury with asthma like features among 24%, chronic obstructive airways disease among 11.4%, bronchiolitis obliterans in 13% and restrictive lung disease in 1.4% of the sample. 12.8% had recurrent chest infections requiring the use of antibiotics. It was concluded that exposure related lung injury had damaged both large and small airways, resulting in different types of obstructive airways disease.

Misra et al studied pulmonary functions of 250 patients with respiratory symptoms during December 1984, with severe and moderate exposure and followed them up every year (3). After the fourth year prevalence of clinical symptoms were as follows: exertional dyspnoea 98.4%, recurrent respiratory infections 78.0%, and chest pain 42.0%. 97.5% had evidence of small airway obstruction, which was suggested as a marker for the diagnosis of toxic gas induced lung disease. In a later report, covering a period till March 1991, it was reported that there was no change in the pulmonary parameters of patients examined, but sequelae of chronic bronchitis and cor pulmonale was increasing (10).

Studies carried out by Bhole et al (11, 12) and Gore et al (13, 14) have established improvement in ventilatory efficiency breathing pattern, breath holding time, vital capacity and other respiratory function parameters as a result of treatment through Yoga. There are no studies available on the yogic treatment of survivors with pulmonary injuries related to the Union Carbide disaster in Bhopal.

OBJECTIVES

The objective of this study is to document objective changes in specific lung function parameters among survivors with chronic respiratory disorder towards an objective assessment of yoga therapy in the treatment survivors of the December 84 Union Carbide disaster in Bhopal.

SAMPLE POPULATION

Persons for this study, that started in 1997, were selected from the population visiting the Sambhavna Clinic with chronic respiratory problems ever since the disaster. Through detailed history taking it was ascertained that none of the persons suffered from any respiratory problems prior to the disaster. Initial screening of the persons was done by the physician at the clinic. Persons with pre-existing pulmonary problems, those with acute respiratory distress and those with pulmonary tuberculosis were excluded from the study. Until April 1999, thirty persons have been included in the study. Of those, 22 have fulfilled the programme, four have made parts of it and four have dropped out.

METHODS

Three types of yoga were used: *Yoga asanas*, that is based on postures, *pranayama*, which is breathing exercises, and *shodhana kriyas* or cleaning, for example rinsing the nose. A programme was made up for each individual, taking in consideration other disabilities like joint pains and *ghabravat* (anxiety attacks).

The participants were initially trained for fifteen days under direct supervision at the clinic. Then they were given a pictorial chart showing their programme, and they were advised to continue with the exercises at home. If they had any problems, they were welcome back to get new instructions.

The participants were asked to come back for evaluation four times during the next half year.

For each participant was registered background data: age, sex, occupation, income, distance from the factory the night of leakage, aggravating factors like fuel and smoking, symptoms, disability and use of medicines for respiratory problems.

At day 1, day 10, day 15, after 1 months, 2 months, 3 months and 6 months the following parameters were measured:

1. Respiratory rate prior to and after standard exercise
2. Pulse rate prior to and after standard exercise
3. Peak flow rate (PFM)

In 1998 a spirometer was introduced, and from then on was also measured:

4. Forced Vital Capacity (FVC)
5. Forced Expiratory Volume in the first second (FEV₁)
6. Peak Expiratory Flow (PEF)
7. Forced Expiratory Rate (FER) (also called Forced Expiratory Flow or FEF₂₅₋₇₅)

Parameters 1 and 2 were measured with a stopwatch. The standard exercise consisted of going down and up one flight of stairs (172 cms) at a steady pace. Initial readings of respiratory and pulse rates were taken after the person has been in shavasana (relaxing) posture for ten minutes, and the later readings were taken after five minutes of completion of the standard exercise.

Parameter 3 was measured with the help of a Peak flow meter (Vitallograph Ltd.) and 4 to 7 with a handheld microspirometer (Microplus, Micro Medical Ltd.). The patient was instructed carefully how to expire in the peak flow meter and the microspirometer. Three tests were done every time, and the maximum values were noted.

The microspirometer counts automatically FVC, FEV₁, PEF and FER. FVC is a measure of the total lung capacity. For evaluation of treatment of obstructive patients, FEV₁ is probably the best measure. For FER, there is a much higher coefficient of variation for repeated measures. It might be as high as 30 percent in obstructive patients.

At the follow-ups from 1 month and onwards, it was also registered how often the participants did exercises at home, and use of medicines for respiratory problems.

All data are analysed in EpiInfo. For median value, which is used for the presentation, 25th and 75th percentiles are given.

RESULTS

Four are still on the programme, and data for the last one or three control visits respectively are missing.

Social data

The group consists of 11 women and 15 men. 24 of them are distributed in the agegroups 10-59 years, and two were above 60. Fifteen persons had no income: three women and five men who had no job, four housewives and three male students. Two women working with wage labour, bidi rolling or domestic work, earned less than 2,000 rupees per month (US\$ 50). Nine persons belonged to the group car mechanics, salesmen, or had private or governmental jobs. Of those, one woman and three men earned less than 2,000 rupees and one woman and four men earned 2,000-4,000 rupees per month. Nine persons had lived within a distance of one kilometre from the Union Carbide plant in 1984, six within 1-2 kilometres, and 11 within 2-3 kilometres from the plant. Ten used kerosine fuel, two wood fuel, and two were smokers or chewers of tobacco and/or bidi (paan).

Medical data

Body mass index (BMI) for this group varied between 13 and 26. The lowest BMI values were found among men in the lowest agegroups. Peak flow rate at the first visit varied between 70 and 450. Twenty-one had breathlessness at rest plus at least one other complaint. Common other complaints were symptoms from the respiratory tract, pain in body, back, joints or head, and mental problems as ghabravat (anxiety attacks) and disturbed sleep. Four had diagnosed hypertension, three anaemia and two asthma bronchiale. One had TB two years ago, and one before the gas leak. One had no disability problem, nine could do their work (including housework) with difficulty, three could not do their work, and nine had difficulties in walking or playing. At the enter of the study, 19 took allopathic medicines and seven took ayurvedic medicines.

Dropouts

Three women and one man dropped out. Background data did not differ from the analysed group. The reasons were for two of them lack of time to do yoga, and for one an acute infection. The fourth was a women with very bad lung function plus a diagnosis of anaemia. She fulfilled the education period but she did no progress. For her the distance was the reason to leave the program.

Yoga exercise at home

At the 6 month follow up, six persons did yoga at home maximum five times per month, five persons did it 6-15 times a month, and eleven persons more than every other day. There was no long term difference between the three groups in the parameters that follow.

Parameters 1-2

The difference of respiratory rate and pulse rate before and after exercise significantly decreased during the study (Fig. 1,2). The significance for the mean values was very high.

Parameters 3-7

Parameters 4-7 were not measured for the first 14 participants in the study. All parameters except FER show an increasing lung function. The significance for the mean values is 0.01 or higher.

Use of medicines

At the last follow up visit, five persons were using allopathic medicine for breathlessness, and two were using ayurvedic medicine. This is a two third reduction of the use of medicines.

CONCLUSION

It is seen that Yoga therapy is an effective means to provide sustained relief to persons suffering from chronic breathlessness as a consequence of toxic gas exposure. Objective assessment of this therapeutic approach shows significant improvement, already during the education period, in pulmonary function among survivors who have suffered pulmonary injury.

Yoga seems to have a prolonged effect after the education period, even if the person do not regularly perform yoga exercise at home. This might be a result of learning a better breathing technique.

DISCUSSION

The study was carried out involving persons from low socio-economic background none of whom were familiar with Yoga. Most have been on a constant medication ever since the disaster and the idea of obtaining relief from symptoms without the aid of drugs was also alien to them. Given this context, additional efforts were required to ensure that people took interest in Yoga training and continued with practice at home. However, all participants reported a sense of well being after yoga training and no further motivation was required after this self realisation. More than seven persons became active in propagating the benefits of yoga in their community.

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DIAGRAMS

Fig. 1. Difference at each control visit between respiratory rate before and after standardised exercise. .

Fig. 2. Difference at each control visit between pulse rate before and after standardised exercise. .

Fig. 3. Peak Flow Rate (PFM).

Fig. 4. Forced Vital Capacity (FVC).

Fig. 5. Forced Expiratory Volume in first second (FEV1).

Fig. 6. Peak Expiratory Flow (PEF).

Fig. 7. Forced Expiratory Rate (FER) (or Forced Expiratory Flow, FEF25-75).