

Proceedings of the Institute of Acoustics

## **VIBROACOUSTIC DISEASE I: THE PERSONAL EXPERIENCE OF A MOTORMAN**

J W Arnot      Rail Maritime and Transport Union, Oban Shipping Branch, Oban, Argyll, Scotland

### **1 INTRODUCTION**

The aim of this paper is to provide a first-hand account of the development of vibroacoustic disease (VAD) in a motorman. I will describe the physical changes and the various costs incurred during the last five years of my professional activity, as I gradually became ill with VAD. My story is not an isolated case. In fact, VAD may be the cause of long term limiting illnesses in a large number of people who live and work in environments rich in low frequency noise (LFN) ( $\leq 500$  Hz, including infrasound)<sup>1</sup>.

Research indicates that the number of affected workers may be significant. Based on my personal experience, I am convinced that if protective solutions were to be implemented, an appreciable improvement would be seen in the number of workers who are off work due to sickness and incapacity. By revealing the cost of illness, I hope to emphasize the need for those exposed to LFN-rich environments to be informed of the risks involved and to be given a list of early symptoms. This would allow them to make their own choices and seek help before permanent and irreversible damage sets in.

VAD is caused by an all-pervading and insidious agent of harm - LFN. Unless the patient is aware of the early symptoms, VAD is difficult to recognize until it is too late; especially since it has not yet reached the mainstream general practitioners, nor the occupational medicine professionals. The sheer number of workers that are possibly being affected by LFN exposure will stress the importance of developing and applying solutions against this agent of disease.

### **2 CASE HISTORY**

#### **2.1 Employment**

At the age of 17, I left school and became apprenticed to an engineering company. Eventually, after thirteen years of working as a land-based mechanic, I was hired as a motorman for a roll on roll off ferry operator sailing to the Hebridean Islands off the West Coast of Scotland. My job description consisted of performing maintenance on running medium speed diesel engines, and involved working in ship's engine rooms and machinery spaces. The usual onboard schedule was twelve hours a day, seven days per week, for periods of three weeks followed by two weeks at home in rotation.

From my Department of Transport, Seamen's Discharge Book, no. UK 092704, I worked onboard seven different vessels for nearly ten years, and was exposed to a total of 38,640 hours of LFN-rich environments. This amount of hours would be achieved in approximately 15 to 18 years of normal shore-side employment. However, crew members live onboard ships and are therefore continuously exposed to LFN-rich environments, even during their break and sleep periods.

## 2.2 Personal Information

On January 15<sup>th</sup>, 2001, I was a 39 year old motorman, married and with two young children, and who had just been signed off sick from work. I have never smoked, never taken recreational drugs and I rarely drink alcohol and never to excess. I have no history of cardiovascular disease, hypertension, nor diabetes. My hobbies are local history, motor boating, swimming and do-it-yourself home improvements. I also used to enjoy cycling and hill walking. My residential environments have always been in rural parts of Britain, far from any sources of LFN.

My medical history was unremarkable. I had worked since leaving school without break, and without significant periods of sick leave, apart from a case of acute tonsillitis during which I was signed off work for a month.

## 2.3 From Early Warning Signs to Disabling Pathology

Within the first few years I noticed that the hearing in my right ear was much worse than in my left. For example, when I was in the engine room I could lift the ear protector off my right ear and hear virtually nothing from the roar of the main engines; if I lifted the left ear protector the noise was actually painful. The engine room was very noisy and our main concern at the time was for the pain that the main engine vibration was causing to our feet and knees. After three years the knee pain became permanent.

After approximately four years of professional activity in ships engine rooms, I began to experience what I now know to be the early stages of VAD. I began to feel what I imagine to be 'hangover' symptoms. I considered this to be particularly unfair since these symptoms appeared without my having incurred in any of the behaviors that normally cause hangovers. When off the ship, I experienced increased bowel urgency and frequency. Also at around the same time, after working very closely with the main engines for a whole three week period, I experienced extra heart beats, or flutters (tachycardia). I was sent to a Cardiologist for investigations by which time my complaint had resolved itself and no further investigations were made.

I began to have panic attacks while sleeping, and awoke abruptly, jumping up to catch my breath. I also experienced broken sleep due to burning and pins & needles sensations in my hands, later diagnosed as bilateral Carpal Tunnel Syndrome, and associated with holding vibrating equipment. Fatigue was slowly beginning to settle in. Bouts of depression began appearing, and with time became more frequent. My family noticed changes in my mood and complained that I was becoming less and less sociable. I developed a short-tempered disposition and felt more irritable.

There was an increasing pain and burning sensations in both of my knees. I lost muscle mass from around my knees. My legs became weaker and I began to have to climb stairs on all fours. At times my vision would blur, both at home and onboard ship. I noticed that I could not tolerate bright light. I used to experience a dry, tickly cough while on board the ship, and I found I was less able to fight off minor infections. All of us found that we had small nose bleeds and congested nasal passages, along with a dry irritating cough, but only while onboard ship. We thought it was caused by air dryness. Coughing often started roughly half an hour after being in the engine room. We all found this a problem and lived on cough medicine and vitamin tablets. Often the only way to stop coughing would be by thumping myself on the chest as hard as could, like an ape beating it's chest.

Areas of numbness and over-sensitivity appeared in different places on my skin. I noticed muscle twitches and spasms in my spine, and I hurt my back more easily. I was unable to control my stomach muscles as they would tighten so much by themselves that I had difficulty in breathing. When I came home from sea I couldn't bear my children running up to hug me as my stomach muscles were so painful, even before the appearance of an umbilical hernia. I developed an increased need to urinate and always felt that I had not completely emptied my bladder. Impotence developed. Noise and crowds became intolerable. Depression set in more permanently.

## Proceedings of the Institute of Acoustics

After about 7 years of occupational exposure, I began to notice a perverse behaviour: I would catch myself making the wrong decision, such as opening the wrong valve or switching the wrong switch. It wasn't that I would forget to do the right thing, but I actually became convinced that I had done the correct thing. I had already witnessed this behaviour among many of the older crew-members with whom I had worked: they would draw attention to themselves by making the wrong choice, i.e., deliberately setting off fire alarms and then claiming they didn't remember, or denying they had caused the entire event.

Muscle twitches, spasms and muscle tightening became more severe and lasted for longer periods of time, often spanning whole weeks going from attack to attack. Usually, these symptoms subsided substantially during my shore leave, and two weeks at home allowed me to recovery sufficiently to return to another three weeks at sea.

In January 2001, I signed off sick with severe back pain and muscle spasms, and I have never returned to work since then. After seeing the Ferry Company doctor I was signed off unfit for duty at sea (ENG 3) with suspected spinal nerve damage. This medical condition was later excluded through the magnetic resonance imaging (MRI) tests.

Later in January 2001, I had an x-ray of the lower back showing Spondylolisthesis at L5. In February 2001, I had a private consultation with an Orthopaedic Consultant, and since nerve entrapment was suspected, a private MRI scan of my lower spine was taken in March 2001. In May 2001 I was given an ultra-sound scan of bladder at Oban hospital, showing that I was retaining urine. In August 2001 I received uro-dynamic tests at the Southern General Urology Department, which suggested that I might suffer from detrusor muscle instability, thus causing poor bladder control. Detrusitol was prescribed with limited success.

In December 2001, I underwent surgery for an umbilical hernia. It was not until after this surgery that all my health problems got worse. I suffered from increasingly broken sleep due to poor breathing and burning fingers related to carpal tunnel syndrome. My headaches became more and more severe. I noticed that I had real difficulty in concentrating for periods during the day. I suffered from daily fatigue attacks lasting three to four hours.

In October 2001, I had a consultation a Professor of Neurology, Dr. Ian Bone, from the Southern General Hospital, in Glasgow. After 16 months of tests, during which many medical conditions were excluded, such as spinal nerve damage and copper poisoning, Dr. Bone suggested that I might be suffering from VAD, as identified by Dr Nuno Castelo Branco and published on the British Medical Association's (BMA) Medline database<sup>2</sup>. Professor Bone arranged for a cranial MRI scan to search for possible brain lesions as seen in VAD.

### 2.4 The Value of a Formal Diagnosis

Desperate to find treatment for my debilitating symptoms, I found a large amount of information about VAD on the BMA Medline database. I posted a question about VAD on an Internet discussion forum and by good fortune I received an answer from one of the Portuguese experts who have been studying the effects of long-term exposure to LFN for more than twenty years, and who identified VAD. I was put in contact with the lead scientist of the VAD project, Dr. Nuno Castelo Branco.

My initial idea was to inquire about possible therapies that might be available. However, over email and without a full examination, any suggestions would be out of order. It was suggested that if I could travel to Portugal, I could be adequately examined and further advised. I traveled to Portugal and was given a wide range of physical examinations to determine whether or not I was suffering from VAD. The hallmark of VAD is pericardial thickening in the absence of an inflammatory process and with no diastolic dysfunction<sup>3</sup>. Echocardiography demonstrated that I had this condition. Other

## **Proceedings of the Institute of Acoustics**

VAD tests were also positive, and the team led by Dr. Nuno Castelo Branco formally diagnosed me with VAD.

I found there was great emotional value in simply meeting and talking with medical professionals who specialized in my illness and who understood what I was experiencing. I particularly found that once given a diagnosis demonstrating the cause of my symptoms, I could reassure myself that I was not going crazy. I had often been suspected of malingering, and was informed that this was not a unique situation, and many patients had been thus accused<sup>1</sup>. The social implications of being considered a malingerer, even on behalf of family members employed within the health industry, were quite demoralizing.

Without a diagnosis I was left in a no-man's-land where none of the medical specialists could suggest treatment. I felt I was left to see whether my symptoms developed further into an accepted illness, or if they would just resolve themselves with the passage of time. I suggest that this is a harmful practice in itself, since the individuals who are in need of help are powerless to help themselves, and the very people who should be able to help do nothing. I also believe that leaving people to wait on incapacity benefit without a diagnosis of any sort is a dreadful waste of skills and experience.

It would be a much more efficient way to deal with workers who are incapacitated from their normal duties if, at the General Practice level, a simple decision could be taken to place the affected person onto a realistic retraining program while they await further tests and diagnosis. This would mean that the worker could find an alternative employment while waiting to find out what caused their ill health.

As my aim is to return to work and enjoy as normal a life as is possible, diagnosis is, of course, extremely valuable when approaching my doctors for treatment and therapy.

### **3 COST**

#### **3.1 Emotional and Social**

Over the past two years, the cost to myself and my family in trying to find a diagnosis and treatment for my condition cannot be measured simply in terms of cash. Loss of self-esteem, and loss of standing in the eyes of my children and friends must also be taken into account. Social exclusion due to the lack of spending cash, and the emotional effect of the constant suggestion that I was just malingering are merely a few of the actual costs of falling ill with an occupational illness that is not yet proscribed in the UK.

I felt that doctors prejudged my case and assumed that I was either looking for a sick note to have time off work, or that I was trying to build a case to sue someone. Neither of which was anywhere near the truth, I simply could not afford to fall ill. What I truly wanted was to get treatment and get back to work as soon as possible. Today, having gone through the full circle and being in the process of returning to work as a self employed man, I feel that I have valid and pertinent questions regarding the effectiveness of the UK's system of dealing with people who are incapacitated from their usual employment.

When one marriage partner falls ill with a long term limiting illness such as that caused by VAD it naturally causes a great deal of stress between husband and wife. When, as with VAD, the illness is not proscribed, the stressors acting on the marriage relationship multiply. Stress multiplies because of things like: greatly reduced family income, prevention from claiming other benefits such as free prescriptions, doubts about the true illness of the debilitated partner i.e. whether they are as ill as they make out. These aspects, taken together with the physical debilitations described above, are a sure recipe to hinder a healthy relationship.

The information I have gathered among researchers and colleagues alike clearly indicate that my clinical, social and financial situation is very far from being a unique case.

### 3.2 Pounds and Pennies

A close estimate of the financial costs incurred by my family is in the region of £50,000, due to loss of earnings, retraining, actively seeking diagnosis, and the increased expenditure associated with ill health. I have been led to believe that the number of people employed in the transport industry that sign off sick from work is twice the national average. As a Rail Maritime & Transport Union representative, I have participated in negotiations concerning pay and working conditions. I and several others present at these meetings were told that because of the high rates of sickness in the Company (a thick wad of sick notes was waved at us from across the table), we could not hope to have the rise we asked for.

Studies to date suggest that as many as 70% of people exposed for long periods to LFN may develop severe stages of VAD. Approximately 30% of the individuals studied do not develop the acute pathology associated with low frequency noise exposure<sup>1</sup>. Studies show that as many as 50% of men occupationally exposed to LFN for more than ten years will develop permanent debilitating illnesses, eventually leading to early disability retirement<sup>1</sup>.

The Confederation of British Industry (CBI) and the Chartered Institute of Personnel and Development (CIPD) estimated that the direct annual cost of sickness absence ranges from £434 to £486 per employee per year<sup>4</sup>. Total days of certified incapacity per year for men and women have risen from £503 million in the financial year 1990/91 to £856.8 million in the year 2000/01. Days of incapacity for men of my age (81.3 million days), with a possible 20 to 25 year exposure to occupational LFN, shows a 31 fold increase to that of men under 20 years of age (2.6 million days)<sup>5</sup>. In 2001/02, 26% (£27.6 billion) of the UK Social Security benefit expenditure was spent on the Sick and Disabled<sup>6</sup>.

During my stay in Lisbon, VAD researchers informed me of their success story at O.G.M.A. (an aircraft manufacturing, maintenance and rework facility which belonged to the Portuguese Air Force), where the initial studies on VAD were conducted in the early 1980's<sup>1</sup>. From 1987 until 1997, an echocardiography monitoring program was established among all noise-exposed workers, mostly aircraft technicians. From 1980 to 1989, there were 21 disability retirements among this group of professionals. From 1989 to 1996 there were none<sup>1</sup>. Similarly, during this period of time, on-the-job accidents and incidents statistically significantly reduced, and absenteeism dropped from 8.5% to 2.3%<sup>1</sup>. By monitoring the evolution of LFN-induced pathology, workers were removed from the noisy job before their symptoms became disabling. Given their technical qualifications, it was fairly easy to place them in other, similar jobs but where exposure to LFN was not an issue. This was only possible because the company's administration decided to allow this sort of intervention, and later reaped its benefits.

### 3.3 Estimate Number of People Exposed to Noise and Vibration in the UK

Noise and vibration are intimately connected. The vibration of solids can produce acoustic phenomena (noise), and noise impacting on solids can produce structural vibration. However, in the vast majority of "noisy" occupational environments, noise (especially LFN) and vibration are present simultaneously. LFN is rarely assessed, but vibration levels have been the object of interest of several research teams throughout the world. Therefore, the results obtained from a recent survey of vibration exposure levels in the UK could be used as an approximate conservative estimate of the number of people exposed to the vibroacoustic agent of disease.

Questionnaires were sent out to a random selection of 21,201 men and women from 34 general practices from across the UK, and to a further 993 men and women selected at random from the

Armed services. During the Summer of 1997 and Winter of 1997/98, 12,907 usable responses (61% response rate) were returned. In a one-week period 7.2 million men and 1.8 million women are exposed to whole body vibration at work, if the occupational use of cars, vans and motorcycles is included. Results suggest that for all occupational sources of exposure, the personal estimated vibration dose value (eVDV) for about 374,000 men and 9000 women exceeds the action level vibration dose value of  $15\text{ms}^{-1}$ , as defined in British Standard 6841<sup>7</sup>.

#### 4 FINAL COMMENTARY

Today, I have successfully retrained as a self employed CORGI registered gas installer thereby largely avoiding noise and vibration. However, my VAD symptoms still interfere with my work. Specifically, after using any type of vibration tool, I have an episode, consisting of blurred vision, severe headaches, and an overall physical and psychological indisposition. My colleagues, and many workers in the UK, continue at risk of developing on-the-job VAD. Symptoms develop over years of professional exposure to LFN and are the cause of a large number of absences due to illness. VAD can be very disabling, and can crush an individual's social and family life. Because VAD is not yet mainstream among general practitioners, nor among occupational medicine professionals, VAD goes undiagnosed in the vast majority of the cases. In fact, malingering seems to be a more frequent diagnosis than any real pathological condition. Most workers are unaware that their symptoms are directly related to their occupational environments, and are suspiciously regarded by the surrounding community. The financial toll on the UK Social Security budget is immense, as well as on company budgets due to high levels of absenteeism. I urge the appropriate authorities to implement protective measures against LFN and to inform employees who are exposed to noise and vibration, so they will be able to protect themselves.

#### 5 REFERENCES

1. N.A.A. Castelo Branco and M. Alves-Pereira (Coord), Vibroacoustic Disease, Aviation Space & Environmental Medicine, Vol. 70 No. 3, Section II, Supplement (1999).
2. N.A.A. Castelo Branco, The Clinical Stages of Vibroacoustic Disease, Unique Identifier 10189165, Medline Identifier 99203048.
3. B.D. Holt, The pericardium. In: V. Furster, R. Wayne Alexander R, and F. Alexander (Eds). Hurst's The Heart, 10<sup>th</sup> ed, McGraw-Hill Professional Publishing, 2061-82. (2000).
4. C. Barham and J. Leonard, Trends and Sources of data on sickness absence, Labour Market Division, Office for National Statistics, [www.statistics.gov.uk/cci/article.asp?id=223](http://www.statistics.gov.uk/cci/article.asp?id=223)
5. Department for Work and Pensions, Sickness, Invalidity and Incapacity Benefit: Days of Certified Incapacity, [www.statistics.gov.uk/statbase/expodata/spreadsheets/D3994.xls](http://www.statistics.gov.uk/statbase/expodata/spreadsheets/D3994.xls)
6. Department for Work and Pensions, Figure 8.4, Social security benefit expenditure: by recipient group 2001/02, Great Britain, [www.statistics.gov.uk/statbase/expodata/spreadsheets/D6474.xls](http://www.statistics.gov.uk/statbase/expodata/spreadsheets/D6474.xls)
7. K.T. Palmer, D.N. Coggon, H.E. Bendall, and M.J. Griffin, Whole Body Vibration Occupational Exposures and their Health Effects in Great Britain. [www.hse.gov.uk/research/crr\\_pdf/1999/CRR99233.pdf](http://www.hse.gov.uk/research/crr_pdf/1999/CRR99233.pdf)