

‘DARK ROOM’ DISEASE

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Abstract. ‘Dark room’ disease describes a collection of symptoms that some healthcare workers experience when exposed to film-processing chemicals. The purpose of this article is to examine the symptoms that are relevant to the use of these substances by radiology technicians (RT) and to investigate the practical precautions that should be taken by the employer and the radiographer in order to protect the radiographer from developing the ‘dark room’ disease.

Keywords: ‘dark room’ disease, symptoms, prevention, industrial medicine, health effects.

AIMS AND BACKGROUND

Even though the ‘dark room’ disease appeared with the creation of radiology laboratories the health community did not show concern until much later. ‘Dark room’ disease is caused from the exposure of the radiology technicians (RT) to chemicals that are used during film processing. It is believed that these chemicals, like most chemicals, can have adverse effects on RT, causing problems in the respiratory system but also in every system of the human organism. The use of protective equipment on behalf of the RT and the construction of the radiology departments according to safety protocols can diminish the existence of the disease.

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‘Imagine that you are a radiologist technician that loves his job but the continuous irritation of your eyes, in combination to the lacrimation is driving you crazy! At the same time, your throat is constantly bothering you as if you have a cold that does not seem to go away. Your voice has become more gruff than usual and day-by-day you feel weaker and more exhausted. Your heart sometimes pounds so fast and hard that you feel it will pop out of your chest. Briefly, you have a pile of symptoms that pester you and destroy your well-being. What makes it worse is that the doctors do not know what is wrong with you. Some of your colleagues even believe than it is all in your mind and that they do not really exist.

Even though this script might seem unrealistic it is perhaps the cruel reality of a radiology technologist that has been attacked by ‘the dark room disease’. This is a disease that affects the people that work in radiological laboratories, but also in processing films (e.g photo shop)¹. It is caused by the exposure of workers to chemical substances that are used for the development and the appearance of radiological films.

The ‘dark room’ disease can be considered a subclass of another disease – the ‘multiple chemical sensitivity’ (MCS). Many researchers report these two diseases as one. The MCS is an allergic disorder where the individual, after repeated exposure to a certain chemical substance, acquires sensitivity against this substance. The result of this sensitivity is that this individual shows symptoms even when exposed to small doses of this substance and, specifically, to a dosage that causes no reaction to an average person. The chemicals incriminated for the infliction of MCS are certain pesticides (mainly organophosphates) and various chemicals that are used as solvents². The elation of symptoms in an individual that has been sensitised is possible to happen even with the exposure to simple, daily stimuli such as perfumes, cigarette smoke and common detergents. The cross-correlation of ‘dark room’ disease with the MCS appears from one more report. It was found that the technologists that have bronchial asthma are more prone to have the antibody against glutaraldehyde (a chemical substance that is incriminated for the growth of this disease) than their colleagues that do not have asthma. This shows the potential role of an allergic – immunological mechanism in the appearance of the disease of the ‘dark room’ as in the MCS (Ref. 3).

The first report on MCS syndrome came in 1952 from Chicago, USA, where doctor Theron Randolph observed that certain patients of his presented a curious reaction to certain foods and chemicals (solvents, constructional materials, newspapers and other materials from ink, furniture, etc.). The ‘dark room’ disease first been heard about in 1980 when Marjorie Gordon, a technologist of radiology from New Zealand, presented a total number of symptoms that, until then, was not included in a certain concrete disease. Mrs Gordon initially exhibited arrhythmias/tachycardia, a gruffy voice and a sore throat. With time she also presented disturbances of vision, terror, nausea, lassitude, serious headaches and ear tinnitus. Her symptoms

were presented a small while after the placement of new radiological instrument in her working place. Initially she was diagnosed as 'acute sensitivity in the toxic effect of chemical substances of the dark room'. Afterwards, she gave the disease its present name. Gordon was the first patient of the 'dark room' disease that her service admitted that her illness is owed to chemical substances that are used in the film processing and was adjudged compensation in 1995 (Ref. 3).

DISCUSSION

The 'dark room' disease has become of great interest the last few years, mainly to people working in places more vulnerable to the illness such as radiological laboratories. The increased appearance of this disease after 1980 is partly owed to the automatic appearance of films that is realised in higher temperatures. If the figures of various studies were interpreted in an absolute way, they would not inspire any particular concern. Roughly 5% of the total of USA population has MCS symptoms, while it is considered that roughly 5% of radiographers will be sensitised permanently to the chemical substances that they use. Also, 1/100 000 technicians will be negatively influenced from fumes of the chemical substances and 1/200–1/300 will suffer from mild skin damage after their contact with a certain chemical substance in the laboratory. The problem of this disease lies in the fact that the technician that develops this disease should be removed from the particular work place and should not be allowed to work in a radiological laboratory again. The second problem is that the symptomatology of this disease decreases perceptibly the quality of life and, potentially, the illness can cause very serious health problems.

It is recognised that developing solutions used to produce radiographs contain substances that are considered guilty for the development of the illness⁴. Most frequent are glutaraldehyde, formaldehyde, sulphur dioxide (SO₂) and acetic acid. Other substances are sulphurous ammonium, hydroquinone and phenol. Exposure to glutaraldehyde is identified as the principal cause of most symptoms, specifically implicated as eye and upper-respiratory tract irritant. Glutaraldehyde is included in most processing chemicals to act as a film hardening agent⁵. Fumes from the use of the above chemicals have erosive, toxic but also cancer-causing action. The Occupational Safety and Health Administration of the USA have established permissible exposure limits of the chemical substances. Indicatively, the limits for certain of them are the following: 10 ppm for acetic acid, 5 mg/m³ for sulphurous ammonium, 2 mg/m³ for hydroquinone, 5 ppm for phenol and 5 ppm for the SO₂ (Ref. 6). There is no guarantee that the technicians exposed to a smaller quantity of chemicals than the allowed dosages will ensure their safety. Studies have shown that there is a synergy between these substances and therefore their simultaneous presence result in multiple negative

Technicians are exposed to chemical substances via their respiratory system and the skin. Processing chemicals enter the body with skin contact, inhalation into the lungs or ingestion⁷ (Table 1). Radiographers can be exposed to these chemicals through manual film processing, cleaning of the internal components of the film processor or by fumes from the normal processing procedure^{8,9}. It is obvious that this exposure can increase if the time spent next to these machines is increased, and therefore is depended on the volume of work¹⁰. In certain studies it appears that men are more prone to the disease than women, which is due to the fact that men customary undertake more work, such as to fix the machine when it is stuck, cleanness of stains from chemicals and management of chemical waste and this increases their exposure to chemicals of the radiological instruments¹¹.

Table 1. Routes of exposure and symptoms of ‘dark room’ disease⁷

Route of exposure	Symptoms
Inhalation	occupational/glutaraldehyde induced-asthma, chemical/metallic taste, sore throat, sinusitis, catarrh, nose bleeds, rhinitis
Contact – direct	dermatitis, skin rash
Contact – indirect (vapour)	eye irritation
Ingestion	sore throat, abdominal pain, cramps, vomiting, diarrhea, coma, liver and kidney damage
Unknown	memory loss, difficulty in concentrating, fatigue, tiredness, headache, nausea

The probability of this disease to occur depends on engineering controls. Appropriate controls and operation of the radiological laboratory will eliminate or reduce the generation of substances, suppress or contain substances, or limit contamination areas in the event of spills and leaks¹². Generally, room ventilation must work in synergy with local exhaust ventilation for successful removal of atmospheric contaminants. It is essential that all air conditioning and venting systems must be designed and installed by air conditioning engineers to ensure appropriate and sufficient ventilation and to prevent the ‘dark room’ disease. Studies have shown that the disease appeared even in radiological laboratories that had a small volume of work. This proves that bad ventilation is an aggravating factor, which is due to lack of safety protocol during the construction and operation of laboratories. In addition, the presence of the characteristic smell, which emanates from chemical vapours, also shows that the space is insufficiently aired, and increases the danger for the technician^{13,14}. Below are the most important factors for a successful installation of a ventilation system:

- the exhaust system must be vented to an external environment, independent of general building air-conditioning;

- it needs to provide fan extraction so that the processor manufacturer specifications are met;
- the fan extraction must operate continuously when chemicals are present in the processor, irrespective of whether it is being used;
- for tabletop and non-vented processors, a fume hood/extraction system should be used and operated whenever the processor contains chemicals⁷.

Furthermore, the 'dark room' disease is a multiplex illness; it includes a number of symptoms that patients may potentially present. Most of the symptoms are similar to those of a common cold or, even an allergic reaction. Some of the symptoms displayed are: sore, watery eyes, persistent nose itching, rheum and sneeze, sore throat, headaches, unjustified fatigue. In order to connect these symptoms with the existence of this illness, these must persist for more from 15 days/year and, should worsen during work. Apart from the above, there is an abundance of symptoms that the patient with dark room disease may present and they are the following¹⁵: memory loss; changes in the disposal: stress, irritation, depression; lack of concentration, gruff voice; face paralysis; nausea; ear tinnitus; blur vision; flushing; nose and mouth (ulcers, bleedings, etc.) mucous disorders; aching joints and muscles; arrhythmia/tachycardia; chest pain/shortness of breath/asthma; menstrual disorders.

However, bibliography reports individual incidents of more infrequent problems that are related with this disease and require particular study. In Ontario, Canada, a patient reported pain in the urinary bladder, which was later proven to be a result of ulcers and fibrosis of the internal wall of the bladder, as an immunological reaction after exposure to chemicals. Furthermore, there were some cases of radiologist technicians with the Sjogren syndrome, a syndrome that includes the disease of the connective tissue and an intense vision disorder. Also reported was the development of the Hashimoto thyroiditis and serious damages related to the liver. More precisely, liver is the organisms metabolic laboratory, where most of the chemical excretion processes take place. Glutaldehyde is found to be most incriminating because of its effect on the activity of enzymes.

Despite of that the interest of health professionals has put this disease at a higher level of importance, there are researchers that support that 'dark room' disease and multiple chemical sensitivity disease are more psychological rather than organic syndromes¹⁶. They base this notion on the fact that many symptoms are similar to the sick building disease, in which the psychological factor is the most prevailing. In addition to this, there is research proving that technicians working in the radiology department show no more symptoms than the people working in the rest of the hospital¹⁷. In their defense, supporters of the 'dark room' disease claim that technicians show increased bronchial asthma compared to an average person and that the control group did not present any symptom¹⁸.

'Dark room' disease is a common disorder that may affect a great number of people working in radiology laboratories all around the world. As tragic as this may sound its prevention is simple and easy. The best solution to the problem is the use of digital technology in the development and appearance of films. It is obvious that the cessation in the use of chemical substance will automatically lead to the elimination of the disease¹¹.

However, because the moment when all the processes of development becomes digital is far away, certain safety rules must be followed both in the construction of radiological laboratories and in the management of chemicals by technicians. The most important measure in prevention is the creation of an ideal laboratory. The processing room must have good ventilation. Below are some of the most important factors for a successful installation of a ventilation system:

- the exhaust system must be vented to an external environment, independent of general building air-conditioning;
- it needs to provide fan extraction so that the processor manufacturer specifications are met;
- the fan extraction must operate continuously when chemicals are present in the processor, irrespective of whether it is being used;
- for tabletop and non-vented processors, a fume hood/extraction system should be used and operated whenever the processor contains chemicals⁷.

The biggest problems are created by fumes, so if these are released into the environment and do not remain in their place of production, technicians will be less exposed¹⁴. A source of fresh air and the maintenance of small positive pressure are essential to prevent the gases from remaining in the laboratory. In reality most laboratories are built without windows and therefore films are developed in sealed rooms that lack in air and sun-light. The ventilation and chemical waste removal pipes must be checked out regularly¹³. The maintenance of radiological machines should follow the specifications protocol. Finally, the floor and all the surfaces should remain clean and stains from chemicals must be immediately cleaned and not remain in the room. Administrative controls are safe work practice systems that reduce employee exposure to substances. Some specific measures of control¹² that must be taken are the following:

- keeping containers of processing chemicals tightly lidded when not in use;
- cleaning up spills immediately;
- prompt cleaning of residues of processing chemicals from empty containers;
- prohibiting eating, drinking and smoking in potentially contaminated areas;
- providing suitable cleaning facilities;

- ensuring that processor and ventilation systems undergo periodic checks to ensure they are properly maintained;
- making first aid facilities readily available, and
- administering possible job rotation away from areas where processing fumes are being emitted.

It is equally important that technologists take preventive measures. It is fundamental that they are correctly educated and briefed of the harmful effect of the chemicals used. Usually technicians spend most of their time to acquire knowledge with regard to precaution from the ionized radiation and show indifference to the effects of chemicals, which have been proved to be equally harmful. The use of personal protective measures when using and managing chemicals is demanded. It is imperative that they use protective glasses, masks, aprons and gloves when necessary¹³.

In case that a technician is diagnosed with the disease then it is essential to confront it conservatively. Therefore a permanent evasion of work in the radiological laboratory is recommended. Moreover, additional treatment may be good nutrition in combination with the reception of antioxidant substances.

CONCLUSIONS

The 'dark room' disease is a hindrance to the career of technicians of radiology. Mrs Warden worked in a radiological laboratory in Oregon, USA. In 1996 a little while after damage in the ventilation system of 'dark room' where she worked, she began to feel that her lungs started to 'shut down'. After that it was impossible to work there again. After going through a judicial conflict she gained the sum of 42 000 \$ as compensation from the enterprise that she worked for. Today she is the chairman for the Task Force on Hazardous Materials of the American Society of Radiologic Technologists. She has drawn up a list with 45 technologists from USA, Canada and New Zealand that suffer the 'dark room' disease and has made a second list where more than 100 health professionals are in daily danger from exposure to chemical substances¹⁹.

Certain developed countries have realised the importance and are fighting for corrective and preventive measures. They are trying to eliminate the risk to health in a healthcare environment caused by exposure to both radiographic film-processing chemicals and disinfectant agents containing glutaraldehyde and other substances. The severity of the deleterious short-term and long-term effects illustrates the need for legal compliance in order to minimise the occurrence of 'dark room' disease⁷. It is clear that unions and government OHS authorities have important roles to play in regulating and enforcing this issue. They must work towards minimising the occurrence of 'dark room' disease by: (a) developing diagnostic criteria; (b) further educating and training professionals in safer handling of substances; (c) take prac-

tical precautions by minimising and eliminating the use of hazardous substances, and last but not least (d) obligating the manufacturer to provide an information pamphlets that will increase the radiographer understanding of hazards associated with these chemicals. Moreover, the incidences of legal proceedings internationally, emphasise the need for awareness on this issue by all parties involved. It also highlights the way to legal compensation for many victims of this disease⁷.

Respectively, in Greece, when radiology technologists were asked about their knowledge on this disease, they seemed puzzled and confused. Someone once stated that those who suffer from multiple chemical sensitivity (a branch of the 'dark room' disease) fight a system that does not want to know the answers. Unfortunately, a lot of work needs to be done.

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