TOXIC JAUNDICE FROM OCCUPATIONAL EXPOSURE TO CHLOROFORM

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SUMMARY

Two outbreaks involving 31 persons with jaundice are described. All had originally been diagnosed as having viral hepatitis. But subsequent investigations showed that all had been exposed to chloroform at work. Toxic jaundice from chemical exposure presents a similar clinical picture to that of viral hepatitis, but fever appears to be uncommon. Doctors who look after workers should be familiar with the type of work and health hazards of their patients. A knowledge of occupational medicine and epidemiology would enable doctors to help in detecting and preventing occupational disease.

INTRODUCTION

Viral hepatitis is a common cause of jaundice. But it is often a presumptive diagnosis made on clinical grounds, especially for type A disease. Jaundice may also arise from occupational exposure to hepato-toxic agents, and the clinical picture may be similar. But it would obviously be important to differentiate the two conditions, as the preventive measures are so very different.

This paper describes two outbreaks of jaundice in Singapore affecting a total of 31 workers who had been diagnosed as having viral hepatitis, but who were subsequently found to be occupationally exposed to chloroform, a known hepatotoxic agent. [1,2,3,4,5]

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First Outbreak

Between October 1973 and July 1974, thirteen workers from a large factory in Singapore were diagnosed by their doctors as having viral hepatitis. Except for two, they all had symptoms of anorexia, nausea and vomiting. The other two who had no symptoms had been noticed by their colleagues to be jaundiced. All thirteen were jaundiced when seen by the doctors.

However, it was noticed by the nurse employed at the factory, that all the thirteen workers came from one section of the factory. She consulted the Industrial Health Division of the Labour Ministry. An investigation was made of the workplace. The affected workers were interviewed regarding their symptoms, family and past medical history, medication and injections. All the histories were negative, except that the workers had had injections of tetanus toxoid given by the company nurse using disposable syringes. None of those interviewed gave a history of fever.

The factory manufactured electrical household articles, eg toasters, electric irons and coffee pots. It employed nearly 1,500 workers, most of whom were young females. The particular department where the jaundiced workers worked had 102 workers whose work was mainly mechanical, related to the sub-assembly of the electric toasters. In one corner of the room were five contact welding machines. No chemical was used in the room except a degreasing agent on the contact welding machines. There was a sweetish odour in the workroom. An open container with the degreasing agent was on the floor next to one of the welding machines. Information from the manufacturers revealed that the chemical contained 99.5% chloroform and 0.5% ethyl alcohol.

The level of chloroform vapour in the air was assessed using detector tubes. It was found to be higher than 400 ppm (parts per million), the upper limit of the range measurable on the detector tubes. Blood samples were taken from five of the workers who had jaundice as well as from four operators on the contact welding machines. The samples were analysed at the Department of Scientific Services. The results showed blood chloroform levels of between 0.10 and 0.29 mg/100ml. [6]

Second Outbreak

Between May and August 1980, eleven cases of acute infectious hepatitis were notified by a hospital to the Ministry of the Environment. All the cases were negative for Hepatitis B surface antigen (HB_SAg). Investigations carried out by that Ministry found that all of them were workers in a factory making radiocassette recorders and digital clock radios. Contaminated drink from a vending machine was thought to be the vehicle of transmission.

Five more cases of infectious hepatitis were reported from this factory between November 1980 and October 1981. As all the cases reported came from the same department of the factory and a chemical smell was detected in the workroom, chemical intoxication was suspected, and the matter was subsequently referred to the Industrial Health Division of the Ministry of Labour in October 1981 for further investigations.

It was found that the factory employed about 360 workers, mostly young females. It consisted mainly of two departments, the Chassis and the Casing Departments. All the hepatitis cases were from the

TABLE I
AIR LEVEL ASSESSMENT OF CHLOROFORM CONDUCTED IN THE CASING DEPARTMENT ON 14 DECEMBER 81

Location	Infrared Gas Analyser		Remarks
	Absorbence	ppm*	
Line 1			
a) Operator 1	0.15%	16.7	During glueing of black ribbon onto casing. The ribbon was dampened in an open dish of chloroform and applied by hand.
b) Operator 2	0.13%	14.4	
c) General environment	0.15%	16.7	
Line 2			
a) Operator 3	0.2 - 0.3%	22.2 - 33.3	During glueing of ribbon onto PVC casing. Chloroform was applied from an open dish with a small brush.
b) General environment	0.15%	16.7	
Line 3			
a) General environment	0.14%	15.6	No chloroform was being used on this line.
Line 4			
a) Operator 4	0.17 - 0.2%	18.9 - 22.2	Glueing of ribbon using a small squeezing bottle.
b) Operator 5	0.22%	24.4	
c) General environment	0-14 - 0.15%	15.6 - 16.7	
Line 5			
a) General environment	0.15%	16.7	No chloroform was being used.
Outside the workroom	0.0%	0.0	

* All measurements were taken at or near the breathing zone of operators.

Casing Department which was located in one big airconditioned room. There were five assembly lines where components were assembled, encased and packed for export. Chloroform was used as an adhesive. At the time of inspection, there were six workers seated at various locations on the assembly lines, who were using the chemical. They applied the chloroform either by squeezing it out from a small plastic bottle, or pouring it out onto a small open dish and applying it with a brush. When the

TABLE II
AIR LEVEL ASSESSMENTS OF CHLOROFORM IN THE CASING DEPARTMENT ON 22 DECEMBER 81

Location	Sampling Time	Level of Chloroform Vapour
Line 3		
General area	30 mins	Nil (due to pump failure)
Breathing zone of operator glueing ribbon onto casing	120 mins	98 mg/m^3 (19.6 ppm)
Breathing zone of operator glueing ribbon onto casing	120 mins	252 mg/m^3 (50.4 ppm)

chloroform was applied to the plastic casing or to other components, it melted the plastic, and various components could then be stuck together. In one part of the workroom was a large tin of chloroform which was covered. Whenever the chemical was required, it was poured out from the tin into the dishes or small bottles for the operators on the assembly lines.

Besides the sixteen hepatitis cases reported, it was found that there had been two more, one hospitalised in May 1980 and the other in October 1980. Of the total of eighteen cases, only six workers were still at the factory, the others having resigned.

An assessment of the chloroform vapour in the air of the work room was made on two occasions. On 14 December 1981, spot tests using a portable infrared gas analyser detected levels between 14.4 and 33.3 ppm. (Table I). On 22 December 1981, air samples were taken over half to two hours using charcoal tubes. Gas Chromatographic analysis carried out by the Department of Scientific Services showed levels of 19.6 ppm and 50.4 ppm. (Table II). The Threshold Limit Value (TLV) of chloroform was 10 ppm. [7] Arrangements were then made for estimation of chloroform level in blood samples. This could only be done on 20 January 1982. On that day, only one worker was using chloroform. (The factory had reduced the number of workers handling chloroform from six to one over the preceding one and a half months because of decreased production demands). The worker using chloroform together with four other workers had blood samples taken. But chloroform was not detected in all the samples.

DISCUSSION

The two outbreaks of toxic jaundice described showed similar features. Both were traced to occupational exposure to chloroform, a known hepatotoxic agent. [1,2,3,4,5] In both outbreaks too, the workers affected had been exposed to the chemical for less than six months. (Table III).

All the cases had originally been diagnosed as having viral hepatitis, a common cause of jaundice. But the diagnosis of toxic hepatitis was made retrospectively based on epidemiological evidence. Occupational exposure to high levels of chloroform vapour was confirmed.

The signs and symptoms of toxic hepatitis from chloroform exposure are similar to those of viral hepatitis. The latter condition is often a presumptive diagnosis made on clinical grounds, especially for type A disease, although a positive test for hepatitis B surface antigen (HB_sAg) would identify hepatitis B disease. However, viral heptitis is usually associated with fever, at least initially. But of the thirteen cases of toxic jaundice in the first outbreak described, none gave a history of fever. In the second outbreak, only four out of the eighteen cases had given a history of fever when seen by their doctors, and fever was recorded in only one case on admission to hospital.

In isolated cases, it would obviously be difficult to differentiate between viral hepatitis and toxic hepatitis from chemical exposure. But doctors who look after workers should at least be familiar with the type of work and health hazards of their patients. The diagnosis of toxic hepatitis would arise from a high index of suspicion. Company doctors would find it useful periodically to do a simple analysis of the statistics on their patients. A

TABLE III
DURATION OF EXPOSURE TO CHLOROFORM BEFORE ONSET OF JAUNDICE

Exposure Period (months)	No of Cases	
	1st Outbreak	2nd Outbreak
< 1	3	2
1 -	4	6
2 -	3	5
3 -	2	3
4 -	0	2
5 -	1	0
6 -	0	0
Total	13	18

case can be made for doctors who look after workers to have some knowledge of occupational medicine and epidemiology. This would help in the detection and prevention of occupational diseases which would be missed unless doctors became more aware of a possible occupational aetiology in some of the diseases which they see.

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