

60-753

Countries of the world

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Egypt

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Table 2 Numbers of vinyl chloride related cases of angiosarcoma of liver by age at diagnosis

Age (years)	No of cases
35-39	11
40-44	24
45-49	17
50-54	18
55-59	20
60-64	17
65-69	8
70-74	3
All ages	118

however, all the cases known to the collaborating organisations and they will probably have been informed, in one way or another, about nearly all cases that have been diagnosed among the relevant groups of employees.

Results

Until the end of 1984, 118 men had been recorded as having vinyl chloride related ASL, of whom three were still alive on 1 January 1985. All the cases had been confirmed histologically: 117 were reported to be hepatoangiosarcomas and one a cholangiosarcoma. No cases were recorded in women, but few women have been employed in manufacturing PVC.

Table 1 shows the breakdown of the cases by date of death. It should be noted that the register was begun in 1974 when vinyl chloride first became firmly established as a risk factor for ASL. Under-reporting is, therefore, less likely to be a problem after this date when special attention began to be paid to the disease. Table 2 gives the age distribution of the 118 men at the time of diagnosis. The mean age at diagnosis is 52. Table 3 gives the number of cases diagnosed and the number of PVC producing factories in each of the 12 countries reporting at least one case of ASL. Some

countries have had cases in most of their factories (France, West Germany); others have had cases clustered in a small number of factories (United States, United Kingdom). Indeed, the United States has had 23 of its 33 cases in just two factories. Other countries that produce PVC but have not reported any cases are shown in table 4.

Table 5 shows the numbers of cases by time since first exposure and maximum exposure time possible. It seems that the incidence of ASL reaches a peak 20-29 years after first exposure but substantial numbers of cases may still occur after more than 30 years. The table also gives hypothetical numbers for expected new cases based on the distribution of cases in men who could have experienced the maximum latency period. These calculations show that the occurrence of vinyl chloride related ASL is not yet at the halfway stage and one might reasonably expect another 150 cases or so with an unknown number of further cases occurring 35 years or more after first exposure. Table 6 shows the principal occupations of the 118 affected men. At least 43% of the men (51/118) had been employed as autoclave cleaners, an occupation that has been thought to have necessitated the highest exposure to vinyl chloride monomer.

Discussion

The reassuring feature of these results is that the number of cases on the register is so small, and, in particular, that only 80 new cases have been diagnosed since 1975, despite the large size of the industry.

In the decade 1975-84, 19 cases were registered from the United States and seven from the United Kingdom. In men aged over 15 about 3300 deaths a year are attributed to all types of liver cancer in the United States and about 550 a year in the United Kingdom. Many of these cancers are probably sec-

Table 3 Distribution of vinyl chloride related cases of angiosarcoma of liver by country. (Number of factories with three or more cases in parentheses)

Country	No of cases	No of factories reporting cases	Total No of factories making PVC		Capacity* in 1972
			Pre-1974	Pre-1964	
United States	35	10 (3)	44	28	2090
W Germany	26	6 (3)	9	7	1155
France	18	5 (3)	7	5	627
Canada	10	1 (1)	4	3	88
United Kingdom	9	2 (1)	7	4	502
Sweden	5	1 (1)	2	1	105
Italy	4	4 (-)	11	7	778
Yugoslavia	4	1 (1)	3	2	60
Czechoslovakia	2	1 (-)	1	1	48
Japan	2	1 (-)	31	16	1699
Belgium	2	1 (-)	2	1	195
Norway	1	1 (-)	1	1	65
All countries reporting cases	118	34 (13)	122	76	9462

*Capacity in kilotonnes pvc production a year (Information supplied by ICT and by recipients of the register).

Table 6 Recorded occupations among ASL cases on register

	No*
Production worker/operator	69
Autoclave cleaner	51
General maintenance/fitter	8
Other jobs	11
Unknown	17
	156

*As several employees have more than one job recorded for them, these numbers do not add up to 118.

fore be expected to be materially increased with the passage of time.

Any method to assess the number of expected new cases is likely to be imprecise. Our method simply looks at the proportions of cases with different latent periods and makes projections based on the distribution of cases that have occurred within different periods of maximum possible latency. In the absence of any information about the numbers of exposed employees it is all that can be done. The results suggest that another 155 cases are likely to be diagnosed within 35 years after first exposure. Compared with the 110 cases in this category diagnosed so far, this means that the industry is approaching the halfway stage in the appearance of ASL. The calculation of 155 more cases within 35 years of first exposure assumes that the hazard was essentially eliminated in the late 1960s. If it was not a further 50 or 60 cases (something slightly less than the number expected to have been induced in men who could have been observed for only 15 to 19 years by the end of 1984) must be added to the total.

Further cases must also be expected to occur 35 or more years after first exposure but it is, as yet, virtually impossible to estimate the number to be expected with any precision. It could, however, easily be around 50. We suggest, therefore, that it should be assumed that there will be another 200-250 deaths from vinyl chloride related ASL over the next 30 years. This estimate is in pronounced contrast with that calculated by Nicholson *et al* who suggest that "within a factor of 2 or 3" there will eventually be a total of 350 deaths from vinyl chloride related ASL in the United States and 1200 in Western Europe alone.⁸ Nicholson *et al* used a complex model to deduce these figures based on the assumption that the incidence of

ASL at any point in time increases in proportion to (i) the first power of the product of the population at risk and the degree of exposure and (ii) a higher power (most probably the third) of the time since exposure first occurred.⁸ Knowledge of the distribution of cases recorded by the National Institute of Occupational Health and Hygiene (1982) by year of first exposure and year of occurrence, the amount of vinyl chloride produced, estimated average exposures at work at different periods from before 1950 to 1970-4, and normal national mortality rates allowed them to make approximate estimates of the variables in these equations and hence to calculate the number of cases that might be expected to occur in the future.

Only time will show which of the two methods will give the better estimate of the number of cases that will eventually be observed. We are encouraged, however, to think that the lower estimate may be the nearer as the method of Nicholson *et al* predicted an increase in the annual number of cases after 1979, whereas the number recorded to date has declined from an average of 9.2 in 1975-9 to an average of 6.8 in 1980-4. The latter figures will, however, almost certainly, be revised upwards in the course of the next few years owing to delayed reporting.

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