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Brief Summary

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Angiosarcoma of the Liver in Vinyl Chloride/Polyvinyl Chloride Workers

1977 Update of the NIOSH Register

Robert Spirtas, Dr. P.H., and Rose Kaminski, M.S. Hyg.

In the December 1974 issue of the Journal of Occupational Medicine (16:809), NIOSH presented data on 26 cases of liver angiosarcoma among vinyl chloride workers, 21 of whom worked in the polymerization process. The present update provides details on 64 cases of angiosarcoma among vinyl chloride polymerization workers reported as of October, 1977. Continued surveillance of these workers is encouraged for the purpose of furthering our knowledge of this disease process in relation to vinyl chloride exposure.

Since the original publication of NIOSH's register of 26 cases of liver angiosarcoma associated with occupational exposure to vinyl chloride or polyvinyl chloride (VC/PVC),[1] evidence has continued to accumulate which further confirms this association. In the May 1975 issue of *JOM*,[2] an additional 12 cases were presented. Since that update, 33 more cases have been reported to NIOSH and one case has been discounted (U.S. Case No. 14) as of October, 1977. This yields a total of 70 cases known to NIOSH, 64 of whom were polymerization workers. Details of the 64 cases among polymerization workers are provided in Table 1. Data on non-polymerization workers is not presented in this update since there has been essentially no change. (One West German case was added to the previously published table of six cases among non-polymerization workers,[2] while one U.S. case (No. 14) was removed because the diagnosis could not be confirmed.)

Table 1 consists of 23 U.S. cases and 41 foreign cases from 11 different countries. The 23 cases identified among U.S. polymerization workers represents approximately 10% of all liver angiosarcomas identified in the U.S. since 1964. This percentage estimate is based on the number of cases identified by the Chronic Diseases Division, Bureau of Epidemiology, CDC, through their nationwide case finding effort for liver angiosarcoma for the years 1964-1974.* In the course of their study, CDC identified approximately 240 cases (confirmed by a panel of pathologists), of which 75% occurred during the 1964-1974 study period.

Some of the information presented in Table 1 is summarized below. The numbers in parentheses represent the medians which were calculated from the data in the previous update.[2] (1) The ages at diagnosis ranged from 37 to 71 years with a median of 49 years (44 years). (2) The latency periods, i.e., years from first exposure to diagnosis, ranged from nine to 38 years with a median of 21 years (17 years). (3) The total years exposed ranged from four to 31 years with a median of 18 years (16 years).

A distribution of the cases by date of diagnosis is presented in Fig 1. Although it is difficult to interpret the aggregation of differing sources of data, and while the data for 1977 is incomplete, this figure suggests a gradual increase over time in the reported cases of VC-induced angiosarcoma. During the past 17 years (1961-1977), a total of 23 cases have been identified in U.S. polymerization workers. Fifty-two percent of these cases had been diagnosed over the past five years. The rise in the number of cases diagnosed in these workers during the 1970's is probably the reflection of two events: (1) the increased surveillance of VC/PVC workers during this time and (2) the growth of the VC/PVC industry after World War II. The 20 to 30 year lag between the growth of the industry after World War II and the increase in the number of diagnosed angiosarcomas among VC/PVC workers observed during the 1970's roughly coincides with the median latency period (21 years).

In regard to some of the observations made from the data in Table 1, it will be interesting to note whether certain trends continue. For instance, the age at diagnosis and latency period appear to be increasing. Some possible explanations for these phenomena are (1) the initial cases may have had heavier exposures, (2) the ini-

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*The results of CDC's case finding effort were obtained through personal communication with Dr. Henry Falk, Chronic Disease Division, Bureau of Epidemiology, CDC, Atlanta, Georgia

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Table 1. — Reported Cases of Angiosarcoma of the Liver Among Vinyl Chloride Polymerization Workers.

Country	Case No.	Birth Date	1st VC or PVC Exposure	Diagnosis of Angiosarcoma	Age at Diagnosis	Years from 1st Exposure to Diagnosis	Total Years of Exposure	Date of Death
Belgium	01	00 00 00	00-00 00	00-00 00	00	00	00	06-29 76
Canada	01*	12 15-13	00-00-44	00 00 55	41	11	11	09-02 55
Canada	02*	03 06-14	00 00 43	00 00 57	43	14	14	12-21 57
Canada	03*	08-26-19	00 00-41	00 00-62	42	21	20	03-22-62
Canada	04*	04-05 19	00 00-45	00 00 67	48	22	22	01-21 68
Canada	05*	05 07-11	00 00 44	00-00 68	57	24	05	07-05 68
Canada	06*	12-15-19	00-00-47	00 00 71	51	24	23	04-10 71
Canada	07*	11-09-19	00-00-46	00 00 72	53	26	25	12-24-72
Canada	08	05 13-20	00-00-47	00-00-73	53	12	05	05-12-73
Canada	09	07-19-21	00-00 46	00-00-74	53	28	25	03-04-74
Canada	10	05-16-15	00-00 53	00-00-75	61	23	14	04-00-77
Czechoslovakia	01*	00 00-28	00 00 57	00 00 73	46	16	16	00-00 74
Czechoslovakia	02*	00 00-26	00-00-51	00 00 66	40	15	15	00-00 66
Fed Rep Germany	01*	05-04-30	10-01-56	09-19 68	38	12	12	01-25-69
Fed Rep Germany	02*	07-26-31	10-14 57	09-25-70	39	13	12	12-14-71
Fed Rep Germany	04	09 04-30	04-16-57	00-00 74	44	17	17	11-25 74
Fed Rep Germany	05*	01-01-32	12 16 62	00 00-75	43	13	12	01-09-75
Fed Rep Germany	07*	09 29-26	04-15 54	00 00-75	49	21	12	11-13-75
Fed Rep Germany	08*	10-19 17	04 19-54	00-00-75	58	22	21	12-25-75
Fed Rep Germany	09*	12-13-34	12-02-59	06-16 76	42	17	15	Alive
Fed Rep Germany	10*	07-25 29	10-10-55	05-28-77	47	22	22	05-28 77
Fed Rep Germany	11*	12-29-36	01 02 61	00-00-77	41	16	10	03-07-77
France	01*	04 15-24	01-00 46	02 13 67	43	21	19	02-19-67
France	02	06-03-11	07 05-59	01-09-75	63	15	12	01 24-75
France	03*	00-00-19	00-00-45	01-00-75	55	29	29	05-29-75
France	04*	01-27-27	10-19-49	01-04 76	49	26	26	01-04-76
France	05*	01-29-38	00-00-65	04-00 76	38	11	10	05-13-75
France	06*	04-14-34	00 00-58	09-00-76	42	18	17	09-12-76
France	07	00-00-27	07-01-50	07-00-75	49	26	23	07 02-75
France	08*	04 01-34	05-23-57	12-03-76	42	19	19	01 30-77
Great Britain	01*	04-20-01	00-00-44	12-00-72	71	28	22	12-00-72
Great Britain	03	06-02 37	02-00 66	12-00-74	37	09	04	12-24-74
Italy	02*	11-13-29	00-00 57	12-13-72	43	15	06	12-00-72
Italy	03*	03-14 20	00 00-53	07-10-75	55	22	21	07-10-75
Japan	01	08 01-22	04 00-53	08 21 74	52	22	22	10-24 75
Norway	01*	12-23-15	03 00-50	12-20-71	56	22	21	01-04 72
Sweden	01*	06 23 27	08 14 51	08 00 74	43	19	18	10 20 70
Sweden	03*	06 10 10	05 00 47	03-19 76	65	29	21	03 19 76
Sweden	04*	11-16-14	00 00 45	05-12-77	62	31	31	05 12 77
USA	01*	10-17-23	12 09-48	03 03 73	49	24	21	03-03 73
USA	02*	08 19-33	11-15 55	05 00-70	37	14	13	09 29 71
USA	03*	05 25-15	11 28 45	12 19 73	58	28	28	12 19 73
USA	04*	01 15 24	07 06 52	08 19 67	43	15	15	01 07 68
USA	05*	01 25 12	06-19-44	04 09 64	52	20	20	04 09 64
USA	06*	11 23-28	01 17-62	02-00 74	46	12	12	07-24-75
USA	07*	05-03-22	08 27 44	00 00 68	45	24	17	03-23-68
USA	08*	05-06-20	10-07 46	08 00 61	41	15	15	08 29 61
USA	09*	11 08-31	05-28-45	03-01-74	43	29	24	03-03 75
USA	10*	08-16 13	06-12-51	05 00-68	55	17	17	05-10 68
USA	11*	05-27-09	10 14 46	03 00-70	61	23	23	03-16 70
USA	12*	11 17-18	09 13-49	05 02-69	50	20	19	05-02-69
USA	13*	12-01-21	12-11-42	05-00-74	52	32	26	07-04-74
USA	16*	11 04-27	05-08 50	00-00 69	41	19	04	03-27-69
USA	17*	05-06 31	06 23 55	10 11-74	43	19	19	Alive
USA	18*	04 22-28	09-15 54	00-00-75	46	21	11	11-02-75
USA	19*	00 00 15	00 00 43	05 19 75	60	32	22	04-06-76
USA	20*	08 31 17	00 00 55	01-30-76	58	21	18	01-30-77
USA	21*	09 02 09	12 00 46	00 00 77	67	30	21	01-02-77
USA	22*	10 02 23	07-11-47	01 30-75	52	29	28	12 04-76
USA	23*	00 00 23	09 0 53	04 05 73	50	15	14	04-06-73
USA	24*	05 07-17	00 00 39	05-27 77	60	38	26	05 27-77
USA	25*	08 07 10	02-00-47	03 10 77	67	30	20	03-10 77
Yugoslavia	01*	04 05 14	00 00 53	04 05 73	59	20	20	04 08-73
Yugoslavia	02*	11 15 31	00 00 50	07 12-73	42	23	18	07-12-73
Total Reported Cases 64								

*Diagnosis was microscopically confirmed

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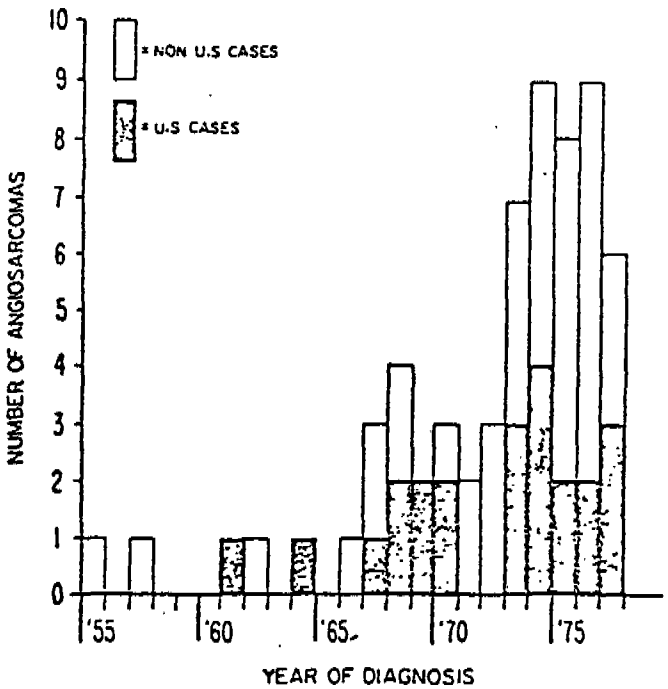

Fig 1. — Number of cases of VC/PVC related angiosarcomas reported to NIOSH by year of diagnosis. (This represents only 63 of the 64 cases known to NIOSH since information on diagnosis is missing for one case.)

tial cases were more biologically susceptible, or (3) random fluctuation. Analysis of the latency period for this disease in vinyl chloride workers should be a fruitful area for future study since multiple etiologies do not seem to be a factor in these cases and the exposure periods can be fairly well defined via employment histories.*

*Recent preliminary findings by NIOSH's Division of Biomedical and Behavioral Science suggest that the interaction of disulfuram with the enzymatic detoxification of ethylene dibromide results in increased carcinogenicity (including angiosarcoma of the liver) in laboratory rats.

One of the values in maintaining this register of cases among vinyl chloride workers is that it provides a base from which hypotheses for future research can be generated. However, the extremely rare occurrence of liver angiosarcoma lends great importance to the need for as complete reporting of the cases as possible if we are to develop a better understanding of liver angiosarcoma in relation to vinyl chloride exposure. The occupational health community is asked to report all new or as of yet unreported cases of angiosarcoma among VC/PVC workers to either Dr. Robert Spirtas or Ms. Rose Kaminski, Surveillance Branch, DSHEFS/NIOSH, 4676 Columbia Parkway, Cincinnati, OH 45226, (513) 684-3284.

In addition to vinyl chloride's association with angiosarcoma of the liver, recent studies have also found vinyl chloride to be associated with excesses in brain cancer and neoplasms of the respiratory and lymphatic systems.[3,4,5] More studies are needed to assess these findings. For an overview of the literature concerning the health effects associated with VC/PVC exposure, the reader is referred to Volume 246 of the Annals of the New York Academy of Sciences.[6]

The authors wish to thank Dr. J. William Lloyd, Dr. Henry Falk and Mr. Richard Waxweiler for their constructive criticisms.

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