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AUTHORS:

O. Wolf

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ORIGINAL

Cancer Morbidity amongst Chemical Workers from a Former Naphthalene Cleaning Plant

Author: O. Wolf

Summary

Despite the large number of chemical substances and compounds with a carcinogenic effect used in the working environment, very few cases of suspected occupational cancer have been notified. Here we report on a cluster of 7 cases of morbidity amongst 15 former naphthalene cleaning workers. On the basis of the results of animal experiments, naphthalene and dichlorodiethylether are suspected of being carcinogenic. Chronic irritations of the mucous membranes and the effects of heat are suspected of syncarcinogenesis. The chance nature of the discovery of such a relationship suggests the need for greater co-operation between clinical doctors, oncological centres and occupational doctors.

The Problem

The number of chemical substances and compounds which are carcinogenic in animal experiments has risen to more than 1000 and, of these, approximately 40 are recognised as being carcinogenic in humans (14). Many of these substances are also found in the working environment such as e.g. arsenic, asbestos, beryllium, nickel, chromium, tar, soot, bitumen, benzol and many other hydrocarbon compounds (1, 10, 11, 13). In the list of occupational diseases of 14.11.1957 No. 18 is listed as skin cancers caused by work-related carcinogenic effects, No. 19 as cancers of the urinary tract due to aromatic amines and No. 31 as cancers of the respiratory tract due to occupational carcinogenic effects (12).

The number of suspected occupational cancers which are notified each year is very small and this is surprising in view of the large number of known carcinogens which are to be found in the working environment. For example, in the German Democratic Republic only 26 cases of cancer were recognised as an occupational disease between 1960 and 1971 and 32 cases in 1972 (14). In 1973 the number of acknowledged new cases of occupational disease 31 increased to 77. This is due to a recording

ORIGINAL

2

15358

phenomenon, since 63 of these new cases were due to : asbestos
(23).

One reason for the large number of unreported cases of occupational cancer is that too little has previously been known about the relationship between occupational exposure and malignant tumours. Secondly, it is difficult to identify a relationship because:

1. from the description of the occupation e.g. specialist chemical worker, it is not immediately possible to identify any possible harmful effects
2. a lot of workers and doctors are not aware of the possible harmful substances
3. because of the long latency periods, workers have often changed their jobs several times so that the causal relationships are obscured even further.

It is always necessary to think of the interaction between several harmful factors in the sense of syncarcinogenesis (1, 11).

Our Own Observations

A cluster of cancer cases, particularly of carcinomas of the larynx, amongst workers from a former naphthalene /purification plant, were brought to our notice. This section was in existence between 1917 and 1968. Most of the employees had worked in the same job for several decades. The average period of exposure was 20 years with only 2 of the naphthalene cleaners having done this job for less than 10 years (cases 4 and 12).

In response to our enquiries, the factory gave us names of 15 workers who had worked in this section in the last 20 - 30 years of its existence. Five of these have died, four of them from cancers (Table 1). Two of them had died from cancer of the larynx (cases 1 and 4), one from a stomach cancer (case 3) and one from a caecum cancer (case 2). We were unable to ascertain the cause of death of one of the former naphthalene workers (case 5). Since the competent oncological centre had received no notification of him, cancer can probably be ruled out.

ORIGINAL

Table 1: Naphthalene cleaning workers who have already died

1. F. O.	7.12.1905 2.7.1970 (71)	Period of exposure 30 years. Smoker, 10 - 12 cigarettes per day. Dec. 1968 hoarseness, Feb. 1969 PE from a nodule tumour of the whole right vocal chord. Histology: polymorphocellular, undiff. carcinoma, suspected metastatic HLC bds.
2. R. G.	4.6.1900 23.3.1971 (76)	Period of exposure more than 30 years. Non-smoker. 1920 lung TBC Section: matured tubo-alveolar adenocarcinoma of the caecum, Intrapulmonary metastasis. Chronic bronchitis.
3. Sch. O.	17.3.1901 25.6.1971 (75)	Period of exposure more than 30 years. Medical history unknown. Section: circular stenosing parvicellular scirrhoid solid carcinoma of the pylorus ventr. metastases.
4. R. P.	22.10.1901 15.7.1973 (75)	Period of exposure 7 years. Smoker, 2 - 3 packets of tobacco per week. Hoarseness from early age. Dyspnoea from 60 onwards. Tracheotomy and PE of a stenosing tumour of the larynx due to acute deterioration on 1.1.1973. Section: circular stenosing keratinizing squamous cell carcinoma of the entire larynx, paratracheal metastases.
5. H. W.	? 1947 16.8.1997 (79)	Period of exposure 27 years. Smoking habits unknown. Clinical: chronic bronchitis, coronary insufficiency, cirrhosis of the liver.

ORIGINAL

15358

4

Table 2. Naphthalene workers treated for cancer

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|----------|-----------|--|
| 6. K. W. | 7.5.1904 | Period of exposure 16 years.
Smoker, 10 cigarettes per day.
(72) Hoarseness since 1960, 1964 total laryngectomy
because of cancer of the larynx. |
| 7. A. O. | 1.12.1908 | Period of exposure 19 years.
Smoker, 5 cigarettes per day.
(65) 1965 histologically confirmed Hodgkin's disease.
Diabetes mellitus, hoarseness since 1946. |
| 8. R. E. | 7.10.1912 | Period of exposure 18 years.
Smoker, 5 cigarettes + per day.
(66) Hoarseness since 1972. 1973 total laryngectomy
because of cancer of the larynx. Chronic pneumato-
bronchitis, Lupus erythematosis, left cheek. |

Table 3. Free from cancer symptoms

- | | | |
|------------|------------|---|
| 9. St. E. | 2.5.1900 | Period of exposure 28 years.
(76) Occasional smoker.
previous gastric complaints, chronic pharyngitis. |
| 10. Th. F. | 6.8.1902 | Period of exposure 21 years.
(74) Non-smoker.
1924 otitis medius, renal and biliary colic. |
| 11. S. A. | 21.11.1909 | Period of exposure 32 years.
(67) Smoker, 10 - 15 cigarettes per day.
1940 ear-radical-op, chronic laryngitis. |
| 12. F. W. | 24.11.1911 | Period of exposure 2 years.
(65) Smoker, 1 packet of tobacco per week.
1960 lung section because of tuberculosis. |

ORIGINAL

15358

5

13. J. J. 17.10.1915 (61) Period of exposure 18 years.
Smoker, two packets of tobacco per week.
Hoarseness since 1950s,
polyps on vocal chords removed twice,
chronic laryngitis.
14. P. K. 22.12.1917 (54) Period of exposure 20 years.
Smoker, 10 - 15 cigarettes per day.
Chronic rhino-pharyngitis-laryngitis sicca
15. K. H. 18.3.1929 (67) Period of exposure 18 years.
Smoker, 10 cigarettes per day.
Chronic pharyngitis-laryngitis.

Of those who are still alive, three have been treated for a tumour or a systematic disease (Table 2).

Two were operated on for carcinoma of the larynx and have so far been recurrence-free for 11 and 2 years respectively (cases 6 and 8).

One has survived a histologically confirmed malignant granuloma [Hodgkin's disease] after treatment with endoxane and radio-therapy and has been symptom-free for 5 years (case 7).

As yet none of the remaining 7 workers from the former naphthalene cleaning plant (Table 3, cases 9 -15) is known to be suffering from any malignant disease. The control studies done on these 7 workers revealed five cases of chronic pharyngitis-laryngitis, which is recognised as one of the factors favouring carcinogenesis (5, 18).

The information which was obtained about smoking habits, where this was possible, cannot be regarded as very objective. A comparison between the cancer sufferers and those who had remained disease free did not reveal any striking differences between them.

ORIGINAL

Technology of Naphthalene Purification

The crude naphthalene which is produced from coal tar was brought in 20 - 30 kg. blocks. It was then melted at 80 - 85°C in underground, closable melting boilers on the open factory site. The melted product was then sucked out into 7.5 t cleaning reactors and heated to 130°C and the remaining water content distilled off. Sodium metal was then added whilst stirring to remove the sulphur. After a reaction time of a few hours, some of the naphthalene was then driven off by increasing the temperature to 180°C. The residue was filled up with crude naphthalene. This was again followed by desiccation and desulphurisation with subsequent distillation. These cycles were repeated up to eight times. The residue was then sucked into a vessel containing water (separating funnel). After sodium sulphide and sodium metal had been scrubbed out, the tar residue was distilled once again. After it had cooled down to approximately 140°C, the remaining naphthalene hard pitch was poured into moulds in an open hall. The technical naphthalene produced by the multiple distillation processes was subject to certain purity requirements in accordance with the terms of TGL 2758. The maximum sulphur content was 0.5 % and the maximum tar content 0.14 %.

Potential for Harm

The total naphthalene purification workers comprised 10 - 12 people. Since the work was done on a 4-shift system with an average of 2 - 3 people per shift, all carrying out all of the necessary work, all of the employees were exposed to the same harmful substances. Most of the naphthalene cleaning process took place in a closed vacuum system. Due to the technology, the only possibility of contact with tar products was during filling of the melting boilers with crude naphthalene, emptying the distillation residue, the so-called naphthalene hard pitch, and also during repair of the apparatus, pipework and such like when there was a possibility of contamination. The crude naphthalene which was delivered in wagons, was intermediately stored in the factory yard and the melting boilers had to be refilled several times a day, 1 - 2 times per shift, using wheel-barrow. When the boilers were opened, tar-laden naphthalene sublimate rose out. The colourless crystal flakes with the

ORIGINAL

15358

7

characteristic moth-ball smell would shimmer in the sunlight. Each crude naphthalene recharging procedure lasted approximately 2 hours. The MAK¹ value for naphthalene is set at 20 mg/m³ with admissible peak concentrations of up to 50 mg/m³ (10, 13). Since, at that time, there was no way of determining the MAK value for naphthalene, workplace concentrations were not determined in the former naphthalene cleaning plant. There are no MAK values for tar and pitch vapours.

Naphthalene, C₁₀H₈, is hardly water soluble but is readily fat-soluble. It is incorporated into the human organism by inhalation or swallowing of dust particles and causes irritation of the mucous membranes. The incorporation of high concentrations leads to headaches, vertigo, optic neuritis and haematuria (10, 13, 20).

As yet there is no information available about the carcinogenic effect of naphthalene in humans (1, 9), although, in experiments with rats and mice, the substance displayed slight carcinogenic effects (21).

When the tar was drained off, 2 - 3 times per week, the hard pitch was poured into moulds in the open hall at approximately 140°C. During this process the room was practically fogged up. The tar vapours irritated the mucous membranes, irritated the throat and caused fits of coughing. The process lasted approximately 1 hour. Tar and its derivatives are the earliest known occupational carcinogens. In 1975 Pott described "chimney sweeps' cancer" and in 1975 Volkmann described the skin cancer of the tar worker (1, 9).

The endangered workers are those who come into contact with tar, soot, pitch, paraffin, asphalt, naphthalene, tar oil and similar (11). This can include chimney sweeps, coal-tar workers, pitch workers, roofers, workers cleaning distillation apparatus, pitch crushers (11).

The carcinogenicity of the tar is determined by its 3 - 4 benzpyrene content (1, 8).

Mostly the effects are via the skin or the respiratory tract and consequently the main organs which are affected are the skin, the larynx and the lungs (1, 11), but the carcinogenic hydrocarbons are capable of inducing cancer

¹ MAK = Maximale Arbeitsplatz-Konzentration
Maximum workplace concentration

ORIGINAL

8

15358

in any organism and in any organ (1). The average latency is given as 20 - 24 years (1 - 50 years) (11).

In accordance with the technology, the naphthalenic hard pitch, the residue from naphthalene ^{purification} was drained off at 130 -140°C. However, sometimes they did not wait for it to cool and the hard pitch was drained off at higher temperatures (approximately 200°C), so that the naphthalene workers could also be exposed to the effects of heat at this time and this is regarded as a determining factor in the mechanism of syncarcinogenesis (1, 6, 13, 18).

Between 1958 and 1968 aroxane distillation was also done in the same section. Aroxane is a dixylenyldiethylether which is made from dimethylphenol and dichlordiethylether and was used as a plasticiser for paints. It was processed in a closed system. It was only as the distillation residue was being drained off that there was brief contact with vapours, which are said to be caustic. This work, which had to be done once a week, lasted for half an hour and was generally very unpopular because of the extremely unpleasant smell. Interestingly, of the raw materials used in aroxane distillation, dichlordiethylether is also known to be an effective carcinogen from animal experiments, even though there are as yet no observations for humans available for this substance either.

Conclusions

Because of the cluster of 7 malignant diseases in this small group of 15 people, who were exposed to the same occupational hazards, we must suspect a relationship between the influence of occupational noxae and the occurrence of cancer and this caused us to notify the carcinomas of the larynx as suspected cases of occupational disease 31 and also to notify our suspicion of the other tumours as an occupational disease. The assessment of these cases is still outstanding.

The chronic irritations of the mucous membrane (caused by naphthalene sublimate during refilling of the crude naphthalene, by residual vapours from aroxane distillation and pitch vapours during emptying of the naphthalene residue) are also under suspicion as syncarcinogens as are the tar-vapours as a known carcinogen and the effects of heat.

ORIGINAL

Because of the complex process of carcinogenesis in occupational cancer with long affection and latency periods, because of the multiplicity of chemical and physical noxae with cumulative and synergetic effects, it is always difficult to identify a possible relationship between occupation and the occurrence of cancer in an isolated case. Thus, even in the seven cases of malignant disease described amongst the naphthalene workers, such a relationship was not suspected in each individual case. It was not until one of the patients with a carcinoma of the larynx mentioned that three of his colleagues were already suffering from throat cancer that we decided to look at the question of a relationship and discovered the other cases of cancer. The chance nature of the discovery of such a relationship is worrying and leads us to consider how the co-operation between clinical doctors, oncological centres and works doctors can be improved in order to uncover the large number of unreported cases of occupationally-induced cancers.

One possible approach would be if:

1. for each cancer patient the possibility of an occupationally related tumour is considered and the occupational history is thoroughly searched for any possibility of harmful substances.
2. more details of possible occupational effects are given on Form II for the notification of a notifiable cancer. Particularly if the patients have had jobs in which they have been exposed to chemical and physical hazards for more than 10 years, even if (or particularly if) this was many years ago.
3. if there is the slightest suspicion of an occupational cancer, the works doctors who are aware of the industrial production processes should be informed so that they can give an opinion regarding the hazard, thus making it possible to record epidemiological and statistical data so that any clustering of cancer cases in circumscribed working collectives can be identified.
4. works doctors register any workers whose work involves particularly high levels of exposure so that, in addition to the routine occupational examinations, preventative medical examinations can also be carried out.

ORIGINAL

References

10

15358

1. Bauer K. H.: Das Krebsproblem [*The cancer problem*], Springer Verlag, Berlin-Heidelberg-New York 1963
2. B.H. and T. Schramm: Arch. Geschwulstforschung [*Archives of cancer research*]45,1974, 291
3. Bittersohl G.: Arch. Geschwulstforschung [*Archives of cancer research*]38,1969, 198
4. Bittersohl G.: Arch. Geschwulstforschung [*Archives of cancer research*]43,1974, 172
5. Blümlein H.: Münchener med. Wochenschr. [*Munich medical weekly*] 37 (1957), 1333
6. Borgert H.: Med. Sachver? [*Medical ?*] 51 (1954), 14
7. Borneff J. and H. Blümlein: Med. Klinik [*Medical clinic*] 13 (1960), 494
8. Braukmann F.: Erdöl und Kohle [*Mineral oil and coal*] (1953), 804
9. Ebhardt E.: Was kennen wir bis heute für canzerogene Substanzen [*What carcinogenic substances do we know today*] Diss. Heidelberg 1961
10. Holstein E.: Grundriß der Arbeitsmedizin [*Principles of occupational medicine*] Johann Ambrosius Barth Verlag, Leipzig 1969
11. Hueper ? C.: Berufskrebs [*Occupational cancer*] Verlag Theodor Steinkopff, Dresden 1964.
12. Koelsch F.: Handbuch der Berufserkrankungen [*Manual of occupational diseases*] VEB Gustav Fischer Verlag, Jena 1962
13. D? Handbuch der Berufserkrankungen [*Handbook of occupational diseases*], VEB Gustav Fischer Verlag, Jena 1972
14. Konetzke G. W.: Arch Geschwulstforschung [*Archives of cancer research*] 43 (1974), 326
15. Konetzke G. W.: Arch Geschwulstforschung [*Archives of cancer research*] 44 (1974), 23
16. Konetzke G. W.: Dt. Gesundheit-Wesen [*German health service*]29(1974), 1384
17. Lieschke G.: HNO 12 (1964), 207
18. Nessel E.: Arch. Ohren-, Nasen- und Kehlkopfheilkunde [*Archives of ear, nose and throat medicine*] 185, (1955), 379.

15358

11

19. Oskan F. W.: HNO-Begutachtung [*HNO Assessment*], Georg Thieme, Leipzig 1971
20. Schwab W.: Arch. Ohren-, Nasen- und Kehlkopfheilkunde [*Archives of ear, nose and throat medicine*] 185 (1965), 243
21. Teichmann B. and T. Schramm: Arch Geschwulstforschung [*Archives of cancer research*] 43 (1974), 381
22. Statistisches Jahrbuch der DDR [*GDR Statistical Year-book*] 1975
23. Jahrbuch: Das Gesundheitswesen DDR [*Year-book: The GDR health service*] 1974

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ORIGINAL

Author's address:
Senior Doctor Dr. O. Wolf, HNO Clinic, Dressau District Hospital,
4502 Dressau, Auenweg 38