

Malignant Mesothelioma of the Pleura in Trieste, Italy

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One hundred and seventy malignant pleural mesotheliomas seen at necropsy at the Institute of Pathological Anatomy of the Trieste University during the period 1968-1987 were reviewed. The series included 153 men and 17 women, aged between 33 and 92 years (median 70 years). Lifetime work histories were obtained from the patients' relatives by personal or telephone interviews in 162 cases. A majority of the male subjects had been employed in "naval" work, 99 people having worked in the shipbuilding industry, 19 in the navy and merchant marine, and 7 in docks. A variety of trades appeared in the remaining histories. Work histories were indicative of occupational exposure to asbestos in 150 cases. A further 5 patients with negative or insufficient data showed asbestos bodies in routine lung sections and 5 women had a history of domestic exposure. A majority of the patients had had their first exposure before 1950. The intervals between first exposure and death ranged from 14 to 71 years (median 48 years). © 1992 Wiley-Liss, Inc.

Key words: asbestos exposure (occupational, domestic), asbestos bodies, necropsy study, shipbuilding industry, maritime trades, petrochemical industry, mesothelioma

INTRODUCTION

The Province of Trieste is a small coastal area, located in northeastern Italy at the border with Slovenia. It covers an area of 212 square kilometers and has a population of 281,988 (1981 census).

In the past, Trieste Province was the site of large industries, shipbuilding being by far the most important of them. In Trieste, a high incidence of malignant pleural mesothelioma was first observed at the beginning of the 1970s [Bianchi et al., 1973; Gobbato and Ferri, 1973]. Subsequently, several investigations on this topic were carried out [Biava et al., 1976, 1983; Bianchi et al., 1978, 1982, 1987]. In the present study, malignant pleural mesotheliomas seen at necropsy at Trieste University during a 20-year period were reviewed.

MATERIALS AND METHODS

In the Province of Trieste, the Institute of Pathological Anatomy of the Trieste University is the only institution in which necropsies are performed. Between January

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1968 and December 1987, a total of 40,826 necropsies were carried out. The annual necropsy rate greatly increased during this period; during the last decade, it corresponded to about 70% of all persons who died at the public hospitals.

Cases of malignant pleural mesothelioma on necropsy diagnosis were reexamined. Clinical records and available microscopic slides were reviewed. Only the cases in which alternative diagnoses could be positively excluded were considered as primary malignancies of the pleura. In such cases, all efforts were made to obtain detailed lifetime occupational histories. Clinical records were examined and additional information was obtained from the patients' relatives by personal or telephone interviews. In the case of female patients, data on the occupations of family members were also collected.

When a given history was apparently negative or difficult to interpret in terms of asbestos exposure, specific enquiries were conducted to establish whether or not that workplace in that period was at risk. People who had worked at the same workplace during the same years were traced and interviewed.

Occupational histories were classified on the basis of the occurrence of asbestos exposure. When the patient had had more than one job at risk, the case was categorized as to the earlier occupation.

Available routine lung sections (paraffin embedding, hematoxylin-eosin staining) were examined for asbestos bodies. The cases were classified into 3 groups: 1, no bodies detected; 2, few bodies (between 1 and about 4-5 per one or more sections); 3, moderate to high amounts of asbestos bodies.

Pleural plaques were not included among the parameters of the present study, because a precise statement about the presence or the absence of plaques was often lacking in necropsy records.

RESULTS

The series consisted of 170 cases. The numbers of cases per year is shown in Table I. The cases observed during the period 1968-1983 were included in previous reports from this Institute [Bianchi et al., 1973, 1978, 1982, 1987]. There were 153 men, aged between 33 and 92 years (mean age 68.7, median age 69) and 17 women aged between 40 and 81 years (mean age 69.7, median age 74). Table II shows the sex and age distribution of the patients.

Mesothelioma had been diagnosed during life in 106 cases. Mesothelioma affected the right pleura in 101 cases, the left pleura in 66, and both sides in 3.

The classic macroscopic picture, a thick neoplastic layer completely encasing the ipsilateral lung, was reported in the majority of cases. However, 3 patients were erroneously diagnosed at necropsy as having pleural fibrosis, only microscopic examination revealing the neoplastic nature of the lesion. The most frequent histological type was the mixed type (90 cases); pure epithelial patterns were observed in 60 cases and pure sarcomatous in 20. Metastases were found in 99 cases.

The majority of the patients had worked in the shipyards (Table III) with various trades (Table IV). Mariners represented the second category in order of frequency. Sailors had been employed in the navy (4 patients) or merchant marine (14 patients), frequently as engine room personnel (Table V). The dock workers included 5 laborers, one electrician, and one customs-house officer.

The patients classified under the term "other industries" had worked in the steel

TABLE I. Annual Numbers of Necropsies and of Malignant Pleural Mesotheliomas in Trieste Province

Year	No. of necropsies	No. of mesotheliomas (%)
1968	523	2 (0.38)
1969	600	2 (0.33)
1970	665	6 (0.90)
1971	853	2 (0.23)
1972	1,054	3 (0.28)
1973	1,243	2 (0.16)
1974	1,462	1 (0.07)
1975	1,873	4 (0.21)
1976	2,249	5 (0.22)
1977	2,523	11 (0.44)
1978	2,708	12 (0.44)
1979	2,689	10 (0.37)
1980	2,797	13 (0.46)
1981	2,700	11 (0.41)
1982	2,760	13 (0.47)
1983	2,890	14 (0.48)
1984	2,770	15 (0.54)
1985	2,835	15 (0.53)
1986	2,821	10 (0.35)
1987	2,818	19 (0.67)

TABLE II. Sex and Age Distribution in 170 Cases of Malignant Pleural Mesothelioma in Trieste Province, 1968-1987

Age (years)	Men (%)	Women (%)	Total
30-34	1 (0.7)	0 (0.0)	1
35-39	1 (0.7)	0 (0.0)	1
40-44	0 (0.0)	1 (5.9)	1
45-49	1 (0.7)	1 (5.9)	2
50-54	5 (3.3)	0 (0.0)	5
55-59	14 (9.2)	0 (0.0)	14
60-64	26 (17.0)	1 (5.9)	27
65-69	29 (19.0)	2 (11.8)	31
70-74	31 (20.3)	8 (47.1)	39
75-79	28 (18.3)	2 (11.8)	30
80-84	12 (7.8)	2 (11.8)	14
85-89	4 (2.6)	0 (0.0)	4
90-94	1 (0.7)	0 (0.0)	1
Total	153 (100.0)	17 (100.0)	170

industry, foundries, smelting furnaces, and brick works. Petrochemical workers had worked in oil refineries as laborers (3 cases) or technicians (2 cases).

Railway workers included one boilermaker, one mechanic, and one train polisher. Of the 2 construction industry laborers, one had a history of contact with asbestos-cement.

Two female patients had histories of working in the textile industry. The former had been employed in rag sorting and the latter in the recycling of canvas sacks. Both the workshops in which these patients had worked have been closed for decades. Concerning the rag sorting, a person who had worked in the same firm could be

TABLE III. Occupational Data in 170 Cases of Malignant Pleural Mesothelioma, Trieste Province

	No. of patients (%)
Shipbuilding industry	99 (58.2)
Navy and merchant marine	19 (11.2)
Dock	7 (4.1)
Petrochemical industry	6 (3.5)
Various industries	6 (3.5)
Railways	3 (1.8)
Construction industry	2 (1.2)
Textile industry	2 (1.2)
Other	8 (4.8)
Domestic asbestos exposure	5 (2.9)
Negative history	5 (2.9)
Insufficient data	8 (4.7)

TABLE IV. Trades of Shipbuilding Industry Workers With Mesothelioma, Trieste Province, 1968-1987

	No. of patients
Mechanic	14
Welder	11
Joiner and carpenter	8
Boilermaker	7
Worker	7
Electrician	5
Laborer	4
Painter	4
Plumber	4
Riveter	4
Shipwright	4
Turner	4
Various	4
Foundryman	3
Draftsman	2
Keeper	2
Crane operator	1
Insulator	1
Storeman	1
Tracer	1
Unknown	8

traced; he testified that fabrics containing asbestos were also processed. As to sack recycling, it could be ascertained that the sacks used in the workshop had contained a variety of materials, including asbestos.

The patients classified as "other" included one boilermaker (workplace unspecified), one road-mender, and one telephone technician; in addition, there were 3 subjects who had worked as storemen in stores where asbestos was on sale; the remaining two patients had worked as plumbers in municipal water-supply departments.

Five women had histories of domestic exposure to asbestos. They had cleaned the work clothes of their husbands, employed in shipyards. Finally, in 5 cases, there

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TABLE V. Trades of Seamen With Mesothelioma, Trieste Province, 1968-1987

	No. of patients
Machinist	9
Navy official	4
Cook	2
Electrician	2
Cabin-boy	1
Steward	1

was no indication of asbestos exposure, and unsatisfactory data were obtained for a further 8 patients.

The duration of asbestos exposure ranged between 4 months and 46 years (Table VI). The patients listed as exposed to asbestos for short periods (less than 10 years) had spent the rest of their worklife in a variety of workplaces. It is possible that some of them have implied additional exposures to asbestos.

The majority of the patients had had their first exposure before 1950 (Table VII).

The latency periods, defined as intervals between first exposure and death, could be calculated in 124 cases, ranging between 14 and 71 years (mean 47 years, median 48 years) (Table VIII).

Routine lung sections, examined in 167 cases, showed asbestos bodies in 114 (68%). The percentages of positive findings showed considerable variations from one occupational group to another (Table IX).

On the basis of occupational histories and of data obtained by specific enquiries, 160 mesotheliomas were classified as asbestos-related. These included the 149 cases whose occupations are listed in Table III, and 6 of the patients classified as "other" (boilermaker, storemen, plumbers). In addition, 5 cases with negative or incomplete histories and with presence of asbestos bodies in lung sections were considered as related to asbestos.

DISCUSSION

Special difficulties are encountered in obtaining data on the geography of malignant mesothelioma. Death certificates, the most common source of information in the epidemiology of cancer, revealed a very low grade of reliability for this particular tumor [Lilienfeld and Gunderson, 1986; Connelly et al., 1987; Nelson et al., 1987; Ribak et al., 1989]. On the other hand, clinical diagnosis remains difficult and in the present series, a significant proportion of the tumors (nearly 40%) have been identified only at necropsy. This suggests that, in evaluating the quality of epidemiologic data on mesothelioma in a given area, the autopsy rate in that territory is a point to be considered.

To assess whether or not a given mesothelioma is asbestos-related can be problematical. In the industrial world, the use of asbestos is widespread, and recently a variety of "unsuspected" occupations have been demonstrated to carry a risk for asbestos-related malignancies [Paci et al., 1987; Talcott et al., 1989; Huncharek et al., 1988, 1989a,b; Järholm et al., 1988; Stein et al., 1989; Huncharek and Muscat,

TABLE VI. Duration of Asbestos Exposure in 128 Mesothelioma Cases, Trieste Province, 1968-1987

Age (years)	Men	Women	Total (%)
Less than 1	1	0	1 (0.8)
1-4	8	0	8 (6.2)
5-9	11	3	14 (10.9)
10-19	12	1	13 (10.2)
20-29	20	0	20 (15.6)
30-39	32	0	32 (25.0)
40-49	39	1	40 (31.2)
Total	123	5	128 (100.0)

TABLE VII. First Exposure to Asbestos in 149 Mesothelioma Cases, Trieste Province, 1968-1987

Calendar years	Men	Women	Total (%)
1910-1919	8	0	8 (5.4)
1920-1929	38	1	39 (26.2)
1930-1939	43	1	44 (29.5)
1940-1949	22	1	23 (15.4)
1950-1959	7	1	8 (5.4)
1960-1969	0	0	0 (0.0)
1970-1979	1	0	1 (0.7)
Before 1950 unspecified	25	0	25 (16.8)
After 1960 unspecified	1	0	1 (0.7)
Total	145	4	149 (100.0)

TABLE VIII. Latency Periods (First Exposure-Death) in 124 Mesothelioma Cases, Trieste Province, 1968-1987

Age (years)	Men	Women	Total (%)
10-19	1	0	1 (0.8)
20-29	5	1	6 (4.8)
30-39	28	0	28 (22.6)
40-49	30	1	31 (25.0)
50-59	40	2	42 (33.9)
60-69	13	0	13 (10.5)
70-79	3	0	3 (2.4)
Total	120	4	124 (100.0)

1990; Kern, 1990; Lerman et al., 1990]. Moreover, asbestos-related mesothelioma is a condition with a very long latent period. This requires that ancient occupational settings are reconstructed, a problem sometimes involving industrial archeology as much as occupational medicine. Another point that deserves attention is the fact that very short periods spent in a workplace polluted by asbestos are sufficient to induce a malignant mesothelioma after many decades. A superficial inquiry may miss those short-term occupations and the patient himself may neglect them. Obviously, the presence or absence of objective signs (such as pleural plaques, pulmonary asbestosis, lung asbestos bodies, and lung asbestos fibers) are of critical value in interpreting the work history data.

TABLE IX. Occupation of Mesothelioma Cases, Trieste Province, 1968-1987

Occupation
Shipbuilding
Navy and marine
Dock
Petrochemical
Various industries
Railways
Construction
Textile industry
Other
Domestic and agricultural
Negative history
No or insufficient data

*Class 1, non-exposed (no or insufficient data); c

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TABLE IX. Occupation and Asbestos Bodies in Lung Sections in Review of Mesothelioma Cases, Trieste Province, 1968-1987*

Occupation	No. cases	Asbestos bodies (%)		
		Class 1	Class 2	Class 3
Shipbuilding industry	98	21.4	39.8	38.8
Navy and merchant marine	19	42.1	36.8	21.1
Dock	7	14.3	71.4	14.3
Petrochemical industry	6	16.7	66.7	16.7
Various industries	6	66.7	16.7	16.7
Railways	2	50.0	50.0	0.0
Construction industry	2	50.0	50.0	0.0
Textile industry	2	50.0	50.0	0.0
Other	8	50.0	37.5	12.5
Domestic asbestos exposure	5	80.0	20.0	0.0
Negative history	5	80.0	0.0	20.0
No or insufficient data	7	42.9	42.9	14.3

*Class 1, no bodies detected; class 2, few bodies (between one and about four to five per one or more sections); class 3, moderate to high amounts of asbestos bodies.

Recently some papers emphasized the relevance of nonasbestos-related mesothelioma [Peterson et al., 1984; Pelnar, 1988]. In the Trieste area, the experience is quite different, with over 90% of the cases being asbestos-related.

The most important feature emerging from the study of the Trieste series is the absolute prevalence of people employed in "naval" work. Taken together, the patients with histories of employment in the shipbuilding industry, navy and merchant marine, and dock represented 73% of the total cases and 77% of the subjects for whom complete histories were available. The extreme relevance of the shipyards as a source of asbestos exposure is well known [Selikoff et al., 1979]. In this respect, the Trieste Province may be included in the rather long list of shipyard areas with high incidences of asbestos-related mesothelioma [McDonald and McDonald, 1977; Edge and Choudhury, 1978; Sheers and Coles, 1980; Tagnon et al., 1980; Connelly et al., 1987; Chailleux et al., 1988; Hulks et al., 1989; Kishimoto et al., 1989; van Gelder et al., 1989; Bianchi et al., 1990]. The trades listed in Table IV confirm that, in the shipbuilding industry, the risk for mesothelioma is not confined to a few particular occupations, involving, on the contrary, all people working in the shipyards.

Less attention has been devoted to the problem of mesothelioma in the maritime trades. A body of evidence indicates that seamen are at risk for asbestos disease [Bianchi et al., 1982, 1983, 1991; Jones et al., 1984; Velonakis et al., 1989; Selikoff et al., 1990; Varouchakis et al., 1991; Bianchi and Brollo, 1991] and in the current series, this category accounted for a substantial portion of the cases. Engine room staff is particularly at risk, but among our patients as well as in other series [Ferguson et al., 1987; Varouchakis et al., 1991], deck department personnel were also represented. This is not surprising, since radiological pleuropulmonary alterations indicative of asbestos exposure are very frequent in all maritime trades [Selikoff et al., 1990].

Dock workers represent a third category at risk in a maritime city, since the merchandise carried by the vessels may include asbestos. In addition, these workers have frequent contact with the ship structures, during repair works.

Apart from naval work, a variety of trades appeared to be associated with

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pleural mesothelioma in the present series. Mesotheliomas in oil refinery workers are of particular interest. While the risk for asbestos disease in the petrochemical industry is well recognized [Lilis et al., 1980], pleural mesothelioma has rarely been reported in this occupational category.

The relevance of asbestos exposure among railway workers [Mancuso, 1988; Maltoni et al., 1989; Merler, 1990] and in some nonasbestos textile industries [Paci et al., 1987] has recently been appreciated. Some cases of the current series represent further examples of those settings of exposure.

Household exposure has been documented in 5 women. Such patients were family members of shipyard workers, and various data demonstrate the importance of asbestos exposure in this category [Bianchi et al., 1991].

In a majority of the current cases, mesothelioma represented the late effect of an exposure to asbestos, dating to before 1950. Nevertheless this does not mean that in Trieste area, pleural malignancies are the prerogative only of older work settings. Some of our patients had their first exposure during the later decades. In addition, data collected in a neighboring similar territory, the Monfalcone area, show that important exposure to asbestos occurred also in recent years [Bianchi et al., 1991].

CONCLUSIONS

The findings obtained in the present study have some general implications that deserve attention. The most important of these is that the risk for asbestos-related mesothelioma is not confined only to some workplaces, but involves a variety of occupational categories. In some workplaces such as many shipyards, severely polluted in the past, the problem of asbestos is well recognized and protective measures have been adopted for a number of years. However, in many other industries, the risk of asbestos exposure is not sufficiently appreciated. This is particularly true in developing countries [Berman, 1986] but also in industrialized countries, where the hazards of asbestos exposure often are not deemed to be major health problems. As a consequence, an epidemic of malignant mesotheliomas might develop in the industrial world in the next decades.

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