



Pleural plaques: Correlation of autopsy findings to radiographic findings and occupational history

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Abstract: An investigation was made to correlate autopsy findings of pleural plaques (PP) with the occupational history and findings of such plaques at X-ray before death. A good correlation was found between occupation and occurrence of PP at autopsy. Using strict criteria, 12.5% of all PP observed at autopsy, including small ones, were visible at X-ray. Almost half (3 of 8) of the widespread changes found at autopsy were seen on the X-rays. With more liberal roentgenological criteria 11 of the 24 cases were noted, but there were also 15 false positives.

Plaques pleurales: Correlation entre leur présence à l'autopsie les anomalies radiographiques et l'anamnèse professionnelle.

Résumé: L'investigation a cherché à corréler la mise en évidence de plaques pleurales à l'autopsie avec l'anamnèse professionnelle et l'observation radiologique de ces mêmes plaques avant la mort. On a trouvé une bonne corrélation entre la profession et l'existence de plaques pleurales à l'autopsie. En utilisant des critères stricts, 12,5% seulement de toutes les plaques pleurales observées à l'autopsie, y compris les petites, étaient visibles aux rayons X. Presque la moitié (3 sur 8) des modifications diffuses découvertes à l'autopsie était visible aux rayons X. Si l'on adopte des critères radiologiques plus larges, on découvre des anomalies dans 11 cas sur 24, mais il y a également 15 faux positifs.

Key words: asbestos - correlation X-ray and autopsy - occupation - pleural plaques.

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Pleural changes are a common finding on X-rays of the lungs. They are mostly late results of pleural trauma. Some are normally occurring soft tissue shadows, and some are the result of exposure to asbestos. These latter changes, "pleural plaques" (PP), may be hyaline or calcified and are often characteristic. With the use of strict roentgenological criteria for PP (Table 1), a good correlation between exposure to asbestos and roentgenological observations of

TABLE 1. The roentgenological criteria for definite pleural plaques used in this study

1. Bilateral changes
2. Typical changes, i. e. uneven, situated mainly in the flanks and the diaphragm. If only seen in the flanks, at least 5 mm thick on a normal-sized chest X-ray. Diaphragmal plaques, if the only finding, not accepted unless bilaterally calcified.
3. Clear costodiaphragmal sinuses
4. Progression in a 5-year period if X-rays are available.

All criteria must be fulfilled except No. 4, if no earlier X-rays are available.

PP was found in a previous study (7). To test these criteria and to see how many PP may be missed, it was decided to compare X-ray findings before death with findings at autopsy, where PP are easily identifiable.

PATIENTS AND METHODS

All patients above 40 years of age from the County of Uppsala upon whom autopsy was performed between 1 October 1976 and 31 March 1977 were investigated for PP.

PP were defined as shining white, irregular elevations of the parietal pleura with well-defined borders, as described by many authors (10, 14). An attempt was made to determine the occupations of the patients from the case reports or other available means, including obituary notices in the local newspapers. X-rays of the lungs from the different hospitals or miniature X-rays from the general health survey were collected. Only films of good technical quality taken within 7 years before death were included. If the terminal disease had led to roentgenological changes, for example pulmonary congestion or pleural exudate, an earlier X-ray was used if available within a 7-year limit, if not, the X-ray was disregarded. The X-rays were scrutinized for pleural changes and were divided into those which fulfilled the criteria for PP (Table 1) (definite cases), those with changes that could be early PP but did not fulfill the criteria (questionable cases), and those with no pleural changes or changes typical for pleural fat, extrathoracic muscles, or past pleurisy. X-rays showing obliteration of one or both costodiaphragmal sinuses, tenting of the diaphragm, and other changes strongly suggesting late results of pleuritis or infection were classified in the last category. The X-rays were classified without any knowledge of the autopsy results or of the occupation of the patients.

RESULTS

Women. Most of the women were housewives. Autopsy was performed on 211 women, 189 of whom had an acceptable X-ray. At autopsy one case with small PP was found, but none of the X-rays showed any PP.

Men. There were 226 male autopsies. The occupations were determined in 198 cases, and were divided into those known to be associated with possible use of asbestos (plumbers, electricians, and workers in the building trade, automobile workshops and factories known to use asbestos) and those known probably not to be. At autopsy, 10 cases with widespread pleural changes typical of PP, and 17 with changes of lesser degree, were found. A comparison between the autopsy findings and the occupational histories was made (Table 2). Of 61 cases with known possible exposure to asbestos, 18 (29.5%) showed PP at autopsy, while in 137 persons with occupations in which asbestos is unlikely to be used, only five PP (3.6%) were found. X-rays were available in 202 cases. In three of the positive autopsy cases no X-rays were available. Three out of eight "widespread" PP were found on X-ray with "definite" criteria, and none out of 16 "small" PP. Thus three out of 24 (12.5%)

TABLE 2. Occupations and pleural plaques at autopsy (men only)

	Total	Typical PP at autopsy	Per cent with PP
Persons in occupations known to give possible exposure to asbestos	61	18	29.5
Persons in occupations where asbestos is unlikely to be used	137	5	3.6
Unknown occupation	28	4	14.3
Total	226	27	11.9

TABLE 3. Findings

Autopsy
signs of
pleural
plaques

were found (Table 2). If "questionable" as PP, 11, but in addition to X-rays. When the autopsy X-rays of the post-mortem were scrutinized. In 10 cases, bilateral, slight changes of the diaphragm

At autopsy, the present investigation found some changes between the literature (2) place and time (4). The radiologist found 1 and 2% among

TABLE 4. Frequency

Author	Frequency
Robinson (15)	15%
Gerber (16)	10%
Timmons (17)	10%
Dorland (18)	10%
Hägg & Sjöström (19)	10%

TABLE 3. Findings of pleural plaques at autopsy and at X-ray (men only)

		X-ray signs of pleural plaques			Total
		Definite	Questionable	None	
Autopsy signs of pleural plaques	Widespread	3	4	1	8
	Moderate small	0	4	12	16
	None	0	15	163	178
	Total	3	23	176	202

were found (Table 3). There were no false positives. If "questionable" cases were diagnosed as PP, 11 of the 24 cases were found, but in addition there were 15 false positives. When the autopsy results were known, the X-rays of the positives autopsies were again scrutinized. In one case it was found that bilateral, slight but definite calcifications of the diaphragm had been overlooked.

DISCUSSION

At autopsy, the frequency of PP in the present investigation was 12%, a figure somewhere between the extremes given in the literature (2.7-49%), depending on the place and time of the investigation (Table 4). The radiological frequency was between 1 and 2% among males above 50, which is

similar to the figures obtained in earlier investigations on the same area (7).

The roentgenological diagnosis of hyaline PP can be a problem. In a multicentre study in Britain (1), no correlation between exposure to asbestos and pleural changes was found. The most probable explanation is that no clear definition of PP was used. Apart from remnants of earlier pleuritis, intrathoracic fat deposits (18) and in some cases intrathoracic muscles (12) may lead to a false diagnosis.

As in the present study, other authors have found that many asbestos-related changes seen at autopsy cannot be seen on X-ray (9, 16). Even if chest roentgenography is an unreliable method of diagnosing PP, some comfort may be found in the fact that widespread changes presumably indicate

TABLE 4. Frequency of PP at autopsy (men only). Selected reports

Author	Population	Place	Per cent	Comment
Robinson (15)	Rural	Florida	2.7	Only PPs with diameter > 5 mm
Gerlach & Timmel (5)	Urban	Halle	24	
Doniach et al. (2)	Urban	London	30	
Hägerstrand & Seifert (10)	Urban	Malmö	49	

heavier exposure to asbestos and therefore probably are more important to find.

Asbestos is possibly not the only cause of PP, but it is generally agreed that it is by far the most common, and PP (if properly defined) can be considered to be a very specific indicator of exposure to this substance (7). This is further confirmed by the good correlation between "asbestos occupations" and PP found in this study. Even slight exposure to asbestos probably increases the risk of bronchial carcinoma in smokers (13, 19). The time from first exposure to asbestos to development of roentgenologically typical PP is about 30 years (7) and the latency time in asbestos-related bronchial cancer is about the same (6, 8, 11). Possibly therefore a risk group could be identified by detecting PP roentgenologically. This has been corroborated by Fletcher (4) and Edge (3), who found that the risk of bronchial carcinoma in dockyard workers in England was more than twice as high in those with PP than in those with similar exposure but without PP. There is also a higher frequency of PP than expected among patients with bronchial carcinoma (8, 17).

CONCLUSION

Failure to detect roentgenological changes does not exclude the possibility that significant pleural changes resulting from exposure to asbestos may be present. With strict roentgenological criteria, between half and one third of widespread PP will be found, and very few false-positive cases will be diagnosed. With wider limits for what shall be diagnosed at X-ray as "probable asbestos changes" or "small PP", more cases of true PP will be diagnosed, but there will also be a considerable number of cases which at autopsy show no sign of PP. Even with such

liberal criteria, a few widespread PP and quite a few moderate to small ones will be missed.

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