Deutsche Gesetzliche Unfallversicherung

VALIDITY OF SILICOSIS EARLY DETECTION AND ITS INFLUENCE ON RISK ESTIMATION IN EPIDEMIOLOGY

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Introduction

Early detection and diagnosis of silicosis among dust exposed workers is based mainly on the presence of rounded opacities on radiographs. It is thus important to examine how reliable the radiographic findings are in comparison to pathological findings. In the present analysis, we evaluated the validity of silicosis early detection and its influence on its related risk estimation in epidemiological studies.

Methods and Results

In a systematic literature search (Medline) 4 studies on a comparison between radiographic and pathological findings of silicosis were identified (table 1).

The sensitivity of radiographic diagnosis of silicosis in an occupational medical care (primary examination) varied between 39% and 71%, and the specifity between 60% and 99%. This means that, if the prevalence of silicosis in dust exposed population is between 2% and 8%, 23% to 56% of silicosis cases are likely to be falsely diagnosed. The dependence of misdiagnosis of silicosis on the prevalence of true silicosis in a working population is given in table 2. Although the sensitivity of silicosis diagnosis improves significantly (100%) in a radiographic re-evaluation (table 1), due to its poor specifity (12%), the quality of the silicosis diagnosis can hardly be improved by the radiographic re-evaluation (table 3).

This problem influences considerably the risk estimation for silicosis and lung cancer in epidemiological studies. Our analysis indicates that invalid diagnosis of silicosis may lead to a finding of 1% to 4% of radiographic silicosis even if there is no case of silicosis (table 4). The risk of silicosis is likely to be overestimated among workers with low dust exposure. The risk may also be underestimated among workers highly exposed to respirable silica (table 4).

Possible reasons for the misdiagnosis of silicosis based on radiographs have been discussed in recent publications. Smoking induced lung appearances, infectious and non-infections granulomas, hamartomas and lung cancer are often considered to be the possible reasons for misdiagnosis of radiographic silicosis.

Studies indicate that 10-68% of the population with pulmonary nodules in radiographs is likely to have lung cancer. In contrast, only 1.3% of the general population (≥ 60 years, 35% smoker) may have lung cancer.

According to our estimation, even when silicosis is not associated with lung cancer, a doubled increased risk of lung cancer can be observed among patients with radiographic silicosis only due to 15% of false diagnosis (table 5).

Table 1: Studies on the quality of radiographic diagnosis of silicosis (≥ ILO 1/1)

Studies	Primary radiographic examination (occupational health screening)			radiographic re-evaluation*
	Hnizdo 1993	Vallyathan 1996	Corbett 1999	Bauer 1997
Setting	Gold mines	Coal mines	Gold mines	Mines
Sample size (n)	557	430	241	97
„Gold standard"	Autopsy	Autopsy	Autopsy	Autopsy
Sensitivity (SE)	39%	?	71%	100%
Specifity (SP)	99%	60%	96%	12%

*due to positive diagnosis in early detection

Table 2: Potential of false positive diagnosis depending on the prevalence of silicosis

Prevalence of silicosis	Estimated false positive diagnosis in screening		
	Hnizdo 1993 (SE=39%, SP=99%)	Corbett 1999 (SE=71%, SP=96%)	Vallyathan 1996 (SE=?, SP<60%)
1%	72%	85%	> 97%
2%	56%	73%	> 95%
4%	38%	57%	> 90%
6%	29%	47%	> 86%
8%	23%	39%	> 82%
10%	19%	34%	> 78%

Table 3: Validity of silicosis diagnosis in a radiographic re-evaluation

Prevalence of silicosis	Estimated false positive diagnosis	
	Health screening (SE=39%, SP=99%)[1]	After radiographic re-examination (SE=100%, SP=12%)[2]
1%	72% →	69%
2%	56% →	52%
4%	38% →	35%
6%	29% →	26%
8%	23% →	21%
10%	19% →	17%

[1]Hnizdo et al., 1993, [2]Bauer et al., 1997

Table 4: Influence of misdiagnosis of silicosis on the risk estimation for silicosis

Assumed silica exposure	Prevalence (cumulative incidence) of silicosis		
	True	estimated[1]	estimated[2]
0	0%	1%	4%
Low1	1%	1.4%	4.7%
Low2	1,6%	1,6%	5.1%
Low3	3%	2,1%	6.0%
Medium1	6%	3,3%	8.0%
Medium2	9%	4,4%	10.0%
Medium3	12%	5,6%	12%
High	15%	6,7%	14.1%

[1]SE=39%, SP=99% (Hnizdo 1993), [2]SE=71%, SP=96% (Corbett 1999)

Table 5: Influence of misdiagnosis of silicosis on the risk estimation for lung cancer

Proportion of false positive diagnosis of silicosis	Estimated RR for lung cancer*
0%	1
10%	1.7
15%	2.0
20%	2.3
30%	3.0
40%	3.7
50%	4.3

*Comparison between patients with and without radiographic diagnosis of silicosis

Conclusion

Our analysis indicated that, in a preventive medical examination of dust exposed workers, 23% to 56% of silicosis identified may be falsely diagnosed. The validity of silicosis diagnosis can hardly be improved by radiographic re-evaluation. This problem may lead to a finding of 1% to 4% of radiographic silicosis even if there are no any cases of silicosis. This problem may also lead to finding of an increased risk lung cancer among silicosis cases, even when silicosis is not associated with lung cancer.

Reference

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