นิพนธ์ต้นฉบับ • Original Article

ความไวและความจำเพาะของแพทย์เวชปฏิบัติทั่วไปในจังหวัดนครราชสีมาในการอ่านภาพถ่ายรังสีทรวงอกของโรคปอดฝุ่นหินระยะเริ่มต้น

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Sensitivity and Specificity of General Practitioners Reading of Early Stage Pneumoconiosis Radiographs

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วัตถุประสงค์: เพื่อศึกษาความไวและความจำเพาะของแพทย์เวชปฏิบัติทั่วไปในการอ่านภาพถ่ายโรคปอดฝุ่นหินระยะเริ่มต้น

วิธีการศึกษา: เป็นการศึกษาเชิงพรรณนา โดยมีกลุ่มตัวอย่างเป็นแพทย์เวชปฏิบัติทั่วไปในจังหวัดนครราชสีมา จำนวน 23 ราย จากกลุ่มตัวอย่างคาดหวัง 43 ราย เข้าร่วมในการศึกษา ภาพถ่ายรังสีทรวงอกระยะเริ่มต้นที่ใช้มีจำนวน 67 ภาพ ก่อนการทดสอบจะมีการแนะนำวิธีการอ่านภาพถ่ายรังสีทรวงอกตามหลัก ILO classification เป็นเวลา 65 นาที โดยมีแพทย์ผู้เชี่ยวชาญระดับ B-reader 3 ท่านเป็นวิทยากรพิจารณาระดับของการเป็นโรคที่ระดับ profusion 0/1 และ 1/0 เพื่อวิเคราะห์หาความไวและความจำเพาะของการอ่าน

ผลการศึกษา: มัธยฐานของความไวที่ระดับการเป็นโรคคือ profusion 0/1 อยู่ที่ร้อยละ 92 (พิสัยควอไทล์ 8) และที่ระดับการเป็นโรคคือ profusion 1/0 อยู่ที่ร้อยละ 90 (พิสัยควอไทล์ 15.79) มัธยฐานของความจำเพาะที่ระดับการเป็นโรคคือ profusion 1/0 อยู่ที่ร้อยละ 19.51 (พิสัยควอไทล์ 9.52) และ

Objective: This study was aimed to find out the sensitivity and specificity in reading early stage pneumoconiotic radiographs by general practitioners (GP).

Materials and method: A screening test was applied. Twenty three of 43 GPs from Nakhon Ratchasima province consented to join the study. The test radiographs consisted of 67 normal and early stage pneumoconiotic films. Before testing, all participants were introduced to basic ILO reading for 65 minutes by 3 B-reader ILO pneumoconiosis experts. The cut-point for disease was set at profusion 0/1 and 1/0. Mean sensitivity and specificity for small opacities detection was analyzed.

Results: The median sensitivity of ILO profusion 0/1 or above was 92% (IQR 8), the median sensitivity of 1/0 cut-point film was slightly lower at 90% (IQR 15.79), while the median specificity for ILO profusion 0/1 or above was 19.51% (IQR 9.52). When stepping the cut-point to profusion 1/0, the median specificity increased to 34.29% (SD 16.46).

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ที่ระดับการเป็นโรคคือ profusion 1/0 เพิ่มขึ้นมาอยู่ที่ร้อยละ 34.29 (พิสัยควอไทล์ 16.46)
สรุป: แพทย์เวชปฏิบัติทั่วไปมีความสามารถในการแปลผลและคัดกรองภาพถ่ายรังสีทรวงอกโรคปอดฝุ่นหินระยะเริ่มต้นได้ การพัฒนาทักษะการอ่านภาพถ่ายรังสีโรคปอดตามหลัก ILO classification จะมีประโยชน์ต่อระบบเฝ้าระวังโรคปอดฝุ่นหินในประเทศไทย
คำสำคัญ: โรคปอดฝุ่นหิน, ภาพถ่ายรังสีทรวงอก, ILO classification, ความไว, แพทย์เวชปฏิบัติทั่วไป

Conclusion: This study showed that general practitioners were able to interpret chest radiographs of workers who have had early stage pneumconiotic radiographs. Therefore, chest X-ray reading skill development for GPshas value for the surveillance system in this country.
Keyword: Silicosis, ILO classification, chest radiograph, sensitivity, general practitioner

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Introduction

Silicosis is a disease of pulmonary system, predominantly in lung parenchyma. It is caused by inhalation of silica dust or silicon dioxide into lungs. Silicosis is found in workers who work inoccupations like, sandstone industry, tunnel drillers, and ceramics manufacturing etc[1]. The silica dust inhaled to lungs deposits in the lung parenchyma, resulting inchronic inflammation and lung fibrosis. Patients who havelungfibrosis will eventually suffer from respiratory distress symptomsin old age[1,2]. Early detection and diagnosis can reduce these problems by removing the group from exposure as soon as possible. In some developing countries such as Thailand, silicosis remains an occupational lung problem that needs recognition[3].

Risk occupations such as, stone grinding, sculpturing or mining are usually small or medium enterprises, and household industries almost all in the informal sector. Environmental exposure is therefore difficult to monitor and control, creating difficulties for medical surveillance programs to discover an early stage cases[4].

In Thailand, active and passive surveillance systems are not well performed[5,6].Incidence of silicosis cases is increasing every year in Thailand whereas in other countries, especially developed countries, the incidence is declining[7,8]. This phenomenon may be due to better environmental control[9], but in Thailand, quantity of silica dust in the workplace particularly in informal sector, household worksites has never had controlled programs. There were 214 patients hospital in Thailand due to respiratory symptoms of silicosis in 2012, and Nakhon Ratchasima province was at the top of table[5]. Hence the importance of surveillance system developing is a better early detection of silicosis cases. Health surveillance for silicosis has been developing in Thailand for a while but there are still gaps. The Thai surveillance program includes many tools, a questionnaire about silica dust exposure history, chest radiograph and spirometry[6,10]. A chest radiograph has an important role in screening even though it is less sensitive and specific than computed tomography[11]. However, it is still an indispensable tool from its cost-efficacy. Unfortunately, there are in sufficient B-readers in Thailand for reading the chest radiographs to support the medical surveillance program[12]. An appropriate courseto enhance family doctors' or GPs' capacityfor early diagnosis from pneumoconiotic radiographs would be useful. A short course training study showed physicians gained proficiency in reading pneumoconiotic radiographs[13]. However, this study did not include GPs and also, the training radiographs were not early stage pneumoconiotic radiographs. In order to further develop the silicosis surveillance system we aimed to assess GPs sensitivity and specificity for reading early stage pneumoconiotic radiographs.

Methods

Study design – Descriptive study (Screening test)

Study population and sample

The target population was GPs working in public hospitals in Nakhon Ratchasima province (either already worked for a year for Nakhon Ratchasima Health Provincial Office, or bonded for future work for a year). GPs already trained in reading other ILO pneumoconiosis radiographs and in occupational medicine were excluded. The study population was a 141 GP. A required sample size of 43 was calculated using the estimation of finite population mean equation. A simple random sampling technique using Microsoft Excel 2010 was used to select the participants. (Figure 1)

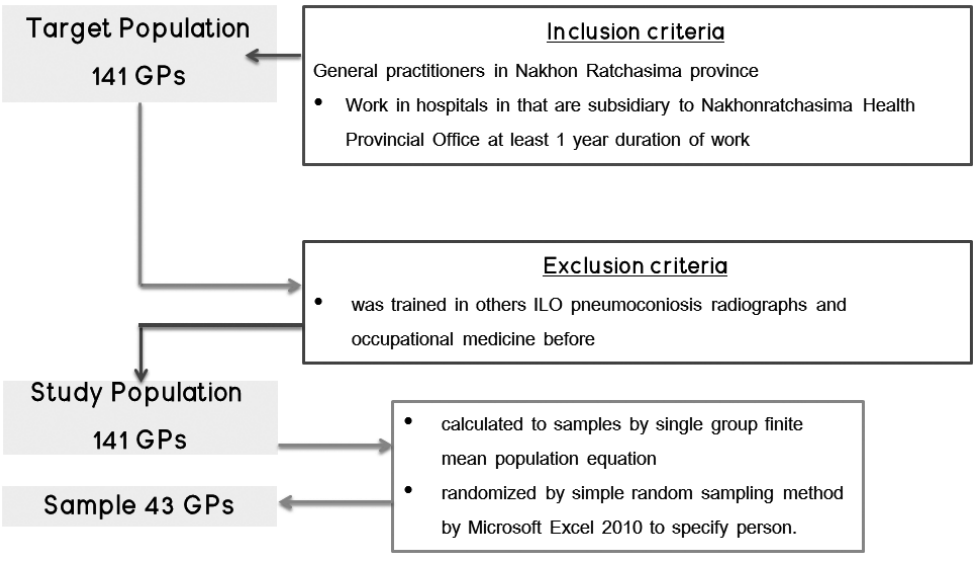

Figure 1 Study population and sample determination

Chest films

We selected standard chest films (14x17 inches) from "Development of a disease surveillance system for silicosis and respiratory disorders in stone carving workers exposed to inorganic dust at Sikhiu district in Nakhon Ratchasima province" (K.Silanan, personal communication). There were 315 films of patients who had history of silica exposure while working as stone carvers. The "good" and "acceptable with no technical defect" films were agreed upon by three B-readers. Sixty seven films were available and patient history was kept confidential. Forty-two films were normal (0/0) profusion, 5 were profusion 0/1, 10 films with profusion 1/0, 5 films of profusion 1/1 and 5 films of profusion > 1/1.

Measurement

The main outcomes include mean sensitivity and mean specificity of readers.

Sensitivity = the proportion of true positive (both examiner and B-reader) reading films (profusion 0/1 and over) per all positive films.

Specificity = the proportion of true negative (both examiner and B-reader) reading films (Normal 0/0 films) per all negative films.

We also graded the sensitivity and specificity in 3 categories; 70% and above were determined good, 50-69% was acceptable and less than 50% was considered poor reading skill. We also analyzed the correctness of reading by categorizing the films to 4 groups in each subcategory using descriptive statistics (frequency, mean with SD).

Correctness = agreement between the GPs profusion score on each film and B-reader's score, (or within 1 subcategory of the B-readers' answer). The details are shown in Table 1

Data collection

We coordinated with Nakhon Ratchasima Provincial Public Health Office, Center Chest Institute of Thailand (CCIT) and Maharat Nakhon Ratchasima Hospital to organize a short ILO introducing course on 2nd February 2016. Experts from CCIT ran a short (65 minute) course explaining the basics of ILO reading radiographs, including an overview of the ILO classification, the reading sheet, small opacities and using of standard films. Afterward, the test ran in 2 periods, 1st with 39 films and 2nd with 28 films. Two minutes was allowed per film for reading and answers recorded on a standard answer sheet.

The completed answer sheet was sent to one of authors to analyze for sensitivity and specificity. Testing was held in Maharat Nakhon Ratchasima Hospital, in a room that has no direct external lighting. A standard viewboxwas used calibrated following ILO Guidelines 2011.

Statistic evaluation

We analyzed all data by SPSS version 19. General characteristics (age, work experience) were analyzed by descriptive statistics(frequency, mean with SD or median with IQR, 95% confident interval). Sensitivity and specificity were determined when cut-point was profusion 0/1 and 1/0 by comparing with B-readers answer.

Ethical consideration

All authors have passed the Khon Kaen University Human Ethics Committee research ethics training course. All participants had research information sheets stating that the results would not be reported to the public, and joining in this study would not affect any work career or future study.

Results

Twenty three of the expected samples of 43 GPs were available for the testing. There were 11 male participants (47.83%) and 12 female (52.17%). Age range was 25-44 years. Average work experience was 3.6 year (median 3 years), most had less than 3 years (47.83%) and 3 participants had more than 5 years' experience. There were only5 GPs (21.74%) who had experience in diagnosis of silicosiscases and only 2 (8.70%) who had silicosis treatment experience. (Table 2)

Table 1 Measurement criteria for allowable of profusion that participants can read. Correctness will count when the answers match or 1 subcategory nearby[14].

Expert's correct answer	Examinee's answer allowed		
0/0 or 0/-	0/-	0/0	0/1
0/1	0/0 or 0/-	0/1	-
1/0	-	1/0	1/1
1/1	1/0	1/1	1/2
1/2	1/1	1/2	2/1
2/1	1/2	2/1	2/2
2/2	2/1	2/2	2/3
2/3	2/2	2/3	3/2
3/2	2/3	3/2	3/3
3/3	3/2	3/3	3/+
3/+	3/3	3/+	

Table 2 General characteristic of participants in the study

Participants' characteristics	Total	%
Gender	23	100
Male	11	47.8
Age		
25-34 years	22	95.7
35-44 years	1	4.3
Female	12	52.2
Work Experience	Mean 3.6 years	
	Median 3 years	
<3 years	11	47.83
3-5 years	9	39.13
>5 years	3	13.04
Experience in silicosis		
Diagnosis cases	5	21.74
Treatment cases	3	8.7

The median sensitivity to detection for 0/1 films and above was92% (IQR 8), while the median sensitivity of 1/0 cut-point film slightly decreased to 90.00% with IQR 15.79 (Table 3). Proportion of participants who was categorized in "good" sensitivity is 23 (100%) when profusion 1/0 was a cut-point and 21 (91.30%) when profusion 1/0 was a cut-point (Figure 3). Both of participants who were categorized in acceptable category had work experience < 3 years.

The medianspecificity to detection 0/1 film was 19.51% (IQR 9.52), while stepping the cut-point to profusion 1/0, the medianincrease to 34.29% (IQR 16.46) (Table 3). There are no physician who was categorized with good specificity in profusion 0/1 cut-point, most (21 GP, 91.30%) were poor, whereas one participant rated good specificity and 3 were acceptable when the cut-point was profusion 1/0. Nevertheless, the majority (19 GP) remain in poor specificity (Figure 3).

For the correctness of readers, when grouping the films in each subcategories, we found that the average of correct answer was highest at profusion >1/1 with 68.7% of correctness. Another subcategories was correct about half (Table 4).

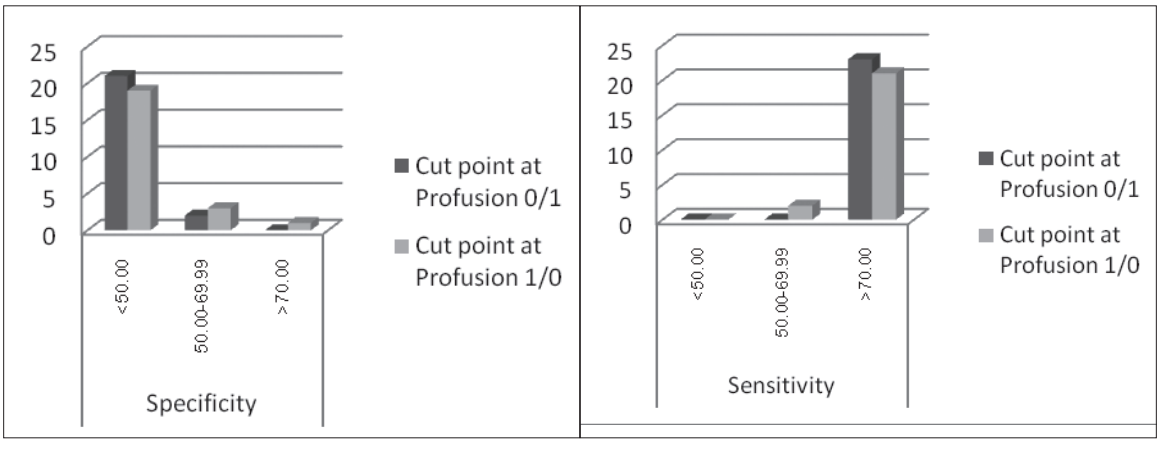

Figure 2 Distribution of GP in categories of sensitivity and specificity

Table 3 Sensitivity and specificity of participants when using profusion 0/1 and 1/0 in cut-point of cases

Sensitivity and specificity of readers	Median (IQR)	95% CI
Sensitivity when using profusion 0/1 as case	92.00 (8.00)	88.00, 96.00
Sensitivity when using profusion 1/0 as case	90.00 (15.79)	85.00, 95.00
Specificity when using profusion 0/1 as case	19.51 (9.52)	16.67, 26.19
Specificity when using profusion 0/1 as case	34.29 (16.46)	27.66, 38.30

Table 4 Proportion of correctness in each subcategory

	Mean of proportion of correct reading films in each subcategory (%)
Profusion > 1/1	68.7
Profusion 1/1	49.94
Profusion 1/0	54.63
Profusion 0/1	47.6

Discussion

This study focused on GPs sensitivity and specificity for detecting early stage abnormality on chest X-ray film after a short ILO introducing course. After training the number of GPs categorized with good sensitivity was 100% and 91.30% at profusion 0/1 and 1/0 respectively. On the other hand, none was categorized with good specificity at any cut-point--only 1 GP had acceptable specificity at cut-point of 1/0 profusion.

Considered in the high sensitivity reading, they demonstrated that general practitioners can detection and abnormal chest films well. In order of fulfill surveillance system need of tools that can early detection and screen workers who are the population at risk, it should have high sensitivity for recruiting the suspected cases as much as possible to further investigation or confirm test. The results of this study that high sensitivity shows that general practitioner can detect an abnormality well despite of low specificity. In the surveillance program there is further evaluation from B-reader to confirm the abnormality thus we can accept the false positive[15].

To explain of the low specificity, there are a great number of early stage of abnormal chest film in the test that was difficult to differentiate from normal 0/0 films. Accordingly, most of participants answered the normal 0/0 film to abnormal films. Moreover, these films that selected into the test films were originally digital films, when converted to analog films there are too much details and overexposure effecting reading and judgment of readers. The number of test films is 67 films while total time for finish is 140 minutes that was greatly long. There is study conducted by C.S. Lee to describe cognitive and behavioral that cause errors in reading radiograph of radiologists, found that most of radiologists concerned about missing some abnormality in the films, causing a false positive in reading[16].

To determine the level of disease at the subcategory of profusion 0/1, the sensitivity of the readers closes to the level of profusion 1/0. There is a study that aimed to estimate sensitivity and specificity of chest radiograph reading by 3 B-readers compared to autopsy to screening of silicosis in 557 of samples who worked in the gold mines, conducted by Hnizdo[17]. They found that when categorized the level of disease at profusion 1/1, the sensitivity is low to 23.6-39.3%, and many of abnormal pathologic patients was not categorized into disease-positive people. On the other hand, the sensitivity was increasing when decreased level of disease to profusion 0/1 in patient who exposed the high level of silica dust. As a consequence, the profusion 0/1 should also be a cut point of disease in the surveillance system in Nakhon Ratchasima province because of no environmental control in the informal sectors.

This study has some limitations. Despite of prudently design of study and samples, the chest

films that were recruited to the test were a remaining radiograph from the previous project. Authors cannot change or improve the quality of them. However, the authors did choose the good quality from the pool as much as possible. Besides, the physicians who participate in this study are all general practitioner that have routine responsibility in community hospitals. Therefore, some of them couldn't participate in the study, giving a response rate of just 53.49%.

Conclusion

This study showed that general practitioners can interpret chest radiographs of workers who have history exposed of silica dust in good sensitivity compared with expert B-reader after introduced of short basic ILO reading radiographs. There are many of cases and chest films in Thailand that are still waiting for interpret due to lack of B-reader. Developing of skill of GP can be useful for the surveillance system in this country.

Recommendation

1. This study results showed that GP can detect an abnormal chest radiograph in high level of sensitivity, the further developing program in reading pneumoconiotic radiographs such as short course with workshop of basic ILO training should be conducted for GP who works in endemic area of silicosis.

2. This study proposed to fulfill the surveillance system in term of provide physicians who can detect a lot of chest radiographs from the surveillance system but cannot represent the appropriate periodic time of x-ray performed to workers, further study about the earliest time of changing in radiograph can fill this gap.

3. Even though the chest radiograph is important in surveillance system of silicosis for silicosis, this is just secondary prevention. The better way to prevent the disease is protecting workers from exposed of silica dust and removing them from exposure.

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