Original Articles

Health assessment for confined space work permit at a regional hospital in Thailand

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Abstract

Introduction: Health assessment for confined space work permit is an occupational health service. The sub-committee of Association of Occupational and Environmental Diseases of Thailand settled 'Guideline for Health Examination of Confined-space Workers'. According to 'Guideline for Health Examination of Confined-space Workers', the minimum tests include complete blood count, spirogram, electrocardiogram, and chest X ray. The minimum physical examinations are blood pressure, pulse rate, weight, height, body mass index, whispering test, far vision test, and general medical examination. The health questionnaire is also included. Objective of the descriptive study was to describe the workers' health abnormalities which were detected in Rayong hospital's health examination to declare workers' fitness for work in confined space.

Method: Rayong hospital provided health examination for 715 confined space workers in 2013. The abnormalities were identified using 'Guideline for Health Examination of Confined-space Workers'.

Result: 97.20% of confined space workers were male. The workers' average age was 29.69 years old. The abnormalities of systolic blood pressure, diastolic blood pressure, body mass index (BMI), chest X ray, electrocardiogram, spirogram, and complete blood count (CBC) were 8.11%, 3.64%, 1.82%, 1.40%, 2.66%, 0.83% and 0.42%, respectively. There were 108 workers who did not get the work permits.

Discussion and Conclusion: Raised blood pressure (BP > 140/90) was the most common and controllable abnormalities. Most of the chest X ray abnormalities were not changed from previous result and did not affect the work permit. Ischemic pattern from electrocardiogram should be reevaluated by cardiologist. Spirogram and CBC were necessary in health examination for work permit. The abnormalities were lower than normal population which may be due to healthy worker effect.

Key words: Confined space, Fitness for work, Occupational health service, Work permit, Association of Occupational and Environmental Diseases of Thailand

Received: 11 June 2014 **Accepted:** 30 December 2014

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Introduction

Confined space is a space that large enough for worker to enter fully with limited opening for entry and exit. Working in confined space is one of the most dangerous jobs[1]. The job's risks are lacking of oxygen, chemicals exposure, explosion, and trapping in confined space[2 - 6]. According to poor ventilation in confined space, sulfur dioxide, hydrogen sulfide, chlorine, carbon monoxide and carbon dioxide can be detected in high concentration[7 - 9]. 24 deaths and 34 injured workers were reported from 8 serious incidents in confined spaces in Thailand during 2003 - 2006[10]. The confined space workers should be healthy and fit enough for this risky job.

For declaration of workers' fitness in Thailand, the local law is concerned of cardiovascular system and respiratory system[11]. Unlike OSHA and NIOSH, it has no classification in confined space[12, 13]. Unlike diving workers' fitness, the local law does not state the specific disease for confined space workers' fitness[14]. The workers who have respiratory diseases or cardiovascular diseases or other diseases which may worsen workers' health while working in confined space should be excluded from confined space training[15].

The sub-committee of Association of Occupational and Environmental Diseases, which included 19 occupational medicine physicians, 1 cardiologist, 1 surgeon, 1 epidemiologist, and 9 occupational health nurses reviewed all available evidence-based literatures and guidelines. By consensus base, the sub-committee settled 'Guideline for Health Examination of Confined-space Workers'.

According to 'Guideline for Health Examination of Confined-space Workers', the minimum tests include complete blood count, spirogram, electrocardiogram, and chest X-ray. The minimum physical examinations are blood pressure, pulse rate, weight, height, body mass index, whispering test, far vision test, and general medical examination. The health questionnaire is included in 'Guideline for Health Examination of Confined-space Workers'.

Objective of this descriptive study was to describe the workers' health abnormalities which were detected in Rayong hospital's health examination to declare workers' fitness for work in confined space by 'Guideline for Health Examination of Confined-space Workers'. The most common confined spaces in Rayong province were storage tanks, silos, boilers, exhausted ducts, tunnels, underground utility vaults and pipelines. Some workers who were not fit for work would not get work permit and be stopped from working in confined spaces.

Methods

Rayong hospital provided health examination for 715 confined space workers in 2013, 1 year prior to the standard settling. The abnormalities were identified using 'Guideline for Health Examination of Confined-space Workers'.

Confined space workers' were all examined by 16 physicians. High blood pressures were all repeated after the workers rested for 30 minutes and the better results were used in fitness evaluation. According to the standard spirometry of Thoracic Society of Thailand Under Royal Patronage, spirograms were all performed at least 3 expiratory efforts for best values, by 9 certified occupational health nurses properly and then interpreted by 2 occupational medicine physicians. Chest X-ray were all interpreted by 3 radiologists. Electrocardiograms were all interpreted by a cardiologist. Blood examinations were analyzed in Rayong hospital's certified laboratory. Far vision is the only one item missing in physical examination last year.

Results

97.20% (695/715) of the confined space workers were male. The average age was 29.69 years old (range 21-57 years old).

Table 1 Demograpic data from health assessment for confined space work permit in a regional hospital in Thailand 2013 (N = 715)

Group	n	Percentage
Gender		
Male	695	97.20
Female	20	2.80
Age (year)		
≤ 30	150	20.98
> 30 - ≤ 40	257	35.94
> 40 - ≤ 50	281	39.30
> 50	27	3.78
Industrial group		
Petrochemical company	554	77.48
Starch company	153	21.40
Sub-contractor	8	1.12

There were 8.11% (58/715), and 3.64% (26/715) cases of elevated systolic blood pressure and diastolic blood pressure (BP > 140/90 mmHg).

29.36% (210/715) of electrocardiograms were abnormal but only 19 abnormal cases were serious. Ischemic patterns in electrocardiogram were detected in 2.66% of population (11/715)

11.19% (80/715) of the chest X-ray results were abnormal but after compared with the previous films, only 1.40% (10/715) were declared unfit with new conditions such as pleural effusion, nodular opacity, suspected tuberculosis.

Only 3 cases had abnormal complete blood count.

None was reported to have hearing problems or communication problems by general physical examination.

Table 2 Abnormal results from health assessment for confined space work permit in a regional hospital in Thailand 2013 (N = 715)

Test	Acceptable value	Abnormal results	Abnormal percentage
SBP	< 140 mmHg	58	8.11
DBP	< 90 mmHg	26	3.64
PR	< 120 BPM	16	2.24
BMI	< 35 kg/m^2	13	1.82
Hct	> 30%	0	0.00
Hb	> 10 g/dl	1	0.14
Plt	> 100,000 cells/mm^2	2	0.28
FVC	> 65% of predicted value	6	0.83
FEV_1/FVC	> 0.70*	12	1.68
FEV_1**	> 65% of predicted value	0	0.00
CXR	infiltrations, suspected tuberculosis, pleural effusion nodular opacity, cardiomegaly, etc.	10	1.40
EKG	arrhythmia, ischemia, tachycardia, etc.	19	2.66

Systolic blood pressure (SBP)
Diastolic blood pressure (DBP)
Pulse rate (PR)
Body mass index (BMI)
Hematocrit (Hct)
Hemoglobin (Hb)
Platelet count (Plt)
Forced vital capacity (FVC)
Forced expiratory volume time (FEV_1)
Chest radiograph (CXR)
Electrocardiography (EKG)

* If age below 50 then FEV_1/FVC > 0.75

** Only for abnormal FEV_1/FVC (n = 12)

8.95% (64/715) were obese and 13 of them were not fit for work by the body mass index (BMI > 35 kg/m^2). Nearly 90% were within normal limit.

Table 3 BMI results from health assessment for confined space work permit in a regional hospital in Thailand 2013 (N = 715)

BMI (kg/m^2)	n	Percentage
< 18.5	13	1.82
18.5 - 30	638	89.23
> 30 - 35	51	7.13
> 35 - 40	11	1.54
> 40	2	0.28

Restrictive spirograms (FVC < 80% of predicted value) were detected in 13.00% of population (93/715) and 6 of them restricted workers to work in confined space (FVC ≤ 65% of predicted value). 12 cases had obstructive spirogram patterns but none of them were restricted to work because the FEV_1/FVC were more than 0.65.

15.10% of population (108/715) didn't get the work permits by the abnormalities were detected.

Table 4 Spirogram results from health assessment for confined space work permit in a regional hospital in Thailand 2013 (N = 715)

Spirogram value	n	Percentage
FVC (% of predicted value)		
> 80	622	87.00
66 - 80	87	12.17
50 - 65	5	0.70
< 50	1	0.13
FEV_1/FVC		
Normal (> 0.70*)	703	98.32
Abnormal (≤ 0.70**)	12	1.68
FEV_1 (% of predicted value)***		
> 80	11	91.67
66 - 80	1	8.33
50 - 65	0	0.00
< 50	0	0.00

* If age below 50 then FEV_1/FVC > 0.75

** If age below 50 then FEV_1/FVC ≤ 0.75

*** Only for abnormal FEV_1/FVC (n = 12)

Discussion and Conclusion

Elevation of systolic and diastolic blood pressure was the most common abnormal physical examination for those who were not fit for work in confined space. High blood pressure may be temporary. Blood pressure may be raised from various workers' conditions such as physical stress, mental stress, and sleeping deprivation. White coated effect was also possible[16]. High blood pressures should be repeated after the workers rested for 30 minutes and the better results should be used in fitness evaluation. The permanent high blood pressure (both systolic and diastolic) is controllable with diet, exercise, and medications. In Rayong, the company's medical consultant (occupational medicine physician), may reevaluate those with abnormal blood pressure after treatments or after lifestyle modifications.

Cardiovascular diseases usually preclude work in confined space[17, 18]. All the workers with serious ischemic patterns were recommended not to work in confined space and to be reevaluated and treated by cardiologist. Exercise stress test is a specific test by cardiologist to detect serious ischemia which is needed to treat. The abnormal electrocardiogram should also be reevaluated for the necessary for visiting the cardiologist by the company medical consultant. In addition, the workers should be excluded from working in confined space and visit cardiologist if they have serious arrhythmia, serious heart block, or serious cardiac hypertrophy[19].

Gross obesity probably limit movement of the worker in confined space[18]. Those with BMI > 35 must be reevaluated seriously by cardiologist if they are really needed to work in confined space[20]. The workers with BMI 30 - 34.9 kg/m^2 are able to work in confined space but trapping in confined space should be concerned by the safety officer, site manager, and the workers themselves. Moreover, the worker with body weight > 130 kg usually have problems wearing harness and fit through 750 mm pipe[12, 17].

Pregnancy also limit movement of the worker in confined space[18]. In addition, many chemicals in confined space have fetotoxic effects such as fetal malformation, low birth weight, intrauterine growth retardation (IUGR). Pregnant worker should not be allowed to enter the confined space. Last menstrual period questionnaire and urine pregnancy test should be considered carefully. However, pregnancy worker was not found in this study.

Restrictive pulmonary diseases may lead to more dangerous situation for working in lacking of oxygen area. Spirogram abnormalities requires special consideration if FEV_1 or FVC < 66% of the predicted value[17]. Many obstructive pulmonary diseases may be reversible. FEV_1/FVC < 70% also requires special consideration for the condition's reversibility and medication requirement. The spirogram interpretation standards are vary[16]. Unlike WATER UK standard, FEV_1 change of < 0.25 L from last year was not considered in 'Guideline for Health Examination of Confined-space Workers'[20]. According to 'Guideline for Health Examination of Confined-space Workers', the workers with moderate, moderate to severe, and severe degree of obstructive and restrictive lung should be restricted to work in confined space.

Spirogram is an occupational tool that is useful for evaluation of respiratory system. Delivering effective spirogram is dependent on the skills of the performer, the calibration of the instrument and the worker's compliance. Thoracic Society of Thailand Under Royal Patronage stated that the standard spirogram require at least 3 expiratory efforts for best values[21]. Spirogram of Rayong hospital have been performed properly by occupational nurses. The spirogram should be performed by certified occupational health nurse, occupational medicine physician, chest medicine physician, or other certified health care personnel[22]. However, many health care providers in Thailand do not meet these standards as Rayong hospital do. The poor standard health care providers perform spirogram by employees with high school degree or lower, or with diploma degree of unrelated field for occupational health. Futhermore, 3 expiratory efforts for best values are not completely performed by many poor standard health care providers in Thailand. This makes the results unreliable and unable to compare the difference in workers' pulmonary function overtime.

The workers should bring the previous film with themselves to compare with the current one if possible. The workers with unchanged abnormalities may be declared fit for work in confined space. The company medical consultant may reevaluate chest X-ray by comparing the film as well. Abnormal chest X-ray with pulmonary function test abnormalities should be reconsidered carefully.

Anemia and thrombocytopenia were rare condition in confined space workers possibly by healthy worker effect. Those who had anemia or thrombocytopenia from previous health examination were treated or quitted this risky job. Complete blood count with platelets should still be used to detect anemia which may lead to severe hypoxia while working in low oxygenation area.

Serious defect in eyesight may cause accident in confined space. In addition the workers may not see the warning sign in emergency situation. Far vision test should be evaluated with and without eyeglasses. The workers who require eyeglasses to correct visual acuity should be evaluated for obtaining adequate seal of specific mask or specific type respirator[17]. Contact lenses wearing is not banned or contraindicated but the safety guidelines should be followed[23, 24].

Whispering test is a simple way to detect deafness. The worker must be able to hear emergency commands, with or without hearing aids[20]. However, the use of hearing aids should be noted and assessment of the ignition risk should be done[17].

Additional investigations such as urinary analysis, fasting blood sugar, step test (endurance), depression and anxiety test, cardiac or stroke risk score, otoscope and fundoscope were recommended in other countries[17, 18, 20.]

Healthy workers who are fit for working in confined space still should not work in this dangerous condition for more than 7 hours per day or 42 hours per week[25]. They must have specific training for working in the workplace's confined space[26, 27].

High blood pressure was the most common abnormal physical examination which was controllable. Most of the chest X ray abnormalities were not changed from the previous results and did not affect the work permit. Ischemic pattern from electrocardiogram should be reevaluated by cardiologist. Spirogram and CBC were necessary in health examination for work permit. The overall abnormalities were lower than normal population which may be due to healthy worker effect.

Recommendation

For worker's safety, health examination should follow 'Guideline for Health Examination of Confined-space Workers'. Quality control of the health examination for working in confined space should be performed by safety officer human resource or medical consultant. The certification of all health care personnel and all equipment's calibration note should be checked. Many abnormalities in health examination were temporary or curable. Some abnormalities required further investigation and treatment properly. The company medical consultant plays important roles in reevaluation for confined space worker.

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บทคัดย่อ

การประเมินสุขภาพเพื่อการออกใบอนุญาตทำงานในที่อับอากาศของโรงพยาบาลแห่งหนึ่งในประเทศไทย

ธีระศิษฏ์ เฉินบำรุง

กลุ่มงานอาชีวเวชกรรม โรงพยาบาลระยอง อำเภอเมืองระยอง จังหวัดระยอง

บทนำ: การประเมินสุขภาพพนักงานที่จะเข้าไปทำงานในที่อับอากาศเป็นบริการตรวจสุขภาพทางอาชีวอนามัย สมาคมโรคจากการประกอบอาชีพและสิ่งแวดล้อมแห่งประเทศไทยได้กำหนดแนวทางร่วมในการตรวจสุขภาพคนทำงานในที่อับอากาศ อันประกอบด้วยความสมบูรณ์ของเม็ดเลือด สมรรถภาพปอด คลื่นไฟฟ้าหัวใจ และเอกซเรย์ปอด รวมไปถึงรายละเอียดการตรวจร่างกายโดยแพทย์ และข้อคำถามเกี่ยวกับสุขภาพ

วิธีการศึกษา: การศึกษาเชิงพรรณนาครั้งนี้แสดงความผิดปรกติที่สามารถตรวจพบจากการตรวจสุขภาพพนักงานที่จะเข้าไปทำงานในที่อับอากาศที่มารับบริการกับโรงพยาบาลระยองในปี พ.ศ. ๒๕๕๖ จำนวน ๗๑๕ ราย

ผลการศึกษา: กลุ่มตัวอย่างร้อยละ ๙๗.๒๐ เป็นเพศชาย อายุเฉลี่ย ๒๙.๖๙ ปี พบความผิดปรกติของความดันโลหิตซิสโตลี ความดันโลหิตไดแอสโตลี ดัชนีมวลกาย เอกซเรย์ปอด คลื่นไฟฟ้าหัวใจ สมรรถภาพปอด และความสมบูรณ์ของเม็ดเลือดร้อยละ ๘.๑๑, ๓.๖๔, ๑.๘๒, ๑.๔๐, ๒.๖๖, ๐.๘๓ และ ๐.๔๒ ตามลำดับ พนักงานที่ไม่ได้รับการออกใบอนุญาตมีจำนวน ๑๐๘ คน

วิจารณ์ และสรุปผลการศึกษา: ความดันโลหิตสูง (ความดันโลหิต > ๑๔๐/๙๐) เป็นภาวะที่พบได้บ่อยและรักษาได้ ผลการตรวจเอกซเรย์ที่ผิดปรกติและไม่เปลี่ยนแปลงไปจากเดิมไม่เป็นอุปสรรคในการทำงาน ภาวะหัวใจขาดเลือดควรส่งพบแพทย์เฉพาะทางโรคหัวใจตรวจเพิ่มเติม การตรวจสมรรถภาพปอดและความสมบูรณ์ของเม็ดเลือดมีความจำเป็นในการตรวจสุขภาพเพื่อการออกใบอนุญาตทำงาน ประชากรกลุ่มอื่นอาจพบความผิดปรกติมากกว่านี้

คำสำคัญ: ที่อับอากาศ, ความสมบูรณ์พร้อมในการทำงาน, บริการทางอาชีวอนามัย, การออกใบอนุญาต, สมาคมโรคจากการประกอบอาชีพและสิ่งแวดล้อมแห่งประเทศไทย